A428 Black Cat to Caxton Gibbet improvements

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Volume 9

Appendices G to K to the Overview of the Alternatives considered at the Black Cat Junction

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9.39 Appendices G to K to the Overview of the Alternatives considered at the Black Cat Junction

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Appendix G – Technical Appraisal Report (November 2016)

A428 Black Cat to Caxton Gibbet

Technical Appraisal Report

HE551495-JAC-GEN-00-REP-C-0001 - Revision P00

November 2016

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1. Introduction

1.1 Context

1.1.1.1 The A428 forms part of the Felixstowe to Birmingham corridor which is an important strategic link connecting seaports on the east coast of England to the Midlands, is part of the trans-European network, and intersects with other major north-south road corridors. The A428 also forms part of a strategic route for vehicles travelling east-west between Oxford and Cambridge, via urban settlements of Milton Keynes and Bedford. It extends approximately 14 km between the A1 the west at St Neots and the A14/M11 in the east at Cambridge.

1.1.1.2 Within this section, the A428 is a single lane carriageway between the A1 and the A1198. This section of the A428 is the only remaining single carriageway section on the route between Felixstowe and the M1 at Milton Keynes.

1.1.1.3 The A428 has previously been identified as experiencing regular congestion and significant reliability issues. The Felixstowe to Midlands route is a focus for future growth and a key corridor for international freight. The existing capacity issues are expected to be exacerbated by planned developments in urban centres along the length of the corridor. The Felixstowe to Midlands Route Based Strategy highlighted the following issues and assessments:

- Junction capacity improvements at the Black Cat Roundabout.
- Severe lack of capacity (links and junctions) on the A428 between the A1 and A1198.
- Create an expressway standard route connecting the A421 from Milton Keynes with the A428 from Cambridge.

1.1.1.4 The A428 route connects the Borough of Bedford and the Central Bedfordshire unitary authorities with the districts of South Cambridgeshire and Huntingdonshire in the county of Cambridgeshire. The Scheme study area includes a section of the A1 between A1/A421 Black Cat Junction and the A1/A428 Wyboston Junction and the length of the A428 running between Wyboston Junction and the A1198 at Caxton Gibbet. The location of the scheme is shown in Figure 1.1.

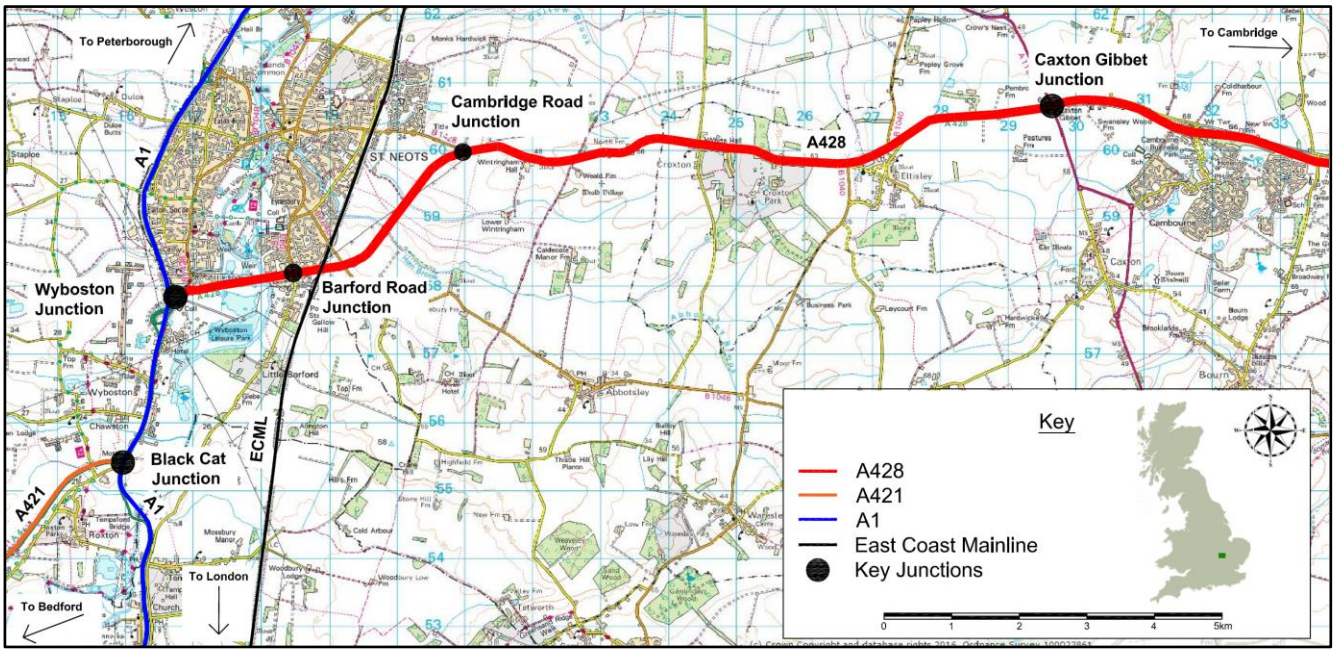

Figure 1.1 - A428 Location Plan

1.1.1.5 There are multiple junctions on the route of varying standard and significance, with only one grade separated junction at Wyboston between the A1 and the A428. There are a significant proportion of priority junctions and private accesses along the single carriageway section of the route and five roundabouts at Black Cat, Wyboston, Barford Road, Cambridge Road and Caxton Gibbet. Of these, Black Cat roundabout (which forms the interchange between the A1 and the A421) has recently been improved as part of Highways England's Pinch Point Programme to alleviate problems at the junction, however, it is recognised that the improvements are not a long term solution.

1.2 Purpose of the Technical Appraisal Report

1.2.1.1 This Technical Appraisal Report (TAR) has been prepared by Jacobs for Highways England as part of PCF Stage 1: Option Identification. It brings together the traffic, economic, safety, operation, maintenance and environmental assessments for the proposals for the A428 Black Cat to Caxton Gibbet, thus forming the basis for deciding which option(s) should be included in the public consultation.

1.2.1.2 The purposes of this report are broadly to:

- Validate the need for the scheme within the framework defined by objectives set out in the Client Scheme Requirements and those in paragraph 2.2.1.1 below.
- Identify and evaluate sustainable options having regard to the Government's New Approach to Appraisal (NATA), economic assessment and value for money, engineering, safety, and effect on the economy, social and environmental factors;
- Describe the alternatives investigated and set out any reasons for rejection; and
- Recommend options for public consultation.

1.2.1.3 The various options outlined in this report have been produced in accordance with the Design Manual for Roads and Bridges (DMRB).

1.2.1.4 The structure of this report is as follows:

- Introduction
- Planning Brief
- Existing Conditions
- Environment Status
- Environment
- Accessibility
- Integration
- Maintenance and Repair Strategy Statement
- Planning Factors
- Description of Route Options
- Traffic Assessment (To be included in future revisions)
- Economic Assessment (To be included in future revisions)
- Safety Assessment
- Operational Assessment (To be included in future revisions)
- Technology Assessment
- Maintenance Assessment
- Constructability and Consenting

- Environmental Assessment
- Assessment Summary
- Appraisal Summary Table (To be included in future revisions)
- Programme
- Conclusions and Recommendations

2. Planning Brief

2.1 Justification for Scheme

2.1.1 The Road Investment Strategy

2.1.1.1 The Infrastructure Act 2015 established Highways England as a government owned strategic highways company to replace the Highways Agency. In March 2015, pursuant to section 3 of the Act, the Road Investment Strategy (RIS) for the period 2015/16-2019/20 was presented to Parliament

2.1.1.2 One of the newly announced and committed schemes in the RIS was described as:

"***A428 Black Cat to Caxton Gibbet*** *– improvement of the A428 near St Neots, linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge, creating an Expressway standard link between the two cities via Bedford. The scheme is expected to include significant improvements to the Black Cat roundabout, where the A1 currently meets the A421.*"

2.1.1.3 All committed schemes in the RIS are intended to enter construction during the plan period; i.e. before 31 March 2020.

2.1.1.4 The RIS also refers to a new Oxford to Cambridge Expressway Strategic study to inform future Road Investment Strategies. It notes that some of the fastest growing towns in England are located in a belt to the north of London. However, transport connections between cities such as Cambridge, Milton Keynes and Oxford are notably poor and create an artificial barrier between hubs of knowledge-based growth. With better links, the synergies between these cities would be stronger, and would do more to drive growth in nearby towns.

2.1.1.5 Much of this Expressway can be created through improvements to the existing road network. It further notes that the RIS commits to widening the A428 from Caxton Gibbet to the Black Cat Roundabout, which will create an Expressway from Cambridge to Milton Keynes.

2.1.1.6 The first stage of work on the Strategic study has been published[1] and notes that:

- There is a strategic lack of east – west connections across this part of the UK.
- Sections of the route function as key national and regional freight routes (A34) and provide access to the national SRN network.
- Sections of the route provide important regional and sub-regional functions, linking communities along the route with the main functional economic areas and improving these sections will significantly improve access to labour markets.
- The current performance of the A34 and the non-expressway sections of the A421 and A428 are constraining its use, restricting functional economic area labour catchments, regional connectivity and economic growth.
- Without strategic transport interventions the forecast increase in travel demand and traffic growth will significantly increase delays and congestion on the primary east-west route, constraining economic growth of the communities within the study area and the key growth areas of Oxford, Milton Keynes and Cambridge.
- There is a need for improved connections across the region and into main urban areas and local centres.

[1] WSP | Parsons Brinkerhoff, Oxford to Cambridge Expressway Strategic Study Deliverable 1 – Examination of the Strategic Case for New Expressway East-West Road Links
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/545354/oxford-to-cambridge-expressway-strategic-study-interim-report.pdf

- Interventions will have a positive impact on travel reliability, network resilience, regional and local connectivity which is vital to support economic growth and enable the delivery of new jobs and homes.
- This in turn will deliver economic benefits in the form of improved productivity. This will enable the area to contribute significantly to the national economy.

2.1.2 National Infrastructure Commission

2.1.2.1 The National Infrastructure Commission (NIC) was established by the Chancellor of the Exchequer in October 2015 with Lord Adonis appointed as its interim Chair. The commission will carry out specific studies on pressing national infrastructure challenges in order to support the long term competitiveness of the UK economy.

2.1.2.2 On 16 March 2016, the Chancellor asked the commission to:

"*…make recommendations [to government] to maximize the potential of the Cambridge – Milton Keynes – Oxford corridor as a single, knowledge intensive cluster that competes on the global stage, whilst protecting the area's high quality environment and securing the homes and jobs the area needs. The commission will look at the priority infrastructure improvements needed and assess the economic case for which investments would generate the most growth.*"

2.1.2.3 The commission will produce:

- an interim report in autumn 2016 that assesses the economic case for planned road and rail investment, maps planned local and national development, identifies constraints to growth, regeneration and quality of life, and future opportunities over the next 30 years.
- a final report in late 2017 that provides recommendations to boost connectivity, growth, jobs, housing, sustainability, local governance and a framework to measure the impact of investment.

2.1.2.4 On 16 November 2016 the Commission published its interim report[2]; a final report is anticipated in late 2017. The interim report states that the Cambridge, Milton Keynes and Oxford Corridor could be the UK's Silicon Valley, but that without a joined up plan for housing jobs and infrastructure across the corridor it will be left behind by its international competitors. A lack of housing and connectivity puts future success of the area at risk. It notes that east of Bedford the Government has already committed to key improvements in the expressway route and that these are being delivered under its current Road Investment Strategy. It recommends that planning for East West rail and the rest of the Oxford –Cambridge Expressway should be taken forward urgently. The NIC will support Highways England in brining forwards proposals for the uncommitted part of the expressway west of Bedford.

2.1.2.5 The Chancellor of the Exchequer, Philip Hammond MP fully endorsed the findings of the Commission's report including a "commitment to deliver the new Oxford to Cambridge Expressway" in his Autumn Statement on 23 November 2016.

2.1.2.6 The strategic significance of the A428 Black Cat to Caxton Gibbet as part of a future Oxford to Cambridge expressway is widely recognised including in the RIS and the recent report of the NIC. The most recent work of the NIC takes it as read that the works in the RIS will be delivered and now look to bring forward proposals to the west of Bedford. There is strong and up to date justification for the entire expressway as part of the development of a world renowned centre of science, technology and innovation. This part of the expressway needs to be brought forward to begin to deliver on that potential.

[2] National Infrastructure Commission, Cambridge – Milton Keynes – Oxford Corridor: Interim Report (2016) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/569867/Cambridge-Milton_Keynes-Oxford_interim_report.pdf

2.1.3 Route to Consent

2.1.3.1 It is assumed that the project will be a Nationally Significant Infrastructure Project (NSIP) requiring consent under the processes set out in the Planning Act 2008. Accordingly the application will be assessed against the National Networks National Policy Statement (NNNPS). For further discussion on the consenting regime, please see section 9.2.

2.2 Existing Problems

2.2.1.1 There are a number of capacity, safety and severance problems that exist along the route that have been identified at stage 0.

2.2.1.2 Ten key problems were identified through the PCF Stage 0 Options Assessment Report (OAR) process:

- There are inadequate public transport options along the corridor; which has only limited bus services and no parallel rail service provision.
- There is a lack of viable alternative east-west routes between Cambridge and other economic centres such as Milton Keynes, Northampton and Bedford.
- There is poor non-motorised user provision along the corridor.
- A number of junctions along the corridor operate close to, or at capacity.
- Peak hour speeds along the corridor are significantly lower than the rest of the day.
- Speeds on the single carriageway sections of the corridor are significantly lower than those that are dualled.
- There is a high degree of journey time variability along the corridor, making it difficult for users to plan their journey with confidence.
- There is low resilience against accidents and incidents on the single carriageway sections of the corridor.
- There is a lack of driver information along the corridor.
- The above problems also constrain economic growth along the corridor.

2.2.1.3 Numerous safety issues have been identified along the route as cited in the OAR:

- Along the study corridor, collision data collected over a five year period from January 2010 to December 2014 recorded 57 accidents (seven serious, 50 slight) along the A1, and 100 accidents (three fatal, 20 serious, 77 slight) along the A428. The locations of the collisions have been analysed, and clusters of collisions have been identified. It is notable that there are major collision clusters at the A1/A421 Black Cat roundabout, and at Caxton Gibbet roundabout.
- Black Cat junction lies 69th in the national safety rankings (1 being the worst safety record) on the strategic road network 2009 to 2011
- There are safety concerns with breakdowns, recovery and emergency vehicle access, in particular where compliant cross sectional carriageway components are not provided, such as hardstrips.

2.2.1.4 For further information please refer to the OAR (reference B2074900/A6S/JAC/A428/XX/RP/PM/00025), Strategic Outline Business Case (SOBC – reference B2074900/A6S/JAC/A428/XX/RP/PM/00030) and section 3 of this report.

2.3 Scheme Objectives and Targets

2.3.1 Road Investment Strategy Objectives

2.3.1.1 The objectives for the A428 Black Cat to Caxton Gibbet Scheme are defined in the client scheme requirements. These reflect the broader objectives and targeted outcomes for designated performance areas as set out in the RIS and the overall goals for the Strategic Road Network (SRN), as well as other national policies. The high level objectives as set out in the client scheme requirements informed by the RIS are as follows:

- Making the network safer;
- Improving user satisfaction;
- Encouraging economic growth;
- Supporting the smooth flow of traffic;
- Helping cyclists, walkers, and other vulnerable road users;
- Keeping the network in good condition;
- Achieving real efficiency; and
- Delivering better environmental outcomes.[3]

2.3.1.2 In March 2015, the RIS set out performance specifications in which schemes will have their targets set and measured by key performance indicators.

2.3.1.3 Wider regional and local polices have been identified as well as their specific objectives. Regional policy literature sets the regional policy context. They identify that investment is needed in the A428, to alleviate local/regional issues to unlock potential growth in the area. Local policy literature sets the local policy context. They outline local challenges of upgrading the A428 to protect local communities while providing a sustainable future.

2.3.2 Scheme Specific Objectives

2.3.2.1 The following table aligns the A428 scheme specific objectives to that of Highways England Delivery Plan 2015-2020 strategic outcomes[4].

Highways England Objectives	A428 Scheme Specific Objectives
Supporting Economic Growth	a) Scheme supports planned economic and housing growth in Bedford, Cambridge and the surrounding sub-region
	b) Scheme supports spatial and strategic transport policies including Local Plans for Bedford, Cambridge and the surrounding sub-region by reducing congestion related delay, improve journey time reliability and increase the overall transport capacity
	c) Scheme promotes use of the strategic route by strategic traffic, and local routes by local traffic
A Safe and Serviceable Network	a) Scheme improves road user safety at the A421 / A1 Black Cat junction and on the A428 corridor between Wyboston and Caxton.
	b) Scheme improves road worker safety

[3] DfT, Road Investment Strategy: for the 2015/16-2019/20 Road Period
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf
[4] Highways England, Delivery Plan 2015-2020. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/424467/DSP2036-184_Highways_England_Delivery_Plan_FINAL_low_res_280415.pdf

Highways England Objectives	A428 Scheme Specific Objectives
A More Free Flowing Network	a) Provide significant capacity improvements to the Black Cat junction where the A1 currently meets the A421
	b) To create an Expressway standard link between the A421 and the existing dual carriageway section of the A428 to Cambridge
	c) Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather
An Improved Environment	a) Improve the environmental impact of transport on communities along the existing A428 corridor
	b) Reduce the impact of new infrastructure on the natural and built environment
A More Accessible and Integrated Network	a) Scheme provides a safe alternative NMU route between communities and seeks to address severance
	b) Improve safety and access for public transport users
Customer Satisfaction	a) Reduce traffic congestion delays and improve journey time reliability
	b) Improve driver information

Table 2.1 - Scheme specific objectives

2.4 Recent Studies

2.4.1 Previous Studies

2.4.1.1 Various Route-Based studies and High Level route analyses have been undertaken prior to the commissioning of PCF Stage 0 works on the scheme. The findings of these reports have been discussed in the Option Assessment Report (OAR), published at PCF Stage 0.

2.4.2 Oxford to Cambridge Expressway

2.4.2.1 As discussed in paragraphs 2.1.1.4 to 2.1.1.6.

2.4.3 PCF Stage 0 Strategy, Shaping and Prioritisation – 2016

2.4.3.1 A PCF Stage 0 study was commissioned to investigate and updated the findings of the existing OAR and Strategic Outline Business Case (SOBC) published by AECOM in 2014. Following the collection of available data and subsequent analysis in the OAR, SOBC and Appraisal Specification Report (ASR), it was identified that the A428 Black Cat to Caxton Gibbet route suffers from a series of problems:

- There are inadequate public transport options along the corridor , which has limited bus services and no parallel rail service provision;
- There is a lack of viable alternative east-west routes between Cambridge and other economic centres such as Milton Keynes, Northampton and Bedford;
- There is poor non-motorised user provision along the corridor;
- A number of junctions along the corridor operate close to, or at capacity;
- Speeds on the single carriageway sections of the corridor are significantly lower than those that are dualled and peak hour speeds along the corridor are significantly lower than the rest of the day;
- There is low resilience against accidents and incidents on the single carriageway section of the corridor, resulting one of the least reliable journey time sections nationally;

- There is a lack of driver information along the corridor;
- The above problems also constrain economic growth along the corridor.
- The route as a whole was identified as having safety and maintenance issues; and
- Stakeholders identified flooding issues along the A1 between Black Cat and Wyboston.

2.4.3.2 A wide range of options were generated based on the identified problems and issues along the corridor. These options were then assessed using a two stage sifting tool that assessed likely performance against the identified problems, route objectives, deliverability and feasibility.

3. Existing Conditions

3.1 Description of Locality

3.1.1.1 The A428 is a strategic route for vehicles travelling east-west between Oxford and Cambridge, via urban settlements including Milton Keynes and Bedford. The A428 extends approximately 14 km between the A1 at St Neots and A14/M11 at Girton near Cambridge. This forms part of a continuous network towards the east and the ports of Harwich and Felixstowe.

3.1.1.2 Cambridge is located at the eastern end of the A428 and to the east of the M11. Cambridge has become home to high-technology industries for software and bioscience companies, as well as the ancient education institution, the University of Cambridge. Cambridge science and business parks are located to the north-east of the town, with access to the A14. Smaller industrial areas are present across the town, including Clifton Road Industrial Estate near Cambridge railway station.

3.1.1.3 Bedford is located to the west of the scheme along the A421. The major employment and industrial land use is broadly located in the near vicinity of the A421, including Elm Farm and Woburn Road Industrial Estates.

3.1.1.4 St Neots is one of the largest and fastest growing towns in Cambridgeshire with a population of 31,165 in 2011. It has undergone two major expansion schemes in the last 10 years including 1,250 new homes at Love's Farm. The town is bounded to the west by the A1 and predominantly to the south by the A428. The major employment site is adjacent to the Wyboston junction in the south-west of the town.

3.1.1.5 Cambourne is a new settlement on the A428, 9 miles west of Cambridge. It is the largest settlement in South Cambridgeshire and is home to South Cambridgeshire District Council and Camborne Business Park.

3.1.1.6 The study area used for the demographic analysis in this chapter is defined by a 50 kilometre buffer around this A428 corridor. The demographic data is also compared against data for the east of England region, and for England as a whole.

3.2 Existing Highway Network

3.2.1.1 The A428 in this area is currently formed of a single carriageway between the A1 at Wyboston and A1198 at Caxton Gibbet, being the only section of the route between the M1 at Milton Keynes and Felixstowe (via A14 from Cambridge) that is not dual carriageway. Throughout this 14 km section, there are changes in width, variations in geometry, access, lighting and lay-by provision. Such characteristics, in combination with the high traffic volumes, are widely cited to result in congestion on the network and increased delays following an incident, which impact journey time reliability and network resilience. In addition there are safety concerns with breakdowns, recovery and emergency vehicle access, in particular where compliant cross sectional carriageway components are not provided, such as hardstrips.

3.2.1.2 A 3 km section of the A1 between the Black Cat junction with the A421 and the Wyboston interchange currently forms the connection between the A421 and the A428 where east-west traffic merges with north-south traffic.

3.2.1.3 The sections of the A1 and A428 perform important functions at the strategic, regional and local levels:

Strategic

- Forms a nationally important corridor between South Midlands and east coast ports
- Provides a western access to Cambridge for HGVs

Regional

- Links major regional centres along the route
- Provides for the distribution of goods and services
- Alternative Route to other national routes

Local

- Forms the St Neots bypass
- Provides the only means of access to some communities along the route, including farmlands and woodlands.

3.2.2 Existing Route Description

Black Cat Roundabout

3.2.2.1 Black Cat roundabout is a partially signalised, at grade, 6 arm roundabout that acts as the junction connecting the A1, A421 and Bedford Road. The roundabout consists of a two lane circulatory and the eastern side of the roundabout has channelization islands to separate A1 southbound traffic from A421 traffic. The partial signalisation is at both the northbound and southbound A1 entries to regulate the flow around the roundabout, as well as controlling access to the channelized A1 southbound lanes.

3.2.2.2 On the east side of the roundabout there is a direct access to a closely neighbouring quarry. There is also an entry arm from the service area in the north-west quadrant of the roundabout.

A1: Black Cat Roundabout to Wyboston Junction

3.2.2.3 The A1 link between the Black Cat and Wyboston junctions consists of rural all-purpose dual (D2AP) carriageway that is approximately 2.3 km in length. There are multiple direct accesses to both residential and commercial properties, as well as road-side rest areas and services, many of which are sub-standard and do not provide adequate visibility.

Wyboston Junctions

3.2.2.4 A grade separated, free flow interchange connects the A1 to the A428 Great North Road in both directions. The shape of this junction takes the form of a modified 3 way – 2 level “trumpet” interchange as described in DMRB TD 22/06.

3.2.2.5 The A428 Great North Road comprises an urban all-purpose dual (D2UAP) carriageway that is approximately 0.7km in length. An at-grade, signalised T-junction with an entry diverge taper provides access to the Wyboston Lakes development; this junction is located approximately equidistant between the Wyboston roundabout and the A1 interchange.

3.2.2.6 Wyboston roundabout is a non-signalised, at grade, 5 arm roundabout that acts as the junction connecting the A1 (southbound offslip), B1428, A428 and Phoenix Park. The circulatory is unmarked and has a width sufficient for two vehicles.

A428: Wyboston Roundabout to Barford Road Roundabout

3.2.2.7 The A428 between Wyboston and Barford Road roundabout is a 1.5 km straight section of rural all-purpose (S2) single carriageway. Along this length, the road crosses the River Great Ouse and Wyboston Lakes via a bridge that is approximately 285 m in length.

3.2.2.8 There are two lay-bys along this length of the A428 which are located as follows:

- A former bus lay-by on the eastbound exit of Wyboston roundabout, and
- A type B lay-by westbound between Wyboston roundabout and the bridge (Type B Lay-by).

Barford Road Roundabout

3.2.2.9 Barford Road roundabout is a non-signalised, at grade, 4 arm, roundabout that acts as the junction between Barford Road and the A428. There are additional left turn lanes separated by splitter islands on the entries of both the A428 arms. The circulatory is unmarked and provides sufficient width for two vehicles.

A428: Barford Road Roundabout to Cambridge Road Roundabout

3.2.2.10 This is a 3.1 km length of rural all-purpose (S2) single carriageway around the south and south east of St Neots. This section passes under the East Coast Main Line (ECML) railway and the B1046 between St Neots and Abbotsley. There are two non-overtaking sections along this length of the route, approximately 900m and 700m in length at the Band D curve (720m radius) and on approach to the Cambridge Road roundabout respectively. These sections are currently marked with a 1.5 m wide ghost island.

3.2.2.11 There are two lay-bys for along this length of the A428 which are located as follows:

- A type B lay-by on the eastbound exit of Barford Road roundabout, and
- A type B lay-by westbound approximately half way between the two roundabouts.

Cambridge Road Roundabout

3.2.2.12 Cambridge Road roundabout is a non-signalised, at grade, 3 arm roundabout that joins the B1428 (Cambridge Road) to the A428. The circulatory carriageway is unmarked which provides sufficient width for two vehicles.

A428: Cambridge Road Roundabout to Toseland Road Junction

3.2.2.13 This is a 3.6 km length of Rural All-Purpose (S2) single carriageway without hardstrips. Along this length there are two horizontal curves that are below the desirable minimum curve and a number of cases where the alignment does not meet the visibility requirements as specified by the DMRB. This section of the A428 has many direct accesses for residential homes, farms and businesses, most of which do not meet the required standards.

3.2.2.14 This section contains two non-overtaking lengths in areas with multiple direct accesses and sub-standard geometry, marked with a 1.5 m wide ghost island and double solid white lines, each of which are approximately 350m in length.

3.2.2.15 There are ten lay-bys for along this length of the A428 which are located as follows:

- A type A lay-by on the westbound approach of Cambridge Road roundabout,
- A type B lay-by approximately 400 m eastbound from Cambridge Road roundabout,
- A type B lay-by approximately 750 m eastbound from Cambridge Road roundabout,
- A type B lay-by approximately 950 m eastbound from Cambridge Road roundabout opposite Wintringham Private Road,
- A type B lay-by approximately 1.1 km eastbound from Cambridge Road roundabout,
- A type B lay-by approximately 1.7 km eastbound from Cambridge Road roundabout,
- A type B lay-by approximately 2.0 km eastbound from Cambridge Road roundabout,
- A type B lay-by approximately 1.3 km westbound from Toseland Road,
- A type B lay-by approximately 2.3 km eastbound from Cambridge Road roundabout, and
- A type B lay-by approximately 2.4 km eastbound from Cambridge Road roundabout.

Toseland Road and Abbotsley Road Junction

3.2.2.16 This is a left / right staggered major/minor ghost island junction connecting Toseland Road and Abbotsley Road to the A428. Both roads are narrow rural all-purpose roads approximately 5 m wide, with the ghost island between them approximately 3.5 m wide. This junction currently does not achieve the visibility requirements for either the approach to or within a junction.

A428: Abbotsley Road Junction to B1040 Eltisley Junctions

3.2.2.17 This is a 3.1 km length of Rural All-Purpose (S2) single carriageway without a hardstrip. There are approximately 7 private accesses for residential properties and agricultural land. The horizontal curve located 400m east of High Street (Croxton) junction is below the desirable minimum curve radius. There is also 1.2 km of 1.5 m wide ghost island providing a non-overtaking section through sub-standard geometry with multiple direct accesses, which extends east from the Abbotsley Road junction.

3.2.2.18 High Street (Croxton) is a 'no through road' single lane access that is unsuitable for HGVs. It is connected to the A428 via a simple T-junction.

3.2.2.19 There are five lay-bys for along this length of the A428 which are located as follows:

- A bus stop lay-by eastbound opposite High Street (Croxton) junction,
- A type B and bus stop lay-by eastbound opposite Croxton Park access road,
- A bus stop lay-by adjacent to Croxton Park access road on the westbound side,
- A type A lay-by approximately 650m westbound from the B1040 junction west of Eltisley, and
- A type B lay-by approximately 300m west of the B1040 junction west of Eltisley, providing a private means of access.

Eltisley Junctions

3.2.2.20 The Eltisley junctions consist of two major / minor ghost island junctions with nearside merging and diverging tapers for the B1040 (north and south). These two junctions are about 650m apart and linked with a continuous ghost islands between them.

3.2.2.21 A third junction towards the south provides access to Eltisley village, approximately 150 m east of the two B1040 junctions. This takes the form of a T-junction with nearside merging and diverging tapers.

A428: Eltisley Junctions to Caxton Gibbet Roundabout

3.2.2.22 Between Eltisley and Caxton Gibbet Roundabout is a 2.2 km length of rural all-purpose (S2) single carriageway without hardstrips. There are two private access roads for farms along the route. The main horizontal curve in this section is below the desirable minimum radius. On the approach to Caxton Gibbet roundabout there are accesses to a petrol station and a small supermarket from the westbound lane and a car wash business from the eastbound lane.

3.2.2.23 There are two lay-bys for along this length of the A428 which are located as follows:

- A type B lay-by approximately 200m westbound from Caxton Gibbet roundabout, and
- A type A lay-by approximately 120m west of Caxton Gibbet roundabout on the eastbound approach at the egress from a former petrol station.

Caxton Gibbet roundabout

3.2.2.24 Caxton Gibbet is a non-signalised, at grade, 4 arm roundabout that acts as the junction between the A428 and the A1198. The circulatory carriageway is unmarked but has sufficient width for two lanes of traffic. The A428 east of Caxton Gibbet becomes a dual carriageway for the remainder of its course.

3.2.3 Lay-bys

3.2.3.1 There are 19 lay-bys on the scheme route which vary in layout, which are described and located above. Concern has been raised with regard to both the standard and siting (including issues associated with positioning, frequency, visibility) of this provision.

3.2.3.2 Assessment indicates that the level and standard of provision of lay-bys on the A428 are well below the minimum standard requirements set out by DMRB. Typical concerns include:

- Layout
- No physical kerbed segregation island
- No through lane provided within lay-bys
- Location on horizontal radius affecting SSD
- Desirable Minimum SSD not achievable on the immediate approach to the start of the lay-by
- Poor merge taper layout
- Length of lay-by

3.2.4 Asset Condition

3.2.4.1 A review of the asset condition of the A1 and A428 between Black Cat roundabout and Caxton Gibbet roundabout has been undertaken making use of available data sources that are maintained by Highways England to monitor and review the condition of the Strategic Road Network (SRN).

3.2.4.2 The review has identified that the majority of the current pavement surfacing material will have exceeded its anticipated lifecycle by 2020, and will require replacement.

3.2.4.3 The review has also highlighted minor maintenance interventions of structures along the A428, with the most significant intervention being the River Great Ouse Crossing which has been identified as having high priority.

3.2.4.4 The River Great Ouse crossing has a cracking concrete bearing pad which requires monitoring at regular intervals, severely deteriorated expansion joints, delamination and spalling at abutments that require repair, and blocked gullies.

3.2.4.5 No issues were identified with geotechnical, lighting, vehicle restraint system (VRS), fencing, signage or technology through analysis of available data.

3.2.5 Existing Structures

3.2.5.1 Refer to Appendix B for details of the existing structures and culverts on the network.

3.2.5.2 Existing structures along the route may require assessment to check their suitability for retention in the scheme.

3.2.6 Non-motorised users

3.2.6.1 The A428 / A1 study area provides some facilities for non-motorised users. These include various footways, crossing facilities and underpasses. To the east of the A1, adjacent to Roxton Road is part of the Sustrans national cycle network (NCN) route number 12.

3.2.6.2 The RBS evidence reports identified that the Black Cat, Wyboston and Caxton Gibbet roundabouts, and the A428 link between Wyboston and Caxton Gibbet have issues regarding cycling and pedestrian provision. Stakeholders highlighted a lack of NMU provision between the Phoenix Park Triangle and the Eaton Socon urban area. Refer to HE551495-JAC-ENM-00-SK-C-0002 to 0003 in Appendix A for a drawing showing NMU and PROW routes around the region.

3.3 Existing Traffic Conditions

3.3.1 Introduction

3.3.1.1 During PCF Stage 0 desktop based data was collected and analysed to understand the current traffic conditions on the route as part of the Option Assessment Report (OAR). This was complimented with surveyed data collected during PCF Stage 1 to better understand the traffic conditions including the commissioning of Automatic Traffic Counts (ATCs), Manual Classified Turning Counts (MCTCs) and an Automatic Number Plate Recognition Survey (ANPR). The following traffic elements have been considered:

- Capacity and capability
- Traffic patterns
- Traffic speeds
- Congestion
- Journey time reliability

3.3.2 Capacity and capability

3.3.2.1 At PCF Stage 0 an initial assessment of link capacity along the route was undertaken using available data sources, following the additional data collection undertaken in PCF Stage 1 this has been updated using these new observed traffic flows to get a more accurate representation of the current conditions on the road as presented in Table 3.1.

Section	Peak hour Volume		DMRB ref. Capacity (Veh/hr)	V/C Ratio	
	AM	PM		AM	PM
Eastbound					
A1 – Black Cat roundabout to Wyboston Interchange	2,316	1,967	3,700	0.63	0.53
A428 – Wyboston Interchange to Barford Road roundabout	1,186	1,007	1,200	0.99	0.84
A428 – Barford Road roundabout to Cambridge Road roundabout	608	637	1,200	0.51	0.53
A428 – Cambridge Road roundabout to B1040 / St Ives Rd junction	900	793	1,200	0.75	0.66
A428 – B1040 / St Ives Rd junction to Caxton Gibbet roundabout	1,021	687	1,200	0.85	0.57
Westbound					
A428 - Caxton Gibbet roundabout to B1040 / St Ives Rd junction	914	751	1,200	0.76	0.63
A428 - B1040 / St Ives Rd junction to Cambridge Road roundabout	1020	805	1,200	0.85	0.67
A428 – Cambridge Road roundabout to Barford Road roundabout	719	630	1,200	0.60	0.53
A428 – Barford Road roundabout to Wyboston Interchange	1,172	1,016	1,200	0.98	0.85
A1 – Wyboston Interchange to Black Cat roundabout	2,193	1,743	3,700	0.59	0.47

Table 3.1 - A428 estimated existing link capacity

3.3.2.2 Several sections of the route are seen to approaching capacity (V/C ratio over 0.85) with the Wyboston interchange to Barford Road roundabout section approaching a V/C ratio of 1 in the AM peak suggesting it is very close to reaching capacity resulting in unstable traffic conditions. While no sections are assessed as currently being over capacity forecast traffic growth from the DfT suggests that several sections will exceed capacity.

3.3.2.3 A previous study on the route carried out an assessment of the current conditions of several junctions on the route, this study assessed Caxton Gibbet roundabout as being over capacity while Wyboston and Barford road junctions were assessed as approaching capacity, as shown in Table 3.2 below.

Junction	RFC
Wyboston Roundabout	0.85
Barford Road Roundabout	0.88
Caxton Gibbet	1.13

Table 3.2 - A428 existing junction capacity assessment

3.3.3 Traffic Patterns

3.3.3.1 At PCF Stage 0 analysis of the traffic patterns on the route was undertaken through reviewing census journey to work data. To improve this at PCF Stage 1 and get a better understanding of traffic movements an Automatic Number Plate Recognition (ANPR) survey was carried out.

3.3.3.2 The ANPR survey covered all major entries and exits on the route as shown in Figure 3.1 below. Through collecting information on vehicles passing from point to point it was possible to construct origin-destination matrices for each peak period to identify key movements.

3.3.3.3 Analysing the data provided by this survey showed that significant traffic on the route is to / from St Neots with approximately 45% of all traffic onto the A428 eastbound at Wyboston interchange going to St Neots in the AM and over 55% of westbound traffic on the A428 to the east of St Neots travelling to St Neots in the PM

3.3.3.4 The data also shows that 38% and 47% of the total eastbound traffic on the A428 between St Neots and Croxton comes from St Neots in the AM peak and PM peak respectively while 49% and 51% of total westbound traffic through Wyboston Interchange comes from St Neots in the same peaks.

3.3.3.5 In addition the movement between the Great North Road to the North of Wyboston roundabout and Barford Road to the North of Barford Road roundabout in both directions suggesting that the A428 acts as alternative for locals as there are limited river crossings within St Neots itself.

3.3.3.6 Overall this data suggests that St Neots is a major generator and attractor of traffic in the area and improving access to the St Neots will be an important factor of any improvement.

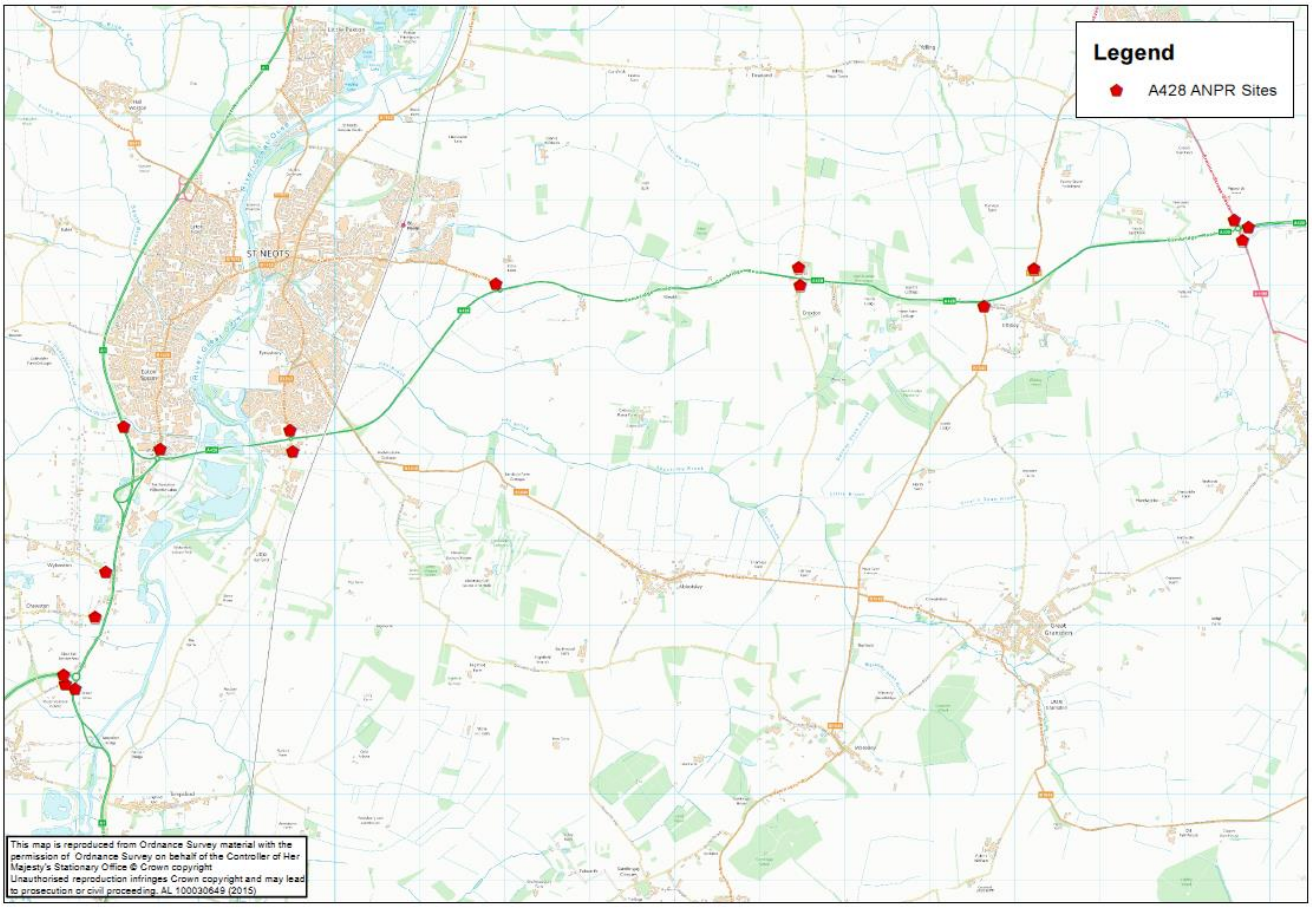

Figure 3.1 - A428 ANPR survey sites

3.3.4 Traffic Speeds

3.3.4.1 Analysis of traffic speeds was undertaken using TrafficMaster journey time data provided by the DfT. A plot of observed average AM and PM speeds on the route is shown in Figure 3.2. The AM peak sees the lowest average speeds on the route.

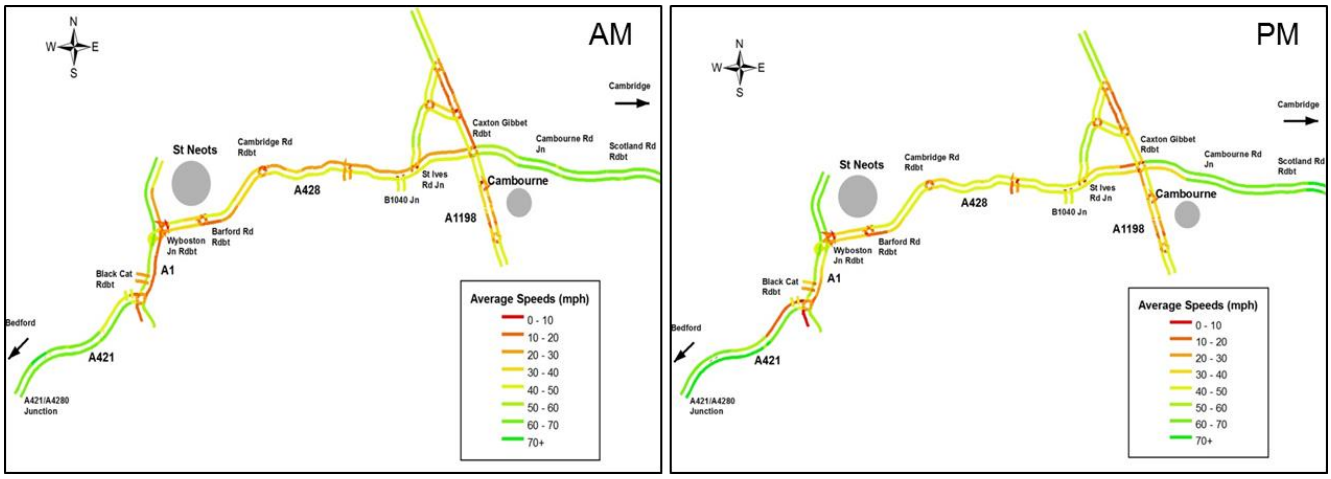

Figure 3.2 - Average traffic speeds

3.3.4.2 The figures clearly show that the average speeds on the single carriageway sections of the route are significantly lower than on the dual carriageway sections on either side of the area of interest (A421 to the west of Black Cat roundabout and the A428 to the east of Caxton Gibbet roundabout). In the AM peak the average speed on the A1 approaching Black Cat Roundabout southbound is particularly slow while the eastbound approach to Caxton Gibbet on the A428 is also seen to be significantly slower than in other time periods.

3.3.5 Congestion

3.3.5.1 Congestion has been considered through looking at delay from the free flow speed on the route (assumed to be the speed experienced by traffic in the off peak period) where the delay can be seen as a representation of congestion. This was undertaken using the TrafficMaster journey time data provided by the DfT, a plot of the AM and PM speeds as a percentage of off peak speed is shown in Figure 3.3.

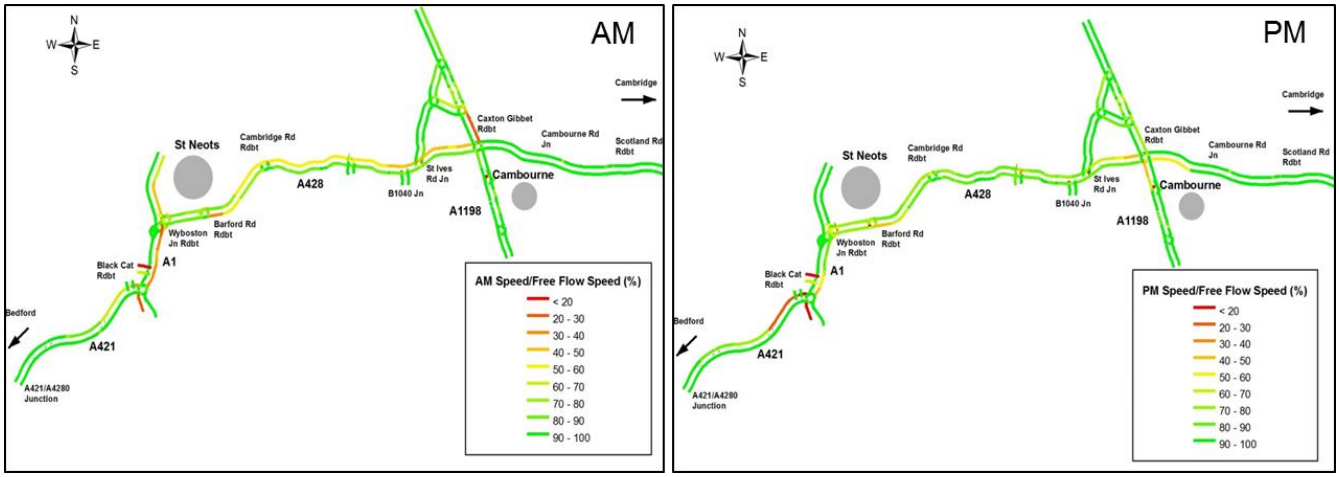

Figure 3.3 - Delay as a representation of congestion

3.3.5.2 This shows that in eastbound traffic on the single carriageway A428 are between 50-60% slower than free flow speeds in the AM peak suggesting that congestion is significantly impacting the performance of the route.

3.3.6 Journey Time Reliability

3.3.6.1 Estimation of a “Buffer Index” (BI) is used to estimate journey time reliability on the route. The BI represents the time a traveller should allow in addition to the average travel time to ensure on time arrival 95% of the time. For example a BI of 50% means that for a trip that takes on average 10 minutes, a traveller should allow an extra 5 minutes in travel time to ensure on time arrival.

3.3.6.2 The BI for each road segment has been calculated using TrafficMaster journey time data where we have the journey time on each link of the Integrated Transport Network (ITN) for every 15 minute period in a year.

3.3.6.3 Peak period travel time reliability is illustrated in Figure 3.4. The reliability analysis shows that peak period travel along the A428 is relatively unreliable, with a significant number of segments having a BI of above 40%. Journey times are more unreliable in the eastbound direction in the morning, and in the westbound direction approaching Black Cat roundabout in the PM. This is likely to be due to commuters travelling to and from Cambridge during peak periods.

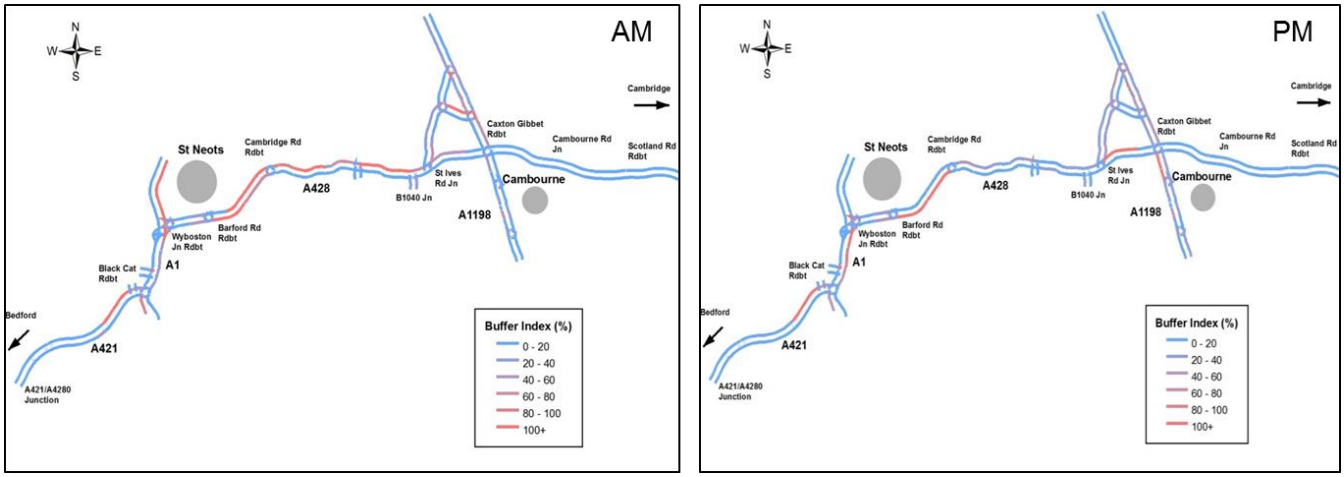

Figure 3.4 - A428 Journey Time Reliability

3.4 Accidents and Incidents

3.4.1 Overview

3.4.1.1 Collision and casualty records attributed to A428 (Wyboston Interchange to Caxton Gibbet Roundabout), A1 (Black Cat Roundabout to Wyboston Interchange) and A421 (Black Cat Roundabout west approach and egress) during the period January 2011 to December 2015 inclusive have been analysed. Data has been taken from validated STATS19 data received from Highways England's system. The most recent five full year period of data has been chosen to provide greater statistical accuracy, and to enable use of other annual data (such as traffic flows) within similar periods. It should be noted that for the local road network in the study area, and for collision cluster identification, the data set is currently based on 2010-2014 and will be updated for a future version of this report.

3.4.1.2 During the period covered, a total of 163 collisions have been recorded in the length of the Strategic Road Network (SRN) reviewed, resulting in 233 casualties (2011-2015 data). In the wider study area, a further 123 collisions occurred on local roads, resulting in 158 casualties (2010-2014 data).

3.4.1.3 The document 'Reported Casualties on the Strategic Network, 2013' (v1.4 dated 19th November 2014) has been used for comparative analysis, based on the years 2011-2013 where appropriate.

3.4.1.4 The data has been reviewed to determine accuracy of location, and where appropriate the locations have been corrected. Plans showing the locations and severity of collisions in the study area are shown in Appendix A (drawing No. HE551495-JAC-HGN-00-SK-C-0015). This analysis updates and enhances previous work carried out and included in the Options Assessment Report, and includes an updated data baseline from 2010-2014 to 2011-2015 for the SRN.

3.4.2 Collision Analysis

3.4.2.1 Table 3.3 shows an overall collision analysis by year and severity for the lengths of SRN and also for local roads. This shows that on the A428, the level of collisions was higher in 2012 and 2014, and that the level of killed or serious injury incidents (KSIs) was higher in 2012, including two fatalities. Casualties on the A1 showed lower levels in 2012 and 2015, but on local roads, a higher level in 2012. This tends to reflect the fluctuations in casualty levels by year, although for 2014, A428 had a much higher level of casualties.

Collisions	Fatal	Serious	Slight	Total
A1				
2011	0	1	13	**14**

Collisions	Fatal	Serious	Slight	Total
2012	0	1	5	**6**
2013	0	2	13	**15**
2014	0	2	9	**11**
2015	0	1	7	**8**
Total	**0**	**7**	**47**	**54**
A428				
2011	0	2	14	**16**
2012	2	2	25	**29**
2013	0	4	13	**17**
2014	0	4	18	**22**
2015	0	3	12	**15**
Total	**2**	**15**	**82**	**99**
A421				
2011	0	1	1	**2**
2012	0	0	1	**1**
2013	0	1	3	**4**
2014	0	1	2	**3**
2015	0	0	0	**0**
Total	**0**	**3**	**7**	**10**
Local Roads				
2011	0	3	15	**18**
2012	0	3	31	**34**
2013	1	3	21	**25**
2014	0	4	24	**28**
2015	0	5	13	**18**
Total	**1**	**18**	**104**	**123**

Table 3.3 - Collisions by year and severity

3.4.3 Collision Clusters

3.4.3.1 The locations of collisions have been analysed for the period January 2010 to December 2014 and clusters identified. These have been split into major clusters (at least 2 collisions per annum – 10 in five years) and other clusters (at least 3 collision within 100 metres within 5 years), and by location on strategic roads or local (County Council) roads. 19 collision clusters are identified and shown in the table below, and also in the plans in Appendix A (drawing No. HE551495-JAC-HGN-00-SK-C-0011).

3.4.3.2 There are major collision clusters at the A1/A421 Black Cat roundabout and A428/A1198 Caxton Gibbet roundabout. These collisions account for a large proportion of those on the A1 (42.9%) and the A428 (29%) within the study area. Black Cat roundabout has been the subject of a recent junction improvement, having been completed in spring 2015. It is not possible at this stage to determine the level of collision reduction which has occurred owing to limited data available.

3.4.3.3 Table 3.4 and Table 3.5 below list the collision clusters identified, and separated according to occurrence on the SRN or local road network. The collision clusters account for 42 collisions on the local road network and 94 collisions on strategic roads in the study area.

Cluster Number	Location	Total Collisions 2010-2014	KSI Collisions 2010-2014	Fatal Weighted Index (FWI)
A428/001	A428/A1198 Caxton Gibbet Roundabout	29	5	1.64
A428/002	A428 Adjacent to Pembroke Farm	3	3	0.30
A428/003	A428 Adjacent to North-East Farm	3	0	0.03
A428/004	A428/B1040 (east arm)	7	0	0.07
A428/005	A428/B1040 (west arm)	4	2	0.22
A428/006	A428 Croxton	4	2	1.12
A428/007	A428 at East Coast Main Line over-bridge	4	1	0.13
A428/008	A428/B1043 Barford Street North	6	0	0.06
A428/009	A428/Great North Road, Wyboston	5	0	0.05
A1/010	A1 at BP Garage/McDonalds Entrance	4	0	0.04
A1/011	A1/A421 Black Cat Roundabout	25	4	0.61
A1/012	A1/Tempsford Bridge (Northbound)	4	2	0.22
Total collisions at SRN cluster locations		**98**	**19**	**4.49**

Table 3.4 - Collision clusters by SRN location and collision severity

Cluster Number	Location	Total Collisions 2010-2014	KSI Collisions 2010-2014	Fatal Weighted Index (FWI)
LR/013	B1428 Cambridge Street/Cromwell Road Double-Mini Roundabout	6	2	0.24
LR/014	B1428 – Cambridge Street/Kings Lane	5	0	0.05
LR/015	B1428 Great North Road/Ackerman Street/School Lane	6	1	0.15
LR/016	B1428 Howard Road/Alpha Drive	7	1	0.16
LR/017	B1043 Barford Road/Cromwell Road	5	1	0.14
LR/018	Barford Road/Caernarfon Road (two small roundabouts)	5	0	0.05
LR/019	Barford Road near Tempsford (just north-east of Stone Bridge – access and bend)	5	2	0.23
LR/020	B1046 Landsbury Farm (bend)	3	0	0.03
Total collisions at local road cluster locations		**42**	**7**	**1.05**

Table 3.5 - Collision clusters by Local Road location and collision severity

3.4.4 Major Collision Clusters

3.4.4.1 Table 3.6 below shows collisions at the major collision clusters in the study area on the SRN, based on data from 2010 – 2014. 54 collisions occurred at these locations, which represents approximately 33% of all collisions on the SRN in the study area. 9 of these were KSIs (a rate of 18%).

Collisions	Fatal	Serious	Slight	Total
A1/A421 Black Cat Roundabout (Prior to improvement scheme Spring 2015)				
2010	0	0	4	4
2011	0	2	3	5
2012	0	0	2	2
2013	0	1	6	7
2014	0	1	6	7
Total	**0**	**4**	**21**	**25**
A428/A1198 Caxton Gibbet				
2010	1	2	3	6
2011	0	0	4	4
2012	0	2	8	10
2013	0	0	3	3
2014	0	0	6	6
Total	**1**	**4**	**24**	**29**

Table 3.6 - Collisions at major junctions by year and severity

3.4.5 Casualty Analysis

3.4.5.1 Table 3.7 below shows an overall casualty analysis by year and severity for the lengths of SRN and also for local roads. This shows that on the A428, the level of casualties was higher in 2012 and 2014, and that the level of KSIs was higher in those years, with two fatalities in 2012. Casualties on the A1 showed a lower level in 2012, but on local roads, a higher level in 2012. This tends to reflect the fluctuations in collision levels by year, although for 2014 on the A428, a significantly higher casualty rate was recorded.

Casualties	Fatal	Serious	Slight	Total
A1				
2011	0	1	17	18
2012	0	1	7	8
2013	0	2	18	20
2014	0	3	15	18
2015	0	1	14	15
Total	**0**	**8**	**71**	**79**
A428				
2011	0	2	22	24
2012	2	2	36	40

Casualties	Fatal	Serious	Slight	Total
2013	0	4	19	23
2014	0	7	38	45
2015	0	1	25	26
Total	**2**	**16**	**140**	**158**
Local Roads				
2010	0	3	26	29
2011	0	3	41	44
2012	1	4	26	31
2013	0	4	30	34
2014	0	5	15	20
Total	**1**	**19**	**138**	**158**

Table 3.7 - Casualties by year and severity (2010-2014 data period)

3.4.6 Casualty Rate

3.4.6.1 An indication of the level of risk can be obtained by introducing the length of the links and the traffic flow. Casualty rates for all casualties and for KSI casualties are shown in the table below, per hundred million vehicle miles (hmvm). The data is based on 2011-2013 performance to enable direct comparison with average rates for SRN dual carriageways (non-motorway) published by Highways England in 2014. Additionally, the Fatal Weighted Index (FWI) is shown; the FWI weights collisions by severity roughly in proportions which occur nationally, and highlights those sections which have the highest levels of these collisions. The value is calculated as follows:

- Fatal Collisions = number x 1
- Serious Collisions = number x 0.1
- Slight Collisions = number x 0.01

3.4.6.2 The links which performed worse than national SRN levels are highlighted red in the table below, and give an indication of areas where improvement would be most likely to contribute to Highways England's KPI to reduce KSI casualties. Table 3.8 shows the following highlights:

- The KSI rate per hmvm was higher than the SRN norm in the A428 Cambridge Road to Caxton Gibbet link.
- The casualty rate per hmvm was higher than the SRN norm on the A1 Black Cat to Wyboston, A428 Wyboston to Cambridge Road and A428 Cambridge Road to Caxton Gibbet links.
- The FWI rate per hmvm was higher than the SRN norm on both A428 links.

Casualties	Fatal	Serious	Slight	Total	KSI rate/ hmvm	SRN KSI rate/ hmvm	Casualty rate/ hmvm	SRN Collision rate/ hmvm	FWI rate/ hmvm	SRN FWI rate/ hmvm
A1	0	4	42	46	2.73	2.86	31.3	26.32	0.56	0.80
A428 (Wyboston to Cambridge Rd Inclusive)	1	2	23	26	4.73	5.56	41	31.70	2.26	1.65
A428 (Cambridge Rd to Caxton Gibbet Inclusive)	1	6	54	61	5.66	5.56	49.3	31.70	1.73	1.65

Table 3.8 - Casualty Rates, KSI and FWI rates per hundred million vehicle miles (2011-2013)

3.4.7 Collision Types

3.4.7.1 Collisions on the Trunk Roads have been analysed to determine their categories as detailed in Table 3.9 below:

Collison Type	A1	A421	A428	Total
Access Conflict	2	0	13	**15**
Avoiding Action	5	0	4	**9**
Circulatory Conflict	6	1	6	**13**
Extenuating Circumstances	5	0	9	**14**
Head On	0	0	5	**5**
Hit Object	0	0	1	**1**
Nose to Tail	20	8	41	**69**
Pedal Cyclist	1	0	3	**4**
Pedestrian	1	0	1	**2**
Side Swipe	4	0	1	**5**
Single Vehicle Loss of Control	10	1	16	**27**
Grand Total	**54**	**10**	**99**	**163**

Table 3.9 - Collisions by type on the SRN

3.4.7.2 The predominant collision type was ‘nose to tail’ (42%) and on the A428; this was particularly noted during 2012. Further investigation and analysis would be necessary to determine whether local circumstances changed during 2012, for instance roadworks being in place.

3.4.7.3 The number of collisions where traffic/congestion was noted was present for 23% of all collisions on the A428; however this is a subjective finding based on the recording of information from the officer attending the collision. On the A1 the level was 26% and A421 20%.

3.4.7.4 Collisions at accesses have been considered on the A428. These were found to involve mainly a vehicle travelling in a westerly direction on the main carriageway (85%), with turning right from the main carriageway being slightly more predominant than turning right from an access/junction to proceed west. Access movements can also have disruptive effect on mainline traffic flows, which may contribute to the 'nose to tail' collision total. It is noted that two accesses between Eltisley and Caxton Gibbet are represented in the list of minor collision clusters.

3.4.7.5 The number of single vehicle loss of control collisions is also of note, with seven on the A428 resulting from a driver/rider failing to negotiate a bend, which is likely to be associated with excess/inappropriate speed albeit this cannot be substantiated.

3.4.8 Non-Motorised User Collisions

3.4.8.1 Non-motorised users (NMUs) are an important aspect of Highways England's Policies for major highway improvements. An analysis has been carried out of all collisions involving NMUs in the study area, and these are shown in Table 3.10 below, for SRN locations and local road locations.

Collisions	Fatal	Serious	Slight	Total
2011	0	0	0	**0**
2012	0	0	1	**1**
2013	0	2	2	**4**
2014	0	0	0	**0**
2015	0	0	1	**1**
Total	**0**	**2**	**4**	**6**

Table 3.10 - NMU collisions with NMU involvement (SRN – 2011-2015)

3.4.8.2 There is a low level of NMU collisions on the trunk roads – A1 locations: 1 each of pedestrian and pedal cyclists involved (Total 2 NMU); and A428: 1 pedestrian and 3 pedal cyclists involved (Total 4). They were all at separate locations so no pattern can be discerned. There is an identified issue of severance at A428/Great North Road Roundabout, Wyboston near St Neots, where the A428 separates St Neots from an industrial, business and leisure area on the south side of the road at Wyboston lakes. This is not reflected by the collision statistics (although the B1428 route is in respect of NMU collisions on Local Roads).

Casualties	Fatal	Serious	Slight	Total
2010	0	0	3	**3**
2011	0	2	4	**6**
2012	0	2	10	**12**
2013	0	2	10	**12**
2014	0	2	1	**3**
Total	**0**	**8**	**28**	**36**

Table 3.11 - NMU Casualties – Local Road Locations

3.4.8.3 NMU collisions account for 37 of 123 collisions on local roads, which is a high level (30%, as compared to 23% nationally)[5]. Of these, 22 were cyclists and 15 were pedestrians.

[5] DfT, Reported Road Casualities Great Britain 2015 – Annual Report – Table RAS 30001

3.4.8.4 Further analysis of NMU collisions on the local road network is planned in co-ordination with the Local Highway Authority, with potential for designated fund work in the St Neots area. Initial work on NMUs and casualties has identified Great North Road route, Cromwell Road and A428/Great North Road, Wyboston roundabout as locations for further consideration.

3.4.9 General Collision Analysis (A428)

3.4.9.1 The following analyses are only related to the 99 collisions recorded on the A428 and document a range of standard analyses which can identify route issues.

3.4.9.2 The proportion of collisions during the hours of darkness is shown in the Table 3.12 below, which for the comparative period is 24% and is comparable with the SRN norm of 24%.[6] It is noted that collisions have substantially reduced during 2015. It is not known whether any remedial works in the form of lighting or road studs/markings have been carried out, although resurfacing with new road studs and markings may have occurred.

Light Condition	2011	2012	2013	2014	2015	Total
Darkness	4	7	6	6	1	**24**
Daylight	12	22	11	16	14	**75**
Total	**16**	**29**	**17**	**22**	**15**	**99**
% Darkness	**25**	**24**	**35**	**27**	**7**	**24**

Table 3.12 - Collisions by year and light conditions

3.4.9.3 Table 3.13 below shows the number of collisions on a wet road surface. For ease of presentation, 'wet' road surface has been recorded when the road surface was listed as Ice / Flood / Snow and this has also been reflected in the national comparison value of 32% (2011-2013)[7]. The comparative value for the route is below this, at 28%. Furthermore no correlation has been found between collisions during the hours of darkness and on a wet road surface.

Road Surface Condition	2011	2012	2013	2014	2015	Total
Wet	6	6	6	7	3	**28**
Dry	10	23	11	15	12	**71**
Total	**16**	**29**	**17**	**22**	**15**	**99**
% Wet	**38**	**21**	**35**	**32**	**20**	**28**

Table 3.13 - Collisions by year and road surface condition

3.4.9.4 The following Table 3.14 shows collisions by time period. In the absence of hourly traffic flow data currently, it is considered that the peak AM period is 07:00-09:00 and peak PM period 16:00-18:00 (highlighted in blue below). When combined, these time periods represent 33 (33%) collisions within the A428.

Time Period	Westbound	Eastbound	Northbound	Roundabout	Southbound	Total
00:00-01:00	1	0	1	0	0	**2**
01:00-02:00	0	0	0	0	0	**0**
02:00-03:00	0	0	0	0	0	**0**
03:00-04:00	0	0	0	0	0	**0**

[6] DfT, Reported Road Casualties on the Strategic Network 2013 – Table L-1 Collisions by Lighting condition, road classification and year
[7] DfT, 'Reported Road Casualties on the Strategic Network 2013' - Table B-6 Collisions by road surface conditions, weather conditions and year

Time Period	Westbound	Eastbound	Northbound	Roundabout	Southbound	Total
04:00-05:00	0	0	0	0	0	**0**
05:00-06:00	0	0	0	1	0	**1**
06:00-07:00	1	3	0	0	0	**4**
07:00-08:00	2	3	0	1	0	**6**
08:00-09:00	3	4	0	1	1	**9**
09:00-10:00	3	3	0	1	1	**8**
10:00-11:00	5	3	0	0	0	**8**
11:00-12:00	2	2	0	0	0	**4**
12:00-13:00	1	3	0	0	0	**4**
13:00-14:00	4	3	0	2	0	**9**
14:00-15:00	2	0	0	0	0	**2**
15:00-16:00	2	1	0	0	1	**4**
16:00-17:00	4	1	1	0	0	**6**
17:00-18:00	8	3	0	1	0	**12**
18:00-19:00	2	1	0	0	0	**3**
19:00-20:00	2	5	0	2	1	**10**
20:00-21:00	0	0	0	0	0	**0**
21:00-22:00	3	0	0	0	0	**3**
22:00-23:00	1	0	0	0	0	**1**
23:00-00:00	1	2	0	0	0	**3**
Total	**47**	**37**	**2**	**9**	**4**	**99**

Table 3.14 - A428 Collisions by year and time of day

3.4.9.5 In order to compare the above to National values[8] the time periods have been grouped as shown in the table below for the period 2011-2013:

Time Period	Section %	SRN %
00:00 – 06:00	2	8
06:00 – 10:00	29	23
10:00 – 14:00	14	21
14:00 – 18:00	27	29
18:00 – 00:00	19	19

Table 3.15 - A428 Collisions by time period (national data comparison)

3.4.9.6 Whilst the westbound direction has generally recorded more collisions, during the period 06:00-10:00 the eastbound carriageway towards Cambridge records more collisions. Traffic congestion was mentioned in 25% of the total collisions during this time period.

[8] DfT, Reported Road Casualties on the Strategic Network 2013 – Table B-4 Collisions by time period, day and year

3.4.9.7 Availability of hourly traffic flows would allow the ability to substantiate peak traffic flows on the A428 whilst vehicle speed data would allow the ability to determine where free flowing traffic conditions occur.

3.4.9.8 Analysis was also undertaken based on collisions by day of the week and month of the year. No variation was observed from national norms.

3.4.9.9 The final analysis undertaken related to the vehicles involved in the collisions:

Route	Bus/Coach	Car	Goods Vehicle			Motorcycle			Not Known	Taxi	Pedal Cycle	Grand Total
			<3.5t	>3.5t – <7.5t	>7.5t	>50cc – 125cc	>125cc-500cc	>500cc				
A1	1	80	9	3	14	1	0	4	0	0	1	**113**
A421	0	10	3	2	3	0	0	2	0	0	0	**20**
A428	3	156	11	3	10	5	1	8	1	1	3	**202**
Grand Total	**4**	**246**	**23**	**8**	**27**	**6**	**1**	**14**	**1**	**1**	**4**	**335**

Table 3.16 - Collisions by route and vehicle types

3.4.9.10 The definition of a Heavy Goods Vehicle in Reported Road Casualties on the Strategic Network 2013 is any vehicle being of more than 3.5 tonnes in weight, and 7 (6%) of all vehicles involved in the collisions for the period reviewed. The National level[9] is 10%, indicating a low level of goods vehicle involvement in collisions on the A428.

3.4.9.11 Powered Two Wheelers account for 11 (9%) of the vehicles which is above the National value of 4%. Pedal Cyclists accounted for two vehicles (2%) which is above the National value of 0.7% but not considered significant based on the very low number of vehicles recorded.

3.4.9.12 On the local network, Pedal Cyclists account for 15% of the vehicles recorded; however a comparable National value cannot be determined.

3.4.10 Incident Data

3.4.10.1 Incident data has been obtained from Highways England's system for the A1 and A428 for the period between July 2015 and August 2016. The data is tabulated below for information purposes only. The numbers recorded by category are generally small, although the level of barrier strikes on A1 is noted.

	A428	A1
Animal In Road	2	1
Asset Damage (e.g. Manhole, Gulley, Gantry, Verge)	3	0
Barrier Damage (e.g. Acoustic, Safety)	4	12
Dangerous Vegetation	1	0
Debris In Road	1	4
Electrical Defects (e.g. Lighting)	2	1
Flooding (e.g. Defective Gullies, Drainage)	1	1
Main Carriageway Defect (e.g. Pothole, Patching, Fretting)	3	0

[9] DfT, Reported Road Casualties on the Strategic Network 2013 – Table E-1i&ii. Number of vehicles by vehicle type, collision severity and year

	A428	A1
Other (Detailed Description Required)	2	0
Other Carriageway Defects (e.g. Kerbs, Lighting Columns)	3	1
Road Traffic Collision	1	2
Signage Issues (e.g. Condition, Damage, Missing)	4	4
Spillages	2	3
Traffic Management	0	1
Vehicle Fire	0	1
Grand Total	**29**	**31**

Table 3.17 - Incident data July 2015 to August 2016

3.4.11 Summary Existing Safety Conditions

- One of the key objectives of the scheme will be to reduce the number of KSIs. The KSI rate per hundred million vehicle miles on the A428 Cambridge Road to Caxton Gibbet link is higher than the national SRN norm for a similar road.
- The fatal weighted index per hundred million vehicle miles on both A428 links is higher than the SRN norm for a similar road.
- The casualty rate per hundred million vehicle miles on the A1 and both A428 links is higher than the national SRN norm for similar roads.
- 42% of collisions on the SRN sections involved nose to tail shunts.
- 17% of collisions on the SRN involved single vehicle loss of control.
- 9% of collisions resulted from access conflicts.
- 23% of collisions were recorded as occurring during periods of congestion.
- 67% of the collisions occurred outside of 0700 – 0800 and 1600 – 1800 time periods.
- Non-Motorised User casualties on the local road network in the study area are comparable to the national norm.
- Barrier damage accounted for the largest number of recorded incidents (not PICs).

3.5 Topography, Land Use, Property and Industry

3.5.1.1 The information contained below is a summary of the content of the Environmental Assessment Report (EAR – reference HE551495-JAC-EGN-00-RP-V-0001). Please refer to the EAR for further detail.

3.5.2 Topography

3.5.2.1 The topography of the area is mostly gently undulating with an overall rise in elevation along the route from west to east. The elevation of the terrain ranges from approximately 15m around Wyboston lakes to the highest point of 66m Above Ordnance Datum (AOD) at Caxton Gibbet.

3.5.2.2 The most significant topographical features are the River Great Ouse and the Wyboston lakes that dissect St Neots from north to south. Here the landscape is characterised by the low lying floodplain of the river Great Ouse that flows south of St Neots and along the east side of the A1.

3.5.2.3 To the east of Black Cat roundabout up to Potton Road the ground rises with large undulating open arable fields. From Potton Road through to Caxton Gibbet the landscape is less undulating and is characterised by medium to large arable fields with scattered, often isolated small woodland blocks and tree belts.

3.5.3 Land Use

3.5.3.1 The land use throughout the study area is varied. However, the main land use is agricultural with the majority of the land being classed as grade 2 (very good) under the Agricultural Land Classification (ALC).

3.5.3.2 St Neots is located in the north-west of the study area and is one of the largest and fastest growing towns in Cambridgeshire with a population of 31,165 in 2011. This town accounts for both the greatest residential land use within the area, and commerce with a major employment site in the south-west of the town, adjacent to the Wyboston junction. There also is a conservation area which ends south of the town adjacent to the A428.

3.5.3.3 There are a few villages located within the study area including; Abbostsley, Eltisley and Croxton (see drawing No. HE551495-JAC-HGN-00-SK-C-0004 in Appendix A). The village of Croxton is also home to Croxton Park which is a Grade II* registered park and garden.

3.5.3.4 Abbotsley Golf Hotel and its two golf courses have a total site area of approximately 100 hectares which is located south of the A428 between St Neots and Abbotsley. There is also another golf course on the land that surrounds Wyboston Lakes.

3.5.4 Property

3.5.4.1 Properties within the study area are a combination of domestic housing, industrial and retail units. As previously mentioned, the largest residential settlement is St Neots. St Neots has undergone two major expansion schemes in the last 10 years including 1,250 new homes at the north-east of the town.

3.5.4.2 There are over 70 listed buildings within the study area. The majority of these are clustered in St. Neots, and Croxton, Eltisley, and Wyboston villages. Of these, there are 14 Grade II listed buildings within 100 metres of the existing road.

3.5.4.3 There are residential properties adjacent to the existing route along Great North Road and Wyboston. Within the wider study area there are various scattered properties; residences in the villages of Wyboston, Little Barford, Croxton and Eltisley; and a number of farms in the open countryside.

3.5.5 Industry

3.5.5.1 There are a number of industrial and commercial buildings in the study area including:

- Grass motor sports circuit, east of Black Cat Roundabout
- Service area – including a Travelodge hotel – at Black Cat Roundabout
- Whitehall industrial estate in Croxton
- Papworth Hotel on Ermine Street, where the A1198 meets the A428
- Kelpie Marine boatyard by Tempsford Bridge
- Little Barford electricity generating power station, south-east of St Neots
- Roxton Garden Centre, approximately 300m south-west of the Black Cat Roundabout
- Abbotsley golf hotel, driving range and Country Club, south-east of St Neots
- Wyboston Leisure Park, south of St Neots

- Premier Inn between St Neots and the Wyboston Leisure Park
- Colmworth Business Park south of St Neots
- Tesco superstore south of St Neots

3.6 Climate

3.6.1.1 The A428, experiences a climate typical of much of terrestrial Southern England. Climatic variables (based on the 30 year average weather conditions) indicate a temperate climate with an average temperature of 10.5 degrees centigrade (°C). Average daily temperatures in summer (July) range from a maximum of 22.8°C to a minimum of 12.4°C. In winter (January) average temperatures range from a maximum of 7.3°C to a minimum of 1.6°C. Temperatures are regulated by the impact of the Gulf Stream, as well as the periodic shift in the positioning of the jet stream in the upper atmosphere. Notably, the highest recorded temperature in the area was 37.3°C in Cavendish, (roughly 50km east of Cambridge) on the 10th August 2003.[10]

3.6.1.2 On average, December is the month with the least sunshine in contrast with July which has the most sunshine. Rainfall data shows that on average roughly 570mm falls on the area each year on average, with October classed as the wettest month with 59 mm of rainfall on average. The number of annual thunderstorms makes a significant contribution to the total annual rainfall. They can occur at any time of the year but are more frequent during the summer months. Over East Anglia, Lincolnshire and Humberside the average number of days of thunder per year is about 15 however there is considerable variability each year.[11]

3.7 Drainage

3.7.1 Existing Drainage

3.7.1.1 A desk study assessment of the existing drainage network serving the A428 between Great North Road Junction and Caxton Gibbet Junction (northbound and southbound) has been undertaken using Highways England HADDMS (Highways Agency Drainage Data Management System) information. It is noted that Highways England HADDMS information is not available for the Great North Road, Black Cat or Caxton Gibbet Junctions. For these junctions freely available online mapping resources have been used to identify the visible surface water drainage collection system at the road surface.

3.7.1.2 The desk study assessment of the existing surface water drainage identified the primary drainage elements used along the A428 between Black Cat and Caxton Gibbet Junctions to be as follows:

- Kerb inlet gullies and traditional kerb/gully drainage;
- Combined kerb drainage at Black Cat Roundabout (appears to be as a result of recent construction works);
- Filter Drains, over-the-edge drainage and grips;
- Grassed surface water channels;
- Oil interceptors have been identified at two locations; and
- Soakaways have been identified at two locations.

3.7.1.3 Surface water drainage runs of traditional kerb and gully drainage and/or kerb inlet gullies appear to be most commonly used for most of the A428 between Great North Road Junction and Caxton Gibbet Junction. The exceptions to this are the multiple long stretches approximately 6.7 kilometres of filter drains and over-the-edge drainage between Barford Road roundabout and Toseland Road junction.

[10] (General information) - http://www.metoffice.gov.uk/public/weather/climate/u1214qgj0
[11] (Thunder and Hail) http://www.metoffice.gov.uk/climate/uk/regional-climates/ee

3.7.1.4 The presence of existing surface water attenuation features such as attenuation ponds, underground attenuation tanks; etc. could not be confirmed by this desk study assessment; however such drainage infrastructure is likely to exist.

3.7.1.5 It is recommended for subsequent project stages that further information on the existing surface water drainage network serving the A428 scheme to be obtained including:

- All available Highways England HADDMS information between Black Cat and Caxton Gibbet junction;
- Topographic and condition assessment (CCTV) surveys together with site inspections to verify the details and condition of the existing surface water drainage network serving the A428 scheme; and
- As-built drawings available from the Local County/District Councils affected by the A428 scheme.

3.7.1.6 This information will be required to inform the surface water drainage design in subsequent project stages.

3.7.2 Study Area Existing Scenario

3.7.2.1 The River Great Ouse cuts through open countryside east of the Black Cat roundabout. Areas around the river are designated as flood zone 3 with a 1 in 100 year chance of annual flooding from the river. The study area also contains the Hen Brook south east of St. Neots, and South Brook and Begwary Brook north of Black Cat: these are all also designated as flood zone 3. All three of these waterbodies are classified as 'moderate ecological status' with the objective of achieving 'good' status by 2027. These waterbodies are within the Upper and Bedford Ouse catchment, which forms part of the Anglian River Basin Management Plan. In addition, there are numerous unnamed field drainage ditches in the study area.

3.7.2.2 The study area falls within the SWSGZ1012 surface water safeguard zone for pesticides, and is within a nitrate vulnerable zone (NVZ) for both surface waters and groundwater. An NVZ is an area of land that drains into water known to be polluted by nitrates.

3.8 Geology

3.8.1 Summary of Geology

3.8.1.1 The underlying geology of the area is composed of mudstone, siltstone and sandstone, with alluvium deposits near the River Great Ouse and till deposits north of the A428 (British Geological Survey, 2015). The surface soils in the area is mainly composed of lime-rich loamy and clayey soils with impeded drainage; around the River Great Ouse the soils are freely draining slightly acid loamy soils and loamy and clayey floodplain soils with naturally high groundwater.

3.8.1.2 In terms of hydrogeology, the study area is classed as unproductive strata, with the nearest bedrock aquifer located approximately 5.2km south-east of the Black Cat junction. The area between St Neots and the Black Cat junction is classed as a secondary A superficial aquifer – this means that there are permeable layers within the drift deposits capable of supporting water supplies at a local level. There are no Groundwater Source Protection Zones (SPZ) in the area (Environment Agency, 2015).

3.8.1.3 The 'Eversden Landfill - Eltisley Landfill' is an authorised landfill, situated 1km north of Eltisley off the B1040. The landfill is operated by Eversden Landfill, with an A6: 'Landfill taking other wastes' licence (Environment Agency, 2015). There are several historic landfill sites throughout the study area:

- Little Barford power station historic landfill (inert waste)
- Great Northern Road historic landfill (inert waste)
- The Lane and Former Gravel Pit historic landfills, in Wyboston (inert, industrial, commercial, and household waste)

- Historic landfill North of Forty Farm (industrial waste)
- Historic landfill west of A1 (waste not specified)
- Little End historic landfill, in Eaton Socon (household waste)

3.8.2 Bedrock Geology

3.8.2.1 The solid geology consists of Oxford Clay Formation below the western part of the scheme and West Walton and Ampthill Clay formations below the eastern part. These are mainly mudstones.

3.8.3 Superficial Geology

3.8.3.1 The majority of the scheme is underlain by superficial deposits, mainly by the Oadby member, which is a till. River Terrace Deposits and Alluvium also occur in the valley of the River Great Ouse

3.9 Mining

3.9.1.1 There are no known underground active or historical mines, however there is as active sand and gravel aggregates quarry site to the east of the Black Cat roundabout with ready mix concrete production facilities.

3.10 Public Utilities

3.10.1 Preliminary (C2) Enquires

3.10.1.1 In order to identify the extent to which the surrounding public utilities could be affected by the proposed scheme, preliminary (C2) Statutory Undertakers enquiries were sent out to Undertakers in the region.

3.10.1.2 Below is a list of Statutory Undertakers that have provided information identifying that they have apparatus within proximity of the proposed scheme:

- National Grid
- BT
- Virgin Media
- Vodafone
- Instalcom

3.10.1.3 RWE npower Little Barford Power Station is also located immediately south of Barford Road Roundabout. As a consequence, there are a number of high voltage overhead power lines within the scheme study area. A detailed review of the returned C2 information identified that a large number of utilities were not among those listed by the Statutory Undertakers which responded, among these were several overhead powerlines which cross the proposed scheme study area as well as water, and telecoms which run along many of the existing roads.

3.10.1.4 For further details on the locations of the apparatus above, and areas with known utilities not returned from through C2 enquiries, please refer to the Statutory Undertakers Plans, as contained in Appendix D (drawings HE551495-JAC-VUT-00-DR-C-0001 to 0012). The gaps in the information are to be filled at PCF Stage 2 as the scheme area becomes more defined.

3.10.2 Limitation in Quality of Information

3.10.2.1 The information supplied by the Statutory Undertakers is based on their historical records and represent an approximate 2D location of their apparatus. Accuracy of these records cannot be guaranteed prior to additional surveys such as GPR and trial holes the construction phase, additional work would be required to confirm the exact location of affected apparatus. Detailed diversions and cost estimates shall be identified through the formal process of (NRSWA C3) budget estimates and C4 detailed estimates once the preferred option is developed.

3.10.3 Likely Specific Issues and Risks

3.10.3.1 A number of the identified apparatus could potentially be affected by the scheme. However, the cost of Statutory Undertakers works is uncertain and carries significant risk.

3.10.3.2 Of the identified Statutory Undertakers at this stage, the following utilities have been identified as high risks to the proposed scheme:

- National Grid Plc has identified a National High Pressure Gas Mains, in the vicinity of Black Cat Junction. Black Cat Junction has been identified as a key area for significant improvement. It is therefore likely that mitigation or diversions of these services would be required as part of any proposed option.
- High voltage overhead power lines running adjacent to the existing A428 between Barford Road and Cambridge Road Junction. Mitigation or diversionary works of these lines may be required.
- High voltage overhead power lines running between Barford Road and the East Coast Mainline, to the South of Little Barford Power Station. Any potential offline scheme is likely to cross the line of these statutory undertakers. Mitigation or diversionary works of these lines may be required.

3.10.3.3 In addition to being shown on the Statutory Undertakers plans (Appendix D), the utilities above have also been identified on the A428 constraints plans, as contained in Appendix A (drawings HE551495-JAC-HGN-00-SK-C-0007 to 0010).

3.10.3.4 There is the risk that Statutory Undertakers apparatus could alter, given the timescales required to progress the scheme to construction. This information would therefore need to be updated as the scheme progresses. This could affect the potential costs of diversion works.

3.10.3.5 As identified in paragraph 3.10.1.3, there are utilities which were not identified during the initial C2 searches and there is the risk that there may also be further Statutory Undertakers which have apparatus within the vicinity of the scheme.

3.11 Technology

3.11.1.1 The (Regional Control Centre) RCC for this section of the A1 and A428 is based at South Mimms in Hertfordshire (East RCC).

3.11.1.2 Both the A1 and A428 currently operate as conventional all-purpose trunk roads, as such there is limited existing technology provision on these roads.

3.11.1.3 Existing technology provision on the A428 between Wyboston (A1) and Caxton Gibbet (A1198) comprises the following:

- Three traffic measurement equipment (TME) traffic counting sites
- A single automatic number plate recognition (ANPR) camera site providing journey time information, which is located on the A428 at the junction with the A1 (Wyboston).
- There are no signals, variable message signs (VMS), closed circuit television (CCTV) or emergency telephones on the A428 between Wyboston and Caxton Gibbet.

3.11.1.4 Existing technology provision on the A1 between the Black Cat Roundabout (A1) and Wyboston comprises the following:

- Three traffic measurement equipment (TME) traffic counting sites
- Two automatic number plate recognition (ANPR) camera sites providing journey time information.

3.11.1.5 The technology equipment on the A428 and A1 described above is shown on Figure 3.5 below. Technology Performance Management Service (TPMS) inventory data is included in Appendix E.

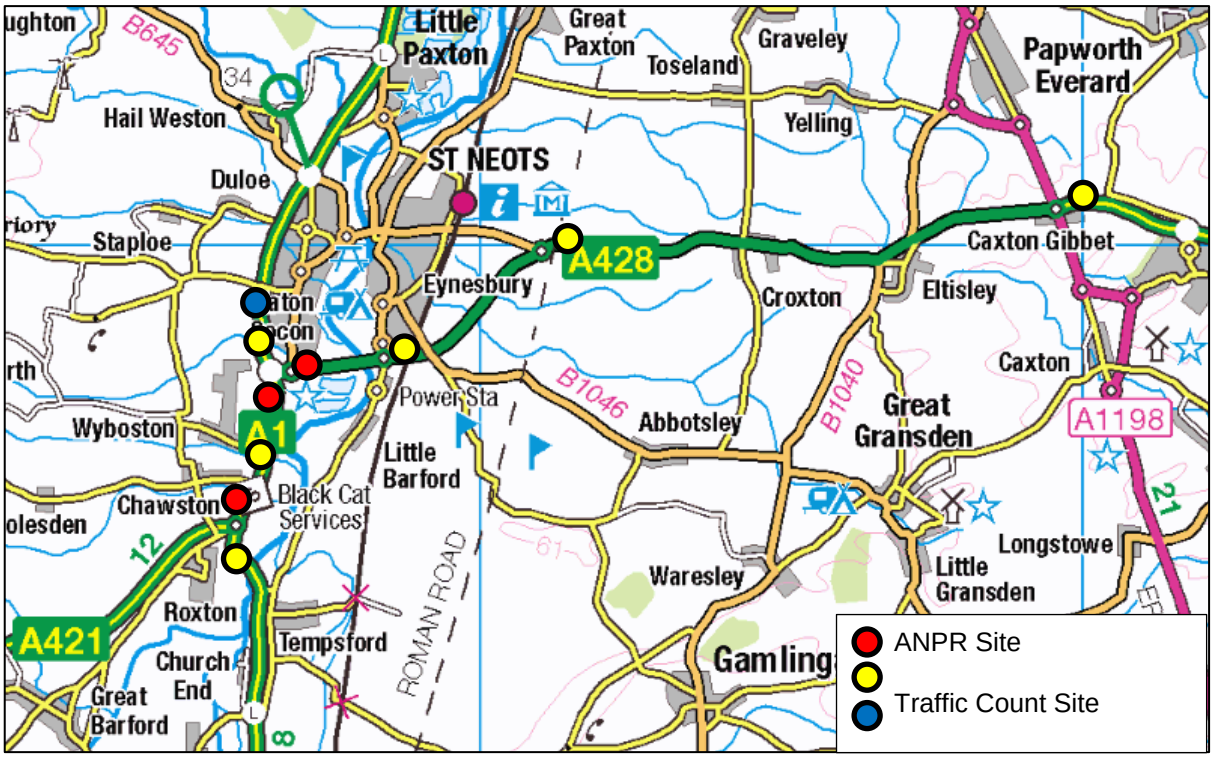

Figure 3.5 - Permanent ANPR and Traffic Count sites

3.11.1.6 Technology assets on the A428 and A1 are maintained by the East RTMC.

3.11.2 ITS Systems

3.11.2.1 There are no signals, VMS or CCTV on the A1 in the vicinity of the Black Cat Roundabout and Wyboston Junction.

3.11.3 Communications Network

3.11.3.1 There is no National Roads Telecommunications Services (NRTS) communications network on the A428 or A1. The nearest existing Transmission Stations are located at Stevenage and Alconbury on the A1(M) and Duxford on the M11. Communications to traffic count and ANPR sites are provided over GSM/GPRS networks.

3.12 Maintenance Access

3.12.1 Existing Maintenance Assessment and Strategy

3.12.1.1 Initial liaison has been carried out with Highways England Operations Directorate (OD) and the Asset Support Contractor (ASC) and existing maintenance strategies, challenges and opportunities identified.

3.12.2 Existing Maintenance and Accesses

3.12.2.1 Maintenance is carried out from within the highway and there are only two areas within the route where specific access facilities are provided off highway. These are:

- Access route from the south side of A428, east of the River Ouse bridge to provide access to the east side of the river and the structure.
- Access from private land near Barford Road junction and near Wyboston junction.

3.12.2.2 There are two stream crossings in the link between Barford Road and Cambridge Road junctions which also provide underpasses for footpaths (PROWs). There is a bridge under the East Coast Main Line (ECML) in this length also.

3.12.2.3 Cyclic maintenance in the section from Cambridge Road to Caxton Gibbet poses particular challenges owing to the level of traffic flow and the geometric standards of that section, and the provision of appropriate traffic management facilities to provide adequate working space. Particular issues are associated with maintenance of drainage, and particularly highway ditches.

3.12.3 Future Maintenance and Repair Strategy

3.12.3.1 Highways England OD and the ASC contractor plan to carry out all required maintenance on the A428 route during the period prior to the commencement of works on the A14 Cambridge to Huntingdon Improvement Scheme, including required surfacing works to permit the use of A428 as a relief and potentially diversion route whilst the A14 works are carried out – the A14 construction programme commences in March 2017 and is concluded in March 2021.

3.12.3.2 A428 and A1198 (Girton to Caxton Gibbet to Godmanchester) is part of a strategic diversion route for A14.

3.12.3.3 Further liaison will be carried out with Highways England OD and the ASC during development of the Maintenance and Repair Strategy Statement at PCF Stage 2.

3.13 Street Lighting

3.13.1.1 The major junctions on the existing A428 route are fully lit, i.e. Black Cat, Wyboston Interchange, Wyboston roundabout, Barford Road roundabout, Cambridge Road roundabout and Caxton Gibbet roundabout. The major/minor priority junctions and access are not currently lit.

3.13.1.2 The existing mainline is partially lit; a system of road lighting is in place over a short section between Black Cat and the A428/B1428 Junction only.

3.13.1.3 The existing lighting mainly consists of High Intensity Discharge (HID) lamps with a small number of Light Emitting Diodes (LEDs) being installed on Black Cat Junction.

3.13.1.4 The existing proportion of Personal Injury Accidents (PIAs) in the hours of darkness on the existing route is less than the national average of 28%, which is considered acceptable.

4. Environmental Status

4.1.1.1 Table 4.1 - Environmental Status Summary summarises the key environmental designations and features against the DMRB topic headings. These are described in more detail in the Environmental Assessment Report (EAR – reference HE551495-JAC-EGN-00-RP-V-0001).

Environmental Issue	Designation
Air quality	• There are no air quality management areas within 1 km of the A428. • There is residential property along the exiting A428 carriageway and A1/A428 junction, particularly at Eynesbury Manor (south St Neots), Croxton and Eltisley.
Cultural heritage	• There are 11 scheduled monuments within 1km of the A428, including two which are adjacent to the existing road network; Tempsford Bridge and Croxton deserted medieval village. Croxton Park is also a Grade II* registered park and garden. • There is a conservation area in the town of St Neots which ends south of the town adjacent to the A428. • There are 14 Grade II listed buildings within 100m of the existing A428. The A1198 near Caxton Gibbet follows the route of the Roman road, Ermine Street. • There is a high potential for unknown archaeology, especially medieval remains given the predominance of moated sites and deserted medieval villages in the area.
Landscape	• Croxton Park is surrounded by and includes numerous mature trees and woodlands, many of which are covered by tree preservation orders (TPO), including along the existing A428. • It is a quiet rural landscape of good quality with a coherent, unspoiled, homogenous character. Significant features include numerous woodlands, mature hedgerows and small-scale stream valleys with attractive open views. This area includes frequent historic landscape features and is of high sensitivity to intrusive development and changes to the landform. • The area between Black Cat and Potton Road is sensitive to intrusive development and changes to landform due to the visual open character. • There is significant woodland cover, including ancient woodland (e.g. Eltisley Wood and Sir John's Wood) and numerous non-designated small and medium-sized deciduous woodlands throughout the farmland to the east of the river Great Ouse, including woodlands on the National Forestry Inventory. • Key visual receptors include scattered rural properties and farms with residential clusters at Croxton cross roads, Abbotsley, Eltisley and Caxton Gibbet. Users of the Ouse Valley Way national trail have views of the A1 between Tempsford and the southern edge of St Neots at Wyboston.
Ecology and nature conservation	• Eversden and Wimpole Woods Special Area of Conservation is designated for bats and is 8.5km from the A428. The closest site of special scientific interest (SSSI), Elsworth wood SSSI, is 1.8km from the A428. In addition four county wildlife sites (CWS) and one protect road verge are located within 1 km of the A428 area. Croxton Park CWS and River Great Ouse CWS are directly adjacent to the existing A428. • There is ancient woodland within 1km of the existing A428, as well as biodiversity action plan priority habitat including deciduous woodland, parkland, hedgerows, young trees and an area of floodplain grazing marsh. • The A428 corridor includes habitat suitable for bats, badgers, birds (including Schedule 1 barn owl), great crested newts, reptiles, otter, water vole, invertebrates (terrestrial and aquatic), species rich hedgerows, species weed communities and watercourses including River Great Ouse.
Geology and soils	• The area immediately east of Black Cat is classified by Bedford Borough Councils as a Mineral Safeguarding Area, and a strategic mineral site. • Soils are generally grade 2 (very good), with pockets of grade 1 (excellent) and grade 3 (good) around Wyboston. • The majority of the superficial deposits in the area are classified as a secondary (undifferentiated) aquifer. The deposits along the A1 are classified as secondary A aquifers. • Potential contamination sources including authorised and historic landfills, fuel stations and highway services, a railway line and associated made ground, Little Barford Power Station and other potential sources including industrial, commercial and agricultural land-use.

Environmental Issue	Designation
Noise and vibration	• Existing noise important areas located 0.3km north of Black Cat roundabout on the Great North Road (A1), and to the west of Cambourne on the existing A428. • There are residential properties along the A1 and to the south of St Neots along the A428.
People and communities	• There is residential property and community and private assets, within the settlements of St Neots, Croxton, Eltisley, Wyboston, and Abbotlsey. • The East Coast Main Line runs north-south parralel to the A1. • There are number of public rights of way crossing over the existing A428.
Road drainage and the water environment	• There are two main rivers and their floodplains located near to the A428; the River Great Ouse and Hen brook, the floodplains are classed as predominantly flood zone 3. • There are five Water Framework Directive water bodies within 1km of the A428; the Ouse (Roxton to Earith), Stone Brook, West Brook, Begwary Brook and Abbotsley and Hen. These are classified as achieving moderate potential, except for the Bergway Brook which is currently achieving good potential. • There are 11 surface water abstraction licenses located around Black Cat and Wyboston.

Table 4.1 - Environmental Status Summary

5. Environment

5.1.1.1 The A1 is situated along the western edge of the study area and lies roughly parallel with the River Great Ouse floodplain and the East Coast Main Line. The existing A428 passes through a mainly rural area, characterised by agricultural fields and small areas of woodland. The villages of Croxton and Eltisley lie to the south of the existing road. There are a number of small settlements and individual business and residential properties which also front onto the road.

5.1.1.2 Croxton Park Grade II* Registered Park and Garden is located adjacent to the A428. The site contains the Croxton deserted medieval village and is also a County Wildlife Site. There is an existing Noise Important Area located on the A428 around Wyboston junction. There are also smaller areas at Caxton Gibbet junction and at Great Barford.

5.1.1.3 The A428 corridor passes through the counties of Cambridgeshire and Bedfordshire and through the local planning authorities of Bedford Borough and Central Bedfordshire Unitary Authority, Huntingdonshire District and South Cambridgeshire District.

5.1.1.4 The Environmental Assessment Report (EAR – reference HE551495-JAC-EGN-00-RP-V-0001) contains a more detailed description of the baseline environment for each environmental topic area.

6. Accessibility

6.1 Severance

6.1.1 Existing NMU Severance

6.1.1.1 The existing route of A421, A1 and A428 between Black Cat Roundabout and Caxton Gibbet Roundabout intersects with a number of public rights of way, footpaths and cycle facilities. Non-motorised users are categorised as pedestrians, cyclists, equestrians and powered wheelchairs for the purpose of this analysis.

6.1.1.2 Locations of existing facilities for non-motorised users (NMU) are shown on drawings HE551495-JAC-ENM-00-SK-C-0001 to 0003 in Appendix A. Key areas of severance currently experienced are:

- Black Cat Roundabout – NMU routes from Roxton to the Black Cat Roundabout services area (restaurant; Travelodge; filling station) and Chawston (McDonalds) are required to cross the A421 at the signalised roundabout at grade.
- A1 Chawston Lane – NMU bridge not available for cyclists
- A428/Great North Road junction – NMU route between Wyboston Lakes and the west side of St Neots crosses the junction at an uncontrolled at-grade crossing.
- A428/Barford Road Junction – NMU route from St Neots to business area crosses the junction at an uncontrolled at-grade crossing.
- A428 between Cambridge Road junction, villages at Croxton, Eltisley and Caxton Gibbet junction – limited NMU facilities, and intersections with public rights of way, requiring at-grade crossing of the route.
- Caxton Gibbet Roundabout – bus stops on A1198 and shared pedestrian/cycle facilities towards Cambourne on the north side of A428 are separated from hotel and McDonalds on the south side of the route by the roundabout, requiring users to cross at uncontrolled, at-grade facilities.

6.1.2 Non-Motorised User Safety

6.1.2.1 Road traffic collisions and casualties have been assessed for the study area for the years 2011-2015, based on validated STATS19 records. Full details of the analysis is shown in the 'Existing Safety Conditions' section of this Technical Appraisal Report. An extract is shown below, covering the existing route affected by the scheme (A421, A1 and A428), and local roads in the remainder of the study area.

6.1.2.2 Refer to section 3.4.8 above for further details and analysis.

6.2 Access to transport system

6.2.1 Existing Public Transport Accessibility

6.2.1.1 Several bus routes operate in the network, and the major ones affected by the proposals are:

- Route X5 – Oxford to Cambridge via Roxton and St Neots – does not stop on A428, but stops at locations on A1, including Wyboston footbridge (Stagecoach (Bedford).
- Route 6 – Fenstanton to St Neots, via Cambourne – travels across A428 from A1198 – non-stop on A428 (Go Whippet)
- Route 1 – Cambridge to St Ives – travels across A428 on A1198 at Caxton Gibbet – bus stop on the north side of the junction (Go Whippet)

- Route 3 and X3 – Cambridge to Huntingdon - travel across A428 on A1198 at Caxton Gibbet – bus stop on the north side of the junction (Go Whippet)
- Route 18 – Cambridge to Cambourne/Caxton/Eltisley – travels along A428 from A1198 to Eltisley – does not stop on A428 (Stagecoach Cambridge)
- Route 28 – St Neots/Cambourne to Gamlingay - travels along A428 from A1198 to Eltisley – does not stop on A428 (Huntingdon Association of Community Transport NB this route is also demand responsive).

6.2.1.2 Two National Express services also operate along the A428 at a frequency of once per day: the 305 service between Liverpool and Clacton-on-Sea and the 314 service between Southport and Cambridge. Both of these services stop at Bedford, St Neots, Cambourne and Cambridge.

6.2.1.3 Local bus routes in the region are shown in Figure 6.1 below.

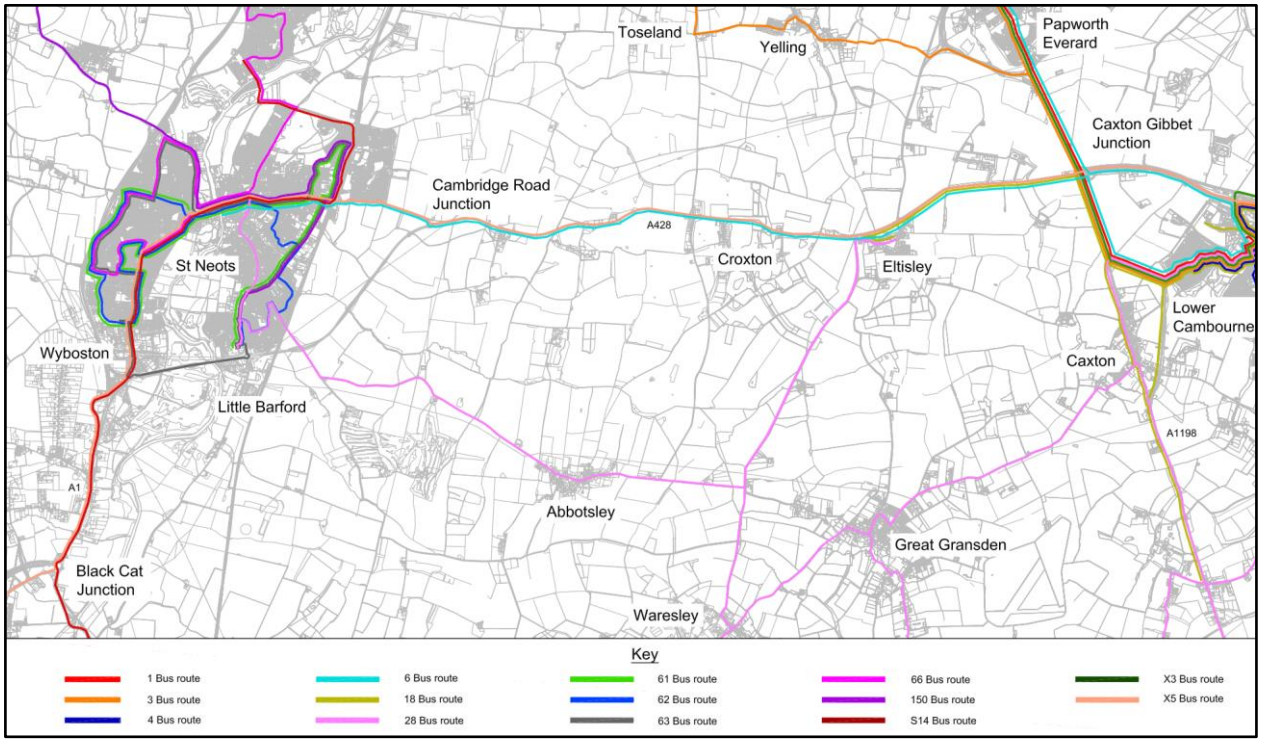

Figure 6.1 - Bus routes around the A428 corridor

6.2.1.4 Bus stops are located on A428 between Wyboston and Caxton Gibbet at Croxton (although no bus services serve them currently). The existing A428 currently bypasses Eltisley although two bus stops are located in the village (18 and 28), with infrequent services towards Cambourne.

6.2.1.5 Bus services from Fenstanton and Huntingdon travel across the route at Caxton Gibbet, and their bus stop is located north of the junction, requiring users to cross the A428 junction at-grade to reach premises including restaurants and a filling station.

6.2.1.6 Route X5 has bus stops on the A1 between Wyboston and Black Cat roundabout, beyond which it serves Roxton. It does not stop on A428 between Cambridge Road and Caxton Gibbet.

6.2.1.7 There is a network of local bus routes which operate in St Neots, with several operators. With the exception of the routes listed in paragraph 6.2.1.1, they do not interact with the A428. Refer to Figure 6.1.

7. Integration

7.1 Transport interchange

7.1.1.1 The A428 provides a key east-west route in the East of England, currently there is no realistic, direct rail alternative to the route and only limited bus services providing links between Bedford, St Neots and Cambridge.

7.1.1.2 Transport interchange describes how the A428 between Black Cat and Caxton Gibbet interacts with other key modes of transport and acts as a key links for access.

7.1.2 Role within the Strategic Road Network

7.1.2.1 The A428 provides an alternative East-West link to the A14 between the M11 and the A1 and onward travel to the M1 via the A421. The route also provides a link between the major population centres of St Neots, Bedford and Milton Keynes and the city of Cambridge as shown in Figure 7.1.

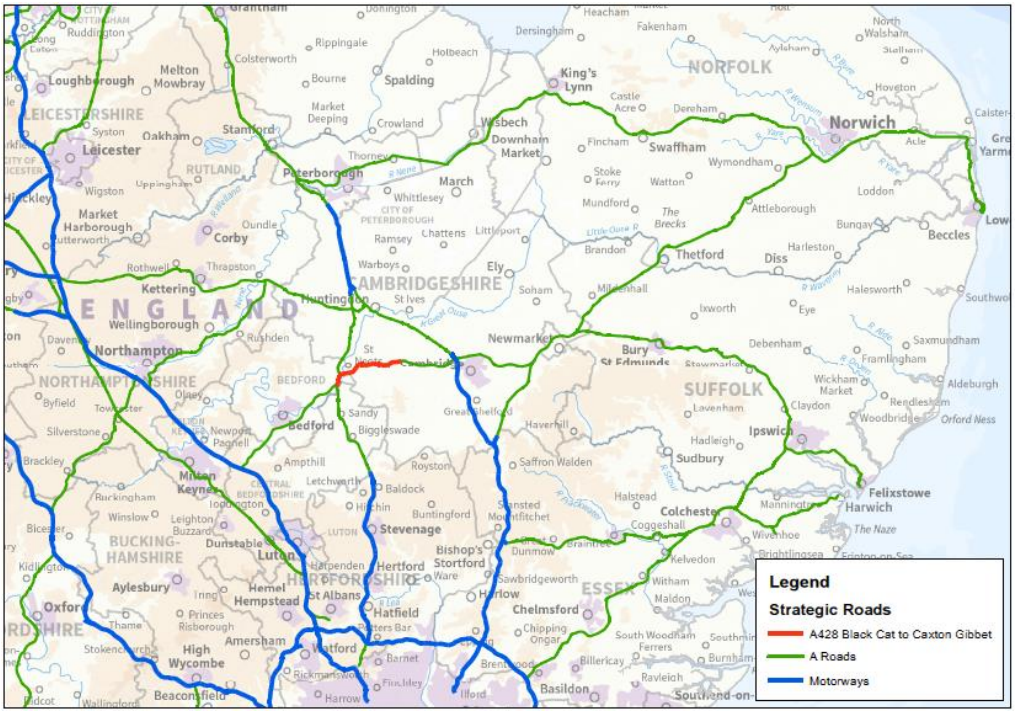

Figure 7.1 - The A428 within the SRN

7.1.2.2 England's Economic Heartland (EEH), a voluntary partnership of councils and local enterprise partnerships between Oxfordshire, Milton Keynes and Cambridgeshire, state that the east-west connectivity between Oxford and Cambridge is the "Achilles heel" for growth and investment in the area. One of their priorities is to push for investment in an "East-West Expressway Road", recognising that this could be delivered incrementally. They reiterate that the A428 between Black Cat roundabout and Caxton Gibbet is a particular issue described as "one of the poorest standard and most congested trunk roads in England" and that the solution to the problem is to upgrade this section to expressway standard, creating a continuous expressway between Cambridge and Milton Keynes.

7.1.2.3 To investigate the need for a continuous expressway between Oxford and Cambridge Highways England have commissioned WSP-Parsons Brinckerhoff to undertake the "Oxford to Cambridge expressway strategic study". Refer to paragraph 2.1.1.4 for further details.

7.1.2.4 In addition to this ongoing study Highways England are currently progressing long standing plans for the A14 to improve conditions for East-West traffic, this improvement is likely to lead to some A428 traffic shifting to the A14. However, data suggests that the majority of traffic on the route is either to/from St Neots, the A1 South of Black Cat Roundabout or the A421 and as such the majority of traffic is expected to remain on the route.

7.1.3 Public Transport

7.1.3.1 St Neots Railway station is located on the East Coast Main Line (ECML) and provides rail services between Peterborough and London Kings Cross every 30 minutes. Cambridge railway station to the east of the route is on the West Anglia Main Line (WAML) and provides regular rail services to London Liverpool Street and London Stansted airport. Bedford is accessed via the Midland Main Line (MML) from London St Pancras, plus Thameslink services from Brighton and South London, and services to Bletchley. The A428 forms a key link between these three stations and subsequently the ECML, WAML, MML and Stansted Airport.

7.1.3.2 There are currently plans to introduce a new East-West Rail route between Oxford and Cambridge. Currently the "Western Section" of the route between Oxford, Milton Keynes, Aylesbury and Bedford as shown in Figure 7.2 below has committed funding and is due for completion in 2019. A business case to support the development of the "Central Section" of the route between Bedford, Sandy and Cambridge is being developed while the "Eastern Section" an improvement of services between Cambridge, Norwich and Ipswich is being reviewed. Routes currently being considered for the central section may pass as far north as the Black Cat junction.[12]

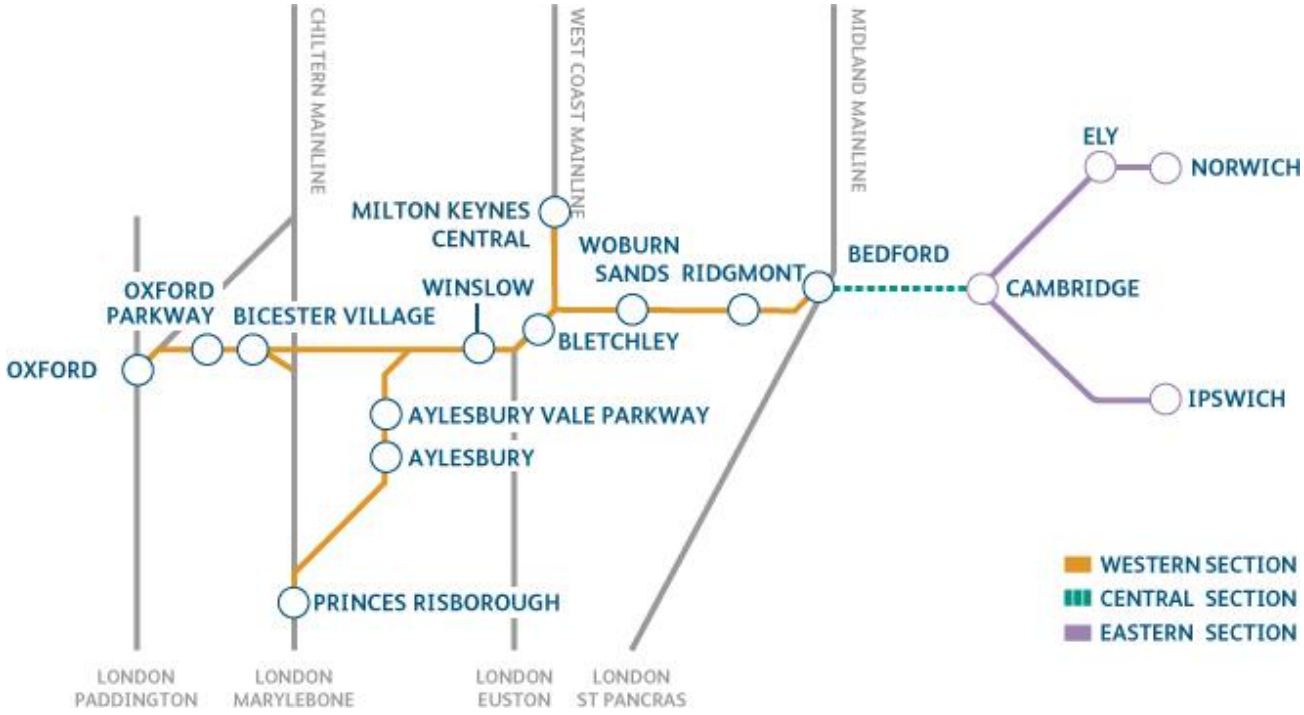

Figure 7.2 - East West Rail (from Network Rail)[13]

7.1.3.3 Should East-West Rail be delivered in full it will provide a realistic alternative to strategic traffic using the A428, however, traffic data shows that significant traffic on the route comes to and from St Neots and as such any residents/workers looking to use this new link would be required to travel Sandy further south on the A1.

[12] Network Rail, 2016. East West Rail – Central Section: Engineering Summary Report
[13] EastWestRail, retrieved from Network Rail, https://www.networkrail.co.uk/east-west-rail/

7.1.3.4 Cambridge County Council are currently proposing a number of public transport improvements in the area, including the provision of a new Park and Ride site for Cambridge located between Cambourne and the A1303 and an Eastbound Bus Priority through Caxton Gibbet Roundabout. The A428 will remain a key link to this new park and ride site for people from St Neots, Bedford and other settlements to the West.

7.1.3.5 For existing local bus routes, refer to section 6.2.1 above.

7.1.4 International Transport Links

7.1.4.1 London Stansted Airport is located to the south and east of the scheme and is accessed via the A428 and M11. London Luton Airport is located to the south and west of the scheme and is accessed via the A421 and M1 as shown in Figure 7.3. For residents in the vicinity of the scheme the A428 is a key link for their journeys to/from their nearest airports. Both airports have significant growth ambitions which could further attract customers.

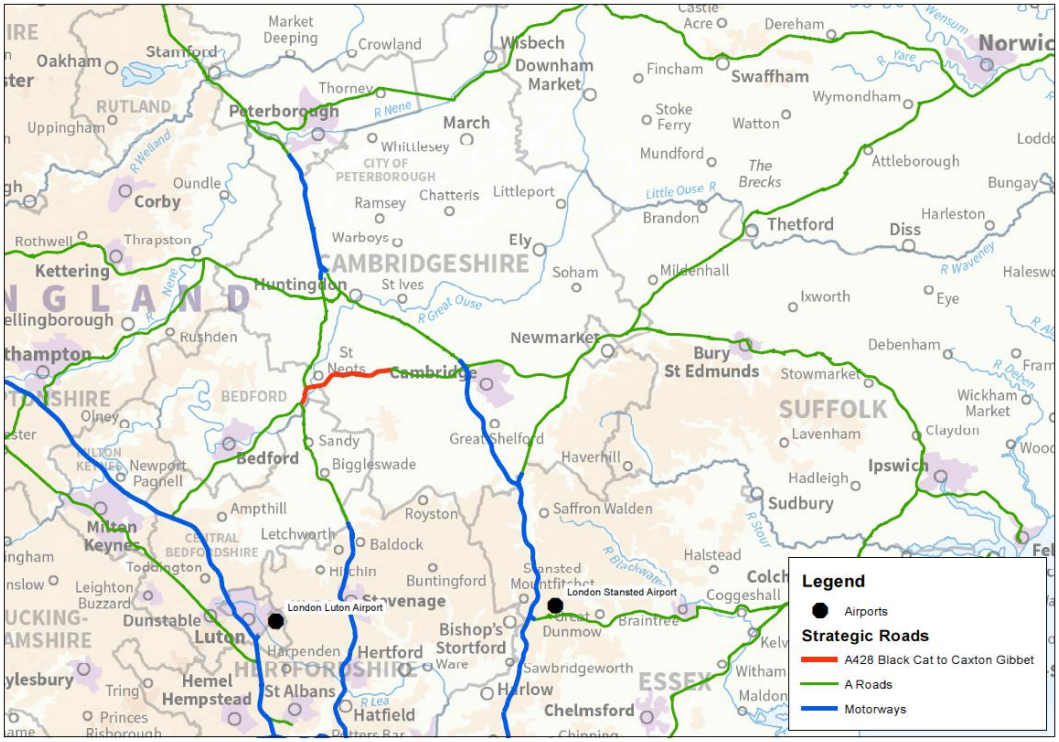

Figure 7.3 - The A428 and airports

7.1.5 Freight Routes

7.1.5.1 East-West access between key ports on the East coast of England (such as Felixstowe and Harwich) and the major North-South roads of the SRN (The A1 and M1) is a well-known issue. Improvements to the A14 should improve conditions; however, it is likely that a large proportion of strategic freight traffic on the A428 will remain on the route to go between east coast ports and distribution centres near the A1 and M1.

7.1.5.2 Should East-West rail be introduced in full providing a high quality rail alternative for freight it is likely that a proportion of road freight will shift towards rail.

8. Maintenance and Repair Strategy Statement

8.1.1.1 Initial liaison has been carried out with Highways England Operations Directorate (OD) and the Asset Support Contractor (ASC) and existing maintenance strategies, challenges and opportunities identified. The potential maintenance challenges and opportunities proposed by the scheme options have been discussed in outline.

8.1.1.2 The Maintenance and Repair Strategy Statement, which will be developed as a detailed PCF product at Stage 2, based on the preferred option, is designed to capture and analyse maintenance strategy for the proposed scheme and will contain maintenance philosophy statements for groups of infrastructure proposed. The strategy will be developed in close liaison with HE OD and the ASC.

8.1.1.3 It will be designed to discharge HE's functions in respect of future maintenance under the Construction (Design and Management) Regulations, 2015 and to address HE's objectives, that no-one will be harmed working on the Strategic Road Network (SRN) and the Aiming for Zero initiative.

9. Planning Factors

9.1 National and Local Policy

9.1.1.1 The following national planning policy documents are relevant to the scheme:

- National Infrastructure Delivery Plan 2016-2021 (2016);
- National Policy Statement for National Networks (2014);
- National Infrastructure Plan (2014);
- National Planning Policy Framework (2012); and other national strategies
- Draft Single Departmental Plan 2015-2020 by the Department for Transport;
- Road Transport Forecasts 2013 (2013);
- Investing in Britain's Future (2013);
- Action for Roads: A network for the 21st Century (2013); and
- Department for Transport Business Plan 2012-2015 (2012).

9.1.1.2 The scheme is located within the following Local Planning Authorities (LPAs):

- Bedford Borough Council;
- Central Bedfordshire Council;
- Huntingdonshire District Council; and
- South Cambridgeshire District Council.

9.1.1.3 The relevant adopted and emerging plans which dictate local planning policy for each LPA are discussed in more detail in the following sections. Importantly, and as noted above the content of emerging plans only hold significant weight once submitted to the Planning Inspectorate.

9.1.2 Bedford Borough Council

9.1.2.1 The current development plan documents in respect of Bedford Borough Council (BBC) comprise of the following documents:

- Saved Local Plan 2002 policies (2013);
- Bedford Borough Core Strategy and Rural Issues Plan (2008);
- The Bedford Town Centre Area Action Plan (2008); and
- The Allocations & Designations Local Plan (2013).

9.1.2.2 The emerging development plan documents in respect of BBC comprise of the following documents:

- Emerging Local Plan 2035: is currently being drafted and is scheduled for adoption mid-2019; and
- Proposed neighbourhood plans at Wyboston, Chawston and Colesden, with an estimated adoption date of Spring 2017.

9.1.3 Central Bedfordshire Council

9.1.3.1 The current development plan documents in respect of Central Bedfordshire Council (CBC) comprise of the following documents:

- Core Strategy and Development Management Policies Development Plan Document (2009); and
- Adopted Site Allocations Development Plan Document (2011).

9.1.3.2 The emerging development plan documents in respect of (CBC) comprise of the following documents:

- Emerging Local Plan: in February 2016 there was a call for sites for a new local plan. This plan is in the very early stages of development, but the LPA is aiming for the adoption of a new plan in September 2018.

9.1.4 Huntingdonshire District Council

9.1.4.1 The current development plan documents in respect of Huntingdonshire District Council (HDC) comprise:

- Core Strategy (2009);
- Local Plan (1995) including Proposals Map;
- Local Plan Alteration (2002); and
- Huntingdon West Area Action Plan (2011).

9.1.4.2 The emerging development plan documents in respect of HDC comprise of the following documents:

- Emerging Local Plan: currently being drafted with an estimated adoption date of February 2019; and
- St. Neots Town Council are close to adopting a neighbourhood plan for the whole parish area. This has been through consultation and appraisal and should be adopted by the end of 2016.

9.1.5 South Cambridgeshire District Council

9.1.5.1 The current development plan documents in respect of South Cambridgeshire District Council (SCDC) comprise:

- Core Strategy Development Plan Document (2007);
- Development Control Policies Development Plan Document (2007);
- Northstowe Area Action Plan (2007);
- Cambridge East Area Action Plan (2008);
- Cambridge Southern Fringe Area Action Plan (2008);
- North-West Cambridge Area Action Plan (2009); and
- Site Specific Policies Development Plan Document (2010).

9.1.5.2 There are a number of SPD's adopted by SCDC, ones significant to the development include:

- Development Affecting Conservation Areas - adopted 15 January 2009;
- Biodiversity - adopted 2 July 2009;
- Trees & Development Sites - adopted 15 January 2009;
- Listed Buildings - adopted 2 July 2009;
- Landscape in New Developments - adopted 2 March 2010; and
- Health Impact Assessment - adopted 8 March 2011.

9.1.5.3 The emerging development plan documents in respect of SCDC comprise of the following documents:

- Emerging Local Plan 2011 - 2013: The amended plan with modifications following examination was submitted to the Planning Inspectorate on 31st March 2016, to be re-considered. The emerging plan should be adopted by the end of 2016.

9.1.5.4 There is a designated Neighbourhood Area within the parish of Gamlingay, which establishes the neighbourhood plan boundary. The Neighbourhood Plan is still being drafted and is not likely to be adopted until 2017.

9.1.6 Minerals and Waste Plans

9.1.6.1 The following waste plans are relevant to Bedford Borough Council and Central Bedfordshire Council:

- Bedfordshire and Luton Minerals and Waste Local Plan First Review: Adopted January 2005 (saved policies); and
- Bedford Borough, Central Bedfordshire and Luton Borough Councils Minerals and Waste Local Plan: Strategic Sites and Policies (2014) (including a policies map).

9.1.6.2 The following waste plans are relevant to Huntingdon District Council and South Cambridgeshire District Council:

- Cambridgeshire and Peterborough Minerals and Waste Core Strategy (2011); and
- Cambridgeshire and Peterborough Minerals and Waste Site Specific Proposals (2012).

9.1.7 Transport Plans

9.1.7.1 The following transport plans are relevant to Bedford Borough Council and Central Bedfordshire Council:

- Bedford Borough Council Local Transport Plan (2011); and
- Central Bedfordshire Council Local Transport Plan (2011).

9.1.7.2 The following transport plans are relevant to Huntingdon District Council and South Cambridgeshire District Council:

- Cambridgeshire Local Transport Plan 2011-2031 Policies and Strategy (2015) (LTP 3);
- Cambridgeshire County Council Transport Strategy for Cambridge and South Cambridgeshire Transport Strategy and High Level Programme (2014);
- Cambridgeshire Local Transport Plan 2011- 2031 Long Term Transport Strategy (2014); and
- Cambridgeshire County Council Transport Strategy for Cambridge and South Cambridgeshire Action Plan and Scheme Details (2014).

9.1.8 Local Enterprise Partnerships

9.1.8.1 The proposed route corridor is within the following Local Economic Partnership (LEP) areas:

- Greater Cambridge and Greater Peterborough LEP; and
- South East Midlands LEP.

9.1.8.2 Both LEP's have published Strategic Economic Plans, as part of their growth fund strategies. Both documents mention the importance of improving road infrastructure for economic growth and stability.

9.1.8.3 The Environmental Assessment Report (EAR – reference HE551495-JAC-EGN-00-RP-V-0001) provides details of the relevant Local Plan policies that are being considered when assessing each environmental topic in respect of the project.

9.2 Consenting Regime

9.2.1.1 In accordance with Section 104 of the Planning Act 2008 in determining the application, provided the decision maker is satisfied that the adverse impact of the proposed development would not outweigh its benefits, the Secretary of State must decide the application in accordance with any relevant National Policy Statement (NPS).

9.2.1.2 In this case the relevant NPS is the National Networks National Policy Statement (NNNPS – December 2014) which was designated, following a vote in Parliament, and adopted as national policy in March 2015. In order to meet the scheme objectives it is most likely that the scheme option taken forward will require a Development Consent Order (DCO). The eventual application will, therefore, need to be structured around the NNNPS and to this end a tracker has been prepared to ensure regard is had to the NNNPS as the scheme proposal evolves.

9.2.1.3 The NNNPS recognises that there is a critical need to improve the national networks to address road congestion and crowding on the railways to provide safe, expeditious and resilient networks that better support social and economic activity; and to provide a transport network that is capable of stimulating and supporting economic growth. However, the Government's policy on development of the Strategic Road Network is not that of predicting traffic growth and then providing for that growth regardless. Individual schemes will be brought forward to tackle specific issues, including those of safety, rather than to meet unconstrained traffic growth (i.e. 'predict and provide').

9.2.1.4 Paragraph 2.10 of the NNNPS indicates that the Government has concluded that at a strategic level there is a compelling need for development of the national networks – both as individual networks and as an integrated system. The guidance is therefore that the Examining Authority and the Secretary of State (SoS) should start their assessment of applications for infrastructure covered by the NNNPS on that basis.

9.2.1.5 The Government's wider policy is to bring forward improvements and enhancements to the existing Strategic Road Network, and this will include improvements to trunk roads, in particular dualling of single carriageway strategic trunk roads and additional lanes on existing dual carriageways to increase capacity and to improve performance and resilience.

9.2.1.6 Applicants should also provide evidence that they have considered reasonable opportunities to deliver environmental and social benefits as part of schemes.

9.2.1.7 Detailed work will be needed to support any application in a wide range of areas. These include (but are not restricted to)

9.2.1.8 An outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects:

- An options appraisal.
- Consideration of design as an integral consideration from the outset of a proposal.
- Objective assessment of the impact of the proposed development on safety.
- Air Quality.
- Biodiversity and Ecological mitigation.
- Flood risk.
- The historic environment.
- Landscape and visual impacts.
- Noise and vibration.
- Water quality and resources.

- Climate change resilience.

9.2.1.9 The Planning Act 2008 process was introduced to streamline the decision-making process for NSIP's, making it fairer and faster for communities and developers alike. The requirement falls on the applicant to ensure that all stakeholders and interested parties are effectively engaged in the development of the project, formal consultation is the responsibility of the applicant, a single decision making process covers all necessary consents including land acquisition and the process is integrated and runs to fixed timetables. Applications are made not to the local planning authority but to the Secretary of State, who has appointed the Planning Inspectorate to examine the application and to make recommendations to the SoS.

9.2.1.10 Construction and alteration highway schemes are only NSIP's if they are:

- in England;
- the Secretary of State or a strategic highway authority is the highway authority for the highway; and
- in relation to the construction or alteration of a highway, other than a motorway, where
- the speed limit for any class of vehicle is expected to be 50 miles per hour or greater, the area of the development is 12.5 hectares or more.

9.2.1.11 Highway improvements in England will only fall within the scope of the NSIP regime where the SoS or strategic highway company is the highway authority and the improvements are "likely to have a significant effect on the environment".

9.2.1.12 The phrase "area of the development" is defined as:

- (a) in relation to construction of a highway, it means the land on which the highway is to be constructed and any adjoining land expected to be used in connection with its construction;
- (b) in relation to alteration of a highway, It means the land on which the part of the highway to be altered is situated and any adjoining land expected to be used in connection with its alteration;

9.2.1.13 If a scheme is an NSIP then it must use the consenting regime in the Planning Act 2008. Failure to do so would be a criminal offence. Should the area of development be less than 12.5 ha, then alternative consenting regimes may need to be examined. It should not be assumed that these are quicker than the Planning Act 2008.

9.3 Stakeholder Engagement

9.3.1 Stakeholder Engagement Strategy

9.3.1.1 A range of engagement with stakeholders has been undertaken over the course of the options analysis and identification phase. The purpose of this engagement has been to develop and build on relationships with stakeholders, provide updates on scheme progress, and obtain early views and comments on potential improvements to the A428 between Black Cat and Caxton Gibbet. Understanding concerns early in the design development helps to feed local, regional and national views into the production of solutions and options.

9.3.1.2 A Communications Plan for the A428 scheme was developed at the start of PCF Stage 1 in order to provide a framework for communications and to set out the approach to engaging stakeholders in this initial phase. The Communications Plan is a live document which is updated at regular stage intervals to continuously reflect the scheme needs and engagement / consultation outputs.

9.3.2 Engagement to date

9.3.2.1 As reflected in the Communications Plan, we have engaged stakeholders in the options identification phase in a variety of formats; notably:

- Forums
- Technical workshops
- One-to-one meetings

9.3.2.2 The forums have been established as a means of regularly engaging with a set of key stakeholders. Seven forums have been established covering specific geographical areas and areas of interest, through which over 80 stakeholders have been invited to attend. The six forums and example of stakeholders invited are noted in Table 9.1.

Forum	Membership
Members forum	
Community forum – Bedford area	Parish representatives around the Bedford, Wyboston and St Neots area (see Figure 9.1)
Community forum – St Neots area	Parish representatives around the St Neots area (see Figure 9.1)
Community forum – Cambourne area	Parish representatives around the Cambourne, Croxton and Gransdens area (see Figure 9.1)
Economic forum	Local authority (planning, policy and regeneration), Chambers of Commerce, Local Enterprise Partnerships, Local business interests
Environmental forum	Local authority (environment), Environment Agency, Natural England, Historic England, Wildlife Trust, Canals and waterways, campaign groups
Road users group	National and regional road interest groups (including Road Haulage Association, Campaign for Better Transport, Sustrans, Alliance of British Drivers)

Table 9.1 - A428 Forum membership

9.3.2.3 The membership of these forums is not fixed and has been updated to reflect growing understanding of the area and noted communities and/or stakeholders of interest. It is anticipated that the membership of forums will continue to grow as interest in the scheme increases.

9.3.2.4 To supplement the forums, some stakeholders have requested one-to-one meetings to further elaborate on scheme progress. These include meetings with parish representatives, local authorities, Members of Parliament and local councillors.

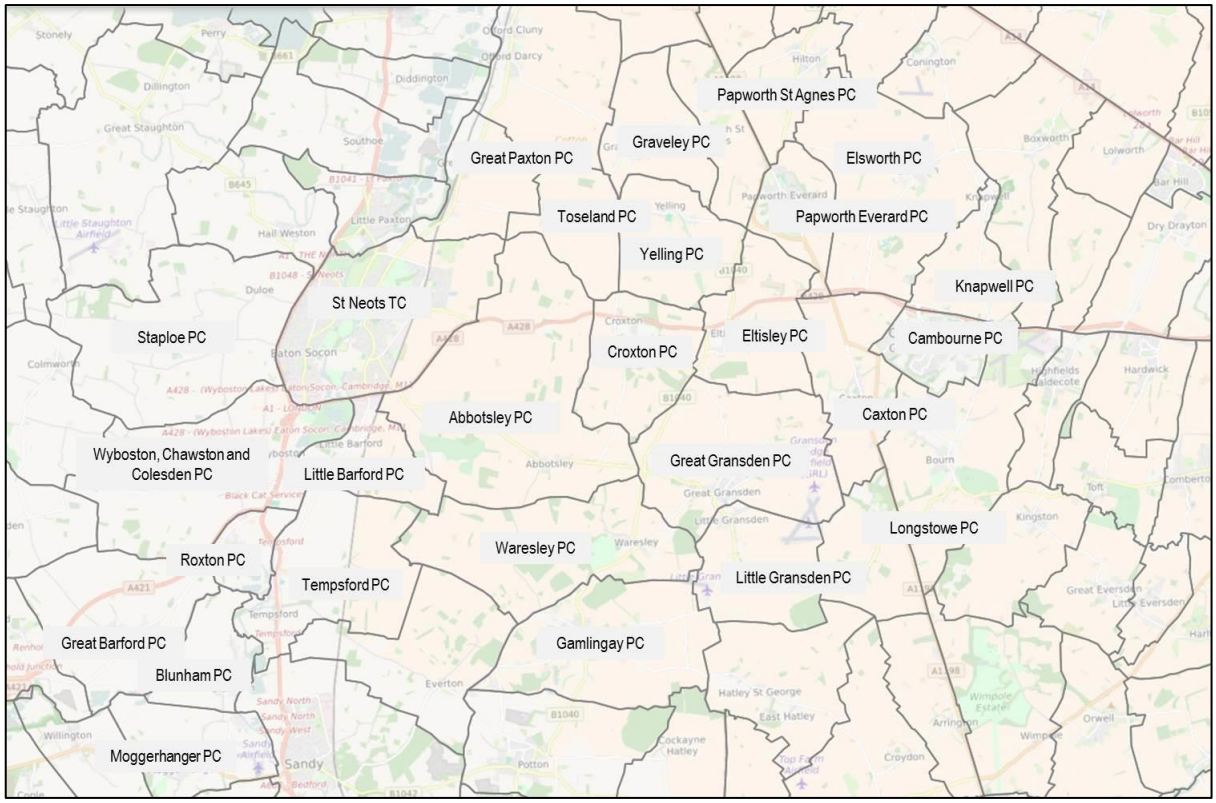

Figure 9.1 - Parishes invited to attend community forums in the Bedford, St Neots and Cambourne areas (November 2016)

9.3.2.5 As well as ad hoc meetings, we have engaged stakeholders on a range of technical matters to discuss specific aspects of the scheme to feed into the options identification process. This includes a workshop with non-motorised user stakeholders to understand current concerns (to be held before the end of 2016), engagement with local authorities to determine local plans and meetings with statutory stakeholders to discuss potential infrastructure overlaps.

9.3.2.6 A full list of the meetings and forums held to date can be found in the Communications Plan Activity Plan.

9.3.3 Key concerns and opportunities arising from engagement to date

9.3.3.1 Early engagement with stakeholders has provided an understanding of current concerns and interests around the A428 scheme which continue to feed into options development. Engagement has also enabled us to refine our engagement approach to ensure we reach as many stakeholders as possible, as well as enable us to deliver pertinent information and updates based on known concerns or queries.

9.3.3.2 Some of the issues raised to date include:

- Environmental concerns, notably of noise and air quality, biodiversity and flood risk;
- Traffic concerns (known current problem areas and impact of the potential scheme);
- Need for consideration of proposed developments and strategic transport studies in the area;
- Various suggestions for improvement were also provided, often relating to the structural layout of potential options or specific areas which need to be improved / not improved.

9.3.3.3 Ongoing engagement and formal consultation will help to elaborate on specific issues and will continue to feed into options analysis and assessment.

9.3.4 Upcoming engagement and consultation

9.3.4.1 Engagement will continue in order to fully develop stakeholder relationships and keep a robust understanding of local, regional and national concerns. To reflect our improved understanding of stakeholder interests and concerns, the Communications Plan has been reviewed and updated for PCF Stage 2 as required.

9.3.4.2 The revised Communications Plan reflects updated key messages, risks and objectives based on the further developed options for the scheme. The revised Communications Plan also sets out requirements for the non-statutory consultation on options to take place in early 2017.

9.3.4.3 To further outline the scope of the options consultation, a Consultation Strategy has been prepared – this sets outs the requirements for events, materials preparation, advertisement, launch and all other aspects of the consultation.

10. Description of Route Options

10.1 Scheme Development History

10.1.1.1 A wide range of options have been generated based on the identified problems and issues along the corridor. These options were then assessed using a two stage sifting tool that assessed likely performance against the identified problems, route objectives, deliverability and feasibility.

10.1.2 Stage 0 summary

10.1.2.1 During PCF Stage 0 (Strategy, Shaping & Prioritisation), as part of the Options Assessment Report (OAR), over 50 options were generated and assessed. Following this assessment the following nine options were shortlisted. These were as follows:

Option Reference (OAR Reference)	Option Description
DN	Do Nothing
A (C1)	A428 full offline dualling with grade separation of Black Cat roundabout and grade separation of Caxton Gibbet roundabout.
D (C2)	A428 full offline dualling with grade separation of Black Cat roundabout and signalisation of Caxton Gibbet roundabout.
E (C5)	A428 bypass to Cambridge Road roundabout with grade separation at Caxton Gibbet roundabout.
F (C6)	A428 bypass to Cambridge Road roundabout with grade separation at Black Cat roundabout and signalisation at Caxton Gibbet.
G (C7)	A428 single lane carriageway bypass to Cambridge Road roundabout with online dualling between Cambridge Road roundabout and Caxton Gibbet roundabout, grade separation at Black Cat roundabout and grade separation at Caxton Gibbet roundabout.
C (C10)	Local junction widening with channelization at existing A428 junctions, grade separation at Caxton Gibbet roundabout, grade separation at Black Cat roundabout and upgrade to existing A1 junctions.
H (C11)	Local junction widening with channelization at existing A428 junctions, signalisation at Caxton Gibbet roundabout, grade separation at Black Cat roundabout and upgrade to existing A1 junctions.
I (C16)	A428 dual carriageway bypass to Cambridge Road roundabout with online dualling between Cambridge Road roundabout and Caxton Gibbet roundabout, grade separation at Black Cat roundabout and grade separation at Caxton Gibbet roundabout.

Table 10.1 - Shortlist of options identified at Stage 0

10.1.2.2 The Strategic Outline Business Case (SOBC) further assessed these 9 options to identify better performing options and to inform recommendations of the preferred option to be taken forward. Aside from construction costings and measurement of economic benefits associated with travel time reduction, a high level qualitative approach was adopted for assessment against the 5 case model.

10.1.2.3 From the 9 options above 6 were identified as better performing options. These options which were progressed through to the SOBC were:

- **Preferred solutions** – Option A/D (C1/C2) – Full offline dualling between Black Cat roundabout and Caxton Gibbet roundabout with grade separation Black Cat roundabout and either grade separation or signalisation at Caxton Gibbet. C1 and C2 are considered to be variants of one another with the only difference being the level of intervention at Caxton Gibbet
- **Next best solutions** – Option G/I (C7/C16) – An offline bypass between Black Cat Roundabout and Cambridge Road Roundabout, either dual or single carriageway standard, online widening

between Cambridge Road Roundabout and Caxton Gibbet roundabout with both Black Cat roundabout and Cambridge Road roundabout being grade separated. Options G (C7) and I (C16) are considered variants of one option, with the only difference being a single carriageway or dual carriageway bypass between Black Cat roundabout and Cambridge Road roundabout.

- **Low cost solutions** – Option C/H (C10/C11) – Local junction widening along the A428, improvements to A1 junctions and Black Cat roundabout grade separated with either Grade Separation or signalisation at Caxton Gibbet roundabout. C1 and C2 are considered to be variants of one another with the only difference being the level of intervention at Caxton Gibbet

10.1.3 Stage 1 Options Identification

10.1.3.1 Following an IDC meeting on the 10th of February 2016, it was established a scheme cost saving exercise would be undertaken as a result of a misalignment of option estimates and available budget for potential options.

10.1.3.2 To contend with affordability constraints the following options were developed at a workshop on 15/03/2016. The options are based on the OAR and SOBC's preferred solutions.

Option Reference	Option Description
D N	Do Nothing – No improvement works to be carried out
A	A428 full offline dualling with grade separation of Black Cat roundabout, grade separation of Cambridge Road roundabout and grade separation of Caxton Gibbet roundabout.
B1	The same as option A, but delivered in 2 phases. Phase 1 – improvements to existing A428 junctions between and including Black Cat and Caxton Gibbet roundabouts, grade separation of Black Cat and Caxton Gibbet roundabouts; and at-grade improvements at Cambridge Road roundabout. Phase 2 – A428 full offline dualling with grade separation of Cambridge Road junction.
B2	The same as option A, but delivered in 2 phases. Phase 1 – offline dualling between Cambridge Road and Caxton Gibbet roundabouts, at-grade junction improvements at Cambridge Road roundabout and grade separation of Caxton Gibbet roundabout. Phase 2 – A428 offline dualling between Black Cat and Cambridge Road roundabouts, with grade separation of Black Cat and Cambridge Road roundabouts.
C	Local junction widening with channelization at existing A428 junctions, grade separation at Black Cat roundabout, at-grade junction improvements at Cambridge Road roundabout, grade separation at Caxton Gibbet roundabout and upgrade to existing A1 junctions.
D	The same as option A, but with signalisation of Caxton Gibbet roundabout. A428 full offline dualling with grade separation of Black Cat roundabout, grade separation of Cambridge Road roundabout and signalisation of Caxton Gibbet roundabout.
E	A428 dual carriageway bypass from Black Cat to Cambridge Road roundabout with grade separation at Black Cat, Cambridge Road and Caxton Gibbet roundabouts. No changes to the mainline carriageway between Cambridge Road and Caxton Gibbet junctions.
F	The same as option E, but with signalisation at Caxton Gibbet roundabout. A428 dual carriageway bypass from Black Cat roundabout to Cambridge Road roundabout with grade separation at Black Cat roundabout, grade separation at Cambridge Road roundabout and signalisation at Caxton Gibbet roundabout. No changes to the mainline carriageway between Cambridge Road and Caxton Gibbet junctions.
G	A428 single lane carriageway bypass from Black Cat roundabout to Cambridge Road roundabout, with online dualling between Cambridge Road roundabout and Caxton Gibbet roundabout. Grade separation at Black Cat, Cambridge Road and Caxton Gibbet roundabouts.

Option Reference	Option Description
H	The same as option C but with signalisation of Caxton Gibbet Roundabout. Local junction widening with channelization at existing A428 junctions, grade separation at Black Cat roundabout, at-grade junction improvements at Cambridge Road roundabout, signalisation of Caxton Gibbet roundabout and upgrade to existing A1 junctions.
I	A428 dual carriageway bypass from Black Cat roundabout to Cambridge Road roundabout with online dualling between Cambridge Road roundabout and Caxton Gibbet roundabout. Grade separation at Black Cat and Caxton Gibbet roundabouts; and at-grade junction improvements at Cambridge Road roundabout.
J	The same as option A but with at-grade improvements at Black Cat roundabout. A428 full offline dualling with at-grade junction improvement of Black Cat Roundabout and grade separation of Caxton Gibbet Roundabout.
K	Online dualling between Cambridge Road roundabout and Caxton Gibbet roundabout with at-grade junction improvements of existing junctions between and including these junctions. No changes to the mainline carriageway between Black Cat and Cambridge Road junctions.
L	Offline dual carriageway between Cambridge Road roundabout and Caxton Gibbet roundabouts. Grade separation of Black Cat, Cambridge Road and Caxton Gibbet roundabouts. No changes to the mainline carriageway between Black Cat and Cambridge Road junctions.
M	Offline dual carriageway between Cambridge Road roundabout to Caxton Gibbet roundabouts, at-grade junction improvements at Cambridge Road roundabout, grade separation of Black Cat and Caxton Gibbet roundabouts. No changes to the mainline carriageway between Black Cat and Cambridge Road junctions.
N	Online dualling between Cambridge Road and Caxton Gibbet roundabouts, grade separation at Black Cat roundabout, at-grade junction improvements to Cambridge Road roundabout and signalisation at Caxton Gibbet roundabout. No changes to the mainline carriageway between Black Cat and Cambridge Road junctions.

Table 10.2 - Options identified at Stage 1 workshop

10.1.3.3 It was clear from the work completed to date that a number of the options were similar variants of the same option. It was considered that it would be of little benefit to assess each of these variants to the same high level of detail during the options identification stage. As described in Table 10.2 above, these variant differences consisted of single junction improvements being at grade rather than grade separated, the addition/omission of signalisation at junctions, differing cross sections along the same alignment and phased approaches to construction etc.

10.1.3.4 As such a chosen option from each of the groups of variants was taken forward to the option identifications stage:

- Options B1, B2, D and J were all discarded as they are all variants of option A, an offline chosen option and preferred solution in the OAR.
- Option H was discarded as it is a variant of option C, the low cost chosen solution in the OAR.
- Option F was discarded as it is a variant of option E, option E was shortlisted option in the OAR.
- Option G is a variant of option I; Option I was a next best solution in the OAR.
- Options K, L, M and N are all options which although may meet the affordability constraints requirement had previously been discounted by the OAR report. They could also all be achieved by phasing one of the 6 chosen options below.

10.1.3.5 To ensure that any possible benefits of the discarded variants are not lost, all of the discarded variants differences will be considered as part of the assessment of the chosen options development during PCF Stages 1 and 2.

10.1.3.6 As a consequence of a review of the options to be assessed, several new options were identified to explore different corridors. This review showed that although an offline option (Option A) was the preferred route in the OAR, little work had been completed to investigate whether an option running to the south of the existing A428 between Cambridge Road and Caxton Gibbet Junctions would be of equal or greater benefit than Option A. It was subsequently decided that it should be assessed as part of the options identification stage.

10.1.3.7 Table 10.3 below describes each of the additional offline route options considered.

Option Reference	Option Description
O-A	Option O-A is an offline dual two-lane Expressway between Black Cat and Caxton Gibbet with a design speed of 120kph. It follows a corridor approximately 500m north of Abbotsley and 1.5km north of Great Gransden. The total length of the proposed route is 18.35km. The option includes grade-separation at Black Cat junction and Caxton Gibbet junction.
O-B	Option O-B is an offline dual two-lane Expressway between Black Cat and Caxton Gibbet with a design speed of 120kph. Option O.B follows the most northerly feasible alignment corridor, south of the existing A428. It follows a corridor approximately 1km north of Abbotsley and 0.25km south of Croxton and Croxton's 'Registered Parks and Grassland' area. The total length of the proposed route is 18.1km. The option includes grade-separation at Black Cat junction and Caxton Gibbet junction.
O-C	Option O-C is an offline dual two-lane Expressway between Black Cat and Caxton Gibbet with a design speed of 120kph. Option O.C follows a corridor approximately 0.45km north of Abbotsley and 0.3km south of Croxton and Croxton's 'Registered Parks and Grassland' area. The total length of the proposed route is 17.75km. The option includes grade-separation at Black Cat junction and Caxton Gibbet junction.
O-D	Option O-D is an offline dual two-lane Expressway between Black Cat and Caxton Gibbet with a design speed of 120kph. Option O.D follows a corridor approximately 0.2km south of Abbotsley and 0.65km south-east of Croxton and Croxton's 'Registered Parks and Grassland' area. The total length of the proposed route is 17.72km. The option includes grade-separation at Black Cat junction and Caxton Gibbet junction.
O-E	Option O-E is an offline dual two-lane Expressway between Black Cat and Caxton Gibbet with a design speed of 120kph. Option O.E follows a corridor approximately 0.75km south of Abbotsley and 1km south-east of Croxton and Croxton's 'Registered Parks and Grassland' area. The total length of the proposed route is 18.3km. The option includes grade-separation at Black Cat junction and Caxton Gibbet junction.

Table 10.3 - Additional southern route options

10.1.3.8 Once five Option O variants had been designed, a systematic analysis was carried out to narrow these down to two options. The analysis compared various factors, including but not limited to, area of construction within the flood zone, proximity to local residential areas, proximity to listed buildings and number of Category B and C roads crossed.

- Option O-B was dropped due to its close proximity with Croxton Park and Eltisley, as well as the large number of culverts required.
- Option O-C was dropped due to its close proximity with Croxton Park and Abbotsley, and large severing of woodland areas.
- Option O-D was dropped due to the large number of major utilities diverted, close proximity with Abbotsley and the large construction area required within a flood zone.

10.1.4 Low Cost Solution

10.1.4.1 Following IDC meetings in July and August it was decided to put further focus on developing options within the funding allocation of £280m. As a result, additional emphasis was put on developing the "low cost option C" design. Using information provided by the traffic team previously unavailable option identification workshops, the development of the design focused attention on seven locations along the existing route to add capacity and improve safety. In order to best meet the objectives and the budget constraint, six variants of the option were developed; Table 10.4 below describes each of the variants and the proposed solution at each location.

10.1.4.2 Based upon preliminary estimates options C20 and C21, were able to be discounted for not meeting the budget constraint; therefore they will not be considered for further assessment. Options C24 and C25 were provided only to obtain cost information for each junction – these will be assessed as part of Option C23.

Option C Variant	Black Cat	Wyboston	Wyboston to Barford Rd	Barford Road	Cambridge Road	Eltisley to Caxton Gibbet	Caxton Gibbet
C20 (Full)	Two-tier grade separated junction with local access	Larger roundabout including access for Wyboston Lakes. Existing signal junction closed.	Carriageway to be dualled with additional bridge structure over the River Great Ouse and flood plain	Larger roundabout to allow for dualled entry	Addition of segregated movement lanes: from St Neots left towards Cambridge and “straight ahead” towards Wyboston	New roundabout to the north east of Eltisley village with online widening to dual carriageway towards Caxton Gibbet	Two-tier grade separated junction with local access
C21 (Targeted)	Two-tier grade separated junction with local access	Larger roundabout including access for Wyboston Lakes. Existing signal junction closed.	Carriageway to be dualled with additional bridge structure over the River Great Ouse and flood plain	Larger roundabout to allow for dualled entry	Addition of segregated movement lanes: from St Neots left towards Cambridge and “straight ahead” towards Wyboston	None	Signalised existing roundabout with “through lanes” to cater for A428 through traffic
C22 (Focused)	Two-tier grade separated junction with local access	Larger roundabout including access for Wyboston Lakes. Existing signal junction closed.	Carriageway to be dualled from Wyboston roundabout, returning to single carriageway over River Great Ouse.	Larger roundabout with longer flares and additional approach lanes	Addition of segregated movement lanes: from St Neots left towards Cambridge and “straight ahead” towards Wyboston	None	Signalised existing roundabout with “through lanes” to cater for A428 through traffic
C23 (Lean)	Two-tier grade separated junction with local access	None	None	None	None	None	Two-tier grade separated junction with local access
C24 – Black Cat only	Two-tier grade separated junction with local access	None	None	None	None	None	None
C25 – Caxton Gibbet only	None	None	None	None	None	None	Two-tier grade separated junction with local access

Table 10.4 - Low cost solutions

10.2 Options to be assessed

10.2.1.1 The final options to be assessed in this TAR are the following and will henceforth be referred to thus and shown in Figure 10.1 - Schematic showing options being assessed below:

- Option 1 (formerly Option A)
- Option 2 (formerly Option C)
- Option 3 (formerly Option E)
- Option 4 (formerly Option I)
- Option 5 (formerly Option O-A)
- Option 6 (formerly Option O-E)
- Option 7 (formerly Option C22)
- Option 8 (formerly Option C23)

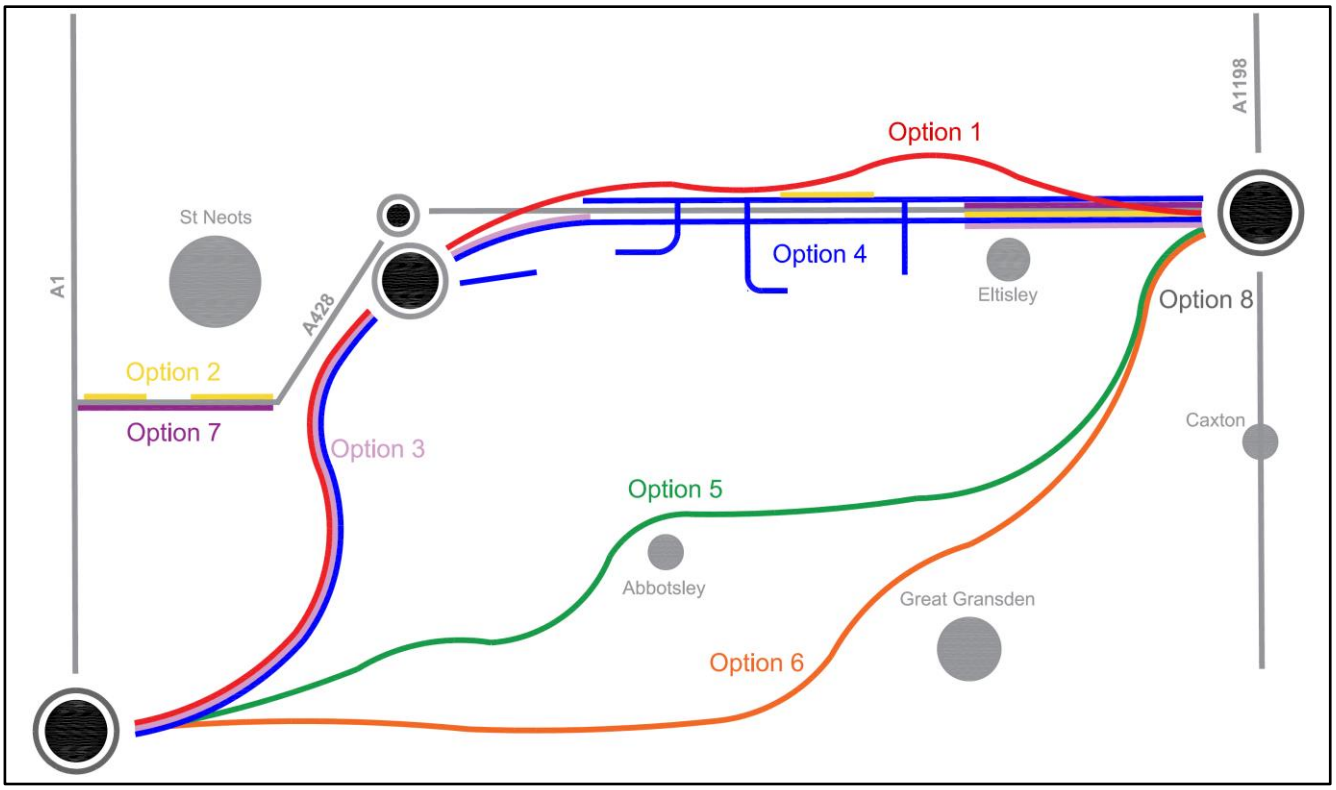

Figure 10.1 - Schematic showing options being assessed

10.2.1.2 Due to the early stages of the design process and the limited availability of traffic data, the design of the options described below are subject to change as the developing traffic model becomes live. The locations and details of new structures to accommodate motorised users, non-motorised users and watercourses were considered when developing options.

10.2.1.3 Where possible new structures will have open abutments to minimise visual obstruction to road users. The need for open or closed abutments will be confirmed for each structure as part of design progression following the preferred route selection.

10.2.1.4 Where footpaths, cycleways, bridleways and farm access roads are severed by the proposed options, NMU and accommodation structures have been proposed. These are detailed by option below. The number of NMU and accommodation structures will be reviewed after a preferred route has been selected and after consultation with private land owners and the public.

10.2.1.5 Traffic sign gantries and retaining walls will be required as part of the proposed layout. The locations of the sign gantries and retaining walls will be determined as part of design progression following the preferred route selection.

10.3 Option 1

10.3.1 Option Layout

10.3.1.1 Option 1 is shown in Figure 10.2 - Option 1and drawings shown in Appendix A (drawings HE551495-JAC-HML-00-SK-C-0701 to 0712).

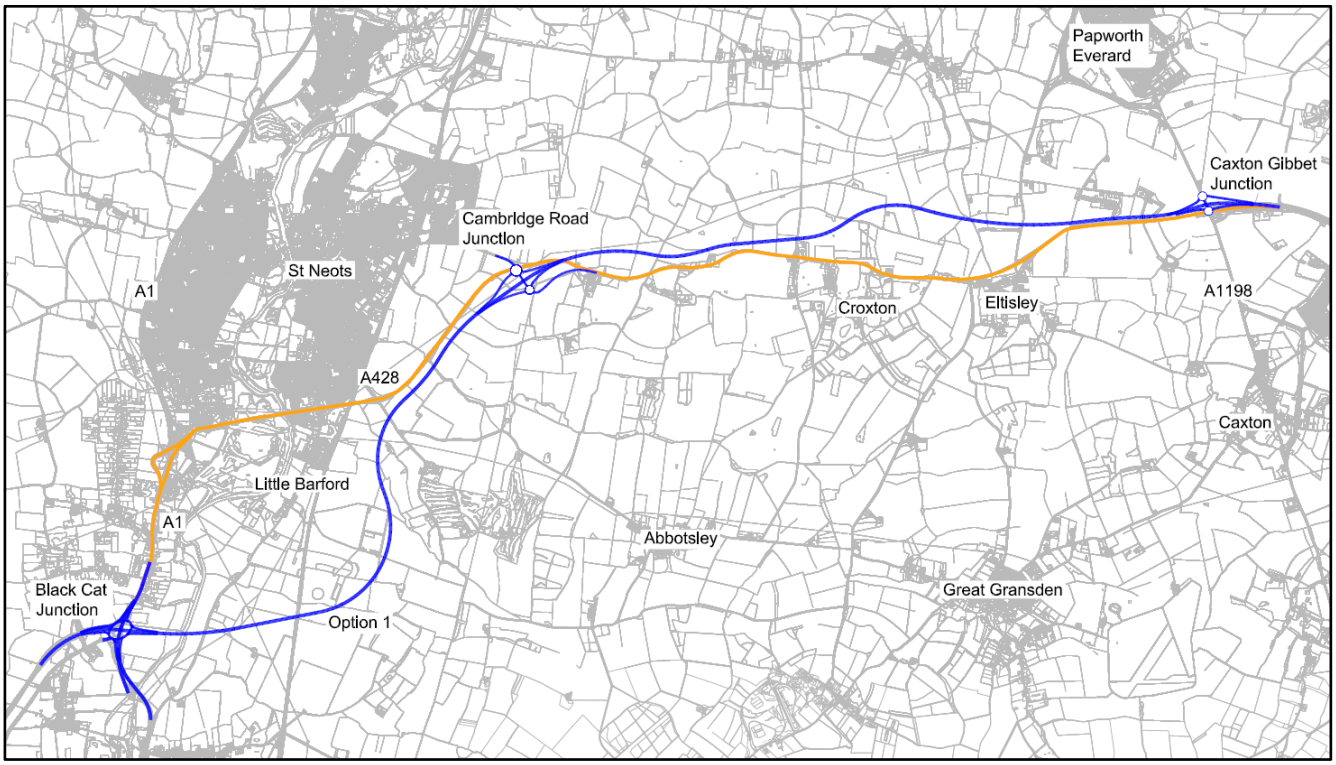

Figure 10.2 - Option 1

10.3.1.2 Option 1 is an offline solution which provides a new Expressway standard link between Black Cat Junction and Caxton Gibbet Junction, whilst also providing a grade separated junction at Cambridge Rd. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3. It is expected there will significant land take.

10.3.1.3 The following improvements for Option 1 will be made:

- New 18.9km A428 offline Expressway Standard alignment between Black Cat Junction and Caxton Gibbet Junction;
- Significant improvement works at Black Cat Junction –grade separated junction;
- Significant improvement works at Cambridge Road Junction – grade separated junction;
- Significant improvement works at Caxton Gibbet Junction – grade separated junction;

- Realignment of the A1 passing through the existing Black Cat Junction to align with the improved Black Cat Junction;
- Tie-in work to the existing A421 west of Black Cat Junction;
- Tie-in work to the existing A428 east of Caxton Gibbet Junction; and
- Tie-in work to existing Bedford Road.

10.3.2 Option Description

A428

10.3.2.1 The A428 will be approximately 18.9km long and will be an offline alignment. The new offline A428 will require tie-in work to the existing A421 west of Black Cat and the A428 east of Caxton Gibbet. The A428 will be designed to meet Expressway Standards. The A428 will be a rural dual two lane all-purpose carriageway.

Black Cat to Cambridge Road

10.3.2.2 Prior to the beginning of the offline alignment, improvement works will be undertaken to the A421 west of Black Cat in order to tie-in the new A428 offline alignment. The works will include approximately 1.15km of the A421 in the form of minor vertical and horizontal alignment adjustments.

10.3.2.3 The general direction of A428 from Black Cat Junction will be an easterly direction. The alignment will head east for approximately 3km crossing significant features such as the River Great Ouse, Barford Road (Unnamed Road) and the East Coast Mainline.

10.3.2.4 The alignment changes to a north direction for approximately 2.5km heading towards the existing A428 and B1046/St Neots Road. The alignment will cross the B1046/St Neots Road and will change to a north east direction.

10.3.2.5 The alignment will remain in a north easterly direction parallel to the existing A428 (southern side) for approximately 2.4km where it will pass through an improved Cambridge Road Junction.

Cambridge Road to Caxton Gibbet

10.3.2.6 The alignment continues north east for a further 0.5 km past Cambridge Road Junction to the existing A428 where it will crosses it.

10.3.2.7 After crossing the existing A428, the new offline alignment changes to an easterly direction. The alignment will remain in easterly direction parallel to the existing A428 (northern side) for approximately 9km. The new alignment will cross significant features such as Toseland Road and B1040/St Neots Road and pass through the improved Caxton Gibbet Junction.

10.3.2.8 The alignment has a slight curve in the alignment north of Croxton Park in order to bypass North Lodge Plantation. Superseded

A1

10.3.2.9 The improvement works at Black Cat Junction will require a realignment of both the northbound and southbound A1 carriageways. Major vertical and horizontal alignment works will be required for the A1 which pass directly through Black Cat Junction.

10.3.2.10 The A1 will make up the top tier of Black Cat Junction and in turn will require major vertical alignment works using embankments in order to pass over Black Cat roundabout and the A428. A long spanning bridge will be used to cross the roundabout and join the embankments which will be constructed up to the outer edge of the roundabout.

10.3.2.11 There are numerous direct property and minor roads access joining the northbound (Chawston Lane and Nagshead Lane) and southbound (Great North Road) carriageways north of Black Cat Junction. At this stage it is unclear whether the scheme will maintain these links and whether the links will be affected by potential improvement works.

Black Cat Junction

10.3.2.12 Black Cat Junction in this option is proposed to be a three tier grade separated junction with an intermediate level roundabout providing the interchange between the A1, the A421 and the new A428. The A421/A428 will form the bottom tier, the roundabout will form the middle tier, and the A1 will form the top tier. It is unclear at this stage whether the junction will be constructed from existing ground level or below existing ground level.

Black Cat Roundabout

10.3.2.13 The roundabout will be approximately 250m in diameter with a circulatory three lane carriageway with a typical cross section. The roundabout will maintain an existing link to Bedford Road with a combined entry and exit arm. The roundabout will have four entry arms – A421 Eastbound, A428 Westbound, A1 Southbound and A1 Northbound. The roundabout will have four exit arms – A421 Westbound, A428 Eastbound A1 Northbound and A1 Southbound.

Slip Roads – Merges and Diverges

10.3.2.14 Black Cat Roundabout will have four merge slip roads and four diverge slip roads. The merge slip roads include: A421 Westbound, A428 Eastbound, A1 Northbound and A1 Southbound. The diverge slip roads include: A421 Eastbound, A428 Westbound, A1 Northbound and A1 Southbound.

10.3.2.15 The A421 diverge eastbound and A1 merge northbound slip road will also serve as segregated lane. The segregated lane will allow free flow traffic movement from the A421 Eastbound to A1 Northbound via A1 merge Northbound.

Cambridge Road Junction

10.3.2.16 Cambridge Road Junction will be a grade separated two tier junction. The top tier of the junction will be the new offline A428 and the bottom tier will be a dumbbell roundabout. It is envisaged that the A428 offline alignment will be constructed on an embankment through the junction with the dumbbell roundabout built at existing ground level.

10.3.2.17 Cambridge Road Junction will maintain network connections to the existing A428 and Cambridge Road/B1428.

Cambridge Road North Dumbbell Roundabout

10.3.2.18 Cambridge Road north dumbbell roundabout will be approximately 110m in diameter. It will be a two lane circulatory carriageway with a typical cross section. The north roundabout will have one entry arm – A428 Eastbound. The entry arm will link to a diverge slip road exiting the A428 eastbound. The north roundabout will have one exit arm – A428 Eastbound. The exit arm will link to a merge slip road entering the A428 eastbound. The north roundabout will also have two combined entry and exit arms. The combined entry and exit arms will maintain connections to Cambridge Road and the existing A428. Appropriate tie-in work will be undertaken to maintain existing connections.

10.3.2.19 Cambridge Road/B1428 link road will be approximately 290m long and will tie-in to the existing Cambridge Road/B1428. The A428 link road will be approximately 227m long and will tie-in to the existing A428.

Cambridge Road South Dumbbell Roundabout

10.3.2.20 Cambridge Road south dumbbell roundabout will be approximately 110m in diameter. It will be a two lane circulatory carriageway with a typical cross section. The south roundabout will have one entry arm – A428 Westbound. The entry arm will link to a diverge slip road exiting the A428 westbound. The south roundabout will have one exit arm – A428 Westbound. The exit arm will link to a merge slip road entering the A428 westbound. The south roundabout will have one combined entry and exit arm. The combined entry and exit arm will maintain a link existing A428.

10.3.2.21 The link road between the south dumbbell roundabout and the existing A428 will be approximately 905m long. It will be a single carriageway with a typical cross section.

Slip Roads – Merges and Diverge

10.3.2.22 Black Cat Roundabout will have two merge slip roads and two diverge slip roads. The merge slip roads include: A428 Eastbound and A428 Westbound. The diverge slip roads include: A428 Eastbound and A428 Westbound.

Caxton Gibbet Junction

10.3.2.23 Caxton Gibbet Junction will be a grade separated two tier junction. The top tier of the junction will be the dumbbell roundabout and the bottom tier will be the offline A428. It is envisaged that the A428 offline alignment will be constructed in cutting through the junction with the dumbbell built at existing ground level.

10.3.2.24 Caxton Gibbet Junction will maintain network connections to the existing A428 and the A1198.

10.3.2.25 The north and south dumbbell roundabouts will be joined by a link road. The link road will be approximately 130m long. It will be a single carriageway with a typical cross section. The link road will pass over the new offline A428.

Caxton Gibbet North Dumbbell Roundabout

10.3.2.26 Caxton Gibbet north dumbbell roundabout will be approximately 77m in diameter and will be a two lane circulatory carriageway with a typical cross section. The north roundabout will remain in the same location of the existing Cambridge Road roundabout. The north roundabout will have one entry arm – A428 Eastbound. The entry arm will link to a diverge slip road exiting the A428 eastbound. The north roundabout will have one exit arm – A428 Eastbound. The exit arm will link to a merge slip road entering the A428 eastbound. The north roundabout will also have two combined entry and exit arms. The combined entry and exit arms will maintain a connection to the A1198 and a new link road.

10.3.2.27 A new link road will be constructed to provide access to Caxton Gibbet Junction for private properties on the north side of the new offline A428. The new access link road will be approximately 1,165m long and will be a single carriageway with a typical cross section.

Caxton Gibbet South Dumbbell Roundabout

10.3.2.28 Caxton Gibbet south dumbbell roundabout will be approximately 77m and will be a two lane circulatory carriageway with a typical cross section. The south roundabout will have one entry arm – A428 Westbound. The entry arm will link to a diverge slip road exiting the A428 westbound. The south roundabout will have one exit arm – A428 Westbound. The exit arm will link to a merge slip road entering the A428 westbound. The south roundabout will have two combined entry and exit arms. The combined entry and exit arms will maintain a links to the existing A428 and the A1198.

10.3.2.29 A connection between the south dumbbell roundabout and the existing A428 and the A1198 will be maintained.

Slip Roads – Merges and Diverge

10.3.2.30 Black Cat Roundabout will have two merge slip roads and two diverge slip roads. The merge slip roads include: A428 Eastbound and A428 Westbound. The diverge slip roads include: A428 Eastbound and A428 Westbound.

10.3.3 Structures

Option 1 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-0701 to 0712).

Existing Structures

10.3.3.1 As part of the development of options for the A428 improvements, the feasibility of widening the existing bridges has been investigated. Details of existing structures are shown in Table B1.1 in Appendix B and on the location plan drawings.

10.3.3.2 Tempsford North Flood Span (BE01), Tempsford Main Span (BE02), Tempsford New South Flood (BE03) and Tempsford South Flood 5 Span (BE04) are all 11.6m wide between parapets. In order to accommodate the proposed A1 southbound carriageway, the bridges would need to be 13.05m wide between parapets. However, considering the uncertainty over a future A1 scheme, there are no plans to widen these existing structures as part of the A428 Black Cat to Caxton Gibbet scheme.

10.3.3.3 Wyboston Footbridge (BE08) was initially to be demolished and replaced with a wider bridge for non-motorised users (NMU). However, considering the uncertainty over a future A1 scheme, a decision has been made to omit any proposed changes to the structure from the A428 Black Cat to Caxton Gibbet scheme.

10.3.3.4 Having considered the need to demolish or widen existing structures affected by the proposed Option 1, one bridge (Roxton Road Bridge (BE14)) and one culvert (CE14) is to be demolished and one culvert (Black Cat Culvert (CE02) is to be extended to accommodate the proposed A1.

10.3.3.5 Roxton Road Bridge (BE14) would obstruct the view of A421 users. To improve road user visibility, it is proposed to demolish the structure and replace it with a longer one (BN219). Refer to Table B1.2 in Appendix B for the BN reference number.

10.3.3.6 Culvert CE14 is to be demolished and the watercourse diverted east, as the proposed A428 is in cut at Caxton Gibbet Junction. A new culvert (CN213) will carry the diverted watercourse under the A428 (refer to Table B1.2 in Appendix B for the CN reference number).

New Structures

10.3.3.7 In total the new structures required for Option 1 include: 11 No motorised user overbridges, 5 No motorised user underbridges, 6 No non-motorised user overbridges and 22 No culverts. See Table B1.2 in Appendix B and the location plan drawings for details.

Black Cat Junction

10.3.3.8 At Black Cat Junction, 3 No overbridges will be provided to facilitate grade separation of the junction. A 5-span viaduct (BN202) will carry the A1 over Black Cat roundabout. Two 3-span overbridges (BN201 & BN203) will carry Black Cat roundabout over the A428. To minimise visual obstruction to A421 road users, a 75m long bridge (BN219) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Cambridge Road Junction

10.3.3.9 Between Black Cat Junction and Cambridge Road Junction, the following structures are proposed: 4 No motorised user overbridges, 2 No motorised user underbridges, 3 No NMU overbridges and 5 No culverts. See Table B1.2 in Appendix B and the location plan drawings for details.

10.3.3.10 The longest proposed structure along the route is an underbridge (BN204) which will carry the new A428 over the River Great Ouse. The proposed viaduct is to be approximately 300m long. The span of this viaduct will need to be reviewed at detailed design stage after completion of a flood risk assessment, as the proposed structure is located on a flood plain. An underbridge (BN207) will be provided to carry the new A428 over the East Coast Main Line Railway in order to minimise disruption to it.

Cambridge Road Junction

10.3.3.11 At Cambridge Road Junction, a 3 span underbridge (BN211) with open abutments is proposed to facilitate grade separation of the junctions. 9 No culverts are proposed to accommodate the watercourses in the area.

Cambridge Road Junction to Caxton Gibbet Junction

10.3.3.12 Between Cambridge Road Junction and Caxton Gibbet Junction, the following structures are proposed: 2 No motorised user overbridges, 2 No motorised user underbridge, 2 No NMU overbridges and 7 No culverts. See Table B1.2 in Appendix B and the location plan drawings for details.

Caxton Gibbet Junction

10.3.3.13 At Caxton Gibbet Junction, a 3 span overbridge (BN218) with open abutments is proposed to facilitate grade separation of the junction. An NMU structure (NMU206) is proposed to the east of the junction to carry a cycleway/footway over the A428. A culvert (CN213) is proposed to the east of the junction to carry a proposed watercourse diversion under the A428.

10.3.4 Proposed NMU facilities

10.3.4.1 Preliminary NMU proposals have been drafted, as part of the Option 1 design. These have attempted to address the NMU issues identified in section 7.1, as well as mitigating or improving any severance issues created by the option itself. It is however accepted that, with the scheme in PCF Stage 1, these proposals are likely to develop following engagement with Stakeholders during the design development.

10.3.4.2 It is proposed that as part of the Option 1 design that solutions to the following existing NMU severance issues will be directly improved by the Option 1 scheme:

- Existing at-grade Black Cat Junction-As part of a grade separated junction improvement at Black Cat, it is proposed to provide a route for NMU's from Roxton to the Chawston Ln junction with the A1. This will be provided by providing a route across Roxton Rd Bridge and along the North West edge of the proposed grade separated Black Cat junction.
- Existing Caxton Gibbet Junction- As part of a grade separated junction improvement at Caxton Gibbet, it is proposed to provide an NMU bridge to the east of the junction. This will provide a grade separated connection for NMU's, which will improve upon the existing situation.

10.3.4.3 The option 1 alignment severs several existing PROW routes (See appendix A for details of existing NMU routes); NMU bridges have been provided in order to mitigate this potential severance along the route.

10.3.4.4 As described in section 7.1 several existing A428 corridor NMU severance issues were identified, namely:

- A428/Great North Rd junction
- A428/Barford Rd junction
- A428 between Cambridge Road Caxton Gibbet and the villages at Croxton, Eltisley and Caxton.

10.3.4.5 It is anticipated that Option 1 will reduce the numbers of vehicles on the existing A428 corridor between Wyboston and Caxton Gibbet. This likely reduction in the number of vehicles is likely to create a greater opportunity to improve the existing PROW severance issues along the existing A428 corridor. As a result of the likely reduction in traffic, provision of improvement features such as at-grade signalised/un-signalised crossings and on road cycle lanes is likely to become more feasibleWhere on road provision is not appropriate, larger improvements such as footways/cycleways within the verge or NMU bridges could be possible. It is anticipated that a combination of the features mentioned above, as well as others, could be used to improve most of the existing A428 corridor NMU severance issues identified between Wyboston and Caxton Gibbet.

10.3.4.6 During the design development, the need for these requirements will need to be balanced with the costs associated with their provision to ensure the most net benefit can be realised.

10.3.5 Drainage

10.3.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.5 below for Option 1. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved area: 78 Ha (Existing Paved area: 6 Ha, Additional Paved area: 72Ha)
Culvert Crossings	The total number of estimated culvert crossings equals 29. This total consists of 24 potential culvert crossings and five existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The 29 culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-0701 to 0712 in Appendix A between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and proposed culvert crossings (e.g. diameter, length, etc.) are summarized in tabular format in Appendix B.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of potential bridge structure at the River Great Ouse which is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-0702 in Appendix A. Details of this potential bridge crossing are summarized in tabular format in Appendix B.
Highway Drainage Outfalls	Total number of potential outfall locations equals 26 (including assumed existing outfalls). This total consists of 22 outfalls discharging to nearby watercourses or existing culvert crossings and four outfalls discharging to the existing surface water drainage system serving the A428. The number of potential outfall locations is subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in proposed the highway geometry. Gravity discharge will be achieved at all outfalls with the exception of two potential outfall locations (Chainage 14410 and Chainage 17380 near Caxton Gibbet junction) for this Route Option. A pumped discharged solution will be required at these two locations. This would add to the capital and operational costs of this Route Option. However, it should be noted that there is a potential to raise the vertical alignment of the proposed road at Chainage 14410 that will facilitate the gravity discharge of the proposed highway drainage to the nearest watercourse and eliminate the need for a pumped discharge solution at this outfall location. This will be investigated and confirmed through review of proposed highway geometry at subsequent project design stages.

Item	Comment
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range between 63,000 m3 to 79,000 m3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground). Online storage by means of oversized pipes may need to be provided at five outfall locations for this Route Option due to spatial constraints.
Other Drainage Issues	Five outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage.

Table 10.5 - Option 1 surface water drainage details

10.4 Option 2

10.4.1 Option Layout

10.4.1.1 Option 2 is shown in Table 10.3 and drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-0801 to 0812).

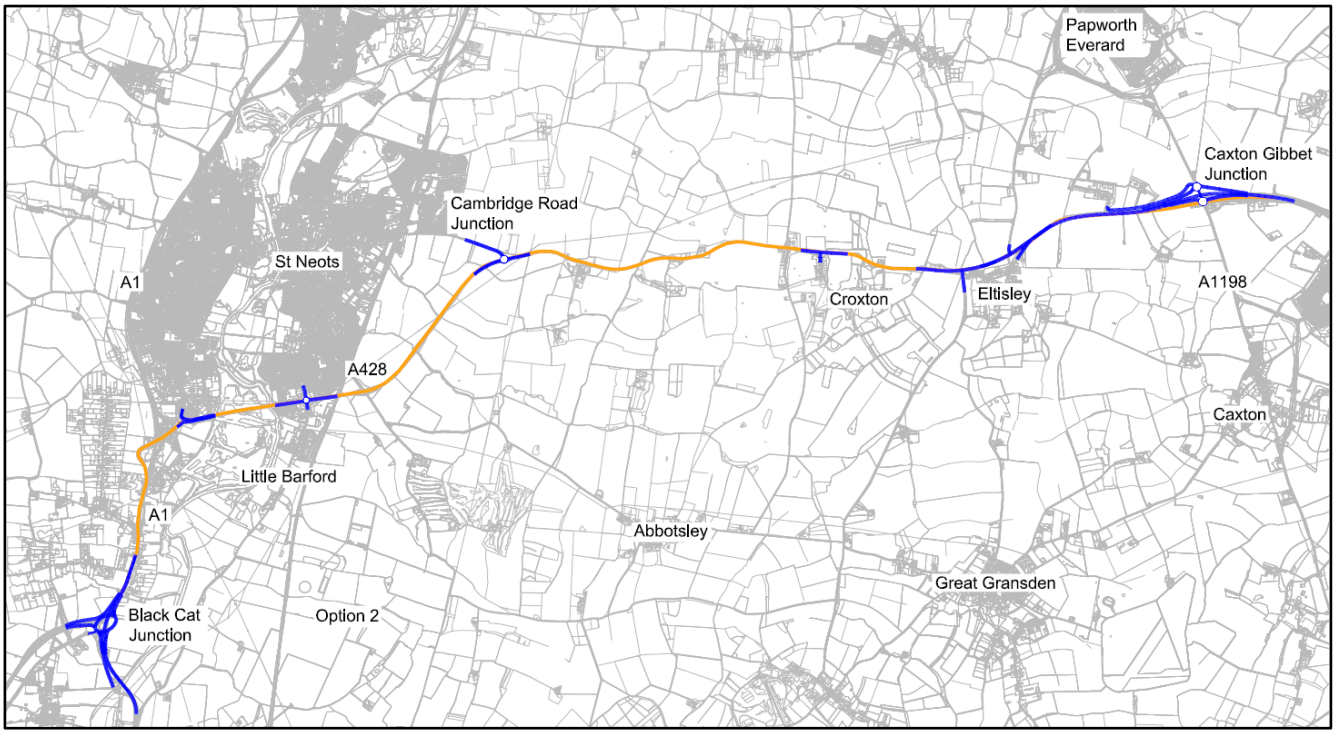

Figure 10.3 - Option 2

10.4.1.2 Option 2 is one of the 'low cost' options. The aim of the option is to provide online junction improvements between, and including Black Cat and Caxton Gibbet Junctions. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3. It is expected land take will be minimal. There will be minimal new structures (culverts and bridges) as a result of the improvements.

10.4.1.3 The following improvements for Option 2 will be made:

- Significant improvement works at Black Cat Junction – grade separated junction;
- At-grade lane segregation and lane widening improvement works at Wyboston Junction;

- At-grade lane widening improvement works at Barford Road Junction;
- At-grade lane widening improvement works at Cambridge Road Junction;
- At-grade junction improvement works at Abbotsley Road / Toseland Road Junction;
- At-grade junction improvement works at High Street Junction;
- At-grade junction improvement works at B1040 / St. Ives Road Junction;
- Significant improvement works at Caxton Gibbet Junction – grade separated junction;
- Realignment improvement works to existing A428 carriageway between B1040 / St. Ives Road and Caxton Gibbet Junctions;
- Realignment of the A428 which passes will pass through the improved Caxton Gibbet Junction;
- Realignment of the A1 at Black Cat Junction;
- Tie-in work to the existing A421 west of Black Cat Junction;
- Tie-in work to the existing A428 east of Caxton Gibbet Junction;
- Tie-in work to existing Bedford Road.

10.4.2 Option Description

A428

10.4.2.1 Option 2 represents localised junction improvement works with some online and offline improvement works. There is one section of the existing A428 where online alignment improvements will be undertaken. Online improvement works will be undertaken to a 700m stretch of online alignment between B1040 / St. Ives Road and Caxton Gibbet Junctions to reduce a sub-standard radii. To accommodate improvement works at Caxton Gibbet Junction, 1.1km of the existing A428 will upgraded to dual carriageway and new 1.3km section of new offline dual carriageway will be constructed.

A1

10.4.2.2 Improvement works to the A1 will be the same as described in Option 1. See section 10.3.2 for more detail.

Black Cat Junction

10.4.2.3 Black Cat Junction is a three tier gyratory junction. The junction will be the meeting point for the A1 and the A421. The A421 will form the bottom tier and will not pass through the junction, but join the middle tier. The roundabout gyratory will form the middle tier, and the A1 will form the top tier. The design of the junction will provide the provision for an offline A428 to be constructed on the bottom tier.

Black Cat Roundabout

10.4.2.4 Black Cat Roundabout will form the middle tier of the junction. The roundabout will be approximately 250m in diameter with a circulatory three lane carriageway with a typical cross section. The roundabout will maintain an existing link to Bedford Road with a combined entry and exit arm. The roundabout will have three entry arms – A421 eastbound, A1 southbound and A1 northbound. The roundabout will have three exit arms – A421 westbound, A1 northbound and A1 southbound.

Slip Roads – Merges and Diverge

10.4.2.5 Black Cat Roundabout will have three merge slip roads and three diverge slip roads. The merge slip roads include: A421 westbound, A1 northbound and A1 southbound. The diverge slip roads include: A421 eastbound, A1 northbound and A1 southbound.

10.4.2.6 The A421 diverge eastbound and A1 merge northbound slip road will also serve as segregated lane. The segregated lane will allow free flow traffic movement from the A421 eastbound to A1 northbound via A1 northbound merge slip road.

Wyboston Junction

10.4.2.7 Improvement works to Wyboston Junction will be at-grade and focus on the east arm of the junction. A 410m section of the eastbound and westbound carriageways, of the east arm, will be widened from single lane carriageways to dual lane carriageway. The widen carriageway will be tied-in to the existing A428.

10.4.2.8 The junction will see the introduction of two segregated lanes. A segregated lane will be provided for traffic movements from A1428 southbound to A428 eastbound i.e. southbound to eastbound traffic movement. A segregated lane will be provided for traffic movements from the A428 westbound to Great North Road southbound i.e. westbound to southbound traffic movement.

Barford Road Junction

10.4.2.9 The improvements to Barford Road Junction will be at-grade and focus on east and west arm of the junction. A 300m section of the eastbound and westbound carriageways, of east and west arms, will be widened from single lane carriageways to dual carriageways. The widened carriageways will tie-in to the existing A428.

Cambridge Road Junction

10.4.2.10 The roundabout will be upgraded to a three lane circulatory carriageway with a typical cross section.

10.4.2.11 The improvements to Cambridge Road Junction will be at-grade and focus on the east and west arm of the junction. A 200m section of the eastbound and westbound carriageways, of east and west arms, will be widened from single lane carriageways to dual carriageways. The widened carriageways will tie-in to the existing A428. A 100m section of the entry lane from Cambridge Road/A1148 into Cambridge Road Roundabout will be widened from one lane to two lanes.

Abbotsley Road / Toseland Road Junction

10.4.2.12 Improvements will be made to traffic movements between the A428 and Toseland Road / Abbotsley Road. This will be a-grade improvement to the general layout of the junction and increasing capacity.

10.4.2.13 The A428 carriageway will be widened in the vicinity of the junction. A 250m section of Toseland Road from the A428 will be realigned westwards. The widened carriageway and realignment will allow the introduction of filter lanes and increase capacity of existing filter lanes. A left turn filter lane will be introduced from the A428 eastbound to the realigned Toseland Road northbound. A left turn filter lane will be introduced from the A428 westbound to Abbotsley Road southbound.

High Street

10.4.2.14 Improvements will be made to traffic movements between the A428 and High Street. This will be at-grade improvement to general layout of the junction and increasing capacity.

10.4.2.15 The A428 carriageway will be widened in the vicinity of the junction. The widened carriageway will allow the introduction of two filter lanes. A right turn filter lane will be introduced for traffic movements from the A428 eastbound to High Street southbound. A left turn filter lane will be introduced for traffic movements from the A428 westbound to Abbotsley Road southbound.

B1040 Junction

10.4.2.16 Improvements will be made to traffic movements between the A428 and the B1040. This will be at-grade improvement to the general layout of the junction and increasing capacity.

10.4.2.17 The A428 carriageway will be widened in the vicinity of the junction. The widened carriageway will allow the introduction of filter lanes and increase capacity of existing filter lanes. A right turn filter lane will be lengthened to increase capacity for traffic movements from the A428 eastbound to the B1040 southbound. A left turn filter lane will be lengthened to increase capacity for traffic movements from the A428 westbound to B1040 southbound. A right turn filter lane will be introduced for traffic movements from the B1040 northbound to the A428 eastbound.

St. Ives Road / B1040 Junction

10.4.2.18 Improvements will be made to traffic movements between the A428, the B1040 and Cambridge Road. This will be done by improving the general layout of the junction and increasing capacity.

10.4.2.19 The A428 carriageway will be widened in the vicinity of the junction. The widened carriageway will increase capacity of existing filter lanes. A left turn filter lane will be lengthened to increase capacity for traffic movements from the A428 eastbound to the B1040 northbound. A left turn filter lane will be lengthened to increase capacity for traffic movements from the A428 westbound to Cambridge Road southbound. A right turn filter lane will be introduced for traffic movements from the B1040 northbound to the A428 eastbound.

Caxton Gibbet Junction

10.4.2.20 Improvement works at Caxton Gibbet Junction will be the same as described in Option 1. Please see paragraph 10.3.2.23 junction description.

10.4.3 Structures

10.4.3.1 Option 2 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-0801 to 0812).

Existing Structures

10.4.3.2 Existing structures to be amended is the same as discussed in Option 1, except for the following addition.

10.4.3.3 Culvert CE13 is to be demolished as the A428 is to move south at this location. Culvert CN48 is proposed to carry the drainage ditch under the proposed offline A428.

New Structures

10.4.3.4 In total the new structures required for Option 2 include: 3 No motorised user overbridges, 2 No NMU overbridges and 2 No culverts.

Black Cat Junction

10.4.3.5 At Black Cat Junction, a 5 span viaduct (BN02) will be provided to carry the A1 over Black Cat roundabout and to facilitate grade separation of the junction. To minimise visual obstruction to A421 road users, a 75m long bridge (BN44) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Cambridge Road Junction

10.4.3.6 Between Black Cat Junction and Cambridge Road Junction, One NMU overbridge is proposed. See Table B2.2 in Appendix B and the location plan drawings for details.

Cambridge Road Junction

10.4.3.7 No structures are proposed.

Cambridge Road Junction to Caxton Gibbet Junction

10.4.3.8 Between Cambridge Road Junction and Caxton Gibbet Junction, one culvert is proposed. See Table B2.2 in Appendix B and the location plan drawings for details.

Caxton Gibbet Junction

10.4.3.9 At Caxton Gibbet Junction a 3 span overbridge (BN16) with open abutments is proposed to facilitate grade separation of the junction. An NMU structure (NMU06) is proposed to the east of the junction to carry a cycleway/footway over the A428. A culvert (CN49) is proposed to the east of the junction to carry a proposed watercourse diversion under the A428.

10.4.4 Proposed NMU facilities

10.4.4.1 Preliminary NMU proposals have been drafted, as part of the Option 2 design. These have attempted to address some of the NMU issues identified in section 7.1, as well as mitigating or improving any severance issues created by the option itself. It is however accepted that, with the scheme in PCF Stage 1, these proposals are likely to develop following engagement with Stakeholders during the design development.

10.4.4.2 It is proposed that as part of the Option 2 design that solutions to the following existing NMU severance issues will be directly improved by the Option 2 scheme:

- Existing at-grade Black Cat Junction-As with Option 1, as part of a grade separated junction improvement at Black Cat, it is proposed to provide a route for NMU's from Roxton to the Chawston Ln junction with the A1. This will be provided by providing a route across Roxton Rd Bridge and along the North West edge of the proposed grade separated Black Cat junction.
- A428/Great North Rd junction- As part of an at grade junction improvement, it is proposed to provide an NMU bridge. At present the proposed bridge is shown to be provided to the east of the junction. This would provide grade separated connection for NMU's, which will improve upon the existing situation.
- Existing Caxton Gibbet Junction- As part of a grade separated junction improvement at Caxton Gibbet, it is proposed to provide an NMU bridge to the east of the junction. This will provide a grade separated connection for NMU's, which will improve upon the existing situation. In addition to this a new NMU route will be provided along the southern side of the new dual carriageway section between Caxton and Eltisley in order to mitigate additional severance caused by the provision of the grade separated junction.

10.4.4.3 The option 2 alignment severs several existing PROW routes (See appendix A for details of existing NMU routes); NMU bridges have been provided in order to mitigate this potential severance along the route.

10.4.4.4 As described in section 7.1 several existing A428 corridor NMU severance issues were identified, namely:

- A428/Barford Rd junction
- A428 between Cambridge Road Caxton Gibbet and the villages at Croxton, Eltisley and Caxton.

10.4.4.5 With Option 2 being an online improvements scheme it is likely to increase the numbers of vehicles on the existing A428 corridor between Black Cat and Caxton Gibbet. This likely increase in the number of vehicles is likely to have a negative impact on 2 existing severance issues listed above. As a result of the likely increase in traffic, provision of on road improvement features such as at-grade signalised/un-signalised crossings and on road cycle lanes is likely to be less feasible. Consequently, larger improvements such as footways/cycleways within the verge or NMU bridges are more likely to be needed as the solution.

10.4.4.6 It is possible that a combination of the features mentioned above, as well as others, could be used to improve most of the existing A428 corridor NMU severance issues identified between Wyboston and Caxton Gibbet. During the design development, the need for these requirements will need to be balanced with the costs associated with their provision. Given the low cost nature of this option, it is unlikely that it will be possible to resolve all of these issues.

10.4.5 Drainage

10.4.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.6 below for Option 2. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved Area: 26 Ha (Existing Paved Area: 11 Ha, Additional Paved Area: 15 Ha)
Culvert Crossings	Total number of estimated culvert crossings equals 12. This total consists of two potential culvert crossings and 10 existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The 12 culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-0801 to 0812 in Appendix A between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and potential culvert crossings (e.g. diameter, length, etc.) are summarized in tabular format in Appendix B.
Main River Crossings	None. However the existing bridge structure at the River Great Ouse may require an assessment for the construction loading to be undertaken at subsequent design phases. The existing bridge structure at River Great Ouse is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-0804 in Appendix A. Details of this existing bridge crossing are summarized in tabular format in Appendix B.
Highway Drainage Outfalls	Total number of potential outfall locations equals 15 (including assumed existing outfalls). This total consists of 13 outfalls discharging to nearby watercourses or existing culvert crossings and two outfalls discharging to the existing surface water drainage system serving the A428. The number of potential outfall locations are subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfalls with the exception of one potential outfall location (Chainage 17200 near Caxton Gibbet Junction) for this Route Option. A pumped discharged solution will be required at this location. This would add to the capital and operational costs of this Route Option.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range between 16,000 m3 to 21,000 m3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground). Online storage by means of oversized pipes may need to be provided at four outfalls due to spatial constraints.

Item	Comment
Other Drainage Issues	Three outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage.

Table 10.6 - Option 2 surface water drainage details

10.5 Option 3

10.5.1 Option Layout

10.5.1.1 Option 3 is shown in Figure 10.4 and drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-1001 to 1012).

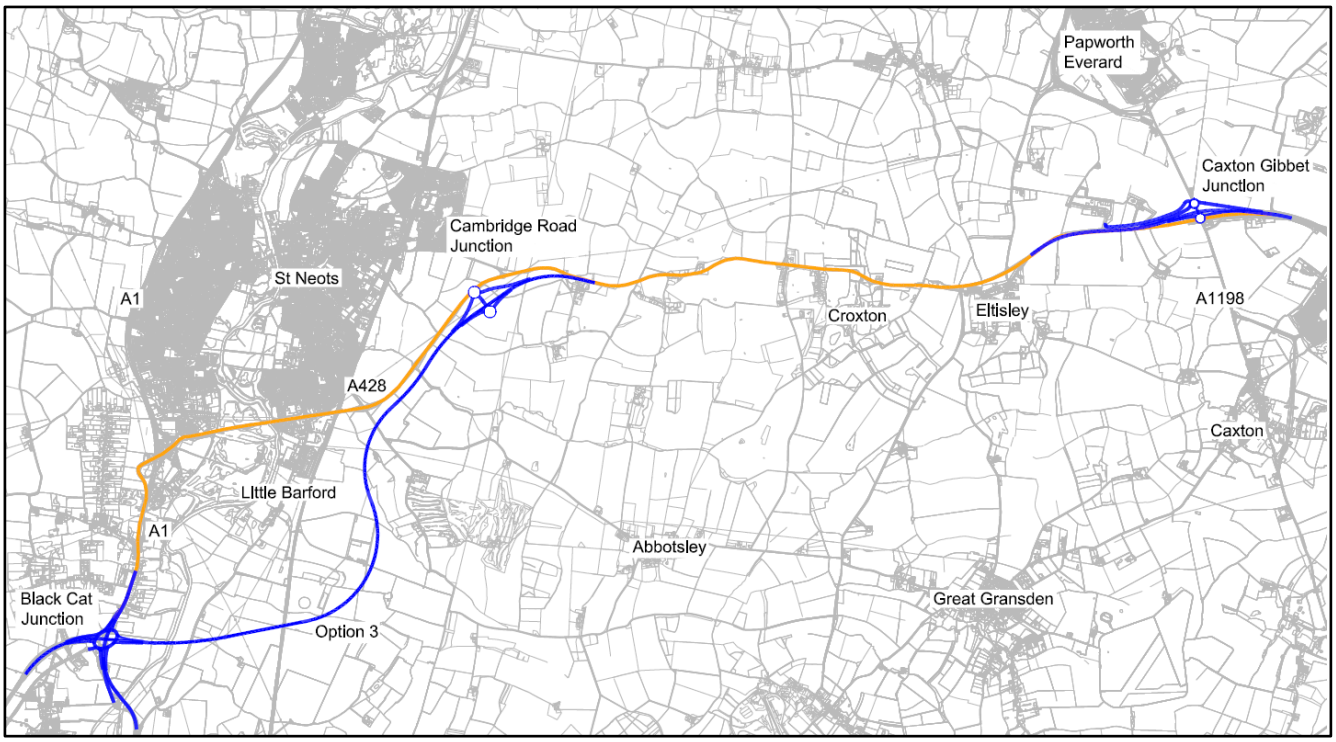

Figure 10.4 - Option 3

10.5.1.2 Option 3 provides a new offline link with high standard geometry (suitable for upgrade to Expressway standards in the future), for the western half of the scheme. As part of this option, Black Cat, Cambridge Rd and Caxton Gibbet junctions are also improved. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3. It is expected there will be significant land take. There will be several new structures (culverts and bridges) as a result of the improvements.

10.5.1.3 The following improvements for Option 3 will be made:

- New 9.9km A428 offline alignment between Black Cat Junction and Cambridge Road Junction;
- Significant improvement works at Black Cat Junction – grade separated junction;
- Significant improvement works at Cambridge Road Junction – grade separated junction;
- Significant improvement works at Caxton Gibbet Junction – grade separated junction;
- Realignment of the A428 which passes will pass through the improved Caxton Gibbet junction;
- Realignment of the A1 at Black Cat junction;

- Realignment improvement works to existing A428 carriageway between B1040 / St. Ives Road and Caxton Gibbet Junctions;
- Tie-in work to the existing A421 West of Black Cat Junction;
- Tie-in work to the existing A428 East of Caxton Gibbet Junction; and
- Tie-in work to existing Bedford Road.

10.5.2 Option Description

A428

10.5.2.1 The A428 will be an offline alignment between Black Cat Junction and Cambridge Road Junction. The offline alignment will be approximately 9.9km long. The new offline A428 will require tie-in work to the existing A421 west of Black Cat and the A428 east of Caxton Gibbet. The A428 will be designed to meet Expressway Standards.

Black Cat Junction to Cambridge Road Junction

10.5.2.2 Prior to the beginning of the offline alignment, improvement works will be undertaken to the A421 west of Black Cat in order to tie-in the new A428 offline alignment. The works are likely to include approximately 1.15km of the A421 in the form of minor vertical and horizontal alignment adjustments.

10.5.2.3 The general direction of A428 from Black Cat Junction will be an easterly direction. The alignment will head east for approximately 3km crossing significant features such as the River Great Ouse, Barford Road (Unnamed Road) and the East Coast Mainline.

10.5.2.4 The alignment changes to a north direction for approximately 2.5km heading towards the existing A428 and B1046/St Neots Road. The alignment will cross the B1046/St Neots Road and will change to a north east direction.

10.5.2.5 The alignment will remain in a north easterly direction parallel to the existing A428 (southern side) for approximately 2.4km where it will pass through an improved Cambridge Road Junction. The offline alignment will tie-in to the existing A428 approximately 1.0km east of the existing Cambridge Road roundabout

Cambridge Road Junction to Caxton Gibbet Junction

10.5.2.6 There is one section of the existing A428 where online alignment improvements will be undertaken. Online improvement works will be undertaken to a 700m stretch of online alignment between B1040 / St. Ives Road and Caxton Gibbet Junctions. To accommodate improvement works at Caxton Gibbet Junction, 1.1km of the existing A428 will upgraded to dual carriageway and new 1.3km section of new offline dual carriageway will be constructed.

Black Cat Junction

10.5.2.7 Improvement works at Black Cat Junction will be the same as described in Option 1. Please see paragraph 10.4.2.3 junction description.

Cambridge Road Junction

10.5.2.8 Cambridge Road Junction will be a two tier junction. The top tier of the junction will be the new offline A428 and the bottom tier will be a dumbbell roundabout. It is envisaged that the A428 offline alignment will be constructed on an embankment through the junction with the dumbbell roundabout built at existing ground level. The new junction will be constructed approximately 400m southeast of the existing Cambridge Road Junction, on the southern side of the existing A428.

Cambridge Road North Dumbbell Roundabout

10.5.2.9 Cambridge Road north dumbbell roundabout will be approximately 90m in diameter. It will be a two lane circulatory carriageway with a typical cross section. The north roundabout will have one entry arm – A428 Eastbound. The entry arm will link to a diverge slip road exiting the A428 eastbound. The north roundabout will have one exit arm – A428 Eastbound. The exit arm will link to a merge slip road entering the A428 eastbound. The north roundabout will also have two combined entry and exit arms. The combined entry and exit arms will maintain connections to the existing A428.

Cambridge Road South Dumbbell Roundabout

10.5.2.10 Cambridge Road dumbbell south roundabout will be approximately 70m in diameter. It will be a two lane circulatory carriageway with a typical cross section. The south roundabout will have one entry arm – A428 Westbound. The entry arm will link to a diverge slip road exiting the A428 westbound. The south roundabout will have one exit arm – A428 Westbound. The exit arm will link to a merge slip road entering the A428 westbound.

Slip Roads – Merges and Diverge

10.5.2.11 Black Cat Roundabout will have two merge slip roads and two diverge slip roads. The merge slip roads include: A428 Eastbound and A428 Westbound. The diverge slip roads include: A428 Eastbound and A428 Westbound.

Caxton Gibbet Junction

10.5.2.12 Improvement works at Caxton Gibbet Junction will be the same as described in Option 1. Please see paragraph 10.3.2.23 junction description.

10.5.3 Structures

10.5.3.1 Option 3 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-1001 to 1012).

Existing Structures

10.5.3.2 Existing structures to be amended are the same as discussed in Option 2.

Proposed Structures

10.5.3.3 In total the new structures required for Option 3 include: 8 No motorised user overbridges, 5 No motorised user underbridges, 4 No NMU overbridges and 11 No culverts.

Black Cat Junction

10.5.3.4 At Black Cat Junction, 3 No overbridges will be provided to facilitate grade separation of the junction. A 5 span viaduct (BN302) will carry the A1 over Black Cat roundabout. Two 3 span overbridges (BN301 & BN303) will carry Black Cat roundabout over the A428. To minimise visual obstruction to A421 road users, a 75m long bridge (BN313) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Cambridge Road Junction

10.5.3.5 Between Black Cat Junction and Cambridge Road Junction, the following structures are proposed; 3 No motorised user overbridges, 4 No motorised user underbridges, 3 No NMU overbridges and 3 No culverts. See Table B3.2 in Appendix B and the location plan drawings for details.

10.5.3.6 The longest proposed structure along the route is an underbridge (BN304) which will carry the new A428 over the River Great Ouse. The proposed viaduct is to be approximately 300m long. The span of this viaduct will need to be reviewed at detailed design stage after completion of a flood risk assessment, as the proposed structure is located on a flood plain. An underbridge (BN307) will be provided to carry the new A428 over the East Coast Main Line Railway in order to minimise disruption to it.

Cambridge Road Junction

10.5.3.7 At Cambridge Road Junction, a 3 span underbridge (BN311) with open abutments is proposed to facilitate grade separation of the junctions. 6 No culverts are proposed to accommodate the watercourses in the area.

Cambridge Road Junction to Caxton Gibbet Junction

10.5.3.8 Between Cambridge Road Junction and Caxton Gibbet Junction, the following structures are proposed: 1 No culvert. See Table B3.2 in Appendix B and the location plan drawings for details.

Caxton Gibbet Junction

10.5.3.9 At Caxton Gibbet Junction, a 3 span overbridge (BN312) with open abutments is proposed to facilitate grade separation of the junction. An NMU structure (NMU304) is proposed to the east of the junction to carry a cycleway/footway over the A428. A culvert (CN306) is proposed to the east of the junction to carry a proposed watercourse diversion under the A428.

10.5.4 Proposed NMU facilities

10.5.4.1 Preliminary NMU proposals have been drafted, as part of the Option 3 design. These have attempted to address the NMU issues identified in section 7.1, as well as mitigating or improving any severance issues created by the option itself. It is however accepted that, with the scheme in PCF Stage 1, these proposals are likely to develop following engagement with Stakeholders during the design development.

10.5.4.2 It is proposed that as part of the Option 3 design that solutions to the following existing NMU severance issues will be directly improved by the Option 1 scheme:

- Existing at-grade Black Cat Junction-As part of a grade separated junction improvement at Black Cat, it is proposed to provide a route for NMU's from Roxton to the Chawston Ln junction with the A1. This will be provided by providing a route across Roxton Rd Bridge and along the North West edge of the proposed grade separated Black Cat junction.
- Existing Caxton Gibbet Junction- As part of a grade separated junction improvement at Caxton Gibbet, it is proposed to provide an NMU bridge to the east of the junction. This will provide a grade separated connection for NMU's, which will improve upon the existing situation. In addition to this a new NMU route will be provided along the southern side of the new dual carriageway section between Caxton and Eltisley in order to mitigate additional severance caused by the provision of the grade separated junction.

10.5.4.3 The Option 3 alignment severs several existing PROW routes (See appendix A for details of existing NMU routes); NMU bridges have been provided in order to mitigate this potential severance along the route.

10.5.4.4 As described in section 7.1 several existing A428 corridor NMU severance issues were identified, namely:

- A428/Great North Rd junction
- A428/Barford Rd junction

- A428 between Cambridge Road Caxton Gibbet and the villages at Croxton, Eltisley and Caxton.

10.5.4.5 It is anticipated that Option 3 will reduce the numbers of vehicles on the existing A428 corridor between Wyboston and Cambridge Rd. This likely reduction in the number of vehicles is likely to create a greater opportunity to improve the existing PROW severance issues between Wyboston and Cambridge Rd. As a result of the likely reduction in traffic, provision of improvement features such as at-grade signalised/un-signalised crossings and on road cycle lanes is likely to become more feasibleWhere on road provision is not appropriate, larger improvements such as footways/cycleways within the verge or NMU bridges could be possible. It is anticipated that a combination of the features mentioned above, as well as others, could be used to improve most of the existing A428 corridor NMU severance issues identified between Wyboston and Caxton Gibbet.

10.5.4.6 However, it is anticipated that Option 3 is likely to increase the numbers of vehicles on the existing A428 corridor between Cambridge Rd and Eltisley. This likely increase in the number of vehicles is likely to have an impact on the existing severance issue along this length. As a result of the likely increase in traffic, provision of on road improvement features such as at-grade signalised/un-signalised crossings and on road cycle lanes is likely to be less feasible. Consequently, larger improvements such as footways/cycleways within the verge or NMU bridges are more likely to be needed as the solution.

10.5.4.7 During the design development, the need for these requirements will need to be balanced with the costs associated with their provision to ensure the most net benefit can be realised.

10.5.5 Drainage

10.5.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.7 below for Option 3. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved Area: 60 Ha (Existing Paved Area: 8 Ha, Additional Paved Area: 52 Ha)
Culvert Crossings	Total number of estimated culvert crossings equals 17. This total consists of 12 potential culvert crossings and five existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The 17 culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-1001 to 1012 in Appendix A between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and potential culvert crossings (e.g. diameter, length, etc.) are summarized in tabular format in Appendix B.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of potential bridge structure at River Great Ouse which is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-1002 in Appendix A. Details of this potential bridge crossing are summarized in tabular format in Appendix B.

Item	Comment
Highway Drainage Outfalls	Total number of potential outfall locations equals 16 (including assumed existing outfalls). This total consists of 13 outfalls discharging to nearby watercourses or existing culvert crossings and three outfalls discharging to the existing surface water drainage system serving the A428. The number of potential outfall locations are subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfalls with the exception of two potential outfall locations (Chainage 2090 and Chainage 17430 near Caxton Gibbet junction) for this Route Option. A pumped discharged solution will be required at these two locations. This would add to the capital and operational costs of this Route Option. However, it should be noted that there is a potential to raise the vertical alignment of the proposed road at Chainage 2090 that will facilitate the gravity discharge of the proposed highway drainage to the nearest watercourse and eliminate the need for a pumped discharge solution at this outfall location. This will be investigated and confirmed through review of proposed highway geometry at subsequent project design stages.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range between 48,000 m3 to 60,000 m3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground). Online storage by means of oversized pipes may need to be provided at one outfall location due to spatial constraints.
Other Drainage Issues	Two outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage.

Table 10.7 - Option 3 surface water drainage details

10.6 Option 4

10.6.1 Option Layout

10.6.1.1 Option 4 is shown in Figure 10.5 and drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-1401 to 1412).

10.6.1.2 The aim of the option is to provide an expressway standard alignment and junction improvements between, and including Black Cat and Caxton Gibbet junctions. This will be offline from the current A428 between Black Cat and Cambridge Road junctions, and online from Cambridge Road to Caxton Gibbet. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3.It is expected there will be significant land take. There will be several new structures (culverts and bridges) as a result of the improvements.

10.6.1.3 The following improvements for Option 4 will be made:

- New A428 offline alignment between Black Cat Junction and Cambridge Road Junction;
- Online carriageway dualling improvements between Cambridge Road and Caxton Gibbet Junction;
- Significant improvement works at Black Cat Junction – grade separated junction;
- Significant improvement works at Cambridge Road Junction – grade separated junction;
- Significant improvement works at Caxton Gibbet Junction – grade separated junction;
- Construction of new access roads between Cambridge Road Junction and Caxton Gibbet Junction;

- Realignment of the A1 at Black Cat Junction;
- Tie-in work to the existing A421 West of Black Cat Junction;
- Tie-in work to the existing A428 East of Caxton Gibbet Junction; and
- Tie-in work to existing Bedford Road.

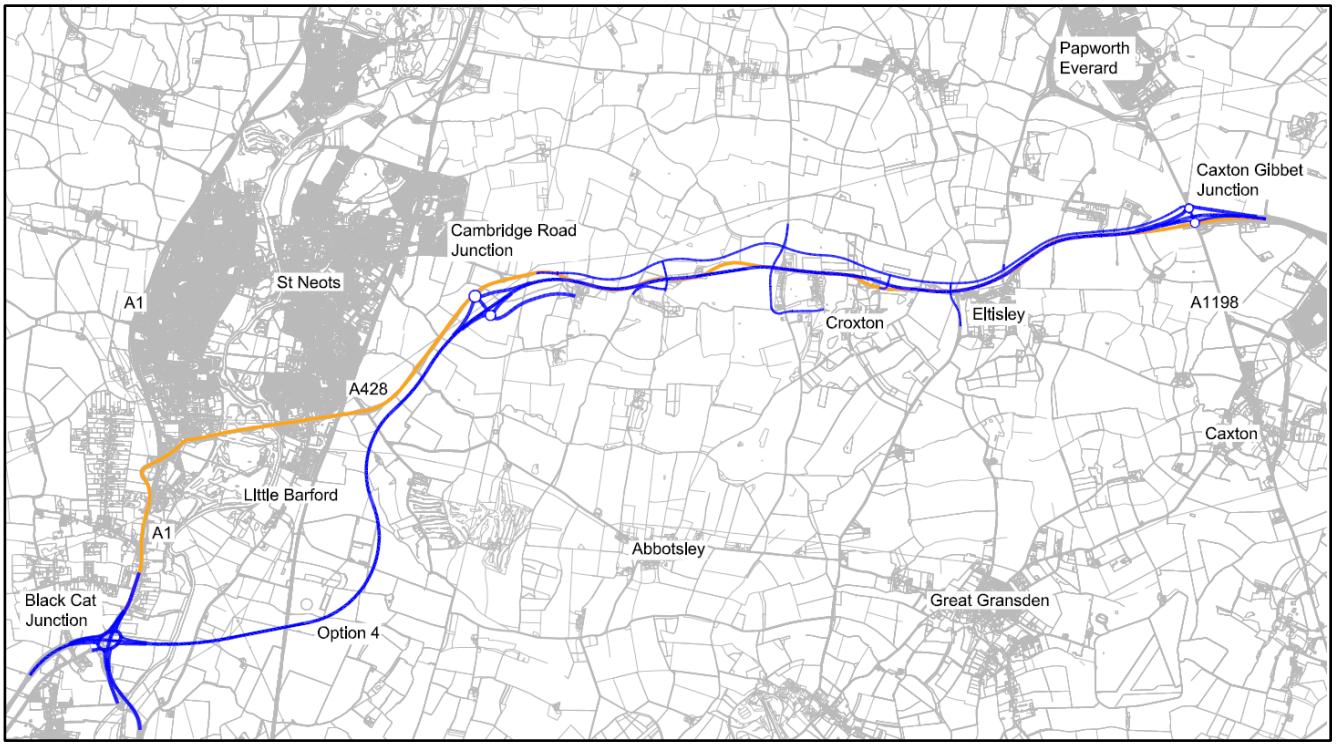

Figure 10.5 - Option 4

10.6.2 Option Description

A428

10.6.2.1 Improvement works to the A428 will include the construction of approximately 9.6km of offline dual carriageway between Black Cat Junction and Cambridge Road Junction. There will also be online dual carriageway improvement works to approximately 5.8km of the existing A428. The A428 will be designed to meet Expressway Standards.

10.6.2.2 The new offline A428 will require tie-in work to the existing A421 west of Black Cat and the A428 east of Caxton Gibbet.

Black Cat Junction to Cambridge Road Junction

10.6.2.3 Prior to the beginning of the offline alignment (East Black Cat), improvement works will be undertaken to the A421 west of Black Cat in order to tie-in the new A428 offline alignment. The works are likely to include approximately 1.15km of the A421 in the form of minor vertical and horizontal alignment adjustments.

10.6.2.4 The general direction of A428 from Black Cat Junction will be an easterly direction. The alignment will head east for approximately 3km crossing significant features such as the River Great Ouse, Barford Road (Unnamed Road) and the East Coast Mainline.

10.6.2.5 The alignment changes to a north direction for approximately 2.5km heading towards the existing A428 and B1046/St Neots Road. The alignment will cross the B1046/St Neots Road and will change to a north east direction.

10.6.2.6 The alignment will remain in a north easterly direction parallel to the existing A428 (southern side) for approximately 2.4km where it will pass through an improved Cambridge Road Junction. The offline alignment will join the upgraded A428 approximately 1.0km east of the existing Cambridge Road roundabout.

Cambridge Road Junction to Caxton Gibbet Junction

10.6.2.7 After the new offline alignment joins the upgraded alignment, it will generally follow the existing alignment towards Caxton Gibbet Junction. All existing junctions which join the existing A428 between Cambridge Road Junction and Caxton Gibbet Junction are not permitted to the join upgraded A428. This is a requirement of Expressway standards. Instead, new local roads will be constructed to maintain local access to existing routes. There will be small sections of upgraded A428 road which will be offline. This is required due to existing features of the environment and to meet DMRB standards. The A428 will be offline in the between mainline chainages 11300-12000 and 13100-13900.

10.6.2.8 Approximately 13.2km of new local access roads will be constructed to maintain local access between Cambridge Road and Caxton Gibbet Junctions, and to maintain access either side (north/south) of the upgraded A428.

10.6.2.9 A new single lane carriageway will be constructed largely parallel between Cambridge Road Junction and Caxton Gibbet Junction; on the northern side of the upgraded A428 (hereafter to be referred as 'Cambridge Road/Caxton Gibbet link road'). The road will be approximately 8.5km long and will tie-in to the existing A428 approximately 400m east of the existing Cambridge Road Junction, and tie-in to the north dumbbellroundabout of the improved Caxton Gibbet Junction.

10.6.2.10 At chainage 10800 of the upgraded mainline A428, a new single carriageway access road will be constructed. The road will maintain a north-south connection between the new Cambridge Road/Caxton Gibbet link road and the southern side of the upgraded A428 for private properties (Weald House and Weald Farm). The road will be approximately 390m long and will pass over the upgraded A428.

10.6.2.11 Between chainage 10350 and 10800 of the upgraded mainline A428, a new single carriageway access road will be constructed. The road will be constructed on the southern side of the upgraded A428 and will be roughly parallel to the mainline. The road will be approximately 440m long and will maintain links between local properties (Weald Farm and Weald House). The road will also provide access to the road described in 10.6.2.10.

10.6.2.12 At chainage 12150 of the upgraded mainline A428, a new single carriageway access road will be constructed. The road will maintain a north-south connection between the new Cambridge Road Junction/Caxton Gibbet link road and the southern side of the upgraded A428 for private properties (Croxton Village). The road will also maintain a link between Toseland Road and Abbotsley Road where the new road will tie-in to respective existing roads. The new road will be approximately1310m long and will pass over the upgraded A428.

10.6.2.13 Between chainage 12340 and 12800 of the upgraded mainline A428, a new single carriageway access road will be constructed. The road will be constructed approximately 400m from the mainline on the southern side of the upgraded A428 and will be roughly parallel to it. The road will be approximately 480m long and will maintain links between local properties (Croxton Village and Croxton Park). The road will also provide access to the road described in 10.6.2.12.

10.6.2.14 At chainage 13640 of the upgraded mainline A428, a new single carriageway access road will be constructed. The road will maintain a north-south connection between the new Cambridge Road/Caxton Gibbet link road and the southern side of the upgraded A428 for private properties (Croxton Village and Croxton Park). The road will be approximately 1310m long and will pass over the upgraded A428

10.6.2.15 At chainage 14420 of the upgraded mainline A428, a new single carriageway access road will be constructed. The road will maintain a north-south connection between the new Cambridge Road/Caxton Gibbet link road and the southern side of the upgraded A428 for private properties (Eltisley Village). The road will be approximately 560m long and will pass over the upgraded A428 and tie-in to the existing B1040.

10.6.2.16 At chainage 15190 of the upgraded mainline A428, a new single carriageway access road will be constructed. The road will create new a connection between the B1040/St. Ives Road and the new Cambridge Road/Caxton Gibbet link road. The road will be approximately 560m long and will pass over the upgraded A428 and tie-in to the existing B1040.

10.6.2.17 To accommodate improvement works at Caxton Gibbet Junction, 1.1km of the existing A428 will upgraded to dual carriageway and new 1.3km section of new offline dual carriageway will be constructed.

Black Cat Junction

10.6.2.18 Improvement works at Black Cat Junction will be the same as described in Option 1. Please see paragraph 10.4.2.3 junction description.

Cambridge Road Junction

10.6.2.19 Improvement works at Cambridge Road Junction will be the same as described in Option 3. Please see paragraph 10.5.2.8 junction description.

Caxton Gibbet Junction

10.6.2.20 Improvement works at Caxton Gibbet Junction will be the same as described in Option 1. Please see paragraph 10.3.2.23 junction description.

10.6.3 Structures

10.6.3.1 Option 4 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-1401 to 1412).

Existing Structures

10.6.3.2 Existing structures to be amended are the same as discussed in Option 1.

Proposed Structures

10.6.3.3 In total the new structures required for Option 4 include: 12 No motorised user overbridges, 5 No motorised user underbridges, 7 No NMU overbridges and 29 No culverts.

Black Cat Junction

10.6.3.4 At Black Cat Junction, 3 No overbridges will be provided to facilitate grade separation of the junction. A 5 span viaduct (BN402) is will carry the A1 over Black Cat roundabout. Two 3 span overbridges (BN401 & BN403will carry Black Cat roundabout over the A428. To minimise visual obstruction to A421 road users, a 75m long bridge (BN417) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Cambridge Road Junction

10.6.3.5 Between Black Cat Junction and Cambridge Road Junction, the following structures are proposed: 3 No motorised user overbridges, 4 No motorised user underbridges, 3 No NMU overbridges and 3 No culverts. See Table B4.2 in Appendix B and the location plan drawings for details.

10.6.3.6 The longest proposed structure along the route is an underbridge (BN404) which will carry the new A428 over the River Great Ouse. The proposed viaduct is to be approximately 300m long. The span of this viaduct will need to be reviewed at the detailed design stage after completion of a flood risk assessment, as the proposed structure is located on a flood plain. An underbridge (BN407) will be provided to carry the new A428 over the East Coast Main Line Railway in order to minimise disruption to it.

Cambridge Road Junction

10.6.3.7 At Cambridge Road Junction, a 3 span underbridge (BN416) with open abutments is proposed to facilitate grade separation of the junctions. 7 No culverts are proposed to accommodate the watercourses in the area.

Cambridge Road Junction to Caxton Gibbet Junction

10.6.3.8 Between Cambridge Road Junction and Caxton Gibbet Junction, the following structures are proposed: 4 No motorised user overbridges, 3 No NMU overbridges and 18 No culverts. See Table B4.2 in Appendix B and the location plan drawings for details.

Caxton Gibbet Junction

10.6.3.9 At Caxton Gibbet Junction, a 3 span overbridge (BN415) with open abutments is proposed to facilitate grade separation of the junction. An NMU structure (NMU407) is proposed to the east of the junction to carry a cycleway/footway over the A428. A culvert (CN411) is proposed to the east of the junction to carry a proposed watercourse diversion under the A428.

10.6.4 Proposed NMU facilities

10.6.4.1 Preliminary NMU proposals have been drafted, as part of the Option 4 design. It is anticipated that, to the west of the Cambridge Rd junction, this option will have the same provision as Option 1. As such, it is anticipated that this option would address the following NMU issues to a similar degree:

- Existing at-grade Black Cat Junction
- A428/Great North Rd junction
- A428/Barford Rd junction
- Mitigation of existing PROW severed by the Option 4 alignment

10.6.4.2 However, between Cambridge Rd and Caxton Gibbet, there is significant difference between Option 4 and Option 1. The provision of the local road on the north side of the online Expressway route is very likely to increase the distances that NMU's would be required to travel to and from the villages along this length such as Croxton and Eltisley. Where possible, bridges have been provided in order to minimise the travel distances required. However, even with future design development, some existing journeys are likely to be significantly lengthened by the provision of this option, which will have a negative effect. The option would however separate NMU's and local traffic from the proposed Expressway which will have a positive effect.

10.6.4.3 It is proposed that as part of the Option 4 design that the existing at grade Caxton Gibbet junction will be grade separated. As part of a grade separated junction improvement at Caxton Gibbet, it is proposed to provide an NMU bridge to the east of the junction. This will provide a grade separated connection for NMU's, which will improve upon the existing situation. The new local A428 route is currently shown as connecting into the northern roundabout of the Caxton gibbet junction. This provides direct connectivity with the regional cycle/pedestrian route.

10.6.4.4 During the design development, the need for these requirements will need to be balanced with the costs associated with their provision to ensure the most net benefit can be realised.

10.6.5 Drainage

10.6.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.8 below for Option 4. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes**.**

Item	Comment
Paved Area	Approximate Total Paved Area: 82 Ha (Existing Paved Area: 10 Ha, Additional Paved Area: 72 Ha)
Culvert Crossings	Total number of estimated culvert crossings equals 41. This total consists of 32 potential culvert crossings and nine existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The 41 culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-1401 to 1412 in Appendix A between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and potential culvert crossings (e.g. diameter, length, etc.) are summarized in tabular format in Appendix B.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of potential bridge structure at River Great Ouse which is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-1402 in Appendix A. Details of this potential bridge crossing are summarized in tabular format in Appendix B.
Highway Drainage Outfalls	Total number of potential outfall locations equals 26 (including assumed existing outfalls). This total consists of 22 outfalls discharging to nearby watercourses or existing culvert crossings and four outfalls discharging to the existing surface water drainage system serving the A428. The number of potential outfall locations are subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfalls with the exception of two potential outfall locations (Chainage 2090 and Chainage 17430 near Caxton Gibbet junction) for this Route Option. A pumped discharged solution will be required at these two locations. This would add to the capital and operational costs of this Route Option. However, it should be noted that there is a potential to raise the vertical alignment of the proposed road at Chainage 2090 that will facilitate the gravity discharge of the proposed highway drainage to the nearest watercourse and eliminate the need for a pumped discharge solution at this outfall location. This will be investigated and confirmed through review of proposed highway geometry at subsequent project design stages.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range between 77,000 m3 to 97,000 m3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground) Online storage by means of oversized pipes may need to be provided at four outfalls location due to spatial constraints.

Item	Comment
Other Drainage Issues	Six outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage.

Table 10.8 - Option 4 surface water drainage details

10.7 Option 5

10.7.1 Option Layout

10.7.1.1 Option 5 is shown in Figure 10.6 and drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2001 to 2012).

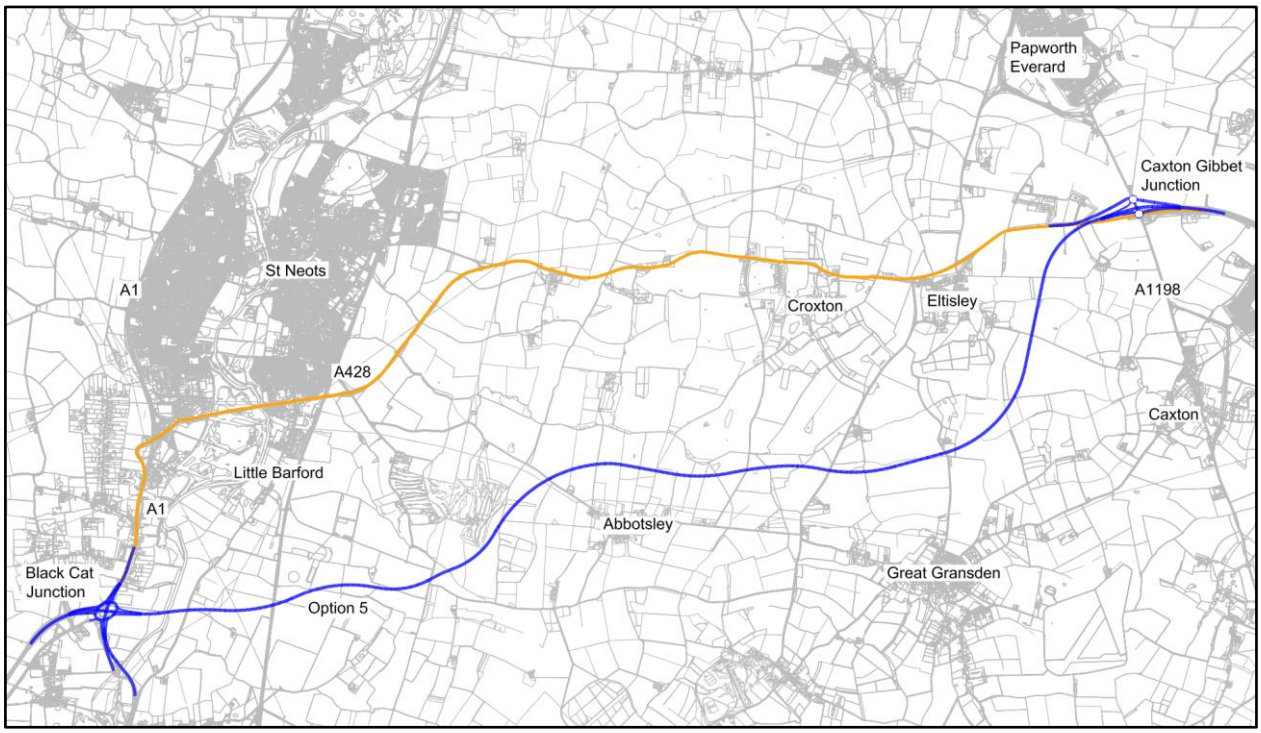

Figure 10.6 - Option 5

10.7.1.2 Option 5 represents an alternative offline solution. The aim of the option is to provide offline alignment and junction improvements between, and including Black Cat and Caxton Gibbet Junctions. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3.It is expected there will be significant land take. There will be several new structures (culverts and bridges) as a result of the improvements.

10.7.1.3 The following improvements for Option 5 will be made:

- New A428 offline alignment between Black Cat junction and Caxton Gibbet junction;
- Significant improvement works at Black Cat junction – grade separated junction;
- Significant improvement works at Caxton Gibbet junction – grade separated junction;
- Realignment of the A1 at Black Cat junction;
- Tie-in work to the existing A421 West of Black Cat junction;
- Tie-in work to the existing A428 East of Caxton Gibbet junction; and

- Tie-in work to existing Bedford Road.

10.7.2 Option Description

A428

10.7.2.1 Option 5 is a wholly offline dual all-purpose carriageway running from Black Cat Junction to Caxton Gibbet Junction, and will be approximately 18.4km long. The A428 will be designed to meet Expressway Standards. The offline alignment is south of the existing A428.The new offline A428 will require tie-in work to the existing A421 west of Black Cat and the A428 east of Caxton Gibbet.

10.7.2.2 From Black Cat to Caxton Gibbet the route is aligned east towards Abbotsley for approximately 5km. The alignment then changes to a north east direction bypassing north Abbotsley for approximately 2km. Past Abbotsley, the route continues east for approximately 5km passing north-west of Great Gransden. The alignment changes to a north direction passing Eltisley to the south, and joins Caxton Gibbet.

Black Cat Junction

10.7.2.3 Improvement works at Black Cat Junction will be the same as described in Option 1. Please see paragraph 10.4.2.3 junction description.

Caxton Gibbet Junction

10.7.2.4 Caxton Gibbet Junction will be a two tier junction. The top tier of the junction will be the dumbbell roundabout and the bottom tier will be the offline A428. It is envisaged that the A428 offline alignment will be constructed in cutting through the junction with the dumbbell built at existing ground level.

10.7.2.5 Caxton Gibbet Junction will maintain network connections to the existing A428 and the A1198.

10.7.2.6 The north and south roundabouts of the dumbbell will be joined by a link road. The link road will be approximately 130m long and will be a single carriageway and with a typical cross section. The link road will pass over the new offline A428.

Caxton Gibbet North Dumbbell Roundabout

10.7.2.7 Caxton Gibbet north dumbbell roundabout will be approximately 77m in diameter and will be a two lane circulatory carriageway with a typical cross section. The north roundabout will have one entry arm – A428 Eastbound. The entry arm will link to a diverge slip road exiting the A428 eastbound. The north roundabout will have one exit arm – A428 Eastbound. The exit arm will link to a merge slip road entering the A428 eastbound. The north roundabout will also have two combined entry and exit arms. The combined entry and exit arms will maintain a connection to the A1198 and a new link road.

10.7.2.8 A new link road will be constructed to maintain access between the existing A428 and Caxton Gibbet Junction. The new access link road will be approximately 1,160m long and will be a single carriageway with a typical cross section.

Caxton Gibbet South Dumbbell Roundabout

10.7.2.9 Caxton Gibbet dumbbell south roundabout will be approximately 77m and will be a two lane circulatory carriageway with a typical cross section. The south roundabout will have one entry arm – A428 Westbound. The entry arm will link to a diverge slip road exiting the A428 westbound. The south roundabout will have one exit arm – A428 Westbound. The exit arm will link to a merge slip road entering the A428 westbound. The south roundabout will have two combined entry and exit arms. The combined entry and exit arms will maintain a links to the existing A428 and the A1198.

10.7.2.10 A connection between the south roundabout of the dumbbell and the existing A428 and the A1198 will be maintained. It is expected minimal work will be required to tie-in the existing roads.

Slip Roads – Merges and Diverge

10.7.2.11 Black Cat Roundabout will have two merge slip roads and two diverge slip roads. The merge slip roads include: A428 Eastbound and A428 Westbound. The diverge slip roads include: A428 Eastbound and A428 Westbound.

10.7.3 Structures

10.7.3.1 Option 5 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2001 to 2012).

Existing Structures

10.7.3.2 Existing structures to be amended are the same as discussed in Option 1.

Proposed Structures

10.7.3.3 In total the new structures required for Option 5 include: 11 No motorised user overbridges, 7 No motorised user underbridges, 3 No non-motorised user overbridges, 1 No NMU underbridge and 13 No culverts.

Black Cat Junction

10.7.3.4 At Black Cat Junction, 3 No overbridges will be provided to facilitate grade separation of the junction. A 5 span viaduct (BN502) will carry the A1 over Black Cat roundabout. Two 3 span overbridges (BN501 & BN503) will carry Black Cat roundabout over the A428. To minimise visual obstruction to A421 road users, a 75m long bridge (BN518) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Caxton Gibbet Junction

10.7.3.5 Between Black Cat Junction and Cambridge Road Junction, the following structures are proposed: 6 No motorised user overbridges, 7 No motorised user underbridges, 2 No NMU overbridges, 1 No NMU underbridge and 12 No culverts. See Table B5.2 in Appendix B and the location plan drawings for details.

10.7.3.6 The longest proposed structure along the route is an underbridge (BN504) which will carry the new A428 over the River Great Ouse. The viaduct is approximately 300m long. The span of this viaduct will need to be reviewed at detailed design stage after completion of a flood risk assessment, as the proposed structure is located on a flood plain. An underbridge (BN507) will be provided to carry the new A428 over the East Coast Main Line Railway in order to minimise disruption to it.

10.7.3.7 This proposed highway alignment will affect the natural catchment draining towards the Peterborough to Stevenage railway line (Great Northern Route). It will increase the catchment draining towards the railway line. Therefore, a culvert (CN502) is proposed on the east side of the railway line to accommodate the additional flow.

Caxton Gibbet Junction

10.7.3.8 At Caxton Gibbet Junction, a 3 span overbridge (BN517) with open abutments is proposed to facilitate grade separation of the junction. An NMU structure (NMU505) is proposed to the east of the junction to carry a cycleway/footway over the A428. A culvert (CN515) is proposed to the east of the junction to carry a proposed watercourse diversion under the A428.

10.7.4 Proposed NMU facilities

10.7.4.1 Preliminary NMU proposals have been drafted as part of the Option 5 design. It is anticipated that this option's provision will be similar to that of option 1. However, given that option 5 does not provide a connection for St Neots traffic at Cambridge Rd, as provided by Option 1, it is likely that this option may not reduce the number of vehicles to the same extent along the existing A428 from Wyboston to Caxton Gibbet. This may increase the cost associated with providing a solution which addresses the NMU severance issues, which were addressed as part of Option 1. In addition to this a new NMU route will be provided along the southern side of the new existing road between Caxton and Eltisley in order to mitigate additional severance caused by the provision of the grade separated junction.

10.7.4.2 During the design development, the need for these requirements will need to be balanced with the costs associated with their provision to ensure the most net benefit can be realised.

10.7.5 Drainage

10.7.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.9 below for Option 5. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved Area: 72 Ha (Existing Paved Area: 6 Ha, Additional Paved Area: 66 Ha)
Culvert Crossings	Total number of estimated culvert crossings equals 20. This total consists of 16 potential culvert crossings and four existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The 20 culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-2001 to 2012 in Appendix A between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and potential culvert crossings (e.g. diameter, length, etc.) are summarised in tabular format in Appendix B.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of potential bridge structure at River Great Ouse which is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-2002 in Appendix A. Details of this potential bridge crossing are summarized in tabular format in Appendix B.
Highway Drainage Outfalls	Total number of potential outfall locations equals 27 (including assumed existing outfalls). This total consists of 22 outfalls discharging to nearby watercourses or existing culvert crossings and five outfalls discharging to the existing surface water drainage system serving the A428. The number of potential outfall locations are subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfalls with the exception of three potential outfall locations (Chainage 13950, Chainage 15100 and Chainage 17000 near Caxton Gibbet junction) for this Route Option. A pumped discharged solution will be required at these three locations. This would add to the capital and operational costs of this Route Option. However, it should be noted that there is a potential to raise the vertical alignment of the proposed road at Chainage 13950 and Chainage 15100 that will facilitate the gravity discharge of the proposed highway drainage to the nearest watercourse and eliminate the need for a pumped discharge solution at this outfall location. This will be investigated and confirmed through review of proposed highway geometry at subsequent project design stages.
Total Estimated Attenuation Storage	Preliminary estimates of attenuation storage volumes range between 61,000 m^3 to 76,000 m^3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground

Item	Comment
Volumes	investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground). Online storage by means of oversized pipes may need to be provided at five outfalls location due to spatial constraints.
Other Drainage Issues	Five outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage. From Chainage 4100m to 6000m the proposed highway is in cutting which includes the intersection of an Ordinary Watercourse. The provision of a culvert at this Ordinary Watercourse will not be feasible. This could result in a significant transfer of surface water between adjacent catchments and could require a large cut-off ditch to convey the contributing flow. This transfer of surface water between adjacent catchments could have an impact on the downstream flood risk. This would need to be reviewed at subsequent project design stages.

Table 10.9 - Option 5 surface water drainage details

10.8 Option 6

10.8.1 Option Layout

10.8.1.1 Option 6 is shown in Figure 10.7 and drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2401 to 2412).

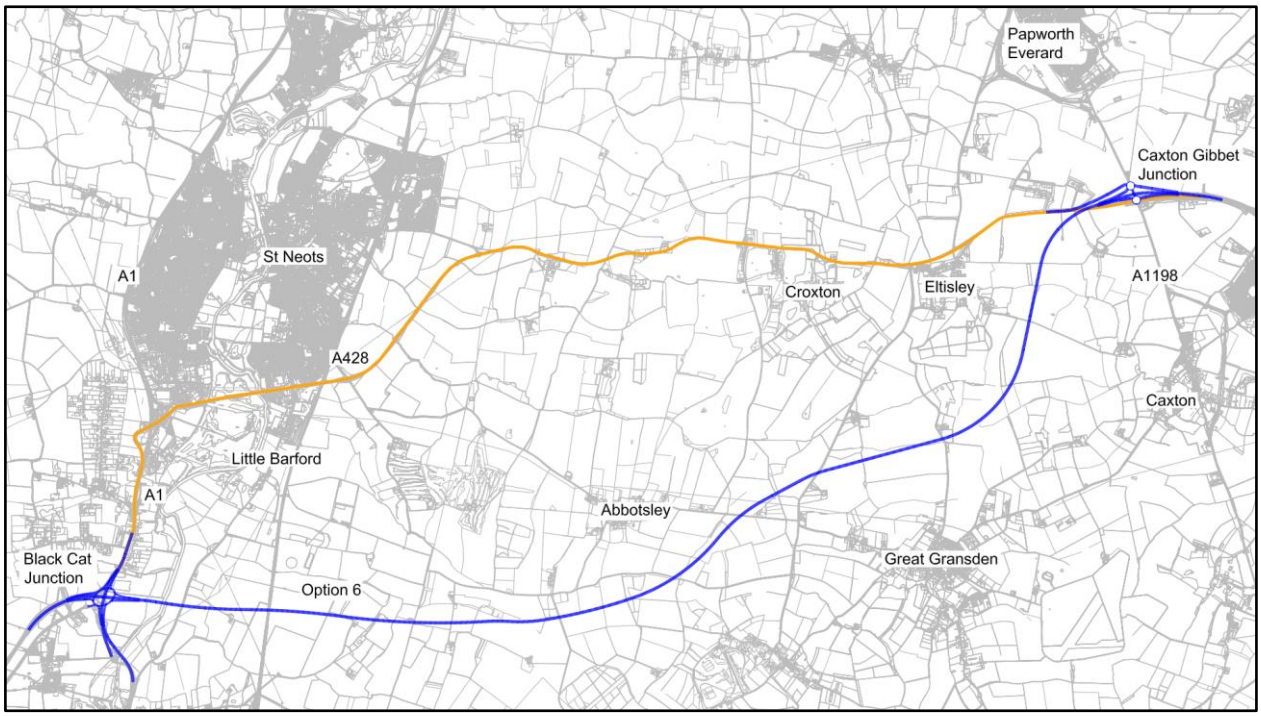

Figure 10.7 - Option 6

10.8.1.2 Option 6 represents a similar alternative offline solution to Option 5. The aim of the option is to provide offline alignment and junction improvements between, and including Black Cat and Caxton Gibbet Junctions. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3.It is expected there will be significant land take. There will be several new structures (culverts and bridges) as a result of the improvements.

10.8.1.3 The following improvements for Option 6 will be made:

- New A428 offline alignment between Black Cat Junction and Caxton Gibbet junction;
- Significant improvement works at Black Cat Junction – grade separated junction;
- Significant improvement works at Caxton Gibbet Junction – grade separated junction;
- Realignment of the A1 at Black Cat junction;
- Tie-in work to the existing A421 West of Black Cat junction;
- Tie-in work to the existing A428 East of Caxton Gibbet junction; and
- Tie-in work to existing Bedford Road.

10.8.2 Option Description

A428

10.8.2.1 Option 6 is a wholly offline dual all-purpose carriageway running from Black Cat Junction to Caxton Gibbet Junction, and will be approximately 18.4km long. The A428 will be designed to meet Expressway Standards. The offline alignment is south of the existing A428.The offline A428 will require tie-in work to the existing A421 west of Black Cat and the A428 east of Caxton Gibbet.

10.8.2.2 From Black Cat to Caxton Gibbet the route is aligned directly east towards Little Gransden for approximately 7km. The alignment changes to a north east direction when it reaches southern Abbotsley. The route bypasses Abbotsley to the South and continues in a north east direction for approximately 5.5km towards the mid-point between Eltisley and Great Gransden where it changes north direction. The alignment continues in a northerly direction towards the Caxton Gibbet.

Black Cat Junction

10.8.2.3 Improvement works at Black Cat Junction will be the same as described in Option 1. Please see paragraph 10.4.2.3 junction description.

Caxton Gibbet Junction

10.8.2.4 Improvement works at Caxton Gibbet Junction will be the same as described in Option 5. Please see paragraph 10.7.2.4 junction description.

10.8.3 Structures

10.8.3.1 Option 6 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2401 to 2412).

Existing Structures

10.8.3.2 Existing structures to be amended are the same as discussed in Option 1.

Proposed Structures

10.8.3.3 In total the new structures required for Option 6 include: 11 No motorised user overbridges, 6 No motorised user underbridges, 1 No NMU overbridge, one NMU underbridge and 12 No culverts.

Black Cat Junction

10.8.3.4 At Black Cat Junction, 3 No overbridges will be provided to facilitate grade separation of the junction. A 5 span viaduct (BN602) will carry the A1 over Black Cat roundabout. Two 3 span overbridges (BN601 & BN603) will carry Black Cat roundabout over the A428. To minimise visual obstruction to A421 road users, a 75m long bridge (BN618) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Caxton Gibbet Junction

10.8.3.5 Between Black Cat Junction and Cambridge Road Junction, the following structures are proposed: 6 No motorised user overbridges, 6 No motorised user underbridges, 1 No NMU underbridge and 11 No culverts. See Table B6.2 in Appendix B and the location plan drawings for details.

10.8.3.6 The longest proposed structure along the route is an underbridge (BN604) which will carry the new A428 over the River Great Ouse. The proposed viaduct is approximately 300m long. The span of this viaduct will need to be reviewed at detailed design stage after completion of a flood risk assessment, as the proposed structure is located on a flood plain. An underbridge (BN607) will be provided to carry the new A428 over the East Coast Main Line Railway in order to minimise disruption to it.

Caxton Gibbet Junction

10.8.3.7 At Caxton Gibbet Junction, a 3 span overbridge (BN617) with open abutments is proposed to facilitate grade separation of the junction. An NMU structure (NMU602) is proposed to the east of the junction to carry a cycleway/footway over the A428. A culvert (CN614) is proposed to the east of the junction to carry a proposed watercourse diversion under the A428.

10.8.4 Proposed NMU facilities

10.8.4.1 Preliminary NMU proposals have been drafted as part of the Option 6 design. It is anticipated that this option's provision will be almost identical to that of Option 5.

10.8.4.2 During the design development, the need for these requirements will need to be balanced with the costs associated with their provision to ensure the most net benefit can be realised.

10.8.5 Drainage

10.8.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.10 below for Option 6. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved Area: 75 Ha (Existing Paved Area: 7 Ha, Additional Paved Area: 68 Ha)
Culvert Crossings	Total number of estimated culvert crossings equals 17. This total consists of 13 potential culvert crossings and four existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The 17 culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-2401 to 2412 in Appendix A between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and potential culvert crossings (e.g. diameter, length, etc.) are summarized in tabular format in Appendix B.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of potential bridge structure at River Great Ouse and is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-2402 in Appendix A. Details of this potential bridge crossing are summarized in tabular format in Appendix B.

Item	Comment
Highway Drainage Outfalls	Total number of potential outfall locations equals 20 (including assumed existing outfalls). This total consists of 16 outfalls discharging to nearby watercourses or existing culvert crossings and four outfalls discharging to the existing surface water drainage system serving the A428. The number of potential outfall locations are subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfalls with the exception of one potential outfall location (Chainage 16944 near Caxton Gibbet Junction) for this Route Option. A pumped discharged solution will be required at this location. This would add to the capital and operational costs of this Route Option.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range between 63,000 m^3 to 79,000 m^3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground). Online storage may be required by means of oversized pipes for three outfalls due to spatial constraints for this Route Option.
Other Drainage Issues	Five outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage. From chainage 5000m to 6000m the proposed highway is in cutting which includes a natural low point. The provision of a culvert crossing at this low point will not be feasible. This would result in a transfer of surface water between adjacent catchments and would require a cut-off ditch to convey the contributing flow. This transfer of surface water between adjacent catchments could have an impact on the downstream flood risk. This would need to be reviewed in subsequent project design stages.

Table 10.10 - Option 6 surface water drainage details

10.9 Option 7

10.9.1 Option Layout

10.9.1.1 Option 7 is shown in Figure 10.8 and drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2701 to 2712).

10.9.1.2 Option 7 represents a 'low cost' Solution and is a variant of Option 2. The aim of the option is to provide junction and alignment improvements between and including Black Cat and Caxton Gibbet Junctions. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3.It is expected there will be minimal land take. There will be several new structures (culverts and bridges) as a result of the improvements.

10.9.1.3 The following improvements for Option 7 will be made:

- Significant improvement works at Black Cat Junction –grade separated junction;
- Significant improvement works at Caxton Gibbet Junction – at-grade signalised roundabout;
- At-grade improvement works and signalisation at Wyboston Junction, with minor carriageway improvements to junction arms;
- At-grade improvement works at Barford Road Junctions, with minor carriageway improvements to junction arms;
- At-grade improvement works at Cambridge Road Junction;
- Realignment of the A428 at Caxton Gibbet Junction;

- Realignment of the A1 at Black Cat Junction;
- Realignment improvement works to existing A428 carriageway between B1040 / St. Ives Road and Caxton Gibbet Junctions;
- Tie-in work to the existing A421 West of Black Cat Junction;
- Tie-in work to the existing A428 East of Caxton Gibbet Junction; and
- Tie-in work to existing Bedford Road.

Figure 10.8 - Option 7

10.9.2 Option Description

A1

10.9.2.1 The improvement works at Black Cat Junction will require a realignment of both the northbound and southbound A1 carriageways. Minor vertical and major horizontal alignment works are required for the A1 carriageways that lead up to the junction for both northbound and southbound carriageways.

10.9.2.2 There are numerous direct property and minor roads access joining the northbound (Chawston Lane and Nagshead Lane) and southbound (Great North Road) carriageways north of Black Cat Junction. At this stage it is unclear whether the scheme will maintain these links and whether the links will be affected by potential improvement works.

Black Cat Junction

10.9.2.3 Black Cat Junction form is considerably different to the Black Cat Junctions presented in other options. Black Cat Junction will be a grade separated dumbbell junction with a link road. The bottom tier (existing ground level) of the junction has been reserved for the provision of the A428 to be constructed in the future. The dumbbell roundabout will form the top tier of the junction.

10.9.2.4 The dumbbell roundabouts will located mid-way between the existing A428 Black Cat roundabout and Roxon Road. The north dumbbell roundabout will be located on the north side of the existing A421 carriageway. The south dumbbell roundabout of the will be located on the south side of the existing A421 carriageway. The north and south roundabouts will be joined by a link road approximately 100m long.

Black Cat North Dumbbell Roundabout

10.9.2.5 Black Cat north dumbbell roundabout will be approximately 75m in diameter. It will be a two lane circulatory carriageway with a typical cross section. The north roundabout will have one entry arm – A421 Eastbound. The entry arm will link to a diverge slip road exiting the A421 eastbound. The north roundabout will have one combined entry and exit arm. The exit lane of the combined entry and exit arm will provide a connection to the A1 northbound via a link road. The entry lane of the combined entry and exit arm will provide a connection from the A1 southbound.

Black Cat South Dumbbell Roundabout

10.9.2.6 Black Cat south dumbbell roundabout will be approximately 75m in diameter. It will be a two lane circulatory carriageway with a typical cross section. The south roundabout will have one exit arm – A421 Westbound. The exit arm will link to a merge slip road entering the A421 westbound. The south roundabout will have two combined entry and exit arms. The combined entry and exit arms will maintain a links to Bedford Road and the A1 northbound/southbound.

10.9.2.7 The exit lane of the A1 northbound/southbound combined entry and exit arm, will provide a connection to the A1 southbound via a merge slip road. The entry lane of the combined entry and exit arm will provide a connection from the A1 northbound via a diverge slip road.

Slip Roads and Link Road

10.9.2.8 Black Cat Roundabout will have three merge slip roads and three diverge slip roads. The merge slip roads include: A421 eastbound, A1 northbound and A1 southbound. The diverge slip roads include: A421 eastbound, A1 northbound and A1 southbound.

10.9.2.9 A link road will be constructed to allow free flowing traffic movements from the A421 eastbound to the A1 northbound. The link road will be formed from the A421 diverge slip road and the A1 merge slip road. The A421 diverge slip road will split from a single lane to two separate single lanes. One lane will enter the north dumbbell roundabout and the other lane will bypass the north dumbbell roundabout to merge with the A1 northbound. The link road will also have a connection from the north dumbbell roundabout in which traffic exiting the roundabout can join the A1 northbound via the link road.

Wyboston Junction

10.9.2.10 Improvement works to Wyboston Junction will focus on improving the general layout of the junction and increasing capacity. The junction will be an at-grade signalised three lane circulatory carriageway with typical cross section. The overall shape of the roundabout will be increased slightly to an elliptical shape. The northern edge of the roundabout will remain in the same location but the southern edge will expand southeast of the existing junction, severing an existing access road (Wyboston Lakes Road). As a result a new access road will be constructed to replace the severed connection. The new access road will be constructed south of the improved roundabout joining Wyboston Lakes Road to the southern edge of the roundabout.

10.9.2.11 The construction of the new access road will change traffic movements to and from Wyboston Lakes Road. The existing signalised junction on Great North Road will be removed, including the filter lane located on southbound Great North Road. Traffic will no longer be able to join Great North Road from Wyboston Lakes Road or exit from Great North Road to Wyboston Lakes Road. The removal of the signalised junction on Great North Road will all allow free flow traffic movements to the A1 Northbound / Southbound and Wyboston Junction.

10.9.2.12 All existing connection to the roundabout will be maintained: B1428 combined entry and exit arm; A1 southbound entry arm; Phoenix Park Road combined entry and exit arm; Great North Road entry arm; Great North Road exit arm; A428 entry arm; and A428 exit arm.

10.9.2.13 The east arm of the roundabout (A428 carriageway) will be widened from a single lane carriageway to dual lane carriageway. Widening will occur for approximately 600m along the eastbound and westbound carriageways. Appropriate tie-in work will be undertaken to taper the mainline from dual carriageway to single carriageway after 600m.

Barford Road Junctions

10.9.2.14 At-grade improvement works to Barford Road Junction will focus on improving the general layout of the junction and increasing capacity. The overall shape of the roundabout will be increased from a two lane roundabout to a three lane roundabout. The position of the roundabout will be moved approximately 20m north of the existing roundabout.

10.9.2.15 The west arm of the roundabout (A428 carriageway) will be widened from a single lane carriageway to dual lane carriageway. Widening will occur for approximately 300m along the eastbound and westbound carriageways. Appropriate tie-in work will be undertaken to taper the mainline from dual carriageway to single carriageway after 300m.

Cambridge Road Junction

10.9.2.16 At-grade improvement works to Cambridge Road Junction will focus on improving the general layout of the junction and increasing capacity. The junction will be a two lane circulatory carriageway with typical cross section. The overall shape and position of the roundabout will remain the same.

10.9.2.17 Two segregated lanes will be constructed to provide free flow traffic movements. A segregated lane will be constructed south of the roundabout to provide free flow traffic movements for the A428 westbound traffic. A segregated left turn lane will be constructed on the northeast side of the roundabout to provide free flow traffic movements from Cambridge Road to the A428 eastbound, with access to Tithe Farm track being severed. A new local access road will be constructed from Cambridge Road to Tithe Farm track to maintain access to Tithe Farm.

Caxton Gibbet Junction

10.9.2.18 At-grade improvement works to Caxton Gibbet Junction will focus on improving the general layout of the junction and increasing capacity. The overall position of the roundabout will remain the same but the layout of the junction will be converted to a signalised roundabout.

10.9.2.19 The roundabout will be a two lane circulatory carriageway with a typical cross section. The roundabout will maintain connections to the A1198 (north and south arms) and the A428 (east and west arms). The conversion of the junction to a Hamburger junction will require the construction of A428 eastbound and A428 westbound through lanes crossing the junction. The west arm (eastbound and westbound carriageways) will be widened from single carriageways to dual carriageways for approximately 300m.

10.9.3 Structures

10.9.3.1 Option 7 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2701 to 2712).

Existing Structures

10.9.3.2 Existing structures to be amended are the same as discussed in Option 1 except for alterations to Culvert CE14 which are not required.

Proposed Structures

10.9.3.3 In total the new structures required for Option 7 include: 5 No motorised user overbridges and 2 No NMU overbridges

Black Cat Junction

10.9.3.4 At Black Cat Junction, two overbridges (BN101 and BN102) will be provided to carry the proposed slip roads over the A1. Further overbridges BN103 and BN104 are proposed to accommodate the possible future extension of the A421. To minimise visual obstruction to A421 road users and to accommodate the proposed junction, a 140m long viaduct (BN107) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Cambridge Road Junction

10.9.3.5 Between Black Cat Junction and Cambridge Road Junction, the following structures are proposed: one NMU overbridge. See Table B7.2 in Appendix B and the location plan drawings for details.

Cambridge Road Junction

10.9.3.6 No structures are proposed at Cambridge Road Junction.

Cambridge Road Junction to Caxton Gibbet Junction

10.9.3.7 No structures are proposed between Cambridge Road Junction and Caxton Gibbet Junction.

Caxton Gibbet Junction

10.9.3.8 An NMU structure (NMU102) is proposed to the east of the junction to carry a cycleway/footway over the A428.

10.9.4 Proposed NMU facilities

10.9.4.1 Preliminary NMU proposals have been drafted as part of the Option 7 design. It is anticipated that this option's provision will be similar to that of option 2 at the following locations:

- Existing at-grade Black Cat Junction
- A428/Great North Rd junction
- A428/Barford Rd junction
- A428 between Cambridge Road Caxton Gibbet and the villages at Croxton, Eltisley and Caxton.

10.9.4.2 It is proposed that as part of the Option 7 design that the existing at grade Caxton Gibbet junction will be signalised. In addition to the signalisation at Caxton Gibbet, it is proposed to provide an NMU bridge to the east of the junction. This will provide a grade separated connection for NMU's, which should improve upon the existing situation.

10.9.4.3 During the design development, the need for these requirements will need to be balanced with the costs associated with their provision. Given the low cost nature of this option, it is unlikely that it will be possible to resolve all of these issues.

10.9.5 Drainage

10.9.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.11 below for Option 7. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved Area: 19 Ha (Existing Paved Area: 8 Ha, Additional Paved Area: 11 Ha)
Culvert Crossings	Total number of culvert crossings equals six. This total consists of six existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. Six culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-2701 to 2712 in Appendix A and between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and potential culvert crossings (e.g. diameter, length, etc.) are summarized in tabular format in Appendix B.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of existing bridge structure at River Ouse which is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-2704. Details of this existing bridge crossing are summarized in tabular format in Appendix A.
Highway Drainage Outfalls	Total number of potential outfall locations equals 13 (including assumed existing outfalls). This total consists of 10 outfalls discharging to nearby watercourses or existing culvert crossings and three outfalls discharging to the existing surface water drainage system serving the A428. The number of potential outfall locations are subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfall locations for this Route Option.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range between 11,000 m³ to 15,000 m³. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground). Online storage may be required by means of oversized pipes for three outfalls due to spatial constraints for this Route Option.
Other Drainage Issues	Four outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage.

Table 10.11 - Option 7 surface water drainage details

10.10 Option 8

10.10.1 Option Layout

10.10.1.1 Option 8 is shown in Figure 10.9 and drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2801 to 2812).

10.10.1.2 Option 8 represents a 'low cost' solution and is a variant of Option 2. The aim of the option is to provide junction improvements at Black Cat and Caxton Gibbet Junctions with alignment improvements at Caxton Gibbet. In doing so, this will help meet the overall scheme targets and objectives as outlined in section 2.3.It is expected there will be minimal land take and land severance. There will be several new structures (culverts and bridges) as a result of the improvements.

10.10.1.3 The following improvements for Option 8 will be made:

- Significant improvement works at Black Cat junction – grade separated junction;
- Significant improvement works at Caxton Gibbet junction – grade separated junction;
- Realignment of the A428 at Caxton Gibbet junction;
- Realignment of the A1 at Black Cat junction;

- Realignment improvement works to existing A428 carriageway between B1040 / St. Ives Road and Caxton Gibbet Junctions;
- Tie-in work to the existing A421 west of Black Cat junction;
- Tie-in work to the existing A428 east of Caxton Gibbet junction; and
- Tie-in work to existing Bedford Road.

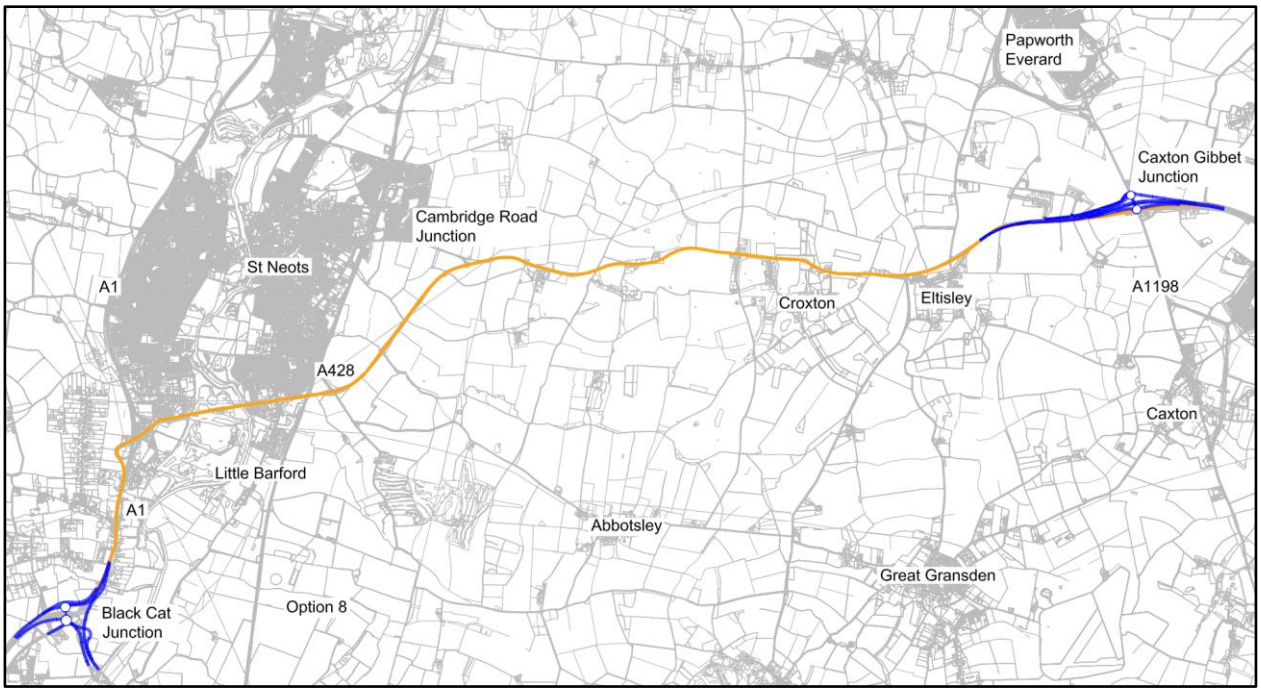

Figure 10.9 - Option 8

10.10.2 Option Description

A1

10.10.2.1 Improvement works to the A1 will be the same as described in Option 7. Please see paragraph 10.9.2.1 junction description.

Black Cat Junction

10.10.2.2 Improvement works at Black Cat Junction will be the same as described in Option 7. Please see paragraph 10.9.2.1 junction description.

Caxton Gibbet Junction

10.10.2.3 Improvement works at Caxton Gibbet will be the same as described in Option 3. See section 10.5 option description for more detail.

10.10.3 Proposed Structures

10.10.3.1 Option 8 structures are shown on drawings in Appendix A (drawings HE551495-JAC-HML-00-SK-C-2801 to 2812).

Existing Structures

10.10.3.2 Existing structures to be amended are the same as discussed in Option 2.

Proposed Structures

10.10.3.3 In total the new structures required for Option 8 include: 6 No motorised user overbridges, 2 No NMU overbridges and 2 No culverts.

Black Cat Junction

10.10.3.4 At Black Cat Junction, two overbridges (BN101 and BN102) will be provided to carry the proposed slip roads over the A1. Further overbridges BN103 and BN104 are proposed to accommodate the possible future extension of the A421. To minimise visual obstruction to A421 road users and to accommodate the proposed junction, a 140m long viaduct (BN107) will replace the existing Roxton Road Bridge (BE14) to the west of the junction.

Black Cat Junction to Cambridge Road Junction

10.10.3.5 Between Black Cat Junction and Cambridge Road Junction, the following structures are proposed: one NMU overbridge. See Table B8.2 in Appendix B and the location plan drawings for details.

Cambridge Road Junction

10.10.3.6 No structures are proposed at Cambridge Road Junction.

Cambridge Road Junction to Caxton Gibbet Junction

10.10.3.7 Between Cambridge Road Junction and Caxton Gibbet Junction, the following structure is proposed: one culvert. See Table B8.2 in Appendix B and the location plan drawings for details.

Caxton Gibbet Junction

10.10.3.8 At Caxton Gibbet Junction, a 3 span overbridge (BN106) with open abutments is proposed to facilitate grade separation of the junction. An NMU structure (NMU102) is proposed to the east of the junction to carry a cycleway/footway over the A428. A culvert (CN101) has been proposed to the east of the junction to carry a proposed watercourse diversion under the A428.

10.10.4 Proposed NMU facilities

10.10.4.1 Preliminary NMU proposals have been drafted as part of the Option 8 design. It is anticipated that this option's provision will be similar to that of option 2 and 7 at the following locations:

- Existing at-grade Black Cat Junction
- A428/Great North Rd junction
- A428/Barford Rd junction
- A428 between Cambridge Road Caxton Gibbet and the villages at Croxton, Eltisley and Caxton.

10.10.4.2 It is proposed that as part of the Option 8 design that the existing at grade Caxton Gibbet junction will be grade separated. As part of a grade separated junction improvement at Caxton Gibbet, it is proposed to provide an NMU bridge to the east of the junction. This will provide a grade separated connection for NMU's, which will improve upon the existing situation. In addition to this a new NMU route will be provided along the southern side of the new dual carriageway section between Caxton and Eltisley in order to mitigate additional severance caused by the provision of the grade separated junction.

10.10.4.3 During the design development, the need for these requirements will need to be balanced with the costs associated with their provision. Given the low cost nature of this option, it is unlikely that it will be possible to resolve all of these issues.

10.10.5 Drainage

10.10.5.1 The key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 10.12 below for Option 8. An overall Summary Table containing the data presented for all the route options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved Area: 22 Ha (Existing Paved Area: 5 Ha, Additional Paved Area: 17 Ha)
Culvert Crossings	Total number of culvert crossings equals six. This total consists of two potential culvert crossings and four existing culvert crossings that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. Six culvert crossing locations are illustrated on drawings HE551495-JAC-HML-00-SK-C-2801 to 2812 in Appendix A between Black Cat Junction and Caxton Gibbet Junction. Details of these existing and potential culvert crossings (e.g. diameter, length, etc.) are summarized in tabular format in Appendix B.
Main River Crossings	None. However the existing bridge structure at River Great Ouse may require an assessment for the construction loading to be undertaken in subsequent project design phases. The existing bridge structure at River Great Ouse is illustrated on drawing No. HE551495-JAC-HML-00-SK-C-2802 in Appendix A. Details of this existing bridge crossing are summarized in tabular format in Appendix B.
Highway Drainage Outfalls	Total number of potential outfall locations equals 18 (including assumed existing outfalls). This total consists of 13 outfalls discharging to nearby watercourses or existing culvert crossings and five outfalls discharging to the existing surface water drainage system serving the A428. Number of potential outfall locations is subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfalls with the exception of one potential outfall location (Chainage 17200 near Caxton Gibbet junction) for this Route Option. A pumped discharged solution will be required at this location. This would add to the capital and operational costs of this Route Option.
Total Estimated Attenuation Storage Volumes	Preliminary estimates range between 20,000 m^3 to 27,000 m^3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground). Online storage may be required by means of oversized pipes for two outfalls due to spatial constraints for this Route Option.
Other Drainage Issues	Five outfalls and their associated attenuation storage are potentially affected by watercourse floodplains. The attenuation storage would need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage.

Table 10.12 - Option 8 surface water drainage details

10.11 Drainage

10.11.1 Surface Water Drainage of Natural Catchments

10.11.1.1 New culvert crossings will be required where new offline road sections for the Route Options intersect Main Rivers, Ordinary Watercourses and/or existing surface water drainage ditches. Existing culverts located along sections of existing road proposed for online widening works may require culvert extensions (See paragraph 10.11.5.1 for climate change considerations).

10.11.1.2 Offline sections and online sections (subject to widening works) of the A428 Route Options traverse primarily agricultural land. Therefore, in certain instances natural catchments will drain towards these road sections. To account for this and to mitigate surface water flood risk from the natural catchment to the Route Options, natural catchment cut-off ditches along the edges of the proposed Route Options will be required to collect, convey and discharge any natural catchment runoff to a nearby watercourse and mitigate surface water flooding of the road.

10.11.2 Surface Water Collection and Conveyance

10.11.2.1 Where practicable existing surface water drainage and outfalls will be retained as part of the proposed surface water drainage. The drainage arrangements and cover depths at existing culvert crossings and the wider drainage network will need to be confirmed with site visits, topographic survey, CCTV survey and As-built information of the existing drainage infrastructure. This will enable the adequacy of this existing surface water drainage (e.g. conveyance capacity and structural integrity) to be assessed as part of the drainage design in subsequent project stages (See paragraph 10.11.5.1 for climate change considerations). At certain locations new outfalls will be required for new surface water drainage, the locations of which will be confirmed in subsequent project design stages.

10.11.2.2 Offline road sections for the A428 Route Options will require new surface water collection and conveyance systems. At this initial stage for open highway unimpeded by junctions with local roads, urban areas, flyovers, etc. it is proposed to collect surface water runoff using surface water channels at the road edges where appropriate. Surface water channels constructed in the verge will be grass or concrete lined. Surface water channels constructed in the central reserve will be concrete lined (on the assumption that the central reserve will be paved). The same design principle applies to existing road sections subject to online widening works.

10.11.2.3 Along any kerbed sections of the highway at intersections with local roads, drainage through underpasses, road sections through urban areas, etc. it will be necessary to use linear drains (e.g. combined kerb drains and slot drains) or trapped gullies for the collection of surface water runoff.

10.11.2.4 Collected surface water runoff will be conveyed using filter drains (i.e. perforated carrier drains) where the disposal of surface water through infiltration is possible and permissible (See paragraph 10.11.3.1 for further discussion). Standard carrier drains will be used in all other locations. The confirmation of appropriate collection methods to be used will be confirmed in subsequent project design stages.

10.11.3 Discharge and Attenuation Storage

10.11.3.1 Discharge of collected surface water runoff will, in order of preference, be into the ground (i.e. infiltration), to a surface water body, to existing surface water sewer or to existing combined sewer. For locations where outfalls are assumed to the A428 existing surface water drainage system the calculated allowable discharge rate will need to be verified against the existing drainage system capacity. The feasibility of different SuDS techniques (e.g. infiltration methods, filter drains, etc.) will be investigated on receipt of further ground investigation (GI) data in subsequent project design stages.

10.11.3.2 As far as reasonably practicable road sections will be drained in a manner that avoids the transfer of water between natural catchments.

10.11.3.3 The A428 route options will introduce an increased amount of impermeable road surfacing and therefore runoff rates and volumes will increase. The runoff rates will have to be restricted to existing site condition runoff rates (for online road widening) or greenfield runoff rates (for new offline road sections) to mitigate increased flood risk to and from the route options.

10.11.3.4 Given that surface water discharge rate at drainage outfalls from the Route Options will have to be restricted attenuation storage will be required. This storage will retain the increased volumetric runoff to facilitate the discharge at existing runoff rates, without increasing flood risk. At this preliminary stage it is assumed that attenuation ponds will be used. Available space will dictate the feasibility of using attenuation ponds. Ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground, etc). For spatially constrained sites (e.g. those road sections subject to online widening works) attenuation storage will be provided through the use of oversized pipes.

10.11.4 Surface Water Treatment and Pollution Control

10.11.4.1 The level of surface water runoff treatment required would vary along the route of the highway and would generally be determined by environmental constraints, discharge methods and the likelihood of contamination. The purpose of treatment is to remove oils and other hydrocarbons, silt, sediment and debris from surface water runoff before discharge. Treatment levels and pollution control requirements (e.g. need for interceptors, etc.) will be investigated and confirmed in liaison with the Environment Agency in subsequent project design stages.

10.11.5 Climate Change

10.11.5.1 Over the design life of the Route Options rainfall intensities are expected to increase due to climate change. Therefore, a climate change uplift factor must be applied to incorporate resilience into the new surface water drainage (e.g. culvert crossings, cut-off ditches, carrier drain system, etc.) for each of the Route Options. Existing surface water drainage (e.g. culvert crossings, cut-off ditches, carrier drain system, etc.) to be retained will have to be assessed for climate change resilience and may require extensions/modifications or potential upsizing to mitigate increasing flood risk to the A428 scheme and surrounding area due to the expected increase in rainfall intensities associated with climate change.

10.12 Technology

10.12.1.1 Options 1, 3, 4, 5 and 6 all propose an expressway standard carriageway of varying lengths from Black Cat to Caxton Gibbet. There are currently no standards detailing the exact requirements expected for an expressway; however, core high level requirements have been endorsed by Highways England and will be used as the basis for this report.

10.12.1.2 For a route to be designated as an expressway, there are 15 high level requirements which includes technology provision. The technology features that would be proposed as part of Options 1, 3, 4, 5 and 6 are described below:

- Regularly spaced Variable Messages Signs (VMS), such as MS4s, will provide incident / traffic management including Variable Mandatory Speed Limits.
- It is assumed Emergency Roadside Telephones will be co-located with Emergency Refuge Areas.
- Enforcement technology will be provided to ensure compliance from the road users.
- An above ground vehicle detection system will be implemented.
- Pan-Tilt-Zoom (PTZ) Closed Circuit Television (CCTV) cameras providing comprehensive coverage.
- All the technology assets provided will be integrated in to the Highways England traffic management system (CHARM) to allow control from the Regional Control Centre (RCC).

10.12.1.3 Options 2, 7 and 8 all propose some major and minor junction improvements along the route corridor. The technology provision for these options will include additional CCTV coverage at key junctions. It is expected that these options will retain the provision of the traffic measurement equipment (TME) traffic counting sites and the ANPR sites for journey time information.

10.13 Street Lighting

10.13.1.1 In order to achieve compliance with TD34/07 'Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Networks', Expressways Technical Note, CIE 115/2010 'Lighting of roads for motor and pedestrian traffic', TD 22/06 'Layout of Grade Separated Junctions' and for safety and operational reasons, the following is recommended:

- All the existing sections of the A428 Black Cat to Caxton Gibbet scheme that are currently lit will remain lit.
- All the junctions shall be partially lit with only the on/off-line conflict points lit.

10.13.1.2 The junctions' on/off-line elements connecting to unlit sections shall extend for a distance long enough to include:

- the 5 seconds of driving at the expected traffic speed of 70mph i.e. 156m from the top of the slip roads;
- the peak traffic queuing distance on the approach to a give way or stop line; and
- the distance required to illuminate any bend at the end of an exit slip road or the beginning of an entry slip road;

10.13.1.3 The junctions' on/off-line elements connecting to lit sections shall be fully lit and lighting extended to tie-in with the lit sections. Gaps of less than four times the stopping sight distance between lit sections are to be lit in accordance with the requirements of TD34/07 C.3.19. Any access roads that will be created because of the new works shall be lit if it is located within an already lit area.

10.13.1.4 Where lighting is being provided, it is recommended to install efficient full cut-off lighting technology such as Light emitting Diodes (LEDs) being dynamically controlled according to traffic flows by Highways England's Central Management System (CMS) and Motorway Road Lighting Control System (MoRLiCS) to reduce the lighting levels where the traffic flow is low in off-peak hours to provide the right amount of light in the right place and at the right time to have a healthier, safer and greener network.

10.13.1.5 Embracing the above recommendations will achieve at least 75% in energy and carbon emission savings and at least 50% in maintenance savings for Highways England. Reliability of the above proposed technology ensures fewer failures hence reduced ad-hoc maintenance visits hence reducing the need for night scouting.

10.13.1.6 The CMS can monitor the performance of the lighting assets to:

- Allow for repair and maintenance of the road lighting before failures occur, by providing early indication of the incorrect operation prior to complete failure.
- Dynamically report defect information from the lighting assets to facilitate faster response to defects with Highways England's lighting stock.
- Ensure road lighting degradation over time is factored into the operating profiles, to ensure consistency of road lighting levels over the lifetime of the road lighting installation.
- Monitor and report on Highways England's actual energy usage for road lighting to evidence England's carbon reduction commitments, and give complete control of energy spend against the backdrop of continued increases in energy costs.
- Control the levels of lighting to achieve the optimum balance between road safety and the impact of road lighting on the environment by reducing light pollution.

11. Traffic Analysis

11.1.1.1 Due to the traffic model not being complete at the time of submission for SGAR 1, this section cannot be completed and therefore is left intentionally blank. A briefing note has been produced (reference HE551495-JAC-GEN-00-REP-C-0002) which describes the progress to date.

12. Economic Assessment

12.1.1.1 Due to the traffic model not being complete at the time of submission for SGAR 1, this section cannot be completed and therefore is left intentionally blank. A briefing note has been produced (reference HE551495-JAC-GEN-00-REP-C-0002) which describes the progress to date.

13. Safety Assessment

13.1 Strategic Safety Action Plan

13.1.1 Impact on the Road Users

13.1.1.1 The scheme option proposals have been considered and reviewed in the context of the overall scheme objectives, including safety. These indicate that the 'Scheme improves road user safety at the A421 / A1 Black Cat junction and on the A428 corridor between Wyboston and Caxton'.

13.1.1.2 This overall scheme objective is based on the existing Highways England's Key Performance Indicator, that the level of killed and serious injured (KSI) casualties be decreased by at least 40% by the end of the year 2020, based on the 2005 – 2009 baseline[14]. Additionally, Highways England's aspiration is for no-one to be hurt whilst using or working on the strategic road network. The Roads Investment Strategy contains an aspiration for zero KSIs by the year 2040. It should be noted that detailed safety objectives would be developed at PCF Stage 2, as part of the PCF Safety Plan.

13.1.1.3 Highways England's Expressway Technical Note (2016) describes a safety objective for Expressway routes as providing a similar safety performance as a dual 3 lane motorway (D3M) without MIDAS. Additionally it is expected that no road user group would be adversely disproportionately affected. In order to meet these objectives, a suite of 15 characteristics are required to be adopted. It is accepted that MIDAS contributes a 13% reduction in collisions, so the measure of new route performance for an Expressway standard route has been taken as D3M plus 13%.

13.1.1.4 The road user safety assessment of each option has been undertaken based on the following parameters:-

- Likely impact on KSI performance of the route based on fatal weighted index (FWI). (FWI considers collisions in the rough proportions which they occur in national statistics. 1 fatal = 1; 1 serious = 0.1; 1 slight = 0.01).
- Compliance with Expressway characteristics, and achievement of Expressway safety objectives.
- Initial assessment of departures from standards
- Potential effect on individual road users groups, including non-motorised users (NMU).

13.1.1.5 Highlights of the existing safety performance of A428 corridor between Black Cat Roundabout (A421/A1) and Caxton Gibbet roundabout (A428/A1198), based on the period 2010 to 2014 can be summarised as follows:

- Casualty rates generally higher than a similar road type on the Strategic Road Network (SRN).
- KSI rate higher in 2010 (A428)
- All casualty rate higher in 2012 (A428)
- All casualty rate higher in 2010, 2011 and 2013 on A1 (Black Cat roundabout to Wyboston (A1/A428).
- Large collision clusters at A421/A1 Black Cat Roundabout and A428/A1198 Caxton Gibbet Roundabout. Each has a low KSI rate. Most collisions resulting in slight injuries. However, Black Cat Roundabout was subject to a pinch-point scheme completed in Spring 2015, and the eastern arm of Caxton Gibbet junction was converted to dual carriageway as part of the Caxton Common to Harwick Improvement scheme in 2007.
- No road users are disproportionately adversely represented in the statistics.

[14] Highways England, Delivery Plan 2015-2020. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/424467/DSP2036-184_Highways_England_Delivery_Plan_FINAL_low_res_280415.pdf

- A428 does not provide a safe environment for NMU use, particularly between Caxton Gibbet, Eltisley and St Neots, and has severance issues for NMUs at B1428 Wyboston and A1198 Caxton Gibbet, where uncontrolled at-grade crossings are provided, and A1 Black Cat junction, where at-grade crossings are a mixture of uncontrolled and partially signalised facilities. Several public rights of way are crossed by the route requiring at-grade crossings at all but two locations, where under-bridges are provided (these are south-west of Cambridge Road junction).

13.1.2 Impact on Road Workers

13.1.2.1 This assessment will cover impact on road workers during the operation and maintenance of the route after its commissioning. Highways England has an overall objective that no-one should be harmed whilst using or working on the SRN. This builds on Highways Agency's Policy of Aiming for Zero for road workers, which has resulted in a number of initiatives such as eliminating crossing of live carriageways by the end of 2016.

13.1.2.2 There will be no specific numerical safety objective set for road workers. This risk will be managed in accordance with the requirements of the Health and Safety at Work Act to be reduced So Far As Is Reasonably Practicable (SFAIRP). This is a legal requirement.

13.1.2.3 The introduction of Expressway roads would reduce risk for road workers in a number of ways. These include the use of concrete barriers, which reduce the level of maintenance and replacement works required, thus reducing exposure to risk, introducing combined emergency and maintenance bays and technology, all of which can improve protection of road workers and facilitate safer maintenance of additional technology assets, and introduction of a five year non-maintenance period after handover of a scheme for operation. Each option has been assessed to consider the impact on road worker safety. Road workers include traffic officers and supply chain workers.

13.2 Option Assessment (Road User and Road Worker Safety)

13.2.1.1 Each of the options is assessed below and a summary of the safety performance of the options is provided in a table at the end of the section.

13.2.1 Option 1

13.2.1.1 This option comprises a D2AP Expressway off-line improvement which follows the alignment of the existing route relatively closely, and provides grade separated junctions at A1 Black Cat, B1428 Cambridge Road and A1198 Caxton Gibbet junctions.

13.2.1.2 The route is likely to perform in accordance with Expressway safety objectives (provided all elements are provided), which would result in substantial reductions in SRN KSI and casualty rates. Exceptions are that potential departures from standards on the western side of Black Cat roundabout may reduce this (the departures are considered to be capable of mitigation with changes to the design), and NMU severance issues at Black Cat and Caxton Gibbet grade separated interchanges would require mitigation.

13.2.1.3 Initial assessment of the residual existing route suggests traffic flow would be reduced substantially by this option, and especially between Cambridge Road and Caxton Gibbet junction (subsequent traffic modelling to confirm this). This would also reduce the casualty rate but mitigation may be required to avoid increased traffic speeds through reduced congestion affecting KSI rates. This option may provide ability to introduce enhanced NMU facilities and deal with severance issues. Severance issues at Wyboston would remain and may need consideration of further mitigation in the de-trunking strategy. The option is assessed as providing major safety benefits.

13.2.1.4 Road worker safety on the proposed route would be improved significantly over the existing route by the provision of a range of measures, including concrete barrier, fixed taper points and combined emergency/maintenance bays, which would reduce maintenance interventions and exposure to risk, or ensure they are designed to maximise safety of road workers and road users.

13.2.2 Option 2

13.2.2.1 This option provides grade separated interchanges at Black Cat and Caxton Gibbet, improved capacity at B1428 Wyboston, B1043 Barford Road, B1428 Cambridge Road, Croxton, and Eltisley junctions.

13.2.2.2 Effectively the grade separated improvements could be considered to improve safety performance (although not KSIs), provided NMU severance issues are mitigated adequately. However, the transition from dual carriageway to single carriageway west of Caxton Gibbet is considered to increase risk in the single carriageway length to the west of the transition and at adjoining junctions, owing to potential increases in traffic speeds when traffic is not congested.

13.2.2.3 Proposals for Wyboston (dedicated left turn slip lane), Barford Road (increased approach widths and dedicated turning lanes) and Cambridge Road (through flow lane) are considered to increase risk for NMUs, particularly at Wyboston and have potential to increase casualties, unless significant mitigation is provided. The improvements proposed at the other junctions are single lane dualling, and these are considered to increase risk of KSIs owing to road user behaviour at this type of junction.

13.2.2.4 Road worker safety is not considered to be improved by the proposals, which may result in a slight additional risk in the section between Wyboston and Caxton Gibbet owing to the junction types proposed and additional complexities in maintenance.

13.2.3 Option 3

13.2.3.1 This option provides grade separated junctions at Black Cat, Cambridge Road and Caxton Gibbet junctions, and a new D2AP Expressway standard off line link between Black Cat and Cambridge Road junctions. The new section of dual carriageway would be expected to operate with Expressway safety performance (provided all elements are provided), potential departures from standards on the western side of Black Cat roundabout may reduce this (the departures are considered to be capable of mitigation with changes to the design).

13.2.3.2 However, there are concerns about the safety performance of the transitions between dual and single carriageway and the single carriageway link section between Cambridge Road and Caxton Gibbet, and junctions between them. The risk of KSI and casualty rates in those areas is considered to be increased.

13.2.3.3 NMU severance issues at Black Cat and Caxton Gibbet grade separated interchanges would require mitigation, and NMU severance at Wyboston on the existing route may require mitigation.

13.2.3.4 Road worker safety would be improved significantly on the new Expressway link, but maintenance of the residual single carriageway between Cambridge Road and Caxton Gibbet would be likely to be worsened in the section as a result of increased traffic, and potentially traffic speeds in light traffic conditions.

13.2.4 Option 4

13.2.4.1 This option provides an Expressway standard D2AP link between Black Cat and Caxton Gibbet, but with the section between Cambridge Road and Black Cat junctions provided largely on line. Owing to the geometry between Cambridge Road and Black Cat junctions to enable the route to be provided on line, it is not considered this section would operate with the required safety performance for an Expressway, and owing to the departures required, may not operate to the required performance of a D2AP route.

13.2.4.2 A separate single carriageway local access route is proposed on the north side of the route. This would provide an opportunity for improved NMU facilities but it would be segregated from the vollages, which are located on the south side of the route, thus requiring bridges at appropriate locations across the Expressway to link to the villages or public rights of way. NMU severance issues at Black Cat and Caxton Gibbet grade separated interchanges would require mitigation, and NMU severance at Wyboston on the existing route may require mitigation.

13.2.4.3 Road worker safety in maintenance activities could be adversely affected by the departures from standard required in the on-line route section between Cambridge Road and Caxton Gibbet.

13.2.5 Option 5 and 6

13.2.5.1 These options provide Expressway D2AP links between Black Cat and Caxton Gibbet interchanges, with grade separated interchanges at those junctions. There are minor alignment differences between the two options in the offline sections, but these are not considered to affect the safety assessment. Assessment notes are as for Option 1, with the exception that traffic to or from the east of St Neots would be required to use the existing A428 route between Cambridge Road and Caxton Gibbet junctions, resulting in higher residual traffic flows on that route (subsequent traffic modelling to confirm) and increased casualty rates. This may limit ability to improve NMU facilities and severance along the existing A428 in that area.

13.2.5.2 Provided all of the Expressway requirements are provided, it is considered the new route would operate with Expressway safety performance, but that the part of the existing route between Cambridge Road and Caxton Gibbet may not have an improved performance.

13.2.6 Option 7

13.2.6.1 This option provides a grade separated junction at Black Cat roundabout, capacity improvements at Wyboston, Barford Road and Cambridge Road, and a signalised roundabout at Caxton Gibbet. Additionally a D2AP link is provided between Wyboston and the River Ouse bridge, just west of Barford Road junction. This proposal is unlikely to improve existing safety performance with the exception of the casualty record (largely slight injuries) at Black Cat junction, and possibly at Caxton Gibbet.

13.2.6.2 The proposal would require significant mitigation to address NMU severance at Wyboston and Caxton Gibbet junctions, whilst it provides little, if any opportunity to improve NMU facilities and severance between Cambridge Road and Caxton Gibbet. Mitigation would also be required to deal with NMU severance and potential impact of departures on the west side of Black Cat junction.

13.2.6.3 Road worker safety would not be improved by this option and is likely to be made more difficult by complexity of junctions and increased traffic on A428, particularly between Cambridge Road and Caxton Gibbet.

13.2.7 Option 8

13.2.7.1 This option is similar to Option 7, but provides a grade separated junction at Caxton Gibbet, with a dual carriageway section terminating just west of the junction. This alternative may provide more opportunity to mitigate severance at Caxton Gibbet junction than Option 7, and potential reduction in casualties (largely slight injury) at Caxton Gibbet, but this is offset by potential safety performance where the dual carriageway transitions to single carriageway and the junctions to the west. It remains similar in road user and road worker safety in other respects.

13.2.8 Option Assessment Summary (Road User and Road Worker Safety)

13.2.8.1 A summary of the assessment based on road user and road worker safety is shown in Table 19.3 and reflects the potential performance of each option in meeting required safety objectives, and contributing to Highways England's overall safety objectives.

13.3 NMU Severance, Safety and Public Transport Accessibility

13.3.1 NMU Options impact

13.3.1.1 Options have been assessed to identify whether they create severance for NMUs, whether the severance is mitigatable and whether the option provides opportunities to reduce existing severance issues within the route, and possibly existing NMU safety issues. The table below shows the number of NMU facilities, by option which are affected. They are categorised into public rights of way (footpaths, bridleways and byways), and other footways and cycle paths. The table shows that Options 1, 3 and 4 intersect significantly more NMU facilities than other options. However, some of these have less overall impact as the intersections are dealt with by provision of grade separated crossings.

13.3.1.2 National Cycle Route (NCR) 12 crosses A421 on Roxton Road bridge, just west of Black Cat Interchange and passes through Chawston, Eaton Socon, Eynesbury and St Neots using a combination of local roads and cycle paths (including a new route across the River Ouse at Willow Bridge), and to the north-west through Hail Weston towards Grafham Water. It is only impacted by the scheme at Roxton Road over-bridge, just west of Black Cat Interchange.

	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
PROW Footpaths affected	17	6	15	16	7	4	6	5
PROW Bridleways affected	3	1	0	3	3	3	0	0
PROW Byways affected	0	0	0	0	0	0	0	0
Footway/ cycle routes affected	2	2	2	2	2	2	2	2
Total	**22**	**8**	**17**	**21**	**12**	**9**	**8**	**7**

Table 13.1 - Crossings of NMU facilities by option

13.3.2 Options Assessment

13.3.2.1 Each option has been assessed against the scheme objectives for NMUs and for public transport accessibility. Elements considered include potential severance and level of mitigation possible, opportunities to deal with historic severance, opportunities to link communities, opportunities to facilitate access to public transport, and safety for users. The table below shows the overall assessment by option for both non-motorised users and public transport users.

13.3.2.2 The assessment presumes that for Options 1, 4, 5 and 6, crossings of new dual carriageway routes would be grade separated with minimal diversion of NMU facility, and that severance created by enlarged grade separated junction improvements at Black Cat and Caxton Gibbet Interchanges would be mitigated to provide improvements, by provision of local facilities to enable users to access facilities on the correct side of the alignment. It is also presumed that NMUs would be prohibited from the new route (Expressway standards), and that suitable alternative facilities would be provided on the existing route to link the existing cycle route adjacent to A428 east of Caxton Gibbet (to Cambourne, Madgingley and Cambridge) with local facilities in St Neots and NCR 12.

13.3.2.3 For Option 3, it is presumed that NMUs would be prohibited from the dual carriageway improvement between Black Cat and Cambridge Road junctions, crossings of the new dual carriageway route would be grade separated with minimal diversion of NMU routes and a suitable link from Cambridge Road to local facilities in St Neots and NCR 12, to provide a suitable alternative route would be provided. Additionally severance created by enlarged grade separated junction improvements at Black Cat and Caxton Gibbet Interchanges would be mitigated to provide improvements, by provision of local facilities to enable users to access facilities on the correct side of the alignment.

13.3.2.4 Option 4 includes a local access road (LAR) on the north side of the proposed route. This route could provide a significant improvement for NMU and public transport accessibility, but the level of improvement is limited to an extent by the LAR location on the opposite side of the route from the villages, with linkages by over-bridges. It is presumed that crossings of the new dual carriageway route would be grade separated with minimal diversion of NMU routes, and severance created by enlarged grade separated junction improvements at Black Cat and Caxton Gibbet Interchanges would be mitigated to provide improvements, by provision of local facilities to enable users to access facilities on the correct side of the alignment.

13.3.2.5 Options 2, 7 and 8 provide various levels of improvements at selected locations and/or links and envisage SRN traffic using Wyboston junction. As a result each could exacerbate existing NMU severance issues with potential mitigation by grade separation, but would involve various levels of diversion for users. Each of these options envisages SRN traffic using the existing route, with selected improvements between Black Cat and Caxton Gibbet junctions. It is considered these offer limited opportunities to improve existing severance between St Neots, Eltisley, Caxton Gibbet and the NMU facilities which extend east of Caxton Gibbet towards Cambourne, Madgingley and Cambridge.

13.3.2.6 Option 7 involves a signalised roundabout at Caxton Gibbet, for which mitigation of NMU and public transport severance is considered more difficult. There are similar difficulties with mitigation of public transport in Option 8.

13.3.2.7 Initial consideration has been given to proposed development adjoining the route, and initial workshops with road user groups and NMU groups, and discussions with the Local Highway Authorities have been initiated to inform the development of the options. At PCF Stage 2, an NMU Context Report would be developed, based on the preferred option.

13.3.3 Options Assessment Summary

13.3.3.1 Please see Table 19.3 for the assessment summary.

13.4 Impact During Construction and Operation – Construction (Design and Management) Regulations 2015

13.4.1.1 This section assesses the health and safety considerations and impacts during construction and use for each option. The maintenance considerations are discussed in more detail in section 16, and a number of health and safety risks also relate to the residual maintenance operations depending on the options.

13.4.1.2 The Scheme falls under the definition of construction work as defined in the Construction (Design and Management) Regulations 2015 (CDM2015). CDM2015 requires a managed approach to the whole life cycle of construction of an asset. This includes management arrangements developed by Highways England, resources for the project with the appropriate knowledge, skills and experience and the application of the principles of prevention to the design process to mitigate hazards.

13.4.2 Regulatory Oversight

13.4.2.1 A short table summarises a basic Regulatory Oversight of the project with respect to Construction (Design and Management) Regulations 2015. The detailed regulatory requirements are outlined in the Regulation and accompanying guidance.

Topic	Key designations and features	
Definition of Construction Work	The Scheme falls under the definition of construction work as defined in the Construction (Design and Management) Regulations 2015 (CDM2015).	
Application of CDM2015 to the project	CDM2015 is the law that applies to the whole construction process on all construction projects, from concept to completion; and describes what each dutyholder must or should do to comply with the law to ensure projects are carried out in a way that secures health and safety.	
Identification and appointment of main CDM2015 dutyholders as project progresses	CDM2015 requires for projects involving more than one contractor, the appointment of a Principal Designer and at the appropriate time before construction commences, a Principal Contractor. For the current stage of the project:	
	Client	Highways England
	Designers	Jacobs UK Ltd
	Principal Designer	Jacobs UK Ltd
	Principal Contractor	TBC by procurement
	Contractors	TBC by procurement
Notification of the project to Health & Safety Executive (HSE)	The estimated scheme scope and programme duration will trigger the requirement for a F10 Notification to HSE	

13.4.3 General

13.4.3.1 All the options represent a significant undertaking with regards to the scale of the construction effort required to deliver the scheme. The options are more fully described in this report in section 10.

13.4.3.2 Further safety-related aspects are described in this report in the following sections:

- Section 13.1 – Impact on the Road User – Strategic Safety Action Plan
- Section 16 – Maintenance Assessment
- Section 17.1 – Constructability

13.4.3.3 As described in section 10, all options involve major junction improvements at the Black Cat and Caxton Gibbet interchanges. The options comprise successively increasing investment along the route ranging from a do-minimum, low-cost option involving work only at Black Cat and Caxton Gibbet junctions in Option 8, to Options 1, 5 and 6 for construction of a new Expressway standard offline route between upgraded Black Cat and Caxton Gibbet junctions.

13.4.3.4 All options have the objective of minimising land-take and impact on property. At the current stage, hazard mitigation takes a strategic-level approach. Major obstacles have been identified and marginal adjustments made to alignments to reduce perceived proximities to major hazards such as high capacity utility supplies.

13.4.3.5 The context within which the safety benefits arise from the scheme are usefully stated in section 3.2 of this report which describes the Existing Highway Network and some of the difficulties of using and working on the network. Very briefly, throughout the 17km section, much of the route does not meet desirable minimum standards of the DMRB across a wide variety of features including:

- Changes in carriageway cross-section (i.e. dual to single carriageway and back again)
- Horizontal and Vertical Alignment
- Lighting
- Lay-by provision
- Entry and exit layouts
- Hardstrips / hard shoulders
- Maintenance access

13.4.3.6 High traffic volumes on this strategic east-west route gives rise to general congestion on the network impacting on journey time reliability and network resilience. Incidents such as breakdowns and equipment failure have a greater than might be expected consequence due to the constrained sections with safety concerns for recovery, emergency vehicle access and maintenance operations.

13.4.3.7 The construction phase for all options generally involves high risk activities connected with

- Working alongside existing high volume traffic flows with no easily accessed alternative diversion route
- Presence of high capacity utility supplies (gas, electricity)
- New structures with associated intensity of construction activity in a constrained area.

13.5 Option Specific Items (CDM 2015)

13.5.1 Options 1, 5 and 6

13.5.1.1 The options involve increased construction activity crossing major obstacles of the River Ouse and East Coast Main Line railway (ECML). They are likely to involve working next to buried services and are likely to involve the diversion of a high pressure gas main and potentially high voltage overhead lines as identified in section 3.10.

13.5.1.2 Whilst sections of the works will involve work next to live traffic, a significant proportion of the works will be constructed offline improving the level of control that the constructor will have over the construction process. This is a significant client-led, design-led feature that would contribute positively to the overall safety performance for the construction of the scheme.

13.5.1.3 These options achieve most of the scheme objectives. Expressway standards are largely achieved with significant safety benefits for user safety, reduced maintenance load and improved access for maintenance operations, greater journey reliability enhanced network resilience and network availability.

13.5.2 Option 3

13.5.2.1 Option 3 includes the major crossings of the River Ouse and ECML and conflicts with the gas main and HV overhead lines as above.

13.5.2.2 This option begins to involve a greater degree of work next to live traffic at the connection east of Cambridge Road and at Caxton Gibbet with the associated increase in difficulty of reduced working space and work phasing.

13.5.2.3 This option provides no global user safety benefits for the section Cambridge Road to Caxton Gibbet and would require road users to still experience the change in carriageway cross-section from dual carriageway to single carriageway or vice-versa.

13.5.3 Option 4

13.5.3.1 Option 4 includes the major crossings of the River Ouse and ECML and conflicts with the gas main and HV overhead lines as above. The construction difficulty is increased because of the greater section of online carriageway worked on between Cambridge Road and Caxton Gibbet. This will involve extensive working in close proximity to live traffic and involve many phases of alteration of traffic management layout.

13.5.3.2 Although road user safety will be improved between Cambridge Road to Caxton Gibbet over the existing layout, benefits will not be maximised because the alignment will be constrained in certain sections by existing features such as properties and some accesses. A greater number of departures from standards will arise.

13.5.4 Option 2, 7 and 8

13.5.4.1 Options 2, 7 and 8 do not involve new crossings for the River Ouse or ECML. However, conflict with the HP gas main remains and some conflict with the HV overhead lines could be anticipated as well as other numerous buried services. Working in close proximity to live traffic is largely confined to the Black Cat and Caxton Gibbet interchanges where most of the work takes place.

13.5.4.2 The overall road user benefits are limited given that significant, turbulent sections of the route between Black Cat and Cambridge Road, and Cambridge Road and Caxton Gibbet are not upgraded.

14. Operational Assessment

14.1.1.1 Due to the traffic model not being complete at the time of submission for SGAR 1, this section cannot be completed and therefore is left intentionally blank. A briefing note has been produced (reference HE551495-JAC-GEN-00-REP-C-0002) which describes the progress to date.

15. Technology Assessment

15.1 Option design implications for the utilisation of technology

15.1.1.1 A description of the existing and proposed technology provision for all options can be found in sections 3.11 and 10.11.1 of this report.

15.1.2 ITS systems

15.1.2.1 Options 1, 3, 4, 5 and 6 have all proposed an expressway standard carriageway along some or the entire route corridor. The expressways technical note published by Highways England in March 2016, requires extensive provision of technology as part of its core requirements. It is expected there would be technology provisions in line with expressway requirements as part of those options.

15.1.2.2 After an initial assessment, Options 5 and 6 which propose an expressway along the entire route corridor, will require approximately 40 VMS (MS4s). These two options will require extensive technology provision. It is expected Options 1, 3 and 4 will require a reduced provision.

15.1.2.3 On reviewing current standards, there is no specific technology provision required for Options 2, 7 and 8; however it would be beneficial to provide CCTV coverage at the improved junctions at Black Cat and Caxton Gibbet. Any additional CCTV coverage should not have any significant implications on the Regional Control Centre (RCC) technology or staff. Confirmation will be required that the CCTV matrix has capacity for this additional input.

15.1.2.4 The provision of VMS and vehicle detection on the approaches to the improved junctions at Black Cat and Caxton Gibbet may be beneficial by providing queue protection and driver information. Further assessment and liaison with the RCC will be required as the scheme progresses to understand the operational benefits.

15.1.2.5 For all options, liaison with the Operations Directorate will be required to confirm they accept any technology proposals.

15.1.2.6 As the scheme progresses, liaison with the National Traffic Information Service (NTIS) will be required in order to inform them of the scheme and how journey times are likely to be affected on the strategic network during construction and after scheme completion.

15.1.3 Communications Network

15.1.3.1 The provision of an expressway will require a communication network along the route corridor. Options 1, 3, 4, 5 and 6 will all require liaison with the National Roadside Telecommunication Service (NRTS) in order for them to provide a communication network which will service the technology proposed. It is likely that this provision will include the need for a Transmission Station located within the corridor.

15.1.3.2 It is likely the technology provision for Options 2, 7 and 8 will not require a NRTS communication network. Communication with the technology sites can be provided using GSM/GPRS networks.

16. Maintenance Assessment

16.1.1 Impact of Operational Regime

16.1.1.1 Should the proposed scheme would be to an Expressway standard, currently defined in Highways England's Technical Note issued in 2015. An Interim Advice Note containing further details is planned for issue. The operational regime would include a number of elements designed to facilitate future maintenance. There would also be a five year maintenance free period after completion.

16.1.1.2 Civils Infrastructure:

- Concrete barrier – this would virtually eliminate repair resulting from collisions, reducing exposure to risk for workers and road users, and increasing network availability.
- Geometric Standards – the use of high standard geometry would facilitate safer operation of routine maintenance and temporary traffic management.
- Structures – New structures would be provided at Black Cat and Caxton Gibbet (New grade separated junctions), the River Great Ouse (viaduct), The East Coast Main Line, side road bridges, minor structures for Non-motorised User crossings, and various culverts. Safe access will be designed to facilitate maintenance of this infrastructure.
- Pavement – pavement would be maintained using standard methods, and would require lane closures.
- Drainage – Safe access would be provided to enable required maintenance of drainage facilities including channels, gullies, attenuation and pollution control measures.
- Soft estate and fencing - Safe access would be provided to enable required maintenance of aspects these elements.

16.1.1.3 Technology:

- Maintenance Access – provision of emergency bays combined with maintenance access bays and technology cabinets, and variable message signs would facilitate safer maintenance of assets.
- MIDAS Detectors – Above ground detection would reduce maintenance requirements on the carriageway, minimising loop detector repair, traffic management interventions and exposure to risk.
- Temporary Traffic Management – Rotating Temporary Traffic Management Signs (ROTTMS) would be provided based on designed fixed taper points to facilitate placing of TM signing without the need for road workers to work from or within the carriageway to place the signs. The signs could be turned on and would provide further protection to road workers engaged in placing cones and lamps from vehicles.
- Variable Message Signs – these can be used to further enhance advance warning of road works and implementation of temporary speed limits.

16.1.2 Maintenance Strategies

16.1.2.1 Initial design hazard elimination and risk reduction has been commenced, which includes elements related to operational and maintenance safety. The development of the maintenance strategy would have the Principles of Prevention at its core using the hierarchy of control – Eliminate, Reduce, Investigate, Control (ERIC) for risk reduction or elimination. This may be achieved through various means, and particularly through avoiding the hazard altogether through design wherever possible by considering occupational and system safety throughout the lifecycle of the asset and minimising exposure to risk. Elements may include:

- Combining cyclic activities (such as routine street lighting repair, drainage, litter picking) in shared traffic management, subject to appropriate risk assessment of adjoining activities, to minimise

network occupation, maximise network availability and minimise periods of exposure to risk for road workers and road users.

- Use of materials and products which minimise required maintenance interventions.
- Scheme design which minimises maintenance interventions required (for example, drainage).
- Off highway maintenance access, where appropriate, from the local road network.
- Safe access routes along the highway and to assets such as structures and roadside equipment.
- Facilitation of design areas of hardened verge for maintenance vehicle access and to facilitate mobile lane closures where appropriate.
- Use of technology to improve our safety in design approach to improve monitoring, durability and ease of access.
- Strategic diversion routes would be developed in collaboration with the Police and Operations Directorate.

16.1.3 Interface with Operational Safety

16.1.3.1 Road worker safety is a core element dealt with in the PCF Safety Plan (PCF Stage 2). The Maintenance and Repair Strategy Statement will be a key product in the development of a safe scheme, and would be developed in co-ordination with other Health and Safety products (managed by the Principal Designer) and Operational Safety products including the Safety Plan (PCF Stage 2), Combined Safety and Hazard Log Report (PCF Stage 3) and Combined Operations Strategy (PCF Stage 3). The Safety Plan would include selection of the appropriate safety management system (SMS). Any maintenance risks identified would be considered as part of the Combined Safety and Hazard Log Report and managed accordingly. Where appropriate, risk assessments would be carried out in accordance with Highways England's Process for Managing Risk on the Strategic Network (DMRB GD04/12).

17. Constructability and Consenting

17.1 Engineering and Constructability

17.1.1 Engineering implications of Geology

17.1.1.1 The ground conditions do not appear to pose any major hazards that would favour one option over another. The major natural obstacle is the crossing of the River Great Ouse and its floodplain, but this is common to all the options, except for Options 2, 7 and 8. It is likely that some ground treatment of the alluvium would be required to construct the embankments on it. This would appear to be the same for all options. Likewise all options must cross the East Coast Mainline (ECML) railway, but the ground conditions seem good with no alluvium recorded.

17.1.1.2 Elsewhere the ground conditions seem good, with either glacial till or mudstones exposed at surface and the topography is low relief, which should not pose major problems for the earthworks of any of the options.

17.1.2 Constructability

17.1.2.1 The 8 options that have been assessed for the A428 Black Cat to Caxton Gibbet scheme provide various levels of complexity of engineering and construction. Details of each of the options and the issues and implications associated with them are discussed in Appendix F. A summary of the key issues are given below.

Options 1 – 8

17.1.2.2 All of the options propose construction works to be undertaken at the A1/A421 Black Cat Junction. These works would involve significant temporary traffic management (TTM) with multiple phases including lane closures and speed restrictions over a sustained period of time. Although every effort should be made to maintain the flow of the A1, full road closures of the existing network would be required at various stages during the construction period. This would be to allow the undertaking of works on new bridge decks, such as lifting of new beams into place. These closures are likely to be undertaken at night to minimise disruption, but could create light and noise pollution.

17.1.2.3 In the vicinity of the existing Black Cat Junction is an existing high pressure gas main. Should this main need to be diverted, this would have a significant impact on the construction programme due to a potential two year lead in period. Therefore any works associated with diverting this main should be programmed early on in the works.

17.1.2.4 All 8 options excluding Option 7 propose the construction of a new grade-separated junction at Caxton Gibbet Junction. Sections of this junction arrangement would be offline, but inevitably there are sections which will be online as it ties-in to the existing A428 and A1198. As previously mentioned any tie-in works to the existing network would require full road closures and a suitable diversion route implemented.

Options 1, 3, 4, 5 and 6

17.1.2.5 For any of the options that propose a link between Black Cat Junction and Cambridge Road Junction, there are constructability issues that need to be taken in to account. Located between the existing Black Cat Junction and the East Coast Mainline (ECML) is a floodplain. In order to cross the floodplain either a viaduct structure or ground treatment works on which an embankment can be constructed would be required.

17.1.2.6 However, the design would need to ensure that the floodplain is not severed, as this would create a dam effect. Should the earthworks solution be progressed, this would impact on the construction programme as allowance would need to be made for a consolidation period. In addition, it is likely that additional land would need to be purchased to provide floodplain compensation.

17.1.2.7 The East Coast Mainline is a significant constraint for these options. In order to facilitate the construction of the structure over the railway a number of 'Rules of the Route' possessions would be required to undertake preparatory works, such as signal sighting and survey works.

17.1.2.8 Rules of the Route possessions would need to be booked a minimum 18 weeks prior to the date of actual works commencing. Activities associated with the main construction of the structure over ECML, including the installation and removal of track monitoring equipment, the installation of the bridge beams, would require to be carried out under a 'Blockade' possession. In accordance with Network Rail possession booking standards, blockade possessions would need to be booked 104 weeks prior to date of actual works commencing.

17.1.2.9 These options partially, if not in their entirety, consist of offline construction. This is beneficial to phasing of the works and allows minimal disruption to the local road networks. However additional road material would be required and subsequently increase the number of lorry movements to and from site.

17.1.2.10 When determining the area of land required to deliver the scheme (red line boundary), consideration would need to be given to the likelihood of a haul road running the length of the scheme as well as areas for compounds and satellite facilities and lay down areas close to proposed structure locations.

Option 4

17.1.2.11 This option proposes online widening between Cambridge Road Junction and Caxton Gibbet Junction. In terms of constructability this provides more issues than an offline solution due to the continuous interface with the existing road network. TTM would be implemented along this section with narrow running lanes and speed restrictions likely over a sustained period.

Options 2 and 7

17.1.2.12 These options include proposed works at the existing junctions along the existing A428 (Option 2) and improvements to the junction at Wyboston (Option 7). During the construction of these improvement works, as they are online, disruptions to the local network would be encountered for certain periods due to the TTM that would be required. However, any tie-in works that require a full road closure should be undertaken at night, when traffic flows are reduced.

17.1.3 Constructability Summary

17.1.3.1 Having assessed the constructability constraints and issues associated with each of the 8 options are identified in Table 17.1 below:

Option No.	Primary Reasons
1	Advantages: • All the works proposed, excluding the tie-ins at Black Cat Junction, Cambridge Road Junction and Caxton Gibbet Junction, are offline resulting in minimal impact on the existing road network.

Option No.	Primary Reasons
	Disadvantages: • 1no. structure required over ECML which would require possession of the railway. Approximate time period for booking blockade possessions -104 weeks prior to the date of actual works; • Crossing of the floodplain between Black Cat Junction and ECML required impacting on construction programme; • Likely shortfall of suitable site-won fill material resulting in the need for imported material; and • Increased volume of new carriageway construction material compared to all other options.
2	Advantages: • Only the construction of Black Cat Junction, Caxton Gibbet Junction and local junction improvements with no expressway link; • No construction required over ECML; • No construction required over the floodplain; and • Construction of Black Cat junction would require less TTM to be implemented as compared to Options 1, 3, 4, 5 and 6.
	Disadvantages: • Majority of the works would involve online widening and junction improvement works which would require significant amount of TTM to be implemented.
3	Advantages: • Majority of the works proposed are offline except tie-ins with the existing carriageway; • Increased opportunity to provide a cut/fill earthworks balance than Options 2, 7 and 8.
	Disadvantages: • 1no. structure required over ECML which would require possession of the railway. Approximate time period for booking blockade possessions -104 weeks prior to the date of actual works; • Crossing of the floodplain between Black Cat Junction and ECML required impacting on construction programme; • Increase in construction materials required compared to Options 2, 7 and 8, impacting on no. of construction/delivery vehicles using the local road network; and • More structures required than Options 2, 7 and 8.
4	Advantages: • Reduced volume of new carriageway construction material required compared to Options 1, 5 and 6.
	Disadvantages: • 1no. structure required over ECML which would require possession of the railway. Approximate time period for booking blockade possessions -104 weeks prior to the date of actual works; • Crossing of the floodplain between Black Cat Junction and ECML required impacting on construction programme; • Approximate 6.7km of online widening leading to long periods of TTM on the existing A428 impacting on the local road network; • Less opportunity to provide an earthworks cut/fill balance for the scheme; and • Significantly more structures affected than other options.
5	Advantages: • All the works proposed, excluding the tie-ins at Black Cat Junction, Cambridge Road Junction and Caxton Gibbet Junction, are offline resulting in minimal impact on the existing road network. • No requirement for the construction of a grade-separated junction at Cambridge Road; and • Reduced skew of the structure over the ECML compared to Options 1, 3 and 4.

Option No.	Primary Reasons
	Disadvantages: • 1no. structure required over ECML which would require possession of the railway. Approximate time period for booking blockade possessions -104 weeks prior to the date of actual works; • Crossing of the floodplain between Black Cat Junction and ECML required, impacting on construction programme; and • Likely shortfall of suitable site-won fill material resulting in the need for imported material.
6	Advantages: As per Option 5 above.
	Disadvantages: As per Option 5 above but with fewer structures required and less volume of imported fill material required.
7	Advantages: • Only the construction of Black Cat Junction, Caxton Gibbet Junction and improvements to Wyboston Junction, with no expressway link. • No construction required over live East Coast Mainline (ECML); • No construction required over the floodplain; and • Overall construction duration would be approximately 18 months.
	Disadvantages: • With minimal suitable site won material available, likely that imported fill material would be required; • Majority of works would involve online widening and junction improvement works which would require significant amount of TTM to be implemented; and • Overall construction duration would be approximately 30 months.
8	Advantages: • Only the construction of Black Cat and Caxton Gibbet Junctions, with no expressway link; • No construction required over ECML; • No construction required over the floodplain; and • Overall construction duration would be approximately 18 months.
	Disadvantages: • Long distance earthworks movements on the existing network required between Caxton Gibbet Junction and Black Cat Junction to provide best cut/fill balance.

Table 17.1 - Constructability summary of options

17.2 Consenting

17.2.1.1 This section identifies the planning considerations for the 8 options being assessed for the A428 Black Cat to Caxton Gibbet scheme. A desk based review of the allocations and designations within a 500m study area of the scheme options has been undertaken as set out below by key theme. The options run through four Local Planning Authority (LPA) administrative boundaries and the options assessment has been set out below by LPA.

17.2.1.2 The requirements and implications of LPA policies are discussed in detail in Appendix G. A summary of the findings for each option is given in this section below.

17.2.2 Option 1

17.2.2.1 This scheme accommodates the ministerial announcement and meets the scheme objectives by creating an Expressway standard dual 2 lane carriageway between the A421 and the existing dual carriageway section of the A428 to Cambridge and provides significant improvements to the Black Cat roundabout. The scheme reflects National Network National Policy Statement (NNNPS) by supporting economic growth, reducing congestion and increasing resilience.

17.2.2.2 The route is offline from the Black Cat junction to Caxton Gibbet junction and the open countryside and environmental local policies apply. Paragraph 5.203 of the NNNPS states that:

"*Applicants should have regard to the policies set out in local plans.*"

17.2.2.3 Paragraph 5.211 of the NNNPS states that

"*The Examining Authority and the Secretary of State should give due consideration to impacts on local transport networks and policies set out in local plans, for example, policies on demand management being undertaken at the local level*".

17.2.2.4 The option will need to be fully justified against the NNNPS and local policies considered to ensure the scheme is not a departure from policy. Please see the National Networks National Policy Statement accordance table for a full review of the NNNPS.

17.2.3 Option 2

17.2.3.1 This option does not meet the scheme objectives or RIS strategy objectives to create an Expressway standard dual 2 lane carriageway linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge. The scheme does not reflect the NNNPS as it is likely the proposed works will not fully address the current congestion and safety issues on the network.

17.2.3.2 Local policy impacts are reduced as the scheme remains online. However, paragraph 5.203 of the NNNPS states that the examining authority and SoS have regard to the policies set out in local plans and therefore a full justification of the option against local plan policy will be required to provide a justification for this option to ensure the scheme is not a departure from policy.

17.2.4 Option 3

17.2.4.1 The scheme ties back into the existing A428 single carriageway around the Cambridge Road junction and therefore does not fully meet the scheme objectives to create an Expressway standard dual 2 lane carriageway linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge. The scheme does not reflect the NNNPS as the proposed works will not fully address the current congestion and safety issues on the network.

17.2.4.2 Local policy impacts are reduced for the elements of the scheme that remain online. However, similar to Option 2, paragraph 5.203 of the NNNPS states that the examining authority and SoS have regard to the policies set out in local plans and therefore a full justification of the option against local plan policy will be required to provide a justification for this option to ensure the scheme is not a departure from policy.

17.2.5 Option 4

17.2.5.1 This option meets the RIS strategy objectives and the scheme objectives to create an Expressway standard dual 2 lane carriageway linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge and the scheme reflects the NNNPS by supporting economic growth, reducing congestion and increasing resilience

17.2.5.2 Parts of the expressway standard dual 2 lane carriageway are online from Cambridge Road to Caxton Gibbet with new parallel local road access. However, the local access roads and offline elements are in close proximity the sensitive policy designations in Croxton and Eltisley. Local policy impacts around these sensitive villages and the open countryside need to be considered. Paragraph 5.203 of the NNNPS states that the examining authority and SoS have regard to the policies set out in local plans and therefore a full justification of the option against local plan policy will be required to provide a justification for this option to ensure the scheme is not a departure from policy.

17.2.6 Options 5 and 6

17.2.6.1 These options meet the RIS strategy objectives and the scheme objectives to create an Expressway standard linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge and the scheme reflects the NNNPS by supporting economic growth, reducing congestion and increasing resilience.

17.2.6.2 In local policy terms this option has the greatest impact on the open countryside and sensitive local environmental policies due to its location and distance from the existing A428. Paragraph 5.203 of the NNNPS states that the examining authority and SoS have regard to the policies set out in local plans and therefore a full justification of the option against local plan policy will be required to provide a justification for this option to ensure the scheme is not a departure from policy.

17.2.7 Option 7

17.2.7.1 This option does not meet the RIS strategy objectives or the scheme objectives to create an Expressway standard dual 2 lane carriageway linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge. Local policy impacts are reduced as the scheme remains online and requires minor junction upgrades and amendments. The scheme does not reflect the NNNPS as the proposed works will not fully address the current congestion and safety issues on the network.

17.2.7.2 Local plan policies apply to the junction upgrades and paragraph 5.203 of the NNNPS states that the examining authority and SoS have regard to the policies set out in local plans and therefore a full justification of the option against local plan policy will be required to provide a justification for this option to ensure the scheme is not a departure from policy.

17.2.8 Option 8

17.2.8.1 This option does not meet the RIS strategy objectives or the scheme objectives to create an Expressway standard dual 2 lane carriageway linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge. The scheme does not reflect the NNNPS as the proposed works will not fully address the current congestion and safety issues on the network. Local policy impacts are greatly reduced as the scheme only requires minor junction upgrades and amendments to Black Cat roundabout and Caxton Gibbet, how local and national policy will still need a full review and justification option to ensure the scheme is not a departure from policy.

18. Environmental Assessment

18.1 Introduction and Methodology

18.1.1.1 The environmental appraisal has been carried out by a team of specialists working in collaboration with the team responsible for the design of each alternative option. Each option has been appraised on whether it is likely to have significant effects on the different environmental topics. These are documented in the Options Appraisal Matrix (OAM) within the Environmental Assessment Report (EAR – reference HE551495-JAC-EGN-00-RP-V-0001) and summarised in Table 18.1of this document.

18.1.1.2 The environmental appraisal considered whether there was likely to be a significant effect, both positive and negative for each of the environmental topics. The significance of the effect of an impact was derived through consideration of the sensitivity of a receptor (sometimes referred to as its value or importance) and the likely magnitude of the impact. The specialists considered the following criteria as part of their professional judgement decision:

- It leads to an exceedance of defined guidelines or widely recognised levels of acceptable change (which will be different for different topics within the environmental assessment, as set out in the relevant section).
- It is likely that the consenting authority will reasonably consider applying a planning condition, requirement or legal agreement to the consent to require specific mitigation to reduce or overcome the effect.
- It threatens or enhances the viability or integrity of a receptor or receptor group of concern.
- It is likely to be material to the ultimate decision about whether or not the consent application should be approved.

18.1.1.3 As this appraisal is at an early stage in the project development, the options were evaluated for potential environmental effects using the scoring scale set out in Table 19.1. Mitigation measures were recorded along with risks and issue associated with the options.

18.2 Results

18.2.1.1 The full OAM within the EAR outlines the potential environmental effects associated with each of the options based on the baseline study and a high level consideration of the potential effects. This is broken down by DMRB topic heading and covers other topics that will be considered as part of the future environmental assessment. Table 18.1 provides a summary of the conclusions of the environmental appraisal at Stage 1 using the six point scale.

Option	Overall environmental score	Conclusions of the environmental appraisal (This is based on a high level assessment of the current designs, the likely significant effects could change as more information comes to light or through future iterations of the designs where effects are designed out)
Do nothing	Not assessed.	Air quality and noise will get worse over time as congestion increases. Doing nothing will also affect the regional economy, if congestion deters businesses from investing in the area.

Option	Overall environmental score	Conclusions of the environmental appraisal (This is based on a high level assessment of the current designs, the likely significant effects could change as more information comes to light or through future iterations of the designs where effects are designed out)
1	Potential significant adverse effect – mitigation maybe possible.	This option has an offline footprint that has been designed to avoid sensitive features. This option would provide an opportunity to move adverse effects associated with the existing road away from Croxton Park and potentially enhance this feature if designed in close collaboration with landscape and heritage specialists. The option would also take traffic away from the Wyboston Junction and potentially improve noise levels at the A1 Noise Important Area (NIA). Overall this is considered to be the environmentally preferred offline option, as it would provide opportunities for improvement to the NIA, NMU access and to Croxton Park. The alignment has also been designed to avoid sensitive features.
2	Potential significant adverse effect – mitigation maybe possible.	This option has a smaller footprint that Option 1 but would require widening of the A428 in vicinity of Croxton Park. Online widening is likely to result in significant effects to the designated site, in terms of visual and setting and through changes to noise and air quality, which may be difficult to mitigate. This option would not provide all of the benefits of Option 1, including reducing the impact of the road on Croxton Park.
3	Potential significant adverse effect – mitigation maybe possible.	This option has a smaller footprint that Option 1, with less visual and land take impacts. This could help improve the NIA to the north of Black Cat. This option would not provide all of the benefits of Option 1, including reducing the impact of the road on Croxton Park. If this was undertaken as a phased part of a longer term scheme, it could lead to significant effects to Croxton Park if it was taken forward as part of an online widening option (see Option 4). It would have similar effects to Option 1 if taken forward as a phased approach to an Option 1 alignment.
4	Significant adverse effect – unlikely to be able to mitigate.	This option is likely to have significant effects around Croxton Park due to the road widening extending immediately adjacent to the designated site and increases to noise and air quality impacting the feature. This is likely to be very difficult to mitigate given the proximity of the option to the designated site. This option will require extensive consultation with statutory stakeholders and is likely to result in costly archaeological mitigation which could have programming implications.
5	Potential significant adverse effect – mitigation maybe possible.	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 5km to the south of the route. This option is likely to require an appropriate assessment due to the proximity to the bat Special Area of Conservation (SAC). The high sensitivity of this area makes this less environmentally favourable than Option 1, as it would require more mitigation to offset potentially significant effects. It would create another major road within the landscape and create additional barriers to protected species migration within the landscape. This option has a higher risk of requiring an Appropriate Assessment than Option 1, as it is closer to the SAC and would have a greater impact on the landscape and habitat corridor.
6	Potential significant adverse effect – mitigation maybe possible.	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 3km to the south of the route. This option is likely to require an Appropriate Assessment due to the proximity to the bat SAC. The high sensitivity of this area makes this less environmentally favourable than Option 1 and Option 5, as it would require more mitigation to offset potentially significant effects. It would create another major road within the landscape and create additional barriers to protected species migration within the landscape. This option has a higher risk of requiring an Appropriate Assessment than Option 1, as it is closer to the SAC and would have a greater impact on the landscape and habitat corridor.
7	Potential significant adverse effect – mitigation maybe possible.	This option is similar to Option 2. However, this would have limited benefit to the NIA and could make noise levels worse in this area. It would also extend the footprint of the road into the nature reserve and conservation area, with impacts on the setting, recreation benefits and ecosystem value of this area. This could lead to significant effects to Croxton Park if it was taken forward as part of an online widening option (see Option 4).

Option	Overall environmental score	Conclusions of the environmental appraisal (This is based on a high level assessment of the current designs, the likely significant effects could change as more information comes to light or through future iterations of the designs where effects are designed out)
8	Slight adverse effect. Effect not significant with typical mitigation.	The junction improvements are likely to have lower risk of significant effects than the widening options. However, further design iterations would be required at Stage 2 to design out potential significant effects associated with landscape of the structures.

Table 18.1 - Environmental Assessment summary

18.2.1.2 Table 18.1 shows that at Stage 1, Option 1 is environmentally preferred option. This would result in environmental benefits to Croxton Park, as traffic is moved away from this designated site. Option 8 has a low environmental effect, as it involves less impact on green field sites, and consequently has a lower impact on ecology, landscape and buried archaeology. Option 4 is least preferred, as this would extend the road into the footprint of Croxton Park and is likely to result in significant effects to the site that would be difficult to mitigate. Options 5 and 6 would affect large areas of the open landscape and would take the route closer to internationally designated sites (designated for bats) to the south, with a higher risk of requiring an appropriate assessment.

19. Assessment Summary

19.1 Assessment Summary Tables

Score colour code	Score	7 point effect scale
Red	-3	Significant adverse effect – unlikely to be able to mitigate
Red / Amber	-2	Potential significant adverse effect – mitigation maybe possible
Amber	-1	Slight adverse effect. Effect not significant with typical mitigation
Light Green	+1	Slight beneficial effect. Effect not significant
Green	+2	Major beneficial effect
Dark Green	+3	Significant beneficial effect
Neutral	0	No effect or a neutral effect due to the balancing out of positive and negative effects

Table 19.1 - Scoring Colour Codes

19.1.1 Environment

Environmental Topic		Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Receptors	Air quality								
	Cultural heritage								
	Landscape								
	Nature conservation								
	Geology and soils								
	Noise and vibration								
	People and community								
	Water environment								
Design Considerations	Waste and materials								
	Climate change								
	Resilience to environmental risks, accidents and disaster								
Crosscutting Topics	Health								
	Ecosystems services								
	Socioeconomics								
Overall environmental score									

Table 19.2 - Environmental Assessment Summary Table

19.1.2 Traffic

19.1.2.1 Due to the traffic model not being complete at the time of submission for SGAR 1, this section cannot be completed and therefore is left intentionally blank. A briefing note has been produced (reference HE551495-JAC-GEN-00-REP-C-0002) which describes the progress to date.

19.1.3 Objectives

19.1.3.1 The following table summarises the assessment of the 8 options from the perspective of the scheme objectives identified in section 2.3.2. These were agreed at a meeting of the technical design leads on 2 November 2016.

Highways England Objectives	A428 Scheme Specific Objectives	Options							
		1	2	3	4	5	6	7	8
Supporting Economic Growth	a) Scheme supports planned economic and housing growth in Cambridge and the surrounding sub-region	3	1	2	3	2	2	1	1
	b) Scheme supports spatial and strategic transport policies including Local Plans for Bedford, Cambridge and the surrounding sub-region by reducing congestion related delay, improve journey time reliability and increase the overall transport capacity	3	0	2	3	3	3	-1	1
	c) Scheme promotes use of the strategic route by strategic traffic, and local routes by local traffic	3	0	1	3	2	2	-1	0
A Safe and Serviceable Network	a) Scheme improves road user safety at the A421 / A1 Black Cat junction and on the A428 corridor between Wyboston and Caxton.	2	-3	-2	-1	1	1	-2	-1
	b) Scheme improves road worker safety	2	-2	-2	-1	1	1	-1	-1
A More Free Flowing Network	a) Provide significant capacity improvements to the Black Cat junction where the A1 currently meets the A421	3	3	3	3	3	3	3	3
	b) To create an Expressway standard link between the A421 and the existing dual carriageway section of the A428 to Cambridge	3	-2	-1	2	3	3	-3	-2
	c) Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather	3	-1	1	2	2	2	-1	-1
An Improved Environment	a) Improve the environmental impact of transport on communities along the existing A428 corridor between Wyboston and Caxton	3	0	1	-1	2	2	0	0
	b) Reduce the impact of new infrastructure on the natural and built environment	-2	-2	-2	-3	-2	-2	-2	-1
A More Accessible and Integrated Network	a) Scheme provides a safe alternative NMU route between communities and seeks to address severance	1	-2	-1	1	1	1	-2	-1
	b) Improve safety and access for public transport users	1	-1	-1	1	1	1	-2	-2
Customer Satisfaction	a) Reduce traffic congestion delays and improve journey time reliability	3	1	2	3	2	2	1	1
	b) Improve driver information	3	0	1	3	3	3	0	0

Table 19.3 - Objective Summary Table

20. Programme

20.1 Programme Constraints

20.1.1.1 In order to meet the RIS delivery plan commitment to start works on site before the end of March 2020, the following key milestone dates have been identified.

- PCF Stage 3 (Preliminary Design) team need to be engaged by April 2017;
- PCF Stage 3 Pre-Application consultation to begin in August 2017 to permit sufficient redesign time prior to Development Consent Order (DCO) submission;
- Draft Development Consent Order (DCO) submitted to the Planning Inspectorate (PINS) by mid-August 2018; and
- Stages 4 and 5 delivered in parallel with Secretary of State Decision by mid-December 2019

20.1.1.2 A summary of proposed Stage Gate Assessment Review (SGAR) dates is as follows:

- PCF Stage 2 – April/May 2017
- PCF Stage 3 – July 2018
- PCF Stage 4/5 – November/December 2019

20.2 Phased Delivery

20.2.1.1 It would be possible to deliver the project in multiple phases should external factors such as traffic management, other schemes on diversion routes, etc. influence the overall delivery programme.

20.2.1.2 Notwithstanding work to be done in later PCF stages as contractors are procured to construct the scheme, it would be possible to progress the scheme using the different options presented here. A flow chart is provided in Figure 20.1 below as an indication of the potential phases which could be employed.

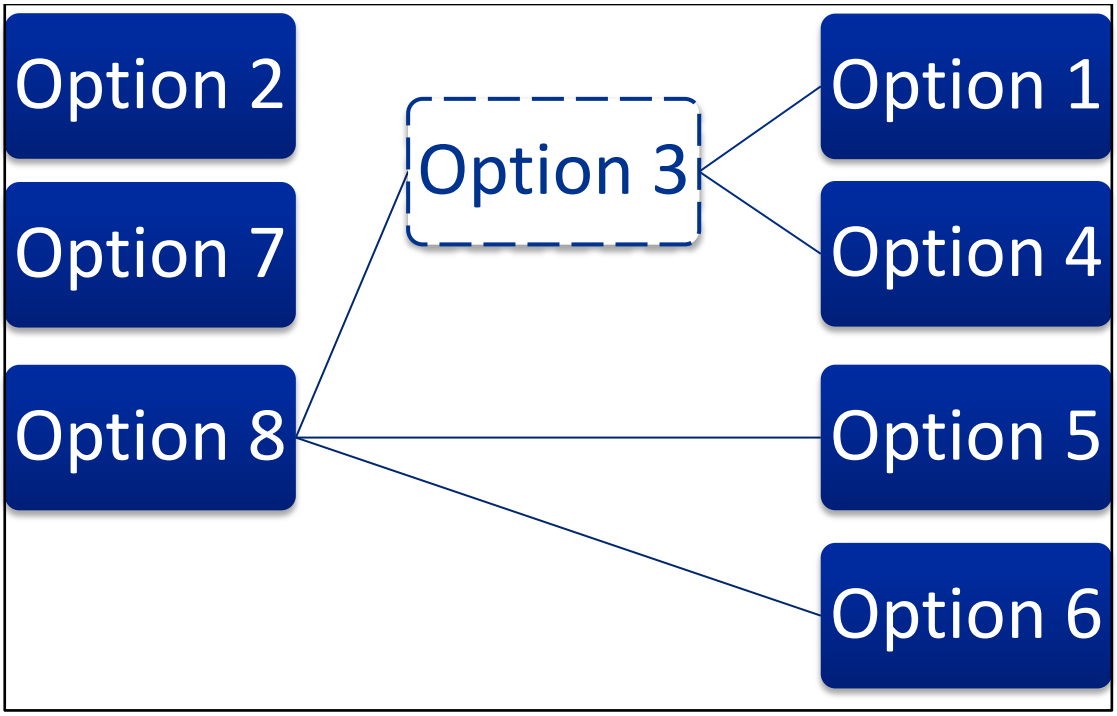

Figure 20.1 - Potential phased delivery of options

21. Conclusion of Recommendations

21.1 Option(s) for Public Consultations

21.1.1.1 Following the findings of the assessments done by the various disciplines is it suggested that Options 1, 5 and 6 are taken forward to the non-statutory consultation in PCF Stage 2. On balance, these options meet the most scheme objectives and provide the most significant benefits with the lowest potential environmental impacts. Option 4 has been discounted since the scheme has a significant negative impact upon local communities and the Grade II* Croxton Park.

21.1.1.2 These recommendations are subject to confirmation of the economics resulting from the completion of the traffic modelling which has not been finalised prior to the submission of this Interim TAR.

21.2 Preferred Solution

21.2.1.1 Based upon the findings to date, our preferred solution is Option 1 as it provides the best connectivity, and the most positive benefits in achieving the objectives.

Appendix H - Annex to the Technical Appraisal Report (May 2017)

A428 Black Cat Junction

Annex to Technical Appraisal Report

HE551495-JAC-GEN-BCJN-RP-CH-001 - Revision P00

May 2017

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1. Introduction

1.1 Context

1.1.1.1 This report is an Annex to the Technical Appraisal Report (TAR) of the A428 Black Cat to Caxton Gibbet Roads Investment Strategy (RIS) scheme, previously issued under document reference HE551495-JAC-GEN-00-REP-C-0001. The Annex focuses solely on the options development of Black Cat Junction.

1.1.1.2 Black Cat Junction is located at the south western end of the proposed A428 scheme, to the south of Wyboston. It is the intersection between the A1, heading north to south, and the A421 that heads west of the junction. The location of Black Cat Junction is shown in Figure 1-1.

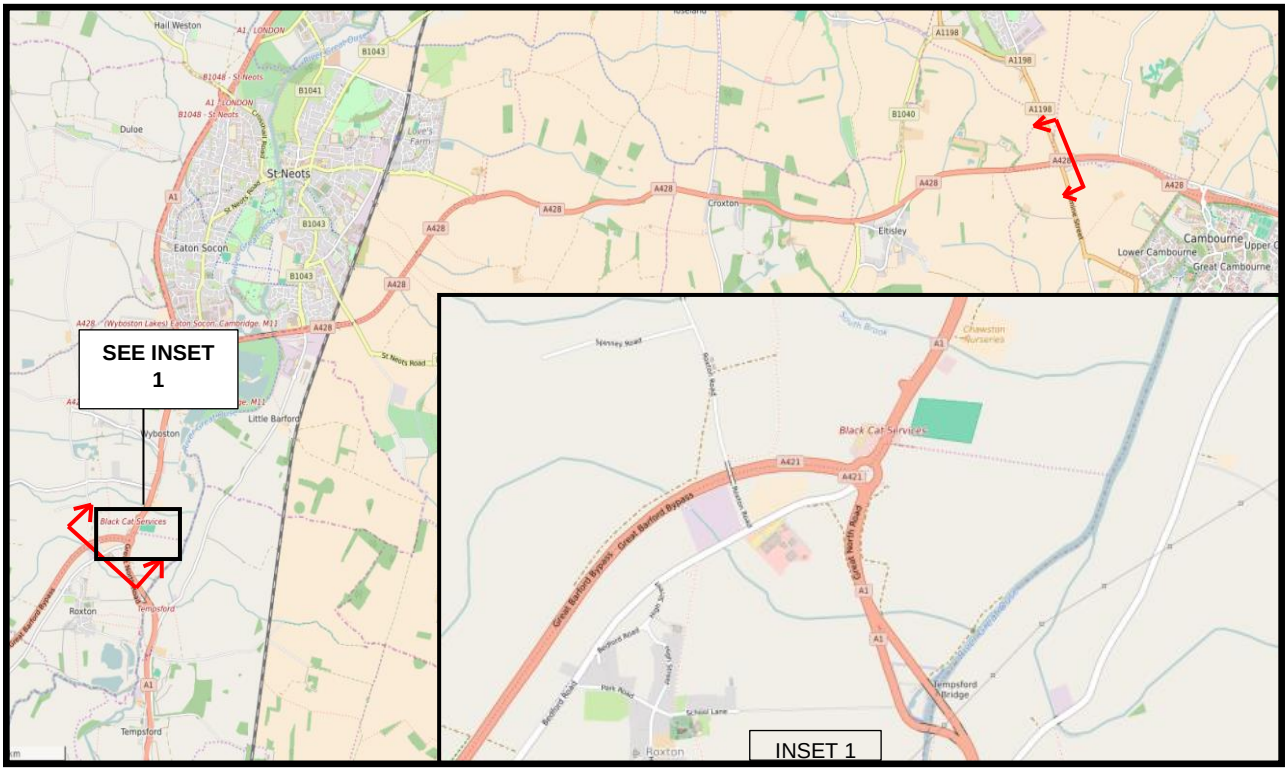

Figure 1-1 Project corridor and location of Black Cat Junction

2. Planning Brief

2.1 Existing Problems

2.1.1.1 The following issues regarding Black Cat Junction were highlighted in the PCF Stage 0 Options Assessment Report (OAR) process:

- Some road links around Black Cat Junction are operating at or above capacity.
- AM peak speeds are particularly low on approach to Black Cat Junction.
- During the AM peak there is significant congestion on the A1 on approach to Black Cat Junction and during the PM peak congestion occurs on the A421 on approach to the junction.
- Black Cat Junction lies 69th in the national safety rankings (1 being the worst safety record) on the strategic road network 2009 to 2011.

2.1.1.2 For further information please refer to the OAR (reference B2074900/A6S/JAC/A428/XX/RP/PM/00025), Strategic Outline Business Case (SOBC – reference B2074900/A6S/JAC/A428/XX/RP/PM/00030) and Section 3 of this report.

3. Existing Conditions

3.1 Highway Network

3.1.1 Black Cat Junction

3.1.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.2 Structures

3.2.1.1 Details of existing bridges are given in Tables B1.1, B2.1 and B3.1 in Appendix B and shown on the structures location plans in Appendix A.

3.2.1.2 Existing structures within the scheme may require assessment to check their suitability for retention in the scheme.

3.3 Traffic

3.3.1.1 For information refer to Chapter 11 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.4 Accidents and Incidents

3.4.1 Existing Safety Conditions Overview

3.4.1.1 Collision and casualty records during the period January 2011 to December 2015 inclusive have been analysed at the following locations:

- Black Cat Junction
- A421 to a point approximately 50 metres west of the Roxton Road over-bridge
- A1 from South Brook to the north of the junction and Tempsford Bridge to the south
- and Bedford Road to a point just west of its junction with Roxton Road.

3.4.1.2 Data has been taken from validated STATS 19 data received from Highways England's system. The most recent five full year period of data available at the start of the preparation of the TAR has been chosen to provide greater statistical accuracy, and to enable use of other annual data (such as traffic flows) within similar periods.

3.4.1.3 During the period covered, a total of 36 collisions has been recorded in the length of the Strategic Road Network (SRN) reviewed, resulting in 51 casualties. A further two collisions occurred on local roads, resulting in four casualties.

3.4.1.4 This analysis updates and enhances previous work carried out and included in the OAR, and includes an updated data baseline from 2010-2014 to 2011-2015.

3.4.1.5 An improvement scheme was carried out at the junction and completed early in 2015, involving signalisation and modified traffic lanes.

3.4.2 Collision Analysis

3.4.2.1 Table 3-1 & Table 3-2 show an overall collision analysis by year and severity for the lengths of Strategic Road Network (SRN) and local roads respectively. This shows that on the A428, the level of collisions was higher in 2012 and 2014 and that the level of killed or seriously injured (KSIs) was higher in 2012, including two fatalities. Casualties on the A1 showed lower levels in 2012 and 2015, but on local roads, a higher level in 2012. This tends to reflect the fluctuations in casualty levels by year, although for 2014, the A428 had a much higher level of casualties.

Collisions	Fatal	Serious	Slight	Total	FWI
2011	0	2	6	8	0.26
2012	0	0	2	2	0.02
2013	0	1	8	9	0.18
2014	0	2	9	11	0.29
2015	0	1	5	6	0.15
Total	0	6	30	36	0.90

Table 3-1 Collisions by year and severity – Black Cat Junction Improvement - A421 and A1 arms, and Circulatory Carriageway

Collisions	Fatal	Serious	Slight	Total	FWI
2011	0	0	1	1	0.01
2012	0	0	0	0	0.00
2013	0	0	1	1	0.01
2014	0	0	0	0	0.00
2015	0	0	0	0	0.00
Total	0	0	2	2	0.02

Table 3-2 Collisions by year and severity (Bedford Road and Roxton Road in area affected)

3.5 Topography, Land Use, Property and Industry

3.5.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.6 Climate

3.6.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.7 Drainage

3.7.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.8 Geology

3.8.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.9 Mining

3.9.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.10 Public Utilities

3.10.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.11 Technology

3.11.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.12 Maintenance Access

3.12.1.1 For information refer to Chapter 3 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.13 Street Lighting

3.13.1.1 The existing Black Cat Junction is a fully lit junction. The existing lighting mainly consists of High Intensity Discharge (HID) lamps and Light Emitting Diodes (LEDs).

3.14 Environment

3.14.1.1 For information refer to Chapter 5 of the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001_Rev 0).

3.15 Accessibility

3.15.1 Existing NMU Severance

3.15.1.1 The existing routes at the Black Cat Junction intersect with a number of existing public rights of way, footways and a national cycle route. Non-motorised users are categorised as pedestrians, cyclists, equestrians and powered wheelchairs for the purpose of this analysis, although it should be noted that there are no equestrian facilities in this area.

3.15.1.2 Key areas of severance currently experienced are:

- Black Cat Junction – NMU routes from Roxton to the Black Cat Junction services area (restaurant; Travelodge; filling station) and Chawston (McDonalds) are required to cross the A421 at the signalised roundabout at grade.
- North side of A421 – Two existing footpaths (public rights of way) are severed at the fence of the highway.
- A1 Chawston Lane – NMU bridge not available for cyclists.

3.15.2 Non-Motorised User Safety

3.15.2.1 Road traffic collisions and casualties have been assessed for the A421/A1 Black Cat Junction for the years 2011-2015, based on validated STATS 19 records. Full details of the analysis is shown in Section 3.4.1of this report. There were no collisions involving pedestrians, cyclists or equestrians on the existing routes covered by the proposed junction improvements.

3.15.3 Existing Public Transport Accessibility

3.15.3.1 Route X5 – Oxford to Cambridge via Roxton and St Neots – operated by Stagecoach (Bedford).

3.15.3.2 Route X5 has bus stops on the A1 between Wyboston and Black Cat Junction, beyond which it serves Roxton. There are bus stops in Bedford Road.

3.15.3.3 There is a network of local bus routes which operate in St Neots, with several operators. Two additional infrequent routes operate in the vicinity of Black Cat Junction:-

3.15.3.4 Route 112 – Biggleswade to St Neots - (operated by Ivel Sprinter).

3.15.3.5 Route 112 operates on Thursdays only, providing two journeys, It runs along Bedford Road (north eastbound) from Great Barford and crosses Roxton Road bridge.

3.15.3.6 Routes W9 and W10 – Shefford to St Neots (with different intermediate points) (operated by Wanderbus).

3.15.3.7 Routes W9 and W10 operate every other Thursday, providing return journeys, operating along Bedford Road and the A1.

4. Maintenance and Repair Strategy Statement

4.1.1.1 Initial liaison has been carried out with Highways England Operations Directorate (OD) and the Asset Support Contractor (ASC) and existing maintenance strategies, challenges and opportunities identified. The potential maintenance challenges and opportunities attributed to the proposed improvements to Black Cat Junction have been discussed in outline. Currently, the junction is signalised and maintenance hardstandings are provided for vehicular access to controller cabinet locations.

4.1.1.2 The Maintenance and Repair Strategy Statement (MRSS), which will be developed as a detailed PCF Product at Stage 2, is designed to capture and analyse maintenance strategy for the proposed scheme and will contain maintenance philosophy statements for groups of infrastructure proposed. The strategy will be developed in close liaison with OD and the ASC.

4.1.1.3 The strategy will be designed to discharge Highways England's functions in respect of future maintenance under the Construction (Design and Management) Regulations, 2015 and to address Highways England's objectives, that no-one will be harmed working on the SRN and the Aiming for Zero initiative.

5. Description of Junction Options

5.1 Scheme Development History

5.1.1 Stage 0 Summary

5.1.1.1 Based on the outcome of the PCF Stage 0 (Strategy, Shaping & Prioritisation) OAR, eight A428 routes were identified to be taken forward (highlighted in Section 10.2 of the TAR).

5.1.2 Stage 1 Options Identification

5.1.2.1 During Stage 1 twelve junction options were generated based on the identified problems and issues at Black Cat Junction. These initial junctions and their descriptions are shown in Table 5-1 below.

Option Reference	Option Description
1a	Dumbbell roundabouts on Roxton Road with merge and diverge slips from A428 and A1 connecting to the two roundabouts.
1b	Dumbbell roundabouts near the existing Black Cat Junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.
1c	Similar to the option 1b above with merge and diverge on the A428 located further away from the mainline.
1d	Dumbbell roundabouts on Roxton Road with merge and diverge slips from A428 connecting to the two roundabouts. New roundabouts on the A1 with merge and diverge slips from A1 connecting to the new roundabout with a side road connecting the roundabout on the A1 and southern roundabout at Roxton.
1e	Dumbbell roundabouts on Roxton Road and A1 with merge and diverge slips from A428 and A1 connecting to the two dumbbell roundabouts.
2a	Dumbbell roundabouts on Roxton Road with diverge and merge from A428 connecting to the roundabouts. Another dumbbell to the east of A1 with diverge and merge from A428 connecting to these roundabouts with southbound diverge and merge on A1 connecting to east roundabout and link roads connecting east and west roundabouts.
2b	One roundabout on Roxton Road with diverge and merge from A428 connecting to the roundabout. Another roundabout to the east of A1 with diverge and merge from A428 connecting to this roundabout with southbound diverge, merge on A1 and link roads connecting this roundabout.
3a	One roundabout at existing Black Cat Junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.
3b	Similar to the option 3a above, with merge and diverge on the A428 moved further away from the mainline.
4	Junction with slip roads and interchange links for all direction. Loop slip roads between A1 northbound and A428 eastbound as well as A1 southbound and A428 westbound.
5	Eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.
6	Eastbound diverge link road from A428 connecting to A1 northbound and diverge slip connecting to existing Black Cat Junction. Southbound diverge link road from A1 connecting to A428 westbound, and westbound merge slip on A428 connecting from existing Black Cat Junction.

Table 5-1 Black Cat Junction options generated during Stage 1

5.1.2.2 These junction options were then assessed using a Red-Amber-Green (RAG) table and the traffic analysis at the junction. Based on the outcome of this, the majority of options were discarded and three options were selected to be taken forward for 3D design. These were:

- Option 1AC – a combination of option 1a and 1c with a northern roundabout bypass between A428 eastbound and A1 northbound. This option was recommended as it accommodates all the traffic movements as well as connecting to the local road network via Bedford Road.
- Option 3B – This option was recommended due to its safety which was determined by a low number of possible collisions points.
- Option 5 – This option was recommended due to its low environmental and social impact. It is also cost effective due to low number of structures required and relatively safe due to the minimal number of collision points in comparison to other options.

5.2 Options to be assessed

5.2.1.1 The final options to be assessed in this Annex are the following and will henceforth be referred to as:

- Option A (formerly Option 1AC)
- Option B (formerly Option 5)
- Option C (formerly Option 3B)

5.3 Option A

5.3.1 Highways

5.3.1.1 Option A is shown in Figure 5-1 and drawings are included in Appendix A (drawings HE551495-JAC-HGN-BCJN-DR-CH-0001).

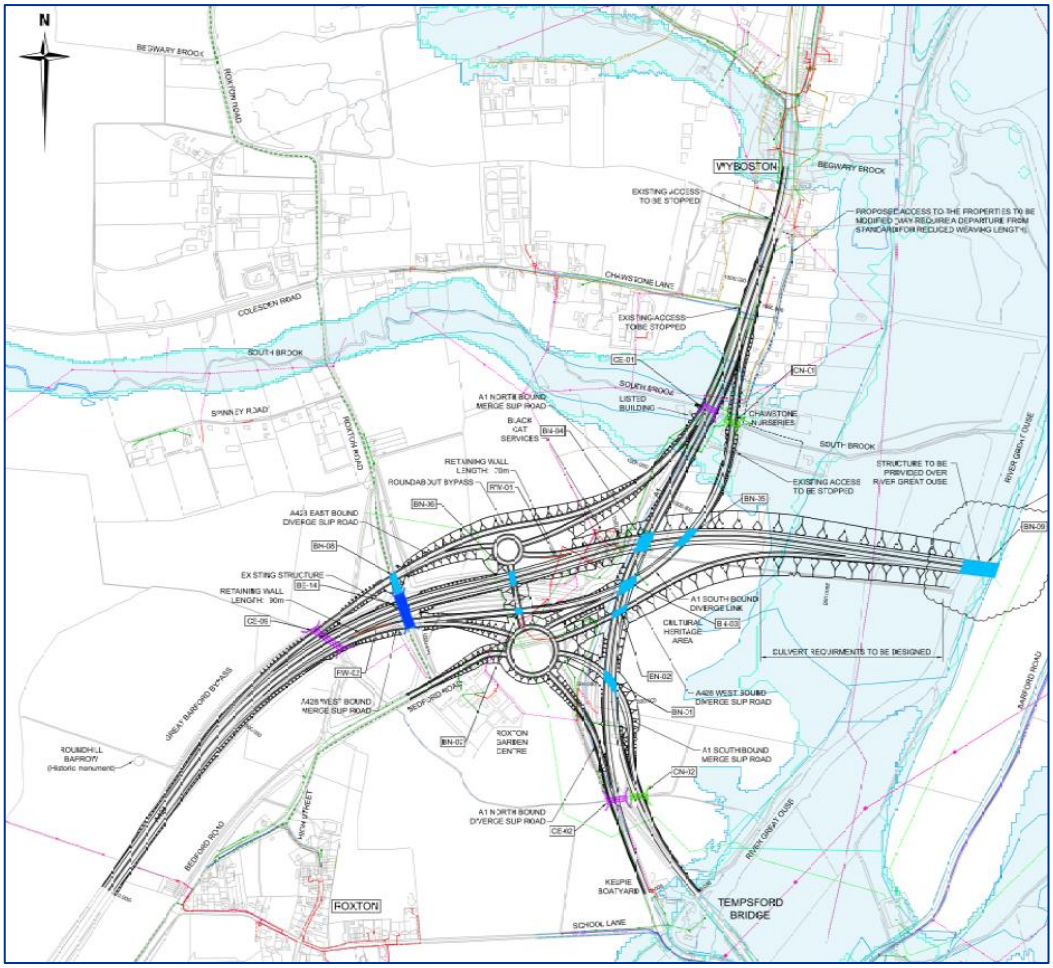

Figure 5-1 Option A General Arrangement

5.3.1.2 Option A is a three-tier grade separated junction with dumbbell roundabouts located between Roxton Road and the existing Black Cat Junction. In this option, the A1 is proposed as the lowest tier and is to be reconstructed east of the existing alignment replacing the existing Black Cat roundabout. The middle tier will be the free-flow link between the A1 southbound and the A428 westbound and the top tier will be the proposed A428.

5.3.1.3 The major traffic flows for this junction are between the A421 eastbound and A1 northbound as well as the A1 southbound and the A428 westbound. Therefore, these routes have been designed as free-flow links with 2-lane carriageways to reduce congestion.

5.3.1.4 This option provides access to all routes between the A1 and A428. It also provides a connection to the local road network via Bedford Road.

5.3.1.5 This option impacts the listed building located to the north of the junction. Accesses need to be provided to the properties severed by the realigned A1 to the north of the junction.

5.3.1.6 The design values of the connector roads in this option can be found in Table E1.1 in Appendix E.

5.3.1.7 For this option, there are two departures from standard. Both refer to insufficient near straight as per Clauses 2.34 (merges) and 2.46 (diverges) in DMRB TD22/06 Layout of Grade Separated Junctions. These departures apply to the A1 southbound merge and the A428 eastbound diverge to roundabout. The near straight values are 0m and 52m respectively. The minimum required near straight value is 75m for the A1 southbound and 70m for the A428 eastbound diverge to the roundabout.

5.3.1.8 There are no combination departures between horizontal and vertical curvatures. A full visibility assessment has not been undertaken. However at the location of bridge structures, verge widening has been applied where necessary as per the desirable minimum SSD for the applicable design speed. A more in-depth analysis of departures and relaxations from standard will be detailed in the Departures from Standard Checklist which is also submitted as a Stage 2 PCF document.

5.3.2 Structures

5.3.2.1 Option A structures are shown on drawing HE551495-JAC-SBR-BCJN-DR-S-0001 in Appendix A.

Existing Structures

5.3.2.2 As part of the option development for the A428 Black Cat Junction improvements, the feasibility of widening the existing bridges has been reviewed. Details of existing bridges are shown in Table B1.1 in Appendix B and on the structures location drawings in Appendix A.

5.3.2.3 The existing structures crossing the river namely -*Tempsford North Flood Span, Tempsford Main Span, Tempsford New South Flood and Tempsford South Flood 5 Span* will all remain unaffected as the scheme begins to the north of the River Great Ouse.

5.3.2.4 *Culvert Brookhouse Chawston (CE01),* at Ch 1230 on the A1, (north of Black Cat Junction) will need to be extended to accommodate the proposed northbound on slip road. The existing culvert is 28m long and will be extended to an overall length of approximately 40m in order to accommodate the proposed A1 northbound carriageway and on slip road.

5.3.2.5 *Black Cat Culvert (CE02),* at Ch 265 on the A1, currently carries the A1 dual carriageway which will be realigned and widened to include new slip roads leading to Black Cat Junction. The existing culvert is approximately 40m long and is long enough to accommodate the proposed re-aligned A1 northbound carriageway and the proposed off slip road.

5.3.2.6 *Culvert (CE09)* , at Ch 765 on the A428, currently carries the existing A421 which will be realigned and widened to create the proposed A428 including new slip roads on both sides. The existing culvert is approximately 114m long and is long enough to accommodate the proposed A428.

5.3.2.7 *Roxton Road Bridge (BE14)*, at Ch 975 on the A428, will be demolished and replaced by a new, longer overbridge (BN08) which will span the proposed A428 and its slip roads.

5.3.2.8 *Existing culverts CE01, CE02 and CE09* will require an inspection and assessment to check their suitability for retention in the scheme. Subject to site investigations to be undertaken at a subsequent project design stage, it is assumed that existing culverts may require extension/modification or potential upsizing subject to a climate change resilience assessment that will be undertaken at a subsequent project design stage.

Proposed Structures

5.3.2.9 *A1 southbound on-slip link overbridge (BN01)* is located at Ch 548 on the A1 southbound and at Ch 510 on the A1 northbound. It will carry the A1 southbound on-slip road over the A1 at a skew of 45^{o}. Overbridges crossing the mainline are generally preferred to have an open aspect, hence a three span overbridge is proposed with a central span of approximately 55m over the A1 and two back spans of 40m each, giving an overall length of 135m.

5.3.2.10 *A428 westbound link overbridge (BN02)* is located at Ch 665 on the A1 northbound and at Ch 710 on the A1 southbound. It will carry the A428 westbound off slip over the A1 at a skew of $35^{o.}$ For reasons described above, the bridge will have three spans. A central span of approximately 45m over the A1 and two back spans of 32m each, giving an overall length of 110m.

5.3.2.11 *A1 southbound off slip link overbridge (BN03)* is located at Ch 730 on the A1 northbound and at Ch 773 on the A1 southbound. It will carry the A1 southbound off slip over the A1 at a skew of 45°. For reasons described above, the bridge will have three spans, a central span of approximately 45m over the A1 and two back spans of 32m each giving an overall length of 110m.

5.3.2.12 *A428/ A1 link overbridge (BN04)* is located at Ch 840 on the A1 northbound and at Ch 775 on the A1 southbound. It will carry the proposed A428 over the A1 at a skew of 35°. For reasons described above, the bridge will have three spans, as central span of approximately 35m over the A1 and two back spans of 25m each, giving an overall length of 85m.

5.3.2.13 *A428 Underbridge (BN05)* is located at Ch 1660 on the A428 and will carry the A428 carriageway over the A1 southbound off slip at a skew of approximately 45°. The structure type could be either a single span (25m) bridge with full height abutments or a three span continuous bridge with an open aspect.

5.3.2.14 *Black Cat Overbridge North (BN06)* along with *BN07* will carry a north-south link over the A428 at Ch 1238 between the new Black Cat Junction roundabouts. It will cross the A428 at a skew of approximately 5°. The structure type could be a three span bridge with an open aspect. The central span would be approximately 35m with two back spans of 25m each, giving an overall length of 85m.

5.3.2.15 *Black Cat Overbridge South (BN07)* along with *BN06* will carry a north-south link between the new Black Cat Junction roundabouts over the A428 westbound on slip. It will cross the slip road at a skew of approximately 10° and could be a single span (20m) integral portal frame with full-height abutments or a three span integral structure with an open aspect.

5.3.2.16 Alternatively structures BN06 & BN07 could be combined to form a multi-span overbridge with an overall length of approximately 120m.

5.3.2.17 *Roxton Road Overbridge (BN08)* will be a multi-span structure at Ch 945 on the A428 which will replace the existing bridge (*Roxton Road BE14)*. It will cross the A428 mainline and its associated slip roads. A four span overbridge would be feasible with an overall length of 140m.

5.3.2.18 *River Great Ouse Viaduct (BN09)* will carry the A428 over the River Great Ouse at Ch 2255. The span arrangement could comprise a central span of 60m over the river and two end spans of 42m each with an overall length of 145m. The west span of the viaduct would span the flood plain surrounding the A428. Additional culverts through the A428 embankment and flood compensation storage are likely to be required to the north and east of the new Black Cat Junction on confirmation of flood plain details at a subsequent project design stage.

5.3.2.19 *Retaining wall (RW01)* will be located at Ch 1350 on the A428 to the north east of the new Black Cat Junction and will be approximately 75m long.

5.3.2.20 *Retaining Wall (RW02)* will be located at Ch 890 on the A428 to the south west of the new Black Cat Junction and will be approximately 100m long.

5.3.2.21 *Brookhouse Chawstone Culvert (CN01)* will be located at Ch 1230 on the A1, east of the existing Brookhouse Chawstone Culvert (CE01). The proposed culvert will carry the southbound off slip road and will cross South Brook at a skew of approximately 20°. The overall span will be approximately 3m and length will be 30m.

5.3.2.22 *Black Cat Culvert (CN02)* will be located at Ch 265 on the A1 and will carry the proposed A1 southbound carriageway and southbound on slip road over Rockham Ditch at a skew of approximately 16°. The proposed culvert is to the east of the existing Black Cat Culvert (CE02) and will have a span/diameter of 1.5m and length of 25m.

5.3.3 Drainage

5.3.3.1 Following the preliminary high level assessment of the surface water drainage strategy described in Section 10.11 of the Technical Appraisal Report (reference HE551495-JAC-GEN-00-REP-C-0001) for A428 Black Cat to Caxton Gibbet, the key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 5-2 below for Black Cat Junction Option A. An overall Summary Table containing the data presented for all three options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved area : 23 Ha (Existing Paved area: 5 Ha, Additional Paved area: 18 Ha)
Culvert Crossings	The total number of estimated culvert crossings for main watercourses equals five. This total consists of two potential culvert crossings (CN-01 and CN02) and three existing culvert crossings (CE-01, CE-02 and CE-09) that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The five main watercourse culvert crossing locations are illustrated on Drawing No HE551495-JAC-SBR-BCJN-DR-S-0001 in Appendix A. Details of these existing and proposed culvert crossings (e.g. diameter, length, etc.) are summarised in tabular format in Table B1.1 & B1.2 of Appendix B. All five main watercourse culvert crossings currently have insufficient cover to the proposed road levels above the existing watercourses. However, it should be noted that there is potential to raise the vertical alignment of the proposed road at these culverts locations in order to achieve minimum cover requirements. This will be investigated and confirmed through a review of the proposed highway geometry at subsequent project design stages. In addition to the five main watercourse culvert crossings, drainage culvert crossings will be required to drain the highway embankments and natural catchment runoff for the proposed junction arrangement in order to mitigate surface water flooding of the proposed road. At this preliminary assessment stage, the total number of estimated drainage culverts equals 19 including one existing culvert that can be retained. This will need to be investigated and confirmed through a review of the proposed highway geometry and embankment details at subsequent project design stages. A high level estimation of the catchment runoff, at this preliminary assessment stage, has indicated that these drainage culverts are likely to be less than 900mm in diameter and therefore are not considered to be structures. This will need to be reviewed and confirmed at subsequent project design stages.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of a potential viaduct structure at the River Great Ouse (BN-09) which is illustrated on Drawing No HE551495-JAC-SBR-BCJN-DR-S-0001 in Appendix A. Details of this potential viaduct structure are summarised in tabular format in Table B1.2 in Appendix B. The existing Tempsford bridge structures crossing the River Great Ouse are not affected by this option.
Highway Drainage Outfalls	Total number of potential outfall locations equals 11. All outfalls will be discharging to nearby watercourses with the possibility for two outfall locations to potentially to discharge to the existing surface water drainage system serving the Black Cat Junction. The number of potential outfall locations is subject to review in subsequent project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at four outfall locations for this Black Cat Junction option. A pumped discharged solution will be required at seven outfall locations. This

	would add significantly to the capital and operational costs for this Option. However, it should be noted that there is a potential to raise the vertical alignment of the proposed road at three outfall locations that will facilitate the gravity discharge of the proposed highway drainage to the nearest watercourse and eliminate the need for a pumped discharge solution at these outfall locations. This will be investigated and confirmed through a review of the proposed highway geometry at subsequent project design stages.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range from 16,000 m^3 to 21,000 m^3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground).
Other Drainage Issues	Six outfalls and their associated attenuation storage are potentially affected by watercourse floodplains for this option. The attenuation storage for five outfall locations will need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage. However online storage by means of oversized pipes will need to be provided at one outfall location due to spatial constraints and the outfall being located in the floodplain of a nearby watercourse. Certain sections of the proposed junction arrangement will require cut-off ditches to collect, convey and discharge external natural catchment runoff to a nearby watercourse in order to mitigate the surface water flooding of the road. This could require large cut-off ditches to convey the contributing flows where the road is in cutting. This transfer of surface water to the adjacent catchments is assumed to have no significant impact to the downstream flood risk, however, this would need to be reviewed in subsequent project design stages.

Table 5-2 Black Cat Junction Option A Preliminary Assessment Surface Water Drainage Details

5.4 Option B

5.4.1 Highways

5.4.1.1 Option B is shown in Figure 5-2 and drawings shown in Appendix A (drawings HE551495-JAC-HGN-BCJN-DR-CH-0002).

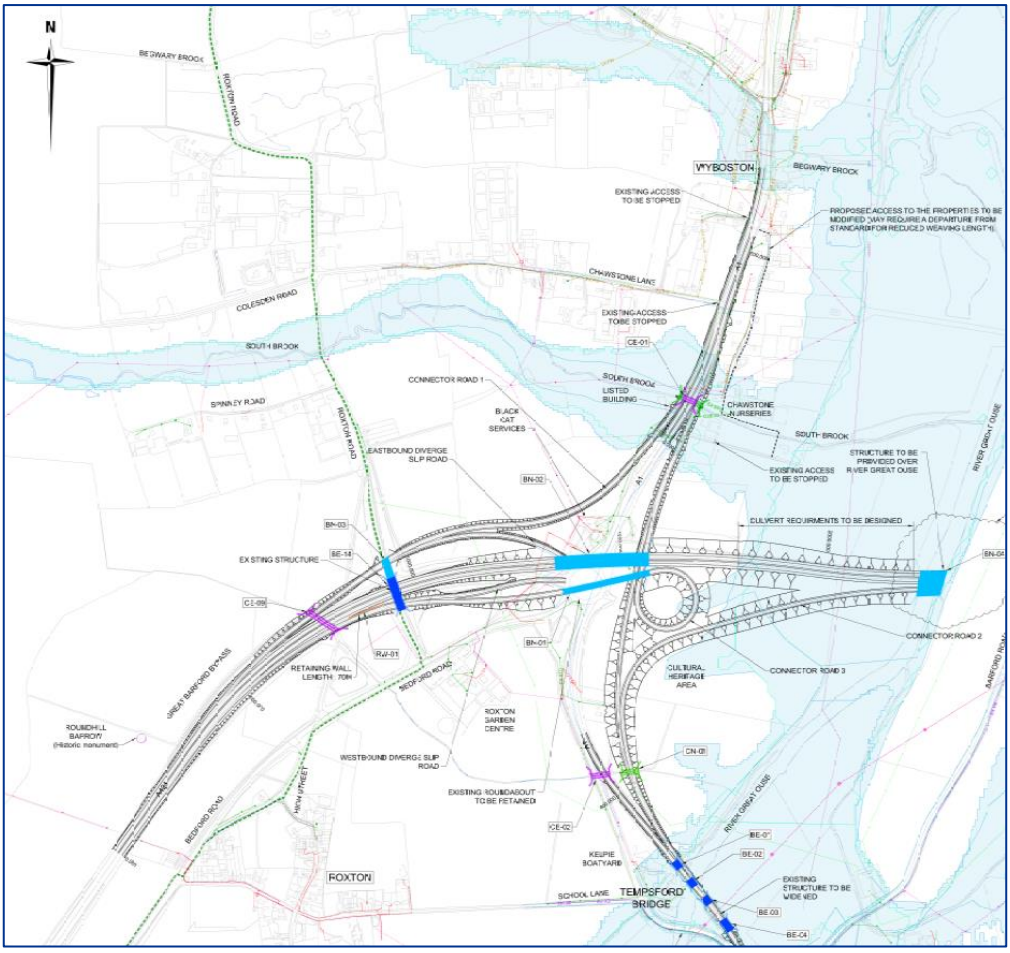

Figure 5-2 Option B General Arrangement

5.4.1.2 Option B involves constructing three main connector roads between the A428 and the A1 based on the most significant traffic flows. These are detailed in the list below.

- A link between the A428 eastbound and the A1 northbound via a one-directional connector road west of the intersection of the A1 and A428 (Connector road 1).
- A link between the A428 westbound and the A1 southbound (Connector road 2).
- A link between the A1 southbound and A428 Westbound (Connector road 3).

5.4.1.3 In order to provide a free-flow route along the A1 southbound, a link has also been designed to bypass the retained roundabout.

5.4.1.4 The existing roundabout is retained and is linked to the A428 via two slip roads that diverge and merge with Connector road 1 and Connector road 3 respectively. The existing A1 is to be retained; however Connector road 2 will act as a bypass of the roundabout.

5.4.1.5 The local road network access to the A428 and A1 is retained via the roundabout connection to Bedford Road.

5.4.1.6 This option does not provide a link between the A1 southbound and A428 Eastbound as this was deemed to have a very low traffic flow. Furthermore, there is no link between the A1 northbound and the A428 eastbound. In this case it is expected traffic will join the A428 via the junction at Wyboston.

5.4.1.7 This option impacts the listed building located to the north of the junction. Accesses need to be provided to the properties severed by the A1 southbound link to the north of the junction.

5.4.1.8 The design values of the connector roads in this option can be found in Table E2.1 in Appendix E.

5.4.1.9 There are no combination departures between horizontal and vertical curvatures. A full visibility assessment has not been undertaken. However at the location of bridge structures, verge widening has been applied where necessary as per the desirable minimum SSD for the applicable design speed. A more in-depth analysis of departures and relaxations from standard will be detailed in the Departures from Standard Checklist which is also submitted as a Stage 2 PCF document.

5.4.2 Structures

5.4.2.1 Option B structures are shown on drawing HE551495-JAC-SBR-BCJN-DR-S-0002 in Appendix A.

Existing Structures

5.4.2.2 As part of the options development for the A428 Black Cat Junction improvements, the feasibility of widening the existing bridges has been reviewed. Details of existing bridges are shown in Table B2.1 in Appendix B and on the structures location drawings in Appendix A.

5.4.2.3 As a part of scheme, the southbound carriageway of the existing A1 will be realigned with the addition of a slip road alongside. To the south of Black Cat Junction, at the location of the proposed widening, there are four existing structures which carry the A1 over the River Great Ouse . These are - Tempsford North Flood Span (BE01) at Ch 260 , Tempsford Main Span (BE02) at Ch 210 , Tempsford New South Flood Span (BE03) at Ch 130 and Tempsford South Flood 5 Span (BE04) at Ch 70 . All are approximately 12m wide between parapets and will need to be widened to approximately 16m to 24m to accommodate the new southbound A1 and its slip road.

5.4.2.4 *Culvert Brookhouse Chawston (CE01)*, at Ch 115 on the A1 (north of Black Cat Junction), will need to be extended on either sides to accommodate the proposed northbound on slip road and southbound off slip road. The existing culvert is 28m long and will be extended to an overall length of approximately 60m.

5.4.2.5 *Black Cat Culvert (CE02)*, at Ch 530 on the A1, currently carries the A1 dual carriageway which will be realigned and widened to include new slip roads leading to Black Cat Junction. The existing culvert is approximately 40m long and is long enough to accommodate the proposed A1 main carriageway.

5.4.2.6 *Culvert (CE09)*, at Ch 750 on the A428, currently carries the existing A421 which will be realigned and widened to create the proposed A428 including new slip roads on both sides. The existing culvert is approximately 114m long and is long enough to accommodate the proposed A428.

5.4.2.7 *Roxton Road Bridge (BE14)*, at Ch 945 on the A428, will be demolished and replaced by a new, longer overbridge (BN03) which will span the proposed A428 and its slip roads.

5.4.2.8 *Existing bridges (BE01, BE02, BE03 and BE04)* and existing culverts *(CE01, CE02 and CE09)* will require assessment to check their suitability for retention in the scheme. Subject to site investigations to be undertaken at a subsequent project design stage, it is assumed that existing culverts may require extension/modification or potential upsizing subject to a climate change resilience assessment that will be undertaken at a subsequent project design stage.

Proposed Structures

5.4.2.9 *A1/A428 Viaduct (BN01)* will be located at Ch 970 on the A1 slip road. It will carry the A428 westbound slip road over the existing Black Cat Junction and the new A1 southbound slip road. The structure will be a five span viaduct with an overall length of approximately 225m. The viaduct will cross Black Cat Junction at 10 ^{o} skew and the A1 slip road at 25 ^{o} skew. The viaduct will be supported on end abutments and on discrete columns or leaf piers at intermediate supports.

5.4.2.10 *Black Cat viaduct (BN02)* will be located at Ch 1470 on the A428. It will carry the new A428 carriageway over the existing Black Cat Junction roundabout and the A1. The structure will be a five span viaduct with an overall length of approximately 260m.

5.4.2.11 *Roxton Road Overbridge (BN03)*, at Ch 945 on the A428, will be similar to BN08 proposed in Option A.

5.4.2.12 *River Great Ouse Viaduct (BN04)*, at Ch 2350 on the A428, will be similar to BN09 proposed in Option A. Additional culverts through the A428 embankment are likely to be required to the north and east of the new Black Cat Junction on confirmation of flood plain details .

5.4.2.13 *Retaining wall (RW01)* will be located at Ch 870 on the A428 along the A428 westbound off slip road immediately to the south of BN03 and will be approximately 100m long.

5.4.2.14 *Black Cat Culvert (CN01)* will be located at Ch 265 on the A1 and will carry the proposed southbound on slip roads over Rockham Ditch at a skew of approximately 16 ^{o}. The proposed culvert is to the east of the existing Black Cat Culvert (CE02) and will have a span/diameter of 1.5m and length of 40m.

5.4.3 Drainage

5.4.3.1 Following the preliminary high level assessment of the surface water drainage strategy described in Section 10.11 of the Technical Appraisal Report (reference HE551495-JAC-GEN-00-REP-C-0001) for A428 Black Cat to Caxton Gibbet, the key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 5-3 below for Black Cat Junction Option B. An overall Summary Table containing the data presented for all three options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved area : 19 Ha (Existing Paved area: 4 Ha, Additional Paved area: 15 Ha)
Culvert Crossings	The total number of estimated culvert crossings for main watercourses equals four. This total consists of one potential culvert crossing (CN-01) and three existing culvert crossings (CE-01, CE-02 and CE-09) that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The four main watercourse culvert crossing locations are illustrated on Drawing No HE551495-JAC-SBR-BCJN-DR-S-0002 in Appendix A. Details of these existing and proposed culvert crossings (e.g. diameter, length, etc.) are summarised in tabular format in Table B2.1 & B2.2 of Appendix B. Three main watercourse culvert crossings currently have insufficient cover to the proposed road levels above the existing watercourses. However, it should be noted that there is potential to raise the vertical alignment of the proposed road at these culverts locations in order to achieve minimum cover requirements. This will be investigated and confirmed through a review of the proposed highway geometry at subsequent project design stages. In addition to the four main watercourse culvert crossings, drainage culvert crossings will be required to drain the highway embankments and natural catchment runoff at the proposed junction arrangement in order to mitigate surface water flooding of the proposed road. At this preliminary assessment stage, the total number of estimated drainage culverts equals 12 including two existing culverts that can be retained. This will need to be investigated and confirmed through a review of the proposed highway geometry and embankment details at subsequent project design stages. A high level estimation of the catchment runoff, at this preliminary assessment stage, has indicated that these drainage culverts are likely to be less than 900mm in diameter and therefore are not considered to be structures. This would need to be reviewed

	and confirmed at subsequent project design stages.
Main River Crossings	Total number of estimated Main River crossings equals five. This consists of a potential viaduct structure at the River Great Ouse (BN-04) and four existing Temsford bridge structures (BE-01, BE-02, BE-03 and BE-04) that will need to be widened to accommodate new southbound A1 and its slip road. Five bridge structures crossings are illustrated on Drawing No HE551495-JAC-SBR-BCJN-DR-S-0002 in Appendix A and their details are summarised in tabular format in Table B2.1 & B2.2 in Appendix B.
Highway Drainage Outfalls	Total number of potential outfall locations equals 11. This total consists of 10 outfalls discharging to nearby watercourses and one outfall discharging to the existing surface water drainage system serving the Black Cat roundabout. There is a possibility for a further two outfall locations to potentially discharge to the existing surface water drainage system serving the Black Cat roundabout. The number of potential outfall locations is subject to review in subsequent project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at all outfalls except for three outfall locations for this Black Cat Junction option. A pumped discharged solution will be required at these three outfall locations. This would add to the capital and operational costs for this Option. However, it should be noted that there will be a possibility to eliminate the need for a pumped discharge solution at one outfall location by combining outfalls. This will be investigated and confirmed through a review of the proposed highway geometry and outfall arrangements at subsequent project design stages.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range from 14,000 m^3 to 17,000 m^3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground).
Other Drainage Issues	Five outfalls and their associated attenuation storage are potentially affected by watercourse floodplains for this option. The attenuation storage for three outfall locations will need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage. However online storage by means of oversized pipes will need to be provided at two outfall locations due to spatial constraints and the outfall being located in the floodplain of a nearby watercourse. Certain sections of the proposed junction arrangement will require cut-off ditches to collect, convey and discharge external natural catchment runoff to a nearby watercourse in order to mitigate the surface water flooding of the road. This could require large cut-off ditches to convey the contributing flows where the road is in cutting. This transfer of surface water to the adjacent catchments is assumed to have no significant impact to the downstream flood risk, however, this would need to be reviewed in subsequent project design stages.

Table 5-3 Black Cat Junction Option B Preliminary Assessment Surface Water Drainage Details

5.5 Option C

5.5.1 Option Layout

5.5.1.1 Option B is shown in Figure 5-3 and drawings shown in Appendix A (drawings HE551495-JAC-HGN-BCJN-DR-CH-0003).

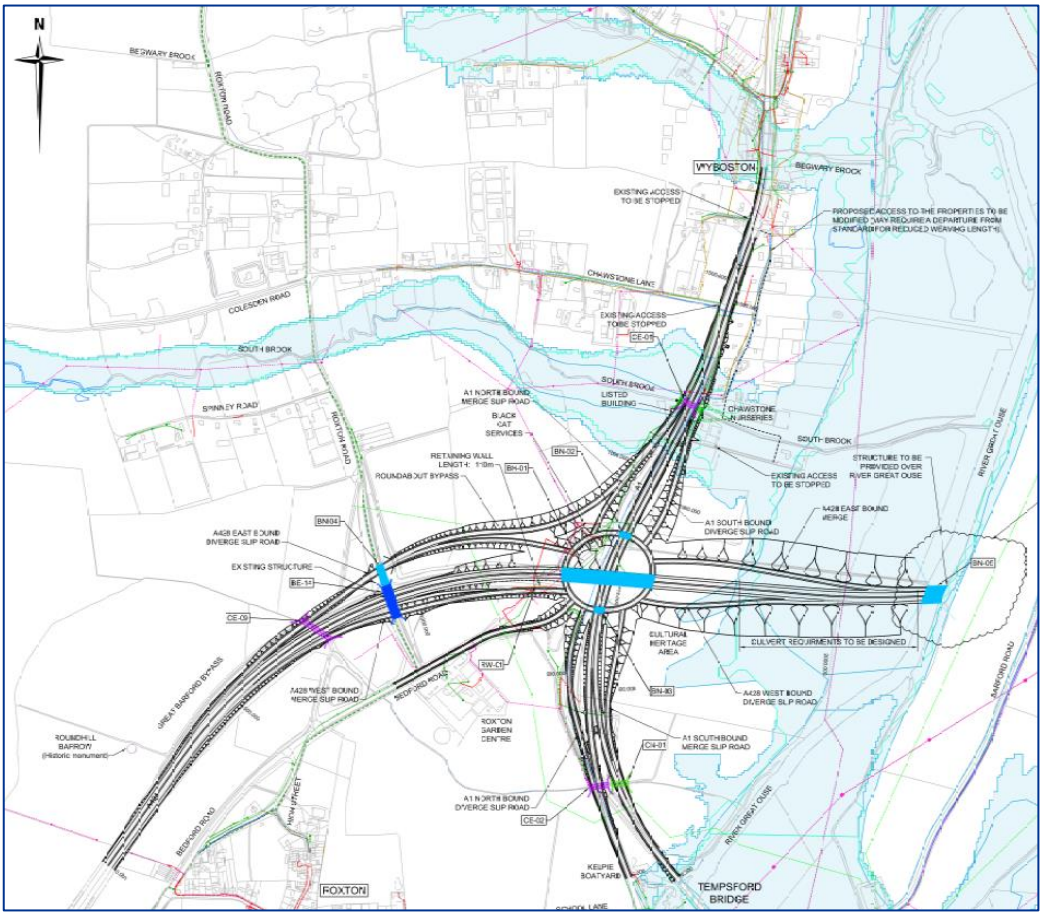

Figure 5-3 Option C General Arrangement

5.5.1.2 Option C involves constructing a three-tier grade separated roundabout. The A1 is the lowest tier at approximately ground level or just below throughout the length of the junction. The roundabout is the tier above that and the A428 is third tier and runs above the roundabout.

5.5.1.3 The radius of the roundabout varies from a 90m to 120m radius. This was required in order to accommodate all eight connector roads as well as connection to the existing highway network via Bedford Road. Merge and diverge slip roads from the A428 westbound and eastbound will connect to the roundabout along with the merge and diverge connector roads from the A1 northbound and southbound.

5.5.1.4 As the major traffic flow is between the A428 eastbound and A1 northbound, a free flow link to bypass the roundabout has been designed. This connector road has also been designed with a 2-lane carriageway in order to reduce congestion.

5.5.1.5 This option impacts the listed building located to the north of the junction. Accesses need to be provided to the properties severed by the realigned A1 to the north of the junction.

5.5.1.6 The design values of the connector roads in this option can be found in Table E3.1 in Appendix E.

5.5.1.7 For this option, there is one departure from standard. It relates to insufficient merge near straight as per Clauses 2.34 in DMRB TD22/06 Layout of Grade Separated Junctions. This departure applies to the A1 southbound merge. The near straight value is 0m and the minimum required near straight value is 75m for the A1 southbound.

5.5.1.8 There are no combination departures between horizontal and vertical curvatures. A full visibility assessment has not been undertaken. However at the location of bridge structures, verge widening has been applied where necessary as per the desirable minimum SSD for the applicable design speed. A more in-depth analysis of departures and relaxations from standard will be detailed in the Departures from Standard Checklist which is also submitted as a Stage 2 PCF document.

5.5.2 Structures

5.5.2.1 Option C structures are shown on drawing HE551495-JAC-SBR-BCJN-DR-S-0003 in Appendix A

Existing Structures

5.5.2.2 As part of the option development for the A428 Black Cat Junction improvements, the feasibility of widening the existing bridges has been reviewed. Details of existing bridges are shown in Table B3.1 in Appendix B and on the structures location drawings in Appendix A.

5.5.2.3 *Culvert Brookhouse Chawston (CE01)*, at Ch 1235 on the A1 (north of Black Cat Junction), will need to be extended to accommodate the proposed northbound on slip road and southbound off slip road. The existing culvert is 28m long and will be extended to an overall length of approximately 60m.

5.5.2.4 *Black Cat Culvert (CE02)*, at Ch 265 on the A1, currently carries the A1 dual carriageway which will be realigned and widened to include new slip roads leading to Black Cat Junction. The existing culvert is approximately 40m long and is long enough to accommodate the proposed re-aligned A1 northbound carriageway and the new off slip road.

5.5.2.5 *Culvert (CE09)*, at Ch 740 on the A428, currently carries the existing A421 which will be realigned and widened to create the proposed A428 including new slip roads on both sides. The existing culvert is approximately 114m long and is long enough to accommodate the proposed A428.

5.5.2.6 *Roxton Road Bridge (BE14)*, at Ch 930 on the A428, will be demolished and replaced by a new, longer overbridge (BN04) which will span the proposed A428 and its slip roads.

5.5.2.7 *Existing culverts CE01, CE02 and CE09* will require assessment to check their suitability for retention in the scheme. Subject to site investigations to be undertaken at a subsequent project design stage, it is assumed that existing culverts may require extension/modification or potential upsizing subject to a climate change resilience assessment that will be undertaken at a subsequent project design stage.

Proposed Structures

5.5.2.8 *A428/Black Cat viaduct (BN01)* will be located at Ch 1470 on the A428. It will carry the new A428 carriageway over the proposed Black Cat Junction roundabout and the A1. It will be located on the top level of the proposed three tier grade separated junction. The structure will be a five span viaduct with an overall length of approximately 230m.

5.5.2.9 *Black Cat Overbridge North (BN02)* will be located at Ch 885 on the A1 to the north of the Black cat roundabout. It will be located on the middle level of the proposed 3 tier grade separated junction over the A1. It will comprise of three spans with an open aspect, a central span approximately 30m over the A1 and two end spans of approximately 21m.

5.5.2.10 *Black Cat Overbridge South (BN03)* will be located at Ch 700 on the A1 to the south of the Black Cat roundabout. It will be located on the middle level of the proposed 3 tier grade separated junction over the new A1. The form of structure will be similar to that of BN02.

5.5.2.11 *Roxton Road Overbridge (BN04),* at Ch 945 on the A428, will be similar to BN08 proposed in Option A.

5.5.2.12 *River Great Ouse Viaduct (BN05),* at Ch 2250 on the A428, will be similar to BN09 proposed in Option A. Additional culverts through the A428 embankment are likely to be required to the north and east of the new Black Cat Junction on confirmation of flood plain details .

5.5.2.13 *Retaining wall (RW01)* will be located at Ch 1300 on the A428 along the A428 westbound on slip road and will be approximately 110m long.

5.5.2.14 *Black Cat Culvert (CN01)* will be located at Ch 265 on the A1 and will carry the proposed A1 southbound carriageway and southbound on slip road over Rockham Ditch at a skew of approximately 16 o. The proposed culvert is to the east of the existing Black Cat Culvert (CE02) with a span/diameter of 1.5m and length of 40m.

5.5.3 Drainage

5.5.3.1 Following the preliminary high level assessment of the surface water drainage strategy described in Section 10.11 of the Technical Appraisal Report (reference HE551495-JAC-GEN-00-REP-C-0001) for A428 Black Cat to Caxton Gibbet, the key drainage details for existing/potential culvert crossings, potential outfall locations, attenuation storage estimates and potential drainage issues are presented in Table 5-4 below for Black Cat Junction Option C. An overall Summary Table containing the data presented for all three options is presented in Appendix C for comparison purposes.

Item	Comment
Paved Area	Approximate Total Paved area : 21 Ha (Existing Paved area: 6 Ha, Additional Paved area: 15 Ha)
Culvert Crossings	The total number of estimated culvert crossings for main watercourses equals four. This total consists of one potential culvert crossing (CN-01) and three existing culvert crossings (CE-01, CE02 and CE-09) that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken in future project design phases. The four main watercourse culvert crossing locations are illustrated on Drawing No HE551495-JAC-SBR-BCJN-DR-S-0003 in Appendix A. Details of these existing and proposed culvert crossings (e.g. diameter, length, etc.) are summarised in tabular format in Table B3.1 & B3.2 of Appendix B. Three culvert crossings will have insufficient cover to the proposed road level above the existing watercourses. However, it should be noted that there is potential to raise the vertical alignment of the proposed road at these culverts locations in order to achieve minimum cover requirements. This will be investigated and confirmed through review of proposed highway geometry at subsequent project design stages. In addition to the four main watercourse culvert crossings, drainage culvert crossings will be required to drain the highway embankments and natural catchment runoff at the proposed junction in order to mitigate surface water flooding of the road. At this preliminary assessment stage, the total number of estimated drainage culverts equals 15 including two existing culverts that can be retained. This will need to be investigated and confirmed through a review of the proposed highway geometry and embankment details at subsequent project design stages. A high level estimation of the catchment runoff, at this preliminary assessment stage, has indicated that these drainage culverts are likely to be less than 900mm in diameter and therefore are not considered to be structures. This will need to be reviewed and confirmed at

	subsequent project design stages.
Main River Crossings	Total number of estimated Main River crossings equals one. This consists of potential viaduct structure at the River Great Ouse (BN-05) which is illustrated on Drawing No HE551495-JAC-SBR-BCJN-DR-S-0003 in Appendix A. Details of this potential viaduct structure are summarized in tabular format in Table B3.2 in Appendix B. The existing Tempsford bridge structures crossing the River Great Ouse are not affected by this option.
Highway Drainage Outfalls	Total number of potential outfall locations equals 11. All outfalls will be discharging to nearby watercourses with the possibility for two outfall locations to potentially discharge to the existing surface water drainage system serving the Black Cat roundabout. The number of potential outfall locations is subject to review in subsequent project design stages and could vary depending on the existing surface water drainage arrangement and/or due to potential changes in the proposed highway geometry. Gravity discharge will be achieved at three outfall locations for this Black Cat Junction Option. A pumped discharged solution will be required at eight outfall locations. This would add significantly to the capital and operational costs for this option. However, it should be noted that there is a potential to raise the vertical alignment of the proposed road at four outfall locations that will facilitate the gravity discharge of the proposed highway drainage to the nearest watercourse and eliminate the need for a pumped discharge solution at these outfall locations. This will be investigated and confirmed through review of proposed highway geometry at subsequent project design stages. There will also be a possibility to eliminate the need for a pumped discharge solution at one outfall location through combined outfalls. This will be investigated and confirmed through a review of the proposed highway geometry and outfall arrangements at subsequent project design stages.
Total Estimated Attenuation Storage Volumes	Preliminary estimates of attenuation storage volumes range from 15,000 m^3 to 19,000 m^3. At this preliminary stage it is assumed that attenuation ponds will be used. However, ground investigation will be required in subsequent project design stages to inform the viability of other discharge methods (e.g. infiltration to ground).
Other Drainage Issues	Five outfalls and their associated attenuation storage are potentially affected by watercourse floodplains for this option. The attenuation storage for four outfall locations will need to be located outside the floodplain to ensure effective operation in flood conditions and avoid the requirement for flood compensation storage. However online storage by means of oversized pipes will need to be provided at one outfall location due to spatial constraints and the outfall being located in the floodplain of a nearby watercourse. Certain sections of the proposed junction arrangement will require cut-off ditches to collect, convey and discharge external natural catchment runoff to a nearby watercourse in order to mitigate the surface water flooding of the road. This could require large cut-off ditches to convey the contributing flows where the road is in cutting. This transfer of surface water to the adjacent catchments is assumed to have no significant impact to the downstream flood risk, however, this would need to be reviewed in subsequent project design stages.

Table 5-4 Black Cat Junction Option C Preliminary Assessment Surface Water Drainage Details

5.6 Technology

5.6.1.1 For all options the locations of any technology will need to be considered together with maintenance access.

5.6.1.2 The level of technology will be dependent on the operating regime. If an Expressway is delivered, it is expected that a high level of signing and signalling will be required. Despite the variations in the layouts, the equipment required for each option is likely to be similar, as it will be dependent on the approaches to the junctions.

5.6.2 Operational Assessment

5.6.2.1 For all options, access to the properties to the north of the junction on the A1 needs to be defined before the operational impact of any weaving can be determined.

5.6.2.2 The impact on egress from the services to the south of Begwary Brook is to be considered, as is signing from the egress to destinations.

5.6.3 Option B

5.6.3.1 This option offers no access to the eastbound A428 from the A1 in either direction and no access to the A1 north from the A428. These movements will be undertaken using the existing junction at Wyboston, requiring significant traffic volumes to remain on the existing, single carriageway section of the A428. This is likely to result in lower safety benefits compared to the other options.

5.6.3.2 Access to the existing roundabout from the A421 eastbound for movements onto A1 southbound or Bedford Rd will require vehicles to undertake an offside diverge. This would be an unusual feature which is likely to cause some operational issues and may not be approved by PTS.

5.6.3.3 Southbound traffic on A1 will either have to go around existing roundabout or diverge near Chawstone Nurseries to use the new link road before merging back in at Tempsford Bridge. These increased manoeuvres for mainline traffic may result in some operational issues by causing congestion seedpoints and will provide lower safety benefits compared to other options.

5.7 Street Lighting

5.7.1.1 In order to achieve compliance with TD34/07 ‘Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Networks’, Expressways Technical Note, CIE 115/2010 ‘Lighting of roads for motor and pedestrian traffic’, TD 22/06 ‘Layout of Grade Separated Junctions’ and for safety and operational reasons, it is recommended that the proposed Black Cat Junction (shown on General Arrangement Options 1, 2 and 3) shall be lit with the following recommended lighting extents:

- The junctions’ on/off-line elements connecting to unlit sections shall extend for a distance long enough to include:
  - (a) The 5 seconds of driving at the expected traffic speed of 70mph i.e. 156m from the top of the slip roads;
  - (b) The peak traffic queuing distance on the approach to a give way or stop line;
  - (c) The distance required to illuminate any bend at the end of an exit slip road or the beginning of an entry slip road;
- The junctions’ on/off-line elements connecting to lit sections shall be fully lit and lighting extended to tie-in with the lit sections.
- Gaps of less than four times the stopping sight distance between lit sections are to be lit in accordance with the requirements of TD34/07 C.3.19;

5.7.1.2 Where lighting is being provided, it is recommended to install efficient full cut-off lighting technology such as Light emitting Diodes (LEDs) being dynamically controlled according to traffic flows by Highways England's Central management System (CMS) and Motorway Road Lighting Control System (MoRLiCS) to reduce the lighting levels where the traffic flow is low in off-peak hours to provide the right amount of light in the right place and at the right time to have a healthier, safer and greener network.

5.7.1.3 Embracing the above technology will achieve at least 50% in energy and carbon emission savings and at least 50% in maintenance savings for Highways England.

5.7.1.4 Reliability of the above proposed technology ensures fewer failures hence reduced ad-hoc maintenance visits hence reducing the need for night scouting.

5.7.1.5 The CMS can monitor the performance of the lighting assets to:

- Allow for repair and maintenance of the road lighting before failures occur, by providing early indication of the incorrect operation prior to complete failure.
- Dynamically report defect information from the lighting assets to facilitate faster response to defects with Highways England's lighting stock.
- Ensure road lighting degradation over time is factored into the operating profiles, to ensure consistency of road lighting levels over the lifetime of the road lighting installation.
- Monitor and report on Highways England's actual energy usage for road lighting to evidence England's carbon reduction commitments, and give complete control of energy spend against the backdrop of continued increases in energy costs.
- Control the levels of lighting to achieve the optimum balance between road safety and the impact of road lighting on the environment by reducing light pollution.

5.8 Traffic Analysis

5.8.1.1 Due to the traffic model not being complete at the time of submission for SGAR 1, this section cannot be completed and therefore is left intentionally blank. A briefing note has been produced (reference HE551495-JAC-GEN-00-REP-C-0001) which describes the progress to date.

6. Economic Assessment

6.1.1.1 Due to the traffic model not being complete at the time of submission for SGAR 1, this section cannot be completed and therefore is left intentionally blank. A briefing note has been produced (reference HE551495-JAC-GEN-00-REP-C-0002) which describes the progress to date.

7. Safety Assessment

7.1 Strategic Safety Action Plan

7.1.1 Impact on the Road Users

7.1.1.1 The three option proposals have been considered and reviewed in the context of the overall scheme objectives, including safety. For the Black Cat Junction element of the scheme, these indicate that the 'Scheme improves road user safety at the A421 / A1 Black Cat Junction'.

7.1.1.2 This overall scheme objective is based on the existing Highways England's Key Performance Indicator, that the level of killed and serious (KSI) injured casualties be decreased by at least 40% by the end of the year 2020, based on the 2005 – 2009 baseline. Additionally, Highways England's aspiration is for no-one to be hurt whilst using or working on the strategic road network. The Roads Investment Strategy contains an aspiration for zero KSIs by the year 2040. It should be noted that detailed safety objectives would be developed at PCF stage 2, as part of the PCF Safety Plan.

7.1.1.3 The road user safety assessment of each option has been undertaken based on the following parameters:-

- Likely impact on KSI performance of the route (based on fatal weighted index (FWI). FWI considers collisions in the rough proportions which they occur in national statistics. 1 fatal = 1; 1 serious = 0.1; 1 slight = 0.01).
- Compliance with Expressway characteristics, and achievement of Expressway safety objectives.
- Initial assessment of departures from standards.
- Potential effect on individual road users groups, including non-motorised users (NMU).

7.1.1.4 The existing safety performance of A1/A421 Black Cat Junction, the A1 and A421 approach and exit arms, and the lengths of Bedford Road and Roxton Road affected are summarised as follows:-

- The annual collision rate for the junctions and area assessed is 6 collisions per annum, of which 18% (one per annum) is serious, the remainder being slight injury.
- The casualty rate is 1.42 per collision.
- The majority of collisions are junction related (for instance, nose to tail shunts and failure to give way).
- The total FWI for the area for the five year period was 0.92 (0.18 per annum).
- No road users are disproportionately adversely represented in the statistics.
- The existing NMU environment at the junction involves users crossing the A421 arms of the junction, and although traffic from the entry arm from A421 is signalised, the egress arm is not, and there are no pedestrian signals.

7.1.2 Impact on Road Workers

7.1.2.1 This assessment covers the impact on road workers during the operation and maintenance of the junction after its commissioning. Highways England has an overall objective that no-one should be harmed whilst using or working on the strategic road network. This builds on Highways Agency's Policy of Aiming for Zero for road workers, which has resulted in a number of initiatives such as eliminating crossing of live carriageways by the end of 2016.

7.1.2.2 There will be no specific numerical safety objective set for road workers. This risk will be managed in accordance with the requirements of the Health and Safety at Work Act to be reduced So Far As Is Reasonably Practicable (SFAIRP). This is a legal requirement.

7.1.2.3 The introduction of Expressway roads would reduce risk for road workers in a number of ways. These include the use of concrete barriers, which reduce the level of maintenance and replacement works required, thus reducing exposure to risk, introducing combined emergency and maintenance bays and technology, all of which can improve protection of road workers and facilitate safer maintenance of additional technology assets, and introduction of a five year non-maintenance period after handover of a scheme for operation. Each option has been assessed to consider the impact on road worker safety. Road workers include traffic officers and supply chain workers.

7.2 Option Assessment (Road User and Road Worker Safety)

7.2.1.1 Each of the options is assessed below and a summary of the safety performance of the options is provided in a table at the end of the section.

7.2.1 Option A

7.2.1.1 The option introduces three level grade-separation (A1 and A428 passing through at separate levels), free-flow link roads for A1 to A421 and vice versa, and a dumbbell roundabout to cater for all other movements at the junction. There are several non-standard features proposed which would require departures – these involve offside merges with free-flow link roads. The level of safety risk introduced is considered unacceptable and it is thought the departures would not be accepted, requiring re-design of the merges. This has resulted in the assessment level. Additionally, the geometry of the link from the roundabout to A1 south appears tight and may result in potential vehicle loss of control. The proximity and volumes of arms on the roundabouts along with the proximity of the southern roundabout to the access to Roxton Nurseries, would appear to introduce additional safety risk.

7.2.1.2 It is considered that, owing to the additional lengths of route, the additional merges and diverges introducing new conflict points, and the likely increase in traffic speeds the overall levels of collisions, and particularly KSI collisions. The increase in risk may be partially offset by the increase in traffic flow to design year.

7.2.1.3 Road worker safety on the main routes through the junction would be improved significantly over the existing route by the provision of a range of measures, including concrete barrier, fixed taper points and combined emergency/maintenance bays. These would reduce maintenance interventions and exposure to risk, or ensure they are designed to maximise safety of road workers and road users. However, the potential complexity of the maintenance requirements for the free-flow links and other elements (including structures) would require carefully considered maintenance access and regimes.

7.2.2 Option B

7.2.2.1 The option introduces two level grade-separation (A428 passing through at a separate level), a free-flow link road for A421 to A1 north, and a grade separated loop for A1 north to A421 traffic. A free-flow link road would be provided for A1 north to south, and for A428 east to A1 south. The existing roundabout would cater for all other movements at the junction. There are several non-standard features proposed which would require departures – these involve offside merges with free-flow link roads. The level of safety risk introduced is considered unacceptable and it is thought the departures would not be tenable, requiring re-design of the merges. This has resulted in the assessment level.

7.2.2.2 The use of a loop is considered to increase the risk of HGVs overturning, and the risk of serious injury to motor cyclists.

7.2.2.3 It is considered that, owing to the additional lengths of route, the additional merges and diverges, and the likely increase in traffic speeds may increase the overall levels of collisions, and particularly KSI collisions. The increase in risk may be partially offset by the increase in traffic flow to design year.

7.2.2.4 This option does not cater for the movement from A1 north to A428 west. Although traffic data suggests this is a relatively small flow, it should be noted that if A14 is closed, this manoeuvre could be subject to significant traffic flow, which would use the existing A428 single carriageway route between A1 Wyboston and A428 Caxton Gibbett, which may increase road user and road worker safety risk there, as well as reducing network resilience (see Maintenance and Repair Strategy). For this reason, the assessment for road worker safety has been shown with a less favourable score than the other options.

7.2.2.5 Road worker safety on the main routes through the junction would be improved significantly over the existing route by the provision of a range of measures, including concrete barrier, fixed taper points and combined emergency/maintenance bays. These would reduce maintenance interventions and exposure to risk, or ensure they are designed to maximise safety of road workers and road users. However, the potential complexity of the maintenance requirements for the free-flow links and other elements (including structures) would require carefully considered maintenance access and regimes.

7.2.3 Option C

7.2.3.1 The option introduces three level grade-separation (A1 and A428 passing through at separate levels), a free-flow link roads for A421 to A1 north, an increased roundabout ICD to cater for all other movements at the junction, and longer slip roads. There are several non-standard features proposed which would require departures – these involve offside diverges and merges with free-flow link roads. The level of safety risk introduced is considered unacceptable and it is thought the departures would not be accepted, requiring re-design of the merges. This has resulted in the assessment level.

7.2.3.2 It is considered that, owing to the additional lengths of route, the additional merges and diverges, and the likely increase in traffic speeds may increase the overall levels of collisions, and particularly KSI collisions. The increase in risk may be partially offset by the increase in traffic flow to design year. In this option, the requirement for A1 north to A421 traffic to travel through the roundabout would result in additional usage compared with Option A, resulting in additional conflicts (although reduced compared with the existing situation as through traffic would bypass the roundabout). The geometry of the A428 east to A1 south link may introduce additional safety risk.

7.2.3.3 Road worker safety on the main routes through the junction would be improved significantly over the existing route by the provision of a range of measures, including concrete barrier, fixed taper points and combined emergency/maintenance bays. These would reduce maintenance interventions and exposure to risk, or ensure they are designed to maximise safety of road workers and road users. However, the potential complexity of the maintenance requirements for the free-flow links and other elements (including structures) would require carefully considered maintenance access and regimes.

7.2.4 Option Assessment Summary (Road User and Road Worker Safety)

7.2.4.1 A summary of the assessment based on road user and road worker safety is shown in the table below and reflects the potential performance of each option in meeting required safety objectives, and contributing to Highways England's overall safety objectives.

Core Programme Objective	Overall Scheme Objective	Option A	Option B	Option C
A Safe and Serviceable Network	a) Proposed scheme improves road user safety	-2	-2	-2
	b) Road Worker Safety	-1	-2	-1

Table 7-1 Operational Assessment - Road user and worker safety

Category	Description
-3	Significant Impact - Will have likely significant Adverse impact – not possible to Mitigate.
-2	Major Impact - Potential Major Adverse Impact – mitigation maybe possible
-1	Minor Impact - Possible Minor Adverse Impact, not significant with mitigation.
0	Neutral - No Impact
1	Minor - Minor Beneficial Impact
2	Major - Major Beneficial Impact
3	Significant - Significant Beneficial Impact

Table 7-2 Option assessment categories

7.3 NMU Severance, Safety and Public Transport Accessibility

7.3.1 NMU Options impact

7.3.1.1 The three junction options have been assessed to identify whether they create severance for NMUs, and it is concluded they all create significant severance between Roxton Road, Bedford Road and the north-west quadrant of the junction to the west side of the A1, and onwards towards Wyboston (McDonalds), to the extent that the existing route, which crosses the A421 at traffic signals would be severed for non-motorised users. The proposed scheme layouts would introduce a need to provide an alternative route for NMUs travelling between Roxton and the north of the junction on the west side of the A1 towards Wyboston.

7.3.1.2 Two potential alternatives could be considered:-

a) A separate NMU bridge linking Roxton Road with the north-west side of the junction.

b) An NMU link on the north side of the A421 (beyond the highway fence line), linking public rights of way west of Roxton Road, Roxton Road, public rights of way which are located in the vicinity of the Little Chef restaurant, and the footway on the west side of A1 north of the junction.

7.3.1.3 NCR 12 crosses A421 on Roxton Road bridge, just west of Black Cat Interchange and passes through Chawston, Eaton Socon, Eynesbury and St Neots using a combination of local roads and cycle paths. It is impacted by the scheme at Roxton Road over-bridge, just west of Black Cat Interchange, and would need to be allowed for in the structures design.

7.3.1.4 The public rights of way, footways and cycle routes affected by the junction improvement are listed in the table below.

Reference	Type	Location	Current Status
FP10*	Footpath (PROW)	North side of A421, west of Roxton Road bridge	Severed in field just west of Roxton Road
FP7*	Footpath (PROW)	North side of A421, east of Roxton Road bridge	Severed at highway boundary
FP36*	Footpath (PROW)	North side of the junction just west of the Little Chef	Joins existing footway on the north side of the junction just west of the Little Chef
FP8*	Footpath (PROW)	North side of the junction/west side of the A1 east of the Little Chef	Joins existing footway on the west side of the A1, east of the Little Chef
NCR 12	National cycle route	Crosses A421 on Roxton Road bridge	Part of on-road cycle route extending from Bedford Road, Roxton, along Roxton Road towards Chawston.

Table 7-3 NMU facilities affected by all options

** NB all are listed as within Wyboston, Chawston and Colesden Parishes*

7.3.1.5 Several bus services (see Section 3.15.3) travel through Black Cat Junction between A1 to the north and Roxton to the south-west. The scheme options permit the operation of the route with minor variation owing to the proposed links between A1 and A421. Bus stops are located near the junction of Bedford Road and Roxton Road.

7.3.1.6 Initial consideration has been given to proposed development adjoining the route, and initial workshops with road user groups and NMU groups, and discussions with the Local Highway Authorities have been initiated to inform the development of the main scheme options. A desire was expressed by cycle groups to link Roxton with the east side of the A1, to facilitate a new route alongside the A428 alignment and beyond towards St Neots, as part of the A428 scheme. At PCF Stage 2, an NMU Context Report would be developed, based on the preferred option.

7.3.2 Options Assessment

7.3.2.1 An assessment of the impact of the options at Black Cat Junction is set out below, based on the factors described above.

7.3.2.2 The impact on pedestrians, cyclists and users of powered users is considered as major, owing to the severance of the NMU link between Roxton and the A1 to the north of the junction. This could be possibly be mitigated as described, providing better links and dealing with historic severance also. The effect on public transport users is considered neutral (although they may be affected during construction).

Core Programme Objective	Overall Scheme Objective	Option A	Option B	Option C
A More Accessible and Integrated Network	a) Proposed scheme provides a safe alternative NMU route between communities and seeks to address severance	-2	-2	-2
	b) Improve safety and access for public transport users	0	0	0

Table 7-4 Options assessment – NMU Severance/Safety and Public Transport Accessibility

Category	Description
-3	Significant Impact - Will have likely significant Adverse impact – not possible to Mitigate.
-2	Major Impact - Potential Major Adverse Impact – mitigation maybe possible
-1	Minor Impact - Possible Minor Adverse Impact, not significant with mitigation.
0	Neutral - No Impact
1	Minor - Minor Beneficial Impact
2	Major - Major Beneficial Impact
3	Significant - Significant Beneficial Impact

Table 7-5 Option assessment categories

8. Maintenance Assessment

8.1.1 Impact of Operational Regime

8.1.1.1 The proposed A428 elements of the scheme would be to an Expressway standard, currently defined in Highways England's Technical Note issued in 2015. An Interim Advice Note containing further details is planned for issue. The operational regime would include a number of elements designed to facilitate future maintenance. There would also be a five year maintenance free period after completion.

8.1.2 Civils Infrastructure

8.1.2.1 Concrete barrier – this would virtually eliminate repair resulting from collisions, reducing exposure to risk for workers and road users, and increasing network availability.

8.1.2.2 Geometric Standards – the use of high standard geometry would facilitate safer operation of routine maintenance and temporary traffic management – however the provision of free-flow links and non-standard geometric features may create additional maintenance challenges.

8.1.2.3 Structures – New structures would be provided at the junction (three level grade-separation in Options A and C, and two levels in Option B). Safe access methods for maintenance will be required. A new, longer structure would be required for Roxton Road, which would need to incorporate NMU facilities, incuding links to footpaths and an NMU link on the north side.

8.1.2.4 Pavement – pavement would be maintained using standard methods, and would require lane closures. The junction proposals include additional links, slip roads and bridges.

8.1.2.5 Drainage – Safe access would be provided to enable required maintenance of drainage facilities including channels, gulleys, attenuation and pollution control measures. The eastern side of the junction is close to a flood plain, which may affect drainage design and maintenance, and may need specific attention in the MRSS.

8.1.2.6 Soft estate and fencing - Safe access would be provided to enable required maintenance of aspects these elements.

8.1.3 Technology

8.1.3.1 Maintenance Access – provision of emergency bays combined with maintenance access bays and technology cabinets, and variable message signs would facilitate safer maintenance of assets.

8.1.3.2 MIDAS Detectors – Above ground detection would reduce maintenance requirements on the carriageway, minimising loop detector repair, traffic management interventions and exposure to risk.

8.1.3.3 Temporary Traffic Management – Rotating Temporary Traffic Management Signs (ROTTMS) would be provided based on designed fixed taper points to facilitate placing of TM signing without the need for road workers to work from or within the carriageway to place the signs. The signs could be turned on and would provide further protection to road workers engaged in placing cones and lamps from vehicles.

8.1.3.4 Variable Message Signs – these can be used to further enhance advance warning of road works and implementation of temporary speed limits.

8.1.4 Maintenance Strategies

8.1.4.1 These are covered in the main part of the TAR and apply to this addendum. However, an additional issue arises with Option B at Black Cat Junction, which does not incorporate a link to/from A1 north and A428 east. Although diversion routes would be dealt with at stage 2 in the MRSS, in discussion with HE OD, Cambridgeshire County Council and emergency services, it is considered that Option B introduces a resilience issue in the event that the A14 is closed as a result of an incident or major works, resulting in traffic being required to travel via A1 and A428 to avoid the closure. Without the appropriate links, this traffic would be required to travel along the existing A428 single carriageway between Wyboston and Caxton Gibbett, rather than the new A428 dual carriageway.

8.1.5 Interface with Operational Safety

8.1.5.1 Road worker safety is a core element dealt with in the PCF Safety Plan (PCF Stage 2). The Maintenance and Repair Strategy Statement will be a key product in the development of a safe scheme, and would be developed in co-ordination with other Health and Safety products (managed by the Principal Designer) and Operational Safety products including the Safety Plan (Stage 2), Combined Safety and Hazard Log Report (Stage 3) and Combined Operations Strategy (Stage 3). Any maintenance risks identified would be considered as part of the Combined Safety and Hazard Log Report and managed accordingly. Where appropriate, risk assessments would be carried out in accordance with Highways England's Process for Managing Risk on the Strategic Network (GD04/12).

9. Constructability and Consenting

9.1.1.1 For the Constructability of the Stage 2 Black Cat Junction options refer to the Constructability report which can be found in Appendix D.

10. Environmental Assessment

10.1 Introduction and Methodology

10.1.1.1 For information refer to the main TAR report (reference HE551495-JAC-GEN-00-REP-C-0001).

10.2 Results

10.2.1.1 Table 10-1 provides a summary of the conclusions of the environmental appraisal at Stage 2 using the six point scale.

Option	Overall environmental score	Conclusions of the environmental appraisal (This is based on a high level assessment of the current designs, the likely significant effects could change as more information comes to light or through future iterations of the designs where effects are designed out) The assessment assumes that this would be completed as part of an overall bypass scheme and not as a standalone junction improvement scheme.
All options	Potential significant adverse effect – mitigation maybe possible.	All options are likely to improve noise and air quality around Wyboston, as a proportion of the through traffic gets diverted onto the bypass. All options have the potential for impacts to a Grade II listed building to the north of Black Cat and potential impacts to unknown buried archaeology. All options encroach into the River Great Ouse corridor and have the potential to impact habitats and species. The area is a habitat enhancement area and additional habitat creation could be undertaken as part of the options to meet Highways England targets for improving biodiversity. All options have a footprint within the floodplain, which will require compensation. All options have a significant footprint within the minerals working area, which could have programming risks and implications.
A	Potential significant adverse effect – mitigation maybe possible.	A three tier junction will have greater landscape and visual impact. There will also be an increased perception of noise impacts, which may be more difficult to mitigate due to the additional junction height.
B	Potential significant adverse effect – mitigation maybe possible.	A two tier junction would have a lower landscape and visual impact than the other two options and be potentially easier to mitigate in terms of noise impacts compared to the other two options. There could be effects to the setting of the Scheduled Monument at Tempsford Bridge, depending on the extent of the works to the south.
C	Potential significant adverse effect – mitigation maybe possible.	A three tier junction will have greater landscape and visual impact. There will also be an increased perception of noise impacts, which may be more difficult to mitigate due to the additional junction height.

Table 10-1 Environmental Assessment summary

10.2.1.2 Table 10-1 shows that at Stage 2, all options have a similar environmental effect. Option B is considered to be the environmentally preferred option, as it is two tiers instead of three and will less of a landscape and visual effect. There is little to distinguish between Options A and C at this stage from an environmental point of view.

10.2.1.3 All options are likely to benefit Wyboston, in terms of noise and air quality effects, assuming that the option is implemented as part of a full scheme rather than as a standalone junction option.

11. Conclusion of Recommendations

11.1 Option(s) for Public Consultation

11.1.1.1 Following the findings of the assessments undertaken by the various disciplines is it suggested that all Options A, B and C are taken forward to the preliminary design PCF Stage 3.

Appendix A. **Drawings**

Option Drawings

HE551495-JAC-HGN-BCJN-DR-CH-0001	Option A General Arrangement
HE551495-JAC-HGN-BCJN-DR-CH-0002	Option B General Arrangement
HE551495-JAC-HGN-BCJN-DR-CH-0003	Option C General Arrangement
HE551495-JAC-SBR-BCJN-DR-S-0001	Option A Structures Location Plan
HE551495-JAC-SBR-BCJN-DR-S-0002	Option B Structures Location Plan
HE551495-JAC-SBR-BCJN-DR-S-0003	Option C Structures Location Plan

N

BEGWARY BROOK
ROXTON ROAD
COLESDEN ROAD
SOUTH BROOK
SPINNEY ROAD
ROXTON ROAD
WYBOSTON
BEGWARY BROOK
EXISTING ACCESS TO BE STOPPED
PROPOSED ACCESS TO THE PROPERTIES TO BE MODIFIED (MAY REQUIRE A DEPARTURE FROM STANDARD FOR REDUCED WEAVING LENGTH)
CHAWSTONE LANE
EXISTING ACCESS TO BE STOPPED
CE-01
CN-01
SOUTH BROOK
LISTED BUILDING
A1 NORTH BOUND MERGE SLIP ROAD
BLACK CAT SERVICES
BN-04
CHAWSTONE NURSERIES
SOUTH BROOK
RETAINING WALL LENGTH: 70m
ROUNDABOUT BYPASS
RW-01
BN-06
BN-05
EXISTING ACCESS TO BE STOPPED
STRUCTURE TO BE PROVIDED OVER RIVER GREAT OUSE
RIVER GREAT OUSE
PROPOSED A428 TO BE TIED INTO MAINLINE OPTION 5 OR 6
A428 EAST BOUND DIVERGE SLIP ROAD
BN-08
BN-09
EXISTING STRUCTURE
BE-14
RETAINING WALL LENGTH: 90m
CE-09
A1 SOUTH BOUND DIVERGE LINK
CULTURAL HERITAGE AREA
BN-03
CULVERT REQUIRMENTS TO BE DESIGNED
RW-02
BN-02
A428 WEST BOUND DIVERGE SLIP ROAD
BN-01
A428 WEST BOUND MERGE SLIP ROAD
BEDFORD ROAD
GREAT BARFORD BYPASS
BARFORD ROAD
BN-07
ROXTON GARDEN CENTRE
A1 SOUTH BOUND MERGE SLIP ROAD
CN-02
ROUNDHILL BARROW (Historic monument)
A428
HIGH STREET
BEDFORD ROAD
A1 NORTH BOUND DIVERGE SLIP ROAD
CE-02
RIVER GREAT OUSE
KELPIE BOATYARD
TEMPSFORD BRIDGE
ROXTON
SCHOOL LANE
SCHEDULED MONUMENT
A1

Notes:

1. All dimensions in metres unless otherwise noted
2. All earthworks designed to a slope of 1V:3H
3. Minimum 8m headroom maintained for structures
4. Additional verge widening may be required to maintain visibility following design of safety barriers
5. Access to local properties to be confirmed
6. Exact locations of utilities to be confirmed
7. Refer to drawings HE551495-JAC-SBR-BCJN-DR-CB-0001 to 0003 for key of existing and proposed structures.

LEGEND:

- Existing National Cycle Route
- Flood zone 2
- Flood zone 3

DRAWING KEY
- NETWORK RAIL BOUNDARY
- ABANDONED PLANT IN GREY

EXISTING WATER KEY
- WATER MAIN - CAMBRIDGE WATER WATER
- MAIN - ANGLIAN WATER

EXISTING GAS/OIL KEY
- NATIONAL HIGH PRESSURE GAS
- LOCAL HIGH PRESSURE GAS
- MEDIUM PRESSURE GAS
- LOW PRESSURE GAS - NGG
- OIL PIPELINE - RWE
- OIL PIPELINE - CLH

EXISTING NATIONAL GRID ELECTRICITY KEY
- 400kV OVERHEAD

EXISTING UKPN ELECTRICITY KEY
- 132kV OVERHEAD
- 33kV OVERHEAD
- 33kV UNDERGROUND
- 11kV OVERHEAD
- 11kV UNDERGROUND
- LOW VOLTAGE OVERHEAD
- LOW VOLTAGE UNDERGROUND
- PLYON 132kV AND OVER
- PLYON
- DUCT TO PYLON
- POLE MOUNTED TRANSFORMER
- SUBSTATION

EXISTING BEDFORD ELECTRICITY KEY
- STREET LIGHTS

EXISTING GTC KEY
- LOW VOLTAGE ELECTRICITY
- HIGH VOLTAGE ELECTRICITY
- LOW PRESSURE GAS

EXISTING BT KEY
- OVERHEAD LINE
- UNDERGROUND DUCT
- JOINT BOX
- CABINET
- KIOSK/TELEPHONE BOX
- TELEGRAPH POLE
- OVERHEAD PROPOSED
- UNGERGROUND PROPOSED
- PROPOSED JOINT BOX
- PROPOSED TELEGRAPH POLE

EXISTING COMMUNICATIONS KEY
- VIRGIN MEDIA DJCT
- VIRGIN MEDIA JOINT BOX
- VIRGIN MEDIA CABINET
- VODAFONE DUCT
- UNIDENTIFIED DUCT
- NETWORK RAIL DUCT
- COMMUNICATION MAST

EXISTING DRAINAGE KEY
- FOUL SEWER
- COMBINED SEWER
- MANHOLE
- SURFACE SEWER
- SURFACE MANHOLE
- SEWAGE TREATMENT PLANT
- PUMPING STATION
- FINAL EFFLUENT SEWER
- FINAL EFFLUENT MANHOLE

DRAFT

0 100 200 300 400 500 m

SCALE 1 : 5000

Rev.	Date	Description of revision	Drawn	Checked	Reviewed	Approved
P00.1	12/04/17		---	---	---	---

DRAWING STATUS

Work in Progress

CLIENT

highways england

Mark Rowe, Service Director, Highways
Seax House, Victoria Road South, Chelmsford, CM1 1QH.
Tel: 0345 6037631

SCHEME TITLE

A428 BLACK CAT TO CAXTON GIBBET STAGE 2

DRAWING TITLE

BLACK CAT JUNCTION
OPTION A
GENERAL ARRANGEMENT

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841x594mm)
1:5000

DRAWING No.
HE551495-JAC-HGN-BCJN-DR-CH-0001

REV.
P00.1

N

BEGWARY BROOK
ROXTON ROAD
WYBOSTON
BEGWARY BROOK
EXISTING ACCESS TO BE STOPPED
PROPOSED ACCESS TO THE PROPERTIES TO BE MODIFIED (MAY REQUIRE A DEPARTURE FROM STANDARD FOR REDUCED WEAVING LENGTH).
CHAWSTONE LANE
A1
COLESDEN ROAD
EXISTING ACCESS TO BE STOPPED
CE-01
SOUTH BROOK
SOUTH BROOK
CONNECTOR ROAD 1
LISTED BUILDING
CHAWSTONE NURSERIES
SPINNEY ROAD
ROXTON ROAD
BLACK CAT SERVICES
SOUTH BROOK
RIVER GREAT OUSE
EASTBOUND DIVERGE SLIP ROAD
BN-02
STRUCTURE TO BE PROVIDED OVER RIVER GREAT OUSE
EXISTING ACCESS TO BE STOPPED
A1
PROPOSED A428 TO BE TIED INTO MAINLINE OPTION 5 OR 6
CULVERT REQUIRMENTS TO BE DESIGNED
BN-03
BE-14
EXISTING STRUCTURE
BN-04
CE-09
CONNECTOR ROAD 2
BN-01
RW-01
RETAINING WALL LENGTH : 70M
CULTURAL HERITAGE AREA
CONNECTOR ROAD 3
BARFORD ROAD
GREAT BARFORD BYPASS
BEDFORD ROAD
ROXTON GARDEN CENTRE
ROUNDHILL BARROW (Historic monument)
WESTBOUND DIVERGE SLIP ROAD
CN-01
EXISTING ROUNDABOUT TO BE RETAINED
A421
BEDFORD ROAD
HIGH STREET
CE-02
RIVER GREAT OUSE
BE-01
BE-02
KELPIE BOATYARD
ROXTON
SCHOOL LANE
TEMPSFORD BRIDGE
EXISTING STRUCTURE TO BE WIDENED
BE-03
BE-04
SCHEDULED MONUMENT
A1

Notes:

1. All dimensions in metres unless otherwise noted
2. All earthworks designed to a slope of 1V:3H
3. Minimum 8m headroom maintained for structures
4. Additional verge widening may be required to maintain visibility following design of safety barriers
5. Access to local properties to be confirmed
6. Exact locations of utilities to be confirmed

LEGEND:

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- Flood zone 2
- Flood zone 3

DRAWING KEY
- NETWORK RAIL BOUNDARY
- ABANDONED PLANT IN GREY

EXISTING WATER KEY
- WATER MAIN - CAMBRIDGE WATER WATER
- MAIN - ANGLIAN WATER

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- LOCAL HIGH PRESSURE GAS
- MEDIUM PRESSURE GAS
- LOW PRESSURE GAS - NGG
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- OIL PIPELINE - CLH

EXISTING NATIONAL GRID ELECTRICITY KEY
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EXISTING UKPN ELECTRICITY KEY
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- 33kV UNDERGROUND
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- PLYON
- DUCT TO PYLON
- POLE MOUNTED TRANSFORMER
- SUBSTATION

EXISTING BEDFORD ELECTRICITY KEY
- STREET LIGHTS

EXISTING GTC KEY
- LOW VOLTAGE ELECTRICITY
- HIGH VOLTAGE ELECTRICITY
- LOW PRESSURE GAS

EXISTING BT KEY
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- UNDERGROUND DUCT
- JOINT BOX
- CABINET
- KIOSK/TELEPHONE BOX
- TELEGRAPH POLE
- OVEREHEAD PROPOSED
- UNGERGROUND PROPOSED
- PROPOSED JOINT BOX
- PROPOSED TELEGRAPH POLE

EXISTING COMMUNICATIONS KEY
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- VIRGIN MEDIA JOINT BOX
- VIRGIN MEDIA CABINET
- VODAFONE DUCT
- UNIDENTIFIED DUCT
- NETWORK RAIL DUCT
- COMMUNICATION MAST

EXISTING DRAINAGE KEY
- FOUL SEWER
- COMBINED SEWER
- MANHOLE
- SURFACE SEWER
- SURFACE MANHOLE
- SEWAGE TREATMENT PLANT
- PUMPING STATION
- FINAL EFFLUENT SEWER
- FINAL EFFLUENT MANHOLE

DRAFT

0 100 200 300 400 500 m

SCALE 1 : 5000

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
P00.1	12/04/17		---	---	---	---

DRAWING STATUS

Work in Progress

CLIENT

highways england

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Seax House, Victoria Road South, Chelmsford, CM1 1QH.
Tel: 0345 6037631

SCHEME TITLE

A428 BLACK CAT TO CAXTON GIBBET STAGE 2

DRAWING TITLE

BLACK CAT JUNCTION
OPTION B
GENERAL ARRANGEMENT

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841x594mm)
1:5000

DRAWING No.
HE551495-JAC-HGN-BCJN-DR-CH-0002

REV.
P00.1

N

BEGWARY BROOK
ROXTON ROAD
COLESDEN ROAD
SOUTH BROOK
SPINNEY ROAD
WYBOSTON
BEGWARY BROOK
EXISTING ACCESS TO BE STOPPED
PROPOSED ACCESS TO THE PROPERTIES TO BE MODIFIED (MAY REQUIRE A DEPARTURE FROM STANDARD FOR REDUCED WEAVING LENGTH)
CHAWSTONE LANE
EXISTING ACCESS TO BE STOPPED
CE-01
SOUTH BROOK
A1 NORTH BOUND MERGE SLIP ROAD
LISTED BUILDING
CHAWSTONE NURSERIES
BLACK CAT SERVICES
SOUTH BROOK
RETAINING WALL LENGTH: 110m
BN-02
BN-01
ROUNDABOUT BYPASS
EXISTING ACCESS TO BE STOPPED
STRUCTURE TO BE PROVIDED OVER RIVER GREAT OUSE
RIVER GREAT OUSE
PROPOSED A428 TO BE TIED INTO MAINLINE OPTION 5 OR 6
A428 EAST BOUND MERGE
A1 SOUTH BOUND DIVERGE SLIP ROAD
BN-04
A428 EAST BOUND DIVERGE SLIP ROAD
EXISTING STRUCTURE
BE-14
CE-09
BN-05
CULTURAL HERITAGE AREA
CULVERT REQUIRMENTS TO BE DESIGNED
RW-01
BN-03
A428 WEST BOUND DIVERGE SLIP ROAD
A428 WEST BOUND MERGE SLIP ROAD
BEDFORD ROAD
GREAT BARFORD BYPASS
ROXTON GARDEN CENTRE
BARFORD ROAD
ROUNDHILL BARROW (Historic monument)
A1 SOUTH BOUND MERGE SLIP ROAD
CN-01
A1 NORTH BOUND DIVERGE SLIP ROAD
CE-02
HIGH STREET
BEDFORD ROAD
RIVER GREAT OUSE
KELPIE BOATYARD
TEMPSFORD BRIDGE
ROXTON
SCHOOL LANE
SCHEDULED MONUMENT
A1

Notes:

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3. Minimum 8m headroom maintained for structures
4. Additional verge widening may be required to maintain visibility following design of safety barriers
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6. Exact locations of utilities to be confirmed
7. Refer to drawings HE551495-JAC-SBR-BCJN-DR-CB-0001 to 0003 for key of existing and proposed structures.

LEGEND:

- Existing National Cycle Route
- Flood zone 2
- Flood zone 3

DRAWING KEY
- NETWORK RAIL BOUNDARY
- ABANDONED PLANT IN GREY

EXISTING WATER KEY
- WATER MAIN - CAMBRIDGE WATER WATER
- MAIN - ANGLIAN WATER

EXISTING GAS/OIL KEY
- NATIONAL HIGH PRESSURE GAS
- LOCAL HIGH PRESSURE GAS
- MEDIUM PRESSURE GAS
- LOW PRESSURE GAS - NGG
- OIL PIPELINE - RWE
- OIL PIPELINE - CLH

EXISTING NATIONAL GRID ELECTRICITY KEY
- 400kV OVERHEAD

EXISTING UKPN ELECTRICITY KEY
- 132kV OVERHEAD
- 33kV OVERHEAD
- 33kV UNDERGROUND
- 11kV OVERHEAD
- 11kV UNDERGROUND
- LOW VOLTAGE OVERHEAD
- LOW VOLTAGE UNDERGROUND
- PLYON 132kV AND OVER
- PLYON
- DUCT TO PYLON
- POLE MOUNTED TRANSFORMER
- SUBSTATION

EXISTING BEDFORD ELECTRICITY KEY
- STREET LIGHTS

EXISTING GTC KEY
- LOW VOLTAGE ELECTRICITY
- HIGH VOLTAGE ELECTRICITY
- LOW PRESSURE GAS

EXISTING BT KEY
- OVERHEAD LINE
- UNDERGROUND DUCT
- JOINT BOX
- CABINET
- KIOSK/TELEPHONE BOX
- TELEGRAPH POLE
- OVERHEAD PROPOSED
- UNGERGROUND PROPOSED
- PROPOSED JOINT BOX
- PROPOSED TELEGRAPH POLE

EXISTING COMMUNICATIONS KEY
- VIRGIN MEDIA DUCT
- VIRGIN MEDIA JOINT BOX
- VIRGIN MEDIA CABINET
- VODAFONE DUCT
- UNIDENTIFIED DUCT
- NETWORK RAIL DUCT
- COMMUNICATION MAST

EXISTING DRAINAGE KEY
- FOUL SEWER
- COMBINED SEWER
- MANHOLE
- SURFACE SEWER
- SURFACE MANHOLE
- SEWAGE TREATMENT PLANT
- PUMPING STATION
- FINAL EFFLUENT SEWER
- FINAL EFFLUENT MANHOLE

DRAFT

0 100 200 300 400 500 m

SCALE 1 : 5000

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
P00.1	12/04/17		---	---	---	---

DRAWING STATUS

Work in Progress

CLIENT

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Tel: 0345 6037631

SCHEME TITLE

A428 BLACK CAT TO CAXTON GIBBET STAGE 2

DRAWING TITLE

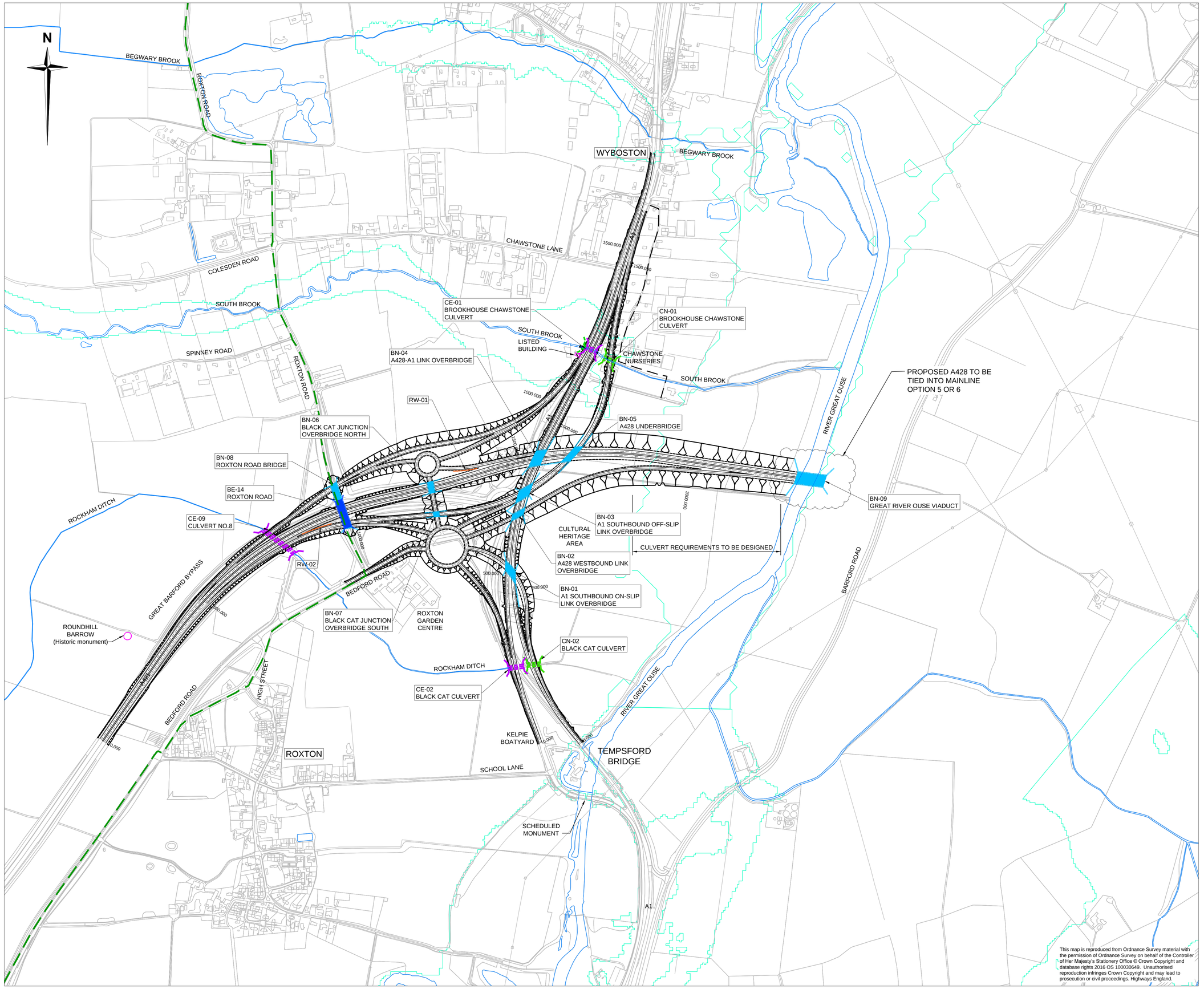
BLACK CAT JUNCTION
OPTION C
GENERAL ARRANGEMENT

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841x594mm)
1:5000

DRAWING No.
HE551495-JAC-HGN-BCJN-DR-CH-0003

REV.
P00.1



Notes

1. Do not scale.
2. All dimensions in metres unless otherwise stated.
3. Refer to Structures Schedule HE551495-JAC-SBR-A428-SH-S

Key

- Existing Watercourse/Rivers
- Existing Bridge, BE-XX
- Existing Culvert, CE-XX
- Proposed Bridge, BN-XX
- Proposed Culvert CN-XX
- Existing Culvert / Proposed Culvert Widening
- Retaining Wall, RW-XX

DRAFT

0 100 200 300 400 500 m

SCALE 1 : 5000

Rev.	Date	Description of revision	Drawn	Checked	Reviewed	Approved
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Tel: 0345 6037631

SCHEME TITLE

A428 BLACK CAT TO CAXTON GIBBET

DRAWING TITLE

BLACK CAT JUNCTION
OPTION A
STRUCTURES LOCATION PLAN

DRAWING UNITS U.N.O.	SCALE AT A1 (841x594mm)
DIMENSIONS IN MILLIMETRES LEVELS IN METRES	

DRAWING No.	REV.
HE551495-JAC-SBR-BCJN-DR-S-0001	P00.1

N

BEGWARY BROOK

ROXTON ROAD

WYBOSTON

BEGWARY BROOK

A1

500.000

CHAWSTONE LANE

COLESDEN ROAD

CE-01
BROOKHOUSE CHAWSTONE
CULVERT

SOUTH BROOK

SOUTH BROOK

LISTED
BUILDING

SPINNEY ROAD

ROXTON ROAD

CHAWSTONE
NURSERIES

SOUTH BROOK

RIVER GREAT OUSE

BN-02
BLACK CAT VIADUCT

A1

PROPOSED A428 TO BE
TIED INTO MAINLINE
OPTION 5 OR 6

CULVERT REQUIREMENTS TO BE DESIGNED

1500.000

2000.000

BN-03
ROXTON ROAD BRIDGE

BE-14
ROXTON ROAD

A1

1000.000

ROCKHAM DITCH

CE-09
CULVERT NO.8

BN-01
A1/A428 INTERCHANGE
VIADUCT

BN-04
GREAT RIVER OUSE VIADUCT

CULTURAL
HERITAGE
AREA

BARFORD ROAD

GREAT BARFORD BYPASS

RW-01

BEDFORD ROAD

ROXTON
GARDEN
CENTRE

ROUNDHILL
BARROW
(Historic monument)

A421

1000.000

HIGH STREET

A1

CN-01
BLACK CAT CULVERT

ROCKHAM DITCH

500.000

RIVER GREAT OUSE

BEDFORD ROAD

CE-02
BLACK CAT CULVERT

BE-01
TEMPSFORD NORTH FLOOD
SPAN

KELPIE
BOATYARD

BE-02
TEMPSFORD MAIN SPAN

ROXTON

SCHOOL LANE

BE-03
TEMPSFORD NEW SOUTH
FLOOD

BE-04
TEMPSFORD SOUTH FLOOD
5 SPAN

0.000

SCHEDULED
MONUMENT

A1

Notes

1. Do not scale.
2. All dimensions in metres unless otherwise stated.
3. Refer to Structures Schedule HE551495-JAC-SBR-A428-SH-S

Key

- Existing Watercourse/Rivers
- Existing Bridge, BE-XX
- Existing Culvert, CE-XX
- Proposed Bridge, BN-XX
- Proposed Culvert CN-XX
- Existing Culvert / Proposed Culvert Widening
- Retaining Wall, RW-XX

DRAFT

0 100 200 300 400 500 m

SCALE 1 : 5000

Rev.	Date	Description of revision	Drawn	Checked	Review'd	Approv'd
P00.1	12/04/17		---	---	---	---

DRAWING STATUS

Work in Progress

CLIENT

highways england

Mark Rowe, Service Director, Highways
Seax House, Victoria Road South, Chelmsford, CM1 1QH.
Tel: 0345 6037631

SCHEME TITLE

**A428 BLACK CAT
TO CAXTON GIBBET**

DRAWING TITLE

BLACK CAT JUNCTION
OPTION B
STRUCTURES LOCATION PLAN

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841x594mm)

DRAWING No.
HE551495-JAC-SBR-BCJN-DR-S-0002

REV.
P00.1

N

BEGWARY BROOK

ROXTON ROAD

WYBOSTON

BEGWARY BROOK

A1

CHAWSTONE LANE

COLESDEN ROAD

CE-01
BROOKHOUSE CHAWSTONE CULVERT

SOUTH BROOK

SOUTH BROOK

LISTED BUILDING

SPINNEY ROAD

ROXTON ROAD

BN-02
BLACK CAT OVERBRIDGE NORTH

CHAWSTONE NURSERIES

SOUTH BROOK

RIVER GREAT OUSE

BN-01
A428/BLACK CAT VIADUCT

PROPOSED A428 TO BE TIED INTO MAINLINE OPTION 5 OR 6

BN-04
ROXTON ROAD BRIDGE

BE-14
ROXTON ROAD

ROCKHAM DITCH

CE-09
CULVERT NO.8

CULTURAL HERITAGE AREA

CULVERT REQUIREMENTS TO BE DESIGNED

BN-05
GREAT RIVER OUSE VIADUCT

RW-01

BN-03
BLACK CAT OVERBRIDGE SOUTH

BARFORD ROAD

GREAT BARFORD BYPASS

BEDFORD ROAD

ROXTON GARDEN CENTRE

ROUNDHILL BARROW
(Historic monument)

A421

CN-01
BLACK CAT CULVERT

ROCKHAM DITCH

CE-02
BLACK CAT CULVERT

HIGH STREET

BEDFORD ROAD

RIVER GREAT OUSE

KELPIE BOATYARD

TEMPSFORD BRIDGE

ROXTON

SCHOOL LANE

SCHEDULED MONUMENT

A1

Notes

1. Do not scale.
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3. Refer to Structures Schedule HE551495-JAC-SBR-A428-SH-S

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DRAFT

0 100 200 300 400 500 m

SCALE 1 : 5000

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SCHEME TITLE

A428 BLACK CAT TO CAXTON GIBBET

DRAWING TITLE

BLACK CAT JUNCTION
OPTION C
STRUCTURES LOCATION PLAN

DRAWING UNITS U.N.O.
DIMENSIONS IN MILLIMETRES
LEVELS IN METRES

SCALE AT A1 (841x594mm)

DRAWING No.
HE551495-JAC-SBR-BCJN-DR-S-0003

REV.
P00.1

Appendix B. **Structures Tables**

Table B1.1 A428 Black Cat Junction Option A – Existing Structures List

Table B1.2 A428 Black Cat Junction Option A – Proposed Structures List

Table B2.1 A428 Black Cat Junction Option B – Existing Structures List

Table B2.2 A428 Black Cat Junction Option B – Proposed Structures List

Table B2.1 A428 Black Cat Junction Option C – Existing Structures List

Table B2.2 A428 Black Cat Junction Option C – Proposed Structures List

Table B1.1 - A428 BLACK CAT JUNCTION OPTION A - EXISTING STRUCTURES LIST

BRIDGES

Jacobs Reference	Str. Key	Structure No.	Existing Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Structure Type	Span Arrangement (m) [Skew]				Overall Span (m)	Total Width (m)	Approx Skew	Overall width of new A428 @ location of the structure (m)	Articulation	Abutment Type	Structure affected by scheme?	Estimated New Deck Area (m2)		Structure Condition	Assessed Capacity	Existing Headroom	Notes
				Eastings	Northings					Span1	Span2	Span3	Span4								Widening	New Structure				
BE01	15621	/A1//86.50/B/1	Tempsford North Flood Span	516186	254697	A1 Dual Carriageway (southbound)	River Great Ouse north flood plain	470	Reinforced concrete (simply supported slab)	8.8	8.8	-	-	17.6	12.6	17 deg	14.05	Fixed with dowels at central pier. Direct bearing at north and south abutments.	Closed abutment	✓(assessment)	-	-	The structure was in good overall condition. There was loss of bitumen surfacing to the asphaltic plug joints over the structure and spalled concrete with some reinforcement exposed.	On all traffic lanes 40T/44T of Assessment LL, 40 units of HB with Associated LL and 40 units of HB without Associated LL.	9.3	Width of structure required = 13.05m between parapets. Structure is 11.6m wide between parapets. There are no plans to widen this structure so the proposed verge widths will be reduced. This structure will require assessment.
BE02	5273	/A1//86.50/B/	Tempsford Main Span	516214	254660	A1 Single Carriageway (southbound)	River Great Ouse	410	Haunched concrete (continuous)	11.43	15.24	11.43	-	38.1	12.2	35 deg	14.05	Fixed with steel pot bearings at south abutment. Elastomeric bearings at all other supports.	Closed abutment	✓(assessment)	-	-	The structure was in fair condition overall. Some areas of water staining and seepage were present.	On all traffic lanes 40T/44T of Assessment LL, 45 units of HB with Associated LL and 45 units of HB without Associated LL.	9.3	Width of structure required = 13.05m between parapets. Structure is 11.6m wide between parapets. There are no plans to widen this structure so the proposed verge widths will be reduced. This structure will require assessment.
BE03	21445	/A1//86.40/B/1	Tempsford New South Flood	516240	254627	A1 Single Carriageway (southbound)	River Great Ouse south flood plain	350	Reinforced concrete (simply supported slabs)	8.8	8.8	-	-	17.6	12.2	17 deg	14.05	Fixed with dowels at central pier. Direct bearing at north and south abutments.	Closed abutment	✓(assessment)	-	-	The structure was in fair condition overall. The east parapet was damaged, the polysulphide sealant required replacing and cracks in the deck joints required sealing to stop water ingress.	On all traffic lanes 40T of Assessment LL and 40 units of HB with Associated LL.	9.3	Width of structure required = 13.05m between parapets. Structure is 11.6m wide between parapets. There are no plans to widen this structure so the proposed verge widths will be reduced. This structure will require assessment.
BE04	5272	/A1//86.40/B/	Tempsford South Flood S Span	516296	254550	A1 Single Carriageway (southbound)	River Great Ouse south flood plain	280	Reinforced concrete (simply supported slabs)	-	-	-	-	5 No. spans @ 6.1m [square] 30.7m total length	12.2	22 deg	14.05	Fixed with dowels at central piers and abutments. **Requires confirmation**	Closed abutment	✓(assessment)	-	-	The structure was in fair condition. There were areas of minor spalling and delamination at the piers, abutments, parapet beams and edge beams. There were rust stains and seepage found on the piers, abutments and soffit. There were vertical cracks to both elevations of all piers.	On all traffic lanes 40T/44T of Assessment LL, 45 units of HB with Associated LL and 45 units of HB without Associated LL.	9.3	Width of structure required = 13.05m between parapets. Structure is 11.6m wide between parapets. There are no plans to widen this structure so the proposed verge widths will be reduced. This structure will require assessment.
BE14	25197	/A421//26.70//	Roxton Road	515495	255376	Roxton Road (Single Carriageway)	Existing A428 (Single Carriageway)	Ch 975 of A428	Composite (continuous)	17.375	34.2	13.425	-	65	9.0	0 deg	26.1	Integral bridge	Open abutment	✓(to be demolished and replaced)	-	712.5	The structure was in good condition. However, some defects were highlighted as requiring some form of remedial action, such as the settlement to the revetments.	On all traffic lanes 40T of Design Traffic Loading and 37.5 units of HB with Associated LL (Design Traffic Loading).	5.87	A428 D2AP is proposed along with slip roads to its north and south at Roxton Bridge. The structure will hence be demolished and replaced with a new overbridge to span over the entire A428 carriageway and its slip roads.

CULVERTS

Jacobs Reference	Str. Key	SMIS Ref	Existing Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Structure Type	Span/Diameter (m)	Length (m)	Approx Skew	Structure affected by scheme?	Estimated New Deck Area (m2)		Structure Condition	Assessed Capacity	Existing / Proposed Clearance (m)	Notes
				Eastings	Northings									Extension	New Structure				
CE01	**5280**	**/A1//87.90//**	Brookhouse Chawston	516210	255820	A1 Dual Carriageway	South Brook	Ch 1230 of A1	Reinforced concrete (simply supported)	3.05m	28.3	0 - 14 deg	✓(extension)	12m	-	Culvert was in good condition. There were 9 missing coping stones to the east parapet and the remaining sandstone copings had areas of delamination and spalls. There was minor cracking to the parapets. Severely corroded reinforcement could be seen were the north east corner of the deck had spalled.	On all traffic lanes 40T/44T of Assessment LL, 45 units of HB with Associated LL and 45 units of HB without Associated LL.	2.4 (existing) 2.4 (for proposed)	Length of culvert required ~40m. Culvert is 28m long, therefore the structure will require extension. An assessment may be required as there will be a change in loading. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database
CE02	**5279**	**/A1//86.90/Q/**	Blackcat Culvert	515990	254930	A1 Dual Carriageway	Rockham Ditch	Ch 265 of A1	Precast concrete pipes and a single ring brick arch.	approx 1.5m	40.0	0 deg	✓(inspection and assessment)	-	-	Culvert was in good condition. Lacked a safety barrier/approved vehicular parapet. There was dense vegetation within the central reserve.	Not recorded in the structure report.	1.5 (existing)	The existing culvert comprises of two parts - the original is a precast concrete pipe which was further extended to a single ring brick arch. The proposed northbound A1 is realigned over the existing road. The proposed southound A1 is offline to the east of existing . An assessment may be required as there will be a change in loading. The exact arrangement of the existing culvert should be confirmed by a site visit at future design stages. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database
CE09	**25189**	**/A421//27.40/Q/**	Culvert No. 8	515308	255288	Existing A428 Single Carriageway	Rockham ditch	Ch 765 of A428	Precast reinforced concrete	1.00m	113.9	69 deg	✓(inspection and assessment)	-	-	TBC	TBC	1.5 (existing)	The proposed A428 and its slip roads to the north and south are aligned over the existing A421 at the location of the culvert. However the culvert is long enough to accommodate 80m to 90m width of the proposed road. However an assessment will be required to verify the capacity for revised loadings. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database

Table B1.2 - A428 BLACK CAT JUNCTION OPTION A - PROPOSED STRUCTURES LIST

BRIDGES

Jacobs Reference	Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Approximate Overall Span (m)	Overall Width (m)	Approx Skew (deg)	Approximate deck area (m^2)	Notes for Option A	Additional comments	Min Headroom requirements (m)	Notes on STAT's
		Eastings	Northings											
BN01	A1 southbound onslip link overbridge	515976	255204	A1 southbound on slip road	A1- D2AP	Ch 548 (A1 southbound) & Ch 510 (A1 northbound)	Central Spans- 55m (outer curve) & 40m (inner curve) - Avg span 48m. Two end spans - Average span 35m each = Total span = 125m appx	19	45^{o} to 50^{o}	2500.0	Overbridge is proposed to cross the new dual carriageway A1 road and to carry the A1 southbound on-slip road. The structure is on a curved alignment of the on slip road with variable span arrangement.	Highways team have not refined the goemetry of the A1 road for sightlines etc for this stage however the structure may or may not have a central pier. The structure type can be a 3 span continuous with steel composite deck, central span over the A1 road with two end spans for open abutments. Alternative option is to divide the central span into 2 with a pier and 2 back spans, a total of 4 span structure.	5.8	
BN02	A428 westbound link overbridge	515994	255360	A428 westbound diverge slip road	A1-D2AP	Ch 665 (A1 northbound) & Ch 710 (A1 southbound)	Central span -45. Two end spans-32m - Total span = 110	14	35^{o}	1540	Overbridge is proposed to cross the new dual carriageway A1 road and to carry the new A428 westbound off slip road which forms a link at the proposed Black cat junction.	The structure type could be a 3 span continuous steel composite overbridge with a central span over the A1 and two end spans with open abutments. Alternatively a pier could be proposed in the central reserve (2.5m wide) to divide he central span into 2 to form a 4 span structure with open abutments.	5.8	
BN03	A1 southbound offslip link overbridge	516012	255422	A1 southbound off slip road	A1-D2AP	Ch 730 (A1 northbound) & Ch 773 (A1 southbound)	Central span -45. Two end spans-32m - Total span = 110	Varies - 21m to 26m. Avg 24m	45^{o}	2650	Overbridge is proposed to cross the new dual carriageway A1 road and to carry the new A428 westbound off slip road which forms a link at the proposed Black cat junction.	The structure type could be a 3 span continuous steel composite overbridge with a central span over the A1 and two end spans with open abutments. Alternatively a pier could be proposed in the central reserve (2.5m wide) to divide he central span into 2 to form a 4 span structure with open abutments.	5.8	
BN04	A428-A1 link overbridge	516055	255525	A428 dual carriageway road	A1-D2AP	Ch 840 (A1 northbound) & Ch 880 (A1 southbound)	Central span -35. Two end spans -25m. Total span = 85	42	35^{o}	3600	Overbridge is proposed to cross the new A1 dual c/w road and to carrry the new A428 dual carriageway.	The structure type could be a 3 span continuous steel composite overbridge with a central span over the A1 and two end spans with open abutments. Alternatively a pier could be proposed in the central reserve (2.5m wide) to divide he central span into 2 to form a 4 span structure with open abutments.	5.8	
BN05	A428 underbridge	516157	255538	A428 D2AP	A1 southbound off slip road	Ch 1660 of A428	25.0	58	47^{o}	1450	A428 dual carriageway road underbridge is proposed to cross the A1 southbound off slip link road. The A1 road crosses at a slight curvature.	The structure to be a precast concrete single span integral bridge with closed abutments.	5.8	
BN06	Black cat junction Overbridge north	515746	255441	Black cat junction road	A428 D2AP	Ch 1238 of A428	Central span - 35m, Two end spans - 25m each Total span = 85m	16	5^{o}	1360	The overbridge forms the link between the proposed interchange roundabouts at Black cat junction. It will be located to the north to cross the proposed 2 lane dual carriageway A428.	Structure could comprise of either precast concrete or steel composite deck as the span lengths are within the allowable limits of the precast concrete beam lengths. Span arrangement could vary between either 3 spans with open abutments or a single span integral deck with closed abutments.	5.8	
BN07	Black Cat junction Overbridge south	515761	255362	Black cat junction road	A428 west bound onslip road	Chainage not specified for the slip road	20.0	16	10^{o}	320	The overbridge forms the link between the proposed interchange roundabouts at Black cat junction. It will be located to the south to cross the 2 lane single carriageway A428 westbound on slip road.	Structure type to be a single span integral / simply supported precast concrete with closed abutment walls.	5.4	
BN08	Roxton Road overbridge South	515504	255331	Roxton road	A428 D2AP and slip roads	Ch 975 of A428	Four span viaduct. Each span ~35m. Overall length = 140m	15	10^{o}	2100	Multispan overbridge carrying Roxton Road is proposed to cross the new A428 and its slip roads to its north and south side.	The structure is typically 4 span viaduct with steel composite deck or precast concrete deck supported on columns/ leaf piers at intermediate positions and full height abutments at the ends.	5.8	
BN09	Great River Ouse Viaduct	516960	255452	A428 D2AP	River Great Ouse	Ch 2350 of A428	Span appx 60m over river and 42m each end spans. Total span = 145m	35	25^{o}	5100	The structure is a A428 underbridge crossing the River great Ouse. The Black cat junction scheme cut off point is at the location of the underbridge.	Structure to be ideally a 3 span continuous steel composite deck.	Clearance TBC	

RETAINING WALLS

Jacobs Reference	Structure Name	Approximate Coordinates		Appxoximate Chainage	Approximate Length (m)	Approximate height (m)	Notes for Option A
		Eastings	Northings				
RW1	Black cat junction North east retaining Wall	515843	255488	Ch 1350 of A428	75	4m to 5m	The retaining wall is located to the north east of proposed Black cat junction along the south side of the A428 east bound slip road.
RW2	Black cat junction South west retaining Wall	515414	255321	Ch 890 of A428	100	5m to 6m	The retaining wall is located to the south west of proposed Black cat junction along the A428 west bound slip road.

CULVERTS

Jacobs Reference	Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Approximate Overall Span / Diameter (m)	Overall Length (m)	Approx Skew (deg)	Approximate deck area (m^2)	Notes for Option A	Additional comments	Min depth above watercourse or cover (m)	Notes on STAT's
		Eastings	Northings											
CN01	Brookhouse Chawston	516272	255798	A1 southbound off slip road	South Brook	Ch 1230 of A1	3.1	28.6	20 deg	N/A	Proposed culvert will carry A1 southbound diverge link road. Size required to be same as the existing Brookhouse Chawstone Culvert.	Based on the proposed vertical alignment of the A1 southbound diverge link provided at Stage 2 , the initial depth above the watercourse is satisfactory.	2.4	
CN02	Black Cat Culvert	516060	254932	A1 southbound off slip road	Rockham Ditch	Ch 265 of A1	1.5	25	16 deg	N/A	Proposed culvert will carry A1 southbound merge slip road. Size required to be same as the existing Black Cat Culvert.	Based on the proposed vertical alignment of the A1 provided at Stage 2 , the initial depth above the watercourse is not satisfactory. The proposed vertical alignment will required to be raised to 3.5m.	3.5	

Table B2.1 - A428 BLACK CAT JUNCTION OPTION B - EXISTING STRUCTURES LIST

BRIDGES

Jacobs Reference	Str. Key	Structure No.	Existing Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Structure Type	Span Arrangement (m) [Skew]				Overall Span (m)	Total Width (m)	Approx Skew	Overall width of new A428/ A1 @ location of the structure (m)	Articulation	Abutment Type	Structure affected by scheme?	Estimated New Deck Area (m2)		Structure Condition	Assessed Capacity	Existing Headroom	Notes
				Eastings	Northings					Span1	Span2	Span3	Span4								Widening	New Structure				
BE01	15621	/A1//86.50/B/1	Tempsford North Flood Span	516186	254697	A1 Dual Carriageway (southbound)	River Great Ouse north flood plain	Ch 260 of A1	Reinforced concrete (simply supported slab)	8.8	8.8	-	-	17.6	12.6	17 deg	24	Fixed with dowels at central pier. Direct bearing at north and south abutments.	Closed abutment	✓(widening)	220	-	The structure was in good overall condition. There was loss of bitumen surfacing to the asphaltic plug joints over the structure and spalled concrete with some reinforcement exposed.	On all traffic lanes 40T/44T of Assessment LL, 40 units of HB with Associated LL and 40 units of HB without Associated LL.	9.3	Width of structure required = 24m including parapets. Structure is 11.6m wide between parapets.A1 southbound carriageway slip road is proposed offline to the east of the existing road at the location of the underbridge. Widening of the structure will be then asymmetrically to its east side by ~12m
BE02	5273	/A1//86.50/B/	Tempsford Main Span	516214	254660	A1 Single Carriageway (southbound)	River Great Ouse	Ch 210 of A1	Haunched concrete (continuous)	11.43	15.24	11.43	-	38.1	12.2	35 deg	23	Fixed with steel pot bearings at south abutment. Elastomeric bearings at all other supports.	Closed abutment	✓(widening)	420	-	The structure was in fair condition overall. Some areas of water staining and seepage were present.	On all traffic lanes 40T/44T of Assessment LL, 45 units of HB with Associated LL and 45 units of HB without Associated LL.	9.3	Width of structure required = 23m including parapets. Structure is 11.6m wide between parapets. A1 southbound carriageway slip road is proposed offline to the east of the existing road at the location of the underbridge. Widening of the structure will be then asymmetrically to its east side by ~11m
BE03	21445	/A1//86.40/B/1	Tempsford New South Flood	516240	254627	A1 Single Carriageway (southbound)	River Great Ouse south flood plain	Ch 130 of A1	Reinforced concrete (simply supported slabs)	8.8	8.8	-	-	17.6	12.2	17 deg	17	Fixed with dowels at central pier. Direct bearing at north and south abutments.	Closed abutment	✓(widening)	90	-	The structure was in fair condition overall. The east parapet was damaged, the polysulphide sealant required replacing and cracks in the deck joints required sealing to stop water ingress.	On all traffic lanes 40T of Assessment LL and 40 units of HB with Associated LL.	9.3	Width of structure required = 17m including parapets. Structure is 11.6m wide between parapets. The A1 at this location is the southbound 2 lane carriageway and is proposed to realign and widen the road by 5m symmetrically.
BE04	5272	/A1//86.40/B/	Tempsford South Flood 5 Span	516296	254550	A1 Single Carriageway (southbound)	River Great Ouse south flood plain	Ch 70 of A1	Reinforced concrete (simply supported slabs)	-	-	-	-	5 No. spans @ 6.1m [square] 30.7m total length	12.2	22 deg	16	Fixed with dowels at central piers and abutments. Requires confirmation	Closed abutment	✓(widening)	180	-	The structure was in fair condition. There were areas of minor spalling and delamination at the piers, abutments, parapet beams and edge beams. There were rust stains and seepage found on the piers, abutments and soffit. There were vertical cracks to both elevations of all piers.	On all traffic lanes 40T/44T of Assessment LL, 45 units of HB with Associated LL and 45 units of HB without Associated LL.	9.3	Width of structure required = 17m including parapets. Structure is 11.2m wide between parapets. The A1 at this location is the southbound 2 lane carriageway and is proposed to realign and widen the road by 5m symmetrically.
BE14	25197	/A421//26.70//	Roxton Road	515495	255376	Roxton Road (Single Carriageway)	Existing A428 (Single Carriageway)	Ch 945 of A428	Composite (continuous)	17.375	34.2	13.425	-	65	9.0	0 deg	26.1	Integral bridge	Open abutment	✓(to be demolished and replaced)	-	712.5	The structure was in good condition. However, some defects were highlighted as requiring some form of remedial action, such as the settlement to the revetments.	On all traffic lanes 40T of Design Traffic Loading and 37.5 units of HB with Associated LL (Design Traffic Loading).	5.87	A428 D2AP is proposed along with a slip roads to its north and south at Roxton Bridge. The structure will hence be demolished and replaced with a new overbridge to span over the entire A428 carriageway and slip roads.

CULVERTS

Jacobs Reference	Str. Key	SMIS Ref	Existing Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Structure Type	Span/Diameter (m)	Length (m)	Approx Skew	Structure affected by scheme?	Estimated New Deck Area (m2)		Structure Condition	Assessed Capacity	Existing Clearance (m)	Notes
				Eastings	Northings									Extension	New Structure				
CE01	**5280**	**/A1//87.90//**	Brookhouse Chawston	516210	255820	A1 Dual Carriageway	South Brook	Ch 115 of A1	Reinforced concrete (simply supported)	3.05m	28.3	0 - 14 deg	✓(extension)	~32m	-	Culvert was in good condition. There were 9 missing coping stones to the east parapet and the remaining sandstone copings had areas of delamination and spalls. There was minor cracking to the parapets. Severely corroded reinforcement could be seen were the north east corner of the deck had spalled.	On all traffic lanes 40T/44T of Assessment LL, 45 units of HB with Associated LL and 45 units of HB without Associated LL.	2.4 (existing) (proposed) 2.4	Along the existing A1 at the location of the culvert there is A1 northbound on slip road and southbound off slip road proposed to the west and east of A1 respectively. Hence to accomodate the additional A1 roads, the culvert will be widened either side to an overall length of ~ 60m. An assessment may be required as there will be a change in loading. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database
CE02	**5279**	**/A1//86.90/Q/**	Blackcat Culvert	515990	254930	A1 Dual Carriageway	Rockham Ditch	Ch 530 of A1 slip road	Precast concrete pipes and a single ring brick arch.	approx 1.5m	40.0	0 deg	✓(inspection and assessment)	-	-	Culvert was in good condition. Lacked a safety barrier/approved vehicular parapet. There was dense vegetation within the central reserve.	Not recorded in the structure report.	1.5 (existing)	The existing culvert comprises of two parts - the original is a precast concrete pipe which was further extended to a single ring brick arch. The proposed northbound A1 is realinged over the existing road. The proposed southound A1 is offline to the east of existing . An assessment may be required as there will be a change in loading. The exact arrangement of the existing culvert should be confirmed by a site visit at future design stages. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database
CE09	**25189**	**/A421//27.40/Q/**	Culvert No. 8	515308	255288	Existing A428 Single Carriageway	Rockham ditch	Ch 750 of A428	Precast reinforced concrete	1.00m	113.9	69 deg	✓(inspection and assessment)	-	-	TBC	TBC	1.5 (existing)	The proposed A428 and its slip roads to the north and south are aligned over the existing A421 at the location of the culvert. However the culvert is long enough to accommodate 80m to 90m width of the proposed road. However an assessment will be required to verify the capacity for revised loadings. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database

Table B2.2 - A428 BLACK CAT JUNCTION OPTION B - PROPOSED STRUCTURES LIST

BRIDGES

Jacobs Reference	Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Approximate Overall Span (m)	Overall Width (m)	Approx Skew (deg)	Approximate deck area (m^2)	Notes for Option B	Additional comments	Min Headroom requirements (m)	Notes on STAT's
		Eastings	Northings											
BN01	A1 / A428 interchange viaduct	515995	255390	A428 westbound onslip road	Existing black cat junction roundabout and proposed A1	Ch 970 of A1 slip road	5 span viaduct . Each span = 45m. Overall length =225m	16	10^{o} at black cat roundabout and 25^{o} at A1	3600.0	A five span viaduct is proposed to carry the A428 on slip road over the existing black cat junction roundabout (which will be retained in this option) and proposed A1 road located further west.	The 5 span continuous structure to be preferably steel composite deck type with multigirder arrangement or ladder beam deck arrangement supported on columns or leaf piers at intermediate positions and full height abutments at the ends.	5.8	
BN02	Black Cat Viaduct	515974	255446	A428	Existing black cat junction roundabout and proposed A1	Ch 1470 of A428	5 span viaduct . Overall length =260m	40	0^{o}	10400	A five span viaduct is proposed to carry the A428 over the existing black cat junction roundabout (which will be retained in this option) and proposed A1 road located further west.	The 5 span continuous structure to be preferably steel composite deck type with multigirder arrangement or ladder beam deck .	5.8	
BN03	Roxton Road bridge	515491	255373	Roxton road	A428 D2AP + slip roads	Ch 945 of A428	Four span viaduct. Each span ~35m. Overall length = 140m	15	10^{o}	2100	Multispan overbridge carrying Roxton Road is proposed to cross the new A428 and its slip roads to its north and south side.	The structure is typically 4 span viaduct with steel composite deck or precast concrete deck supported on columns/ leaf piers at intermediate positions and full height abutments at the ends.	5.8	
BN04	Great River Ouse Viaduct	516795	255394	A428 D2AP	River Great Ouse	Ch 2350 of A428	Span appx 60m over river and 42m each end spans. Total span = 145m	52	15^{o}	7550	The structure is a A428 underbridge crossing the River great Ouse. The Black cat junction scheme cut off point is at the location of the underbridge.	Structure to be ideally a 3 span continuous steel composite deck. Alternatively 2 separate structures can be proposed to carry the A428 and slip road.	Clearance TBC	

RETAINING WALLS

Jacobs Reference	Structure Name	Approximate Coordinates		Appxoximate Chainage	Approximate Length (m)	Approximate height (m)	Notes for Option B
		Eastings	Northings				
RW1	A428 West slip retaining wall	515436	255329	Ch 870 of A428	100	~2m	-

CULVERTS

Jacobs Reference	Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Approximate Overall Span (m)	Overall Length (m)	Approx Skew (deg)	Approximate deck area (m^2)	Notes for Option B	Additional comments	Min depth above watercourse or cover (m)	Notes on STAT's
		Eastings	Northings											
CN01	Black Cat Culvert	516080	254934	A1 southbound off slip road	Rockham Ditch	Ch 265 of A1	1.5	40	16 deg	N/A	Proposed culvert will carry A1 southbound off slip road. Size required to be same as the existing Black Cat Culvert.	Based on the proposed vertical alignment of the A1 provided at Stage 2 , the initial depth above the watercourse is not satisfactory. The proposed vertical alignment will required to be raised to 3.5m.	3.5	

Table 3.1 - A428 BLACK CAT JUNCTION OPTION C - EXISTING STRUCTURES LIST

BRIDGES

Jacobs Reference	Str. Key	Structure No.	Existing Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Structure Type	Span Arrangement (m) [Skew]				Overall Span (m)	Total Width (m)	Approx Skew	Overall width of new A428/ A1 @ location of the structure (m)	Articulation	Abutment Type	Structure affected by scheme?	Estimated New Deck Area (m2)		Structure Condition	Assessed Capacity	Existing Headroom	Notes
				Eastings	Northings					Span1	Span2	Span3	Span4								Widening	New Structure				
BE14	25197	/A421//26.70//	Roxton Road	515495	255376	Roxton Road (Single Carriageway)	Existing A428 (Single Carriageway)	Ch 930 of A428	Composite (continuous)	17.375	34.2	13.425	-	65	9.0	0 deg	26.1	Integral bridge	Open abutment	✓(to be demolished and replaced)	-	712.5	The structure was in good condition. However, some defects were highlighted as requiring some form of remedial action, such as the settlement to the revetments.	On all traffic lanes 40T of Design Traffic Loading and 37.5 units of HB with Associated LL (Design Traffic Loading).	5.87	A428 D2AP is proposed along with slip roads to its north and south at Roxton Bridge. The structure will hence be demolished and replaced with a new overbridge to span over the entire A428 carriageway and its slip roads.

CULVERTS

Jacobs Reference	Str. Key	SMIS Ref	Existing Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Structure Type	Span/Diameter (m)	Length (m)	Approx Skew	Structure affected by scheme?	Estimated New Deck Area (m2)		Structure Condition	Assessed Capacity	Existing Clearance (m)	Notes
				Eastings	Northings									Extension	New Structure				
CE01	**5280**	**/A1//87.90//**	Brookhouse Chawston	516210	255820	A1 Dual Carriageway	South Brook	Ch 1235 of A1	Reinforced concrete (simply supported)	3.05m	28.3	0 - 14 deg	✓(extension)	~32m	-	Culvert was in good condition. There were 9 missing coping stones to the east parapet and the remaining sandstone copings had areas of delamination and spalls. There was minor cracking to the parapets. Severely corroded reinforcement could be seen were the north east corner of the deck had spalled.	On all traffic lanes 40T/44T of Assessment LL, 45 units of HB with Associated LL and 45 units of HB without Associated LL.	2.4 (existing) 2.4 (proposed)	Along the existing A1 at the location of the culvert there is A1 northbound on slip road and southbound off slip road proposed to the west and east of A1 respectively. Hence to accomodate the additional A1 roads, the culvert will be widened either side to an overall length of ~ 60m. An inspection and assessment may be required as there will be a change in loading. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database
CE02	**5279**	**/A1//86.90/Q/**	Blackcat Culvert	515990	254930	A1 Dual Carriageway	Rockham Ditch	Ch 265 of A1	Precast concrete pipes and a single ring brick arch.	approx 1.5m	40.0	0 deg	✓(inspection and assessment)	-	-	Culvert was in good condition. Lacked a safety barrier/approved vehicular parapet. There was dense vegetation within the central reserve.	Not recorded in the structure report.	1.5 (existing)	The existing culvert comprises of two parts - the original is a precast concrete pipe which was further extended to a single ring brick arch. The proposed northbound A1 is realinged over the existing road. The proposed southound A1 is offline to the east of existing. An assessment may be required as there will be a change in loading. The exact arrangement of the existing culvert should be confirmed by a site visit at future design stages. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database
CE09	**25189**	**/A421//27.40/Q/**	Culvert No. 8	515308	255288	Existing A428 Single Carriageway	Rockham ditch	Ch 740 of A428	Precast reinforced concrete	1.00m	113.9	69 deg	✓(inspection and assessment)	-	-	TBC	TBC	1.5 (existing)	The proposed A428 and its slip roads to the north and south are aligned over the existing A421 at the location of the culvert. However the culvert is long enough to accommodate 80m to 90m width of the proposed road. However an inspection and assessment will be required to verify the capacity for revised loadings. A climate change resilience assessment may be required to assess capacity at future design stages. The existing culvert information is obtained from Highways England's SMIS database

Table B3.2 - A428 BLACK CAT JUNCTION OPTION C - PROPOSED STRUCTURES LIST

BRIDGES

Jacobs Reference	Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Approximate Overall Span (m)	Overall Width (m)	Approx Skew (deg)	Approximate deck area (m^2)	Notes for Option B	Additional comments	Min Headroom requirements (m)	Notes on STAT's
		Eastings	Northings											
BN01	A428/ Black cat viaduct	516009	255421	A428 D2AP	Black cat junction and A1	Ch 1470 of A428	5 span viaduct . Each span = 46m. Overall length =230m	33	17° at A1	7600.0	A five span viaduct is proposed to carry the A428 over proposed black cat roundabout and A1. The black cat roundabout is proposed over the new A1. The viaduct is approximately 16.5m high above the proposed A1.	The 5 span continuous structure to be preferably steel composite deck type with multigirder arrangement or ladder beam deck arrangement supported on columns or leaf piers at intermediate positions and full height abutments at the ends.	5.8	
BN02	Black cat Overbridge North	516053	255521	Black cat junction north	A1	Ch 885 of A1	For a 3 span structure - Central span- 30m & 2 end spans 21m each. Overall length = 72m. For Single span integral bridge - 30m	15	11° at A1	1100	A multispan or single span overbridge is proposed to carry the Black cat junction roundabout over proposed A1.	A three span overbridge with open abutments with central span over A1 and 2 end spans. Deck could be a continuous precast concrete or steel composite. Alternatively a single span integral bridge can be proposed with closed abutments.	5.8	
BN03	Black cat Overbridge North	515988	255343	Black cat junction south	A1	Ch 700 of A1	For a 3 span structure - Central span- 30m & 2 end spans 21m each. Overall length = 72m. For Single span integral bridge - 30m	15	11° at A1	1100	A multispan or single span overbridge is proposed to carry the Black cat junction roundabout over proposed A1.	A three span overbridge with open abutments with central span over A1 and 2 end spans. Deck could be a continuous precast concrete or steel composite. Alternatively a single span integral bridge can be proposed with closed abutments.	5.8	
BN04	Roxton Road bridge	515491	255374	Roxton road	A428 D2AP + slip roads	Ch 945 of A428	Four span viaduct. Each span ~35m. Overall length = 140m	15	10°	2100	Multispan overbridge carrying Roxton Road is proposed to cross the new A428 and its slip roads to its north and south side.	The structure is typically 4 span viaduct with steel composite deck or precast concrete deck supported on columns/ leaf piers at intermediate positions and full height abutments at the ends.	5.8	
BN05	Great River Ouse Viaduct	516790	255330	A428 D2AP	River Great Ouse	Ch 2255 of A428	Span appx 60m over river and 42m each end spans. Total span = 145m	38	25°	1980	The structure is a A428 underbridge crossing the River great Ouse. The Black cat junction scheme cut off point is at the location of the underbridge.	Structure to be ideally a 3 span continuous steel composite deck.	Clearance TBC	

RETAINING WALLS

Jacobs Reference	Structure Name	Approximate Coordinates		Appxoimate Chainage	Approximate Length (m)	Approximate height (m)	Notes for Option C
		Eastings	Northings				
RW1	Black cat junction south west retaining Wall	515835	255400	Ch 1300 of A428	110	~5m	The retaining wall is located to the south west of black cat junction along the A428 west bound on slip road.

CULVERTS

Jacobs Reference	Structure Name	Approximate Coordinates		Carries	Crosses	Approximate Chainage	Approximate Overall Span (m)	Overall Length (m)	Approx Skew (deg)	Approximate deck area (m^2)	Notes for Option C	Additional comments	Min depth above watercourse or cover (m)	Notes on STAT's
		Eastings	Northings											
CN01	Black Cat Culvert	516080	254934	A1 southbound off slip road	Rockham Ditch	Ch 265 of A1	1.5	40	16 deg	N/A	Culvert will carry the A1 southbound merge link road. Size required to be same as the existing Black Cat Culvert.	Based on the proposed vertical alignment of the A1 provided at Stage 2 , the initial depth above the watercourse is not satisfactory. The proposed vertical alignment will required to be raised to 3.5m.	3.5	

Appendix C. **Drainage Outfall Summary**

Table C1.1 – Options Comparison Summary Table

Table C1.1 – Options Comparison Summary Table

Proposed Route Option	Estimated Paved Area			Estimated Number of Culvert Crossings[5/6]			Estimated Number of Main River Crossings/ Bridge Structures[7]			Estimated Number of Outfalls[1] / Discharge Arrangement				Estimated Attenuation Storage Volume Range[3]	Outfalls likely to be affected by Watercourse Floodplain
	Approximate Total Paved Area	Existing Paved Area	Additional Paved Area	Total Estimated Culverts	Existing Identified Culverts	New Proposed Culverts	Total Estimated River Crossings	Existing Bridge Structures	New Proposed Bridge Structures	Total Estimated Outfalls[1]	Outfalls Discharging to Nearest Watercourse	Outfalls Discharging to Existing Drainage System[4]	Outfalls that may need a Pumped Discharge Solution[2]		
	(Ha)	(Ha)	(Ha)	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	m^3	No.
Option A	23	5	18	5	3	2	1	-	1	11	11	-	7	16000-21000	6
Option B	19	4	15	4	3	1	5	4	1	11	10	1	3	14000-17000	5
Option C	21	6	15	4	3	1	1	-	1	11	11	-	8	15000-19000	5

Notes:

1. This includes assumed existing outfalls. The number of potential outfall locations are subject to review in future project design stages and could vary depending on the existing surface water drainage arrangement and/or potential changes in the proposed highway geometry.

2. A pumped discharge solution is assumed for outfalls that may not achieve gravity discharge to nearby watercourses and is subject to review in future project design stages. All Route Options for the Black Cat Junction will require some outfalls with pumped discharges with Option B having fewer outfalls needing pumped discharges compared to Options A and C. It is noted that there is potential to raise the vertical alignment of the proposed road at three and four outfall locations for Option A and C respectively which would facilitate gravity discharge to the adjacent watercourse and eliminate the need for a pumped discharge solution. This will be investigated and confirmed through review of proposed highway geometry in subsequent design stages. There will also be a possibility to eliminate the need for a pumped discharge solution at one outfall location by combining outfalls and attenuation arrangements for Options B and C that would need to be investigated and confirmed through review of the proposed highway geometry and outfall arrangements at subsequent project design stages.

3. Attenuation storage will largely be achieved with the use of attenuation ponds. Online storage by means of oversized pipes will be required for the outfalls with spatially constrained sites. Option A and C will have one outfall location whereas Option B will have two outfall locations that would need online storage by means of oversized pipes due to the outfall being located in the floodplain of the nearest watercourse.

4. All outfalls will be discharging to nearby watercourses except for Option B where one outfall will be discharging to the existing surface water drainage system serving the Black Cat roundabout. For all options, there is a possibility for two outfall locations to potentially discharge to the existing surface water drainage system serving the Black Cat roundabout. For the outfalls discharging to the existing surface water drainage system, it is assumed that the existing surface water drainage system will have the capacity to accept the additional greenfield runoff from the widened road sections. This will have to be established at subsequent project design stages when existing surface water drainage system details become available.

5. This includes existing and new culvert crossings for the main watercourses and their floodplains. All options have existing culverts that may require extensions/modifications or potential upsizing subject to a climate change resilience assessment to be undertaken at subsequent project design stages. All options have culvert crossings with insufficient cover to the proposed road levels above the existing watercourses. It should be noted that there is potential to raise the vertical alignment of the proposed road at these culverts locations in order to achieve minimum cover requirements. This will be investigated and confirmed through a review of the proposed highway geometry at subsequent project design stages.

6. In addition to the main watercourse culvert crossings, drainage culvert crossings will be required to drain the proposed highway embankments and natural catchment runoff at the proposed junction arrangement for all options in order to mitigate surface water flooding of the road. At this preliminary assessment stage, the number of drainage culvert crossings is estimated to be 19 for Option A, 12 for Option B and 15 for Option C. It is noted there is potential to retain one existing culvert for Option A and two existing culverts for Options B and C. However, this would need to be reviewed at subsequent project design stages. A high level estimation of the catchment runoff, at this preliminary assessment stage, has indicated that these drainage culverts are likely to be less than 900mm in diameter and therefore are not considered to be structures. However, this would need to be reviewed at subsequent project design stages.

7. This includes existing and new bridge structures crossing the River Great Ouse and its floodplain. All options will have a new viaduct structure over the River Great Ouse for the proposed A428, east of Black Cat roundabout. The existing four bridge structures at Tempsford bridge which cross the River Great Ouse south of the Black Cat roundabout will remain unaffected for Options A and C, whereas, for Option B, these existing bridge structures will need to be widened to accommodate the new southbound A1 and its slip road.

8. For all options, certain sections of the proposed junction arrangement will require cut-off ditches to collect, convey and discharge natural catchment runoff to a nearby watercourse in order to mitigate the surface water flooding of the road. This could require large cut-off ditches to convey the contributing flows where the road is in cutting. This transfer of surface water to the adjacent catchments is assumed to have no significant impact to the downstream flood risk, however, this would need to be reviewed in subsequent project design stages.

Appendix D. **Constructability Report**

A428 Black Cat to Caxton Gibbet

Highways England

Construction Methodology & Phasing Report ADDENDUM

PCF Stage 2

HE551495-JAC-ZZZ-BCJN-REP-C-0001

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Contents

Executive Summary

The proposals announced as part of the Road Investment Strategy, published in 2014 include; improvement of the A428 near St Neots, linking the A421 to Milton Keynes with the existing dual carriageway section of the A428 to Cambridge.

The scheme is awaiting acceptance of an updated RIS commitment that specifies that Black Cat roundabout will be delivered as Phase 1 of the scheme.

Highways England have previously advised that they do not want existing stage 1 PCF deliverables to be amended to incorporate decisions made at a later date and hence the assessment of Phase 1 Black Cat junction only options shall not be included within the Interim Technical Appraisal Report (TAR) but instead included within a new Annex to the TAR that details that assessment.

The purpose of this Construction Methodology and Phasing Report Addendum is to inform that Annex for the TAR.

1. Introduction

Following completion of PCF Stage 1 – Option Identification, the shortlist list of options identified in the Technical Assessment Report (TAR) that were presented at a non-statutory consultation in March and April 2017 shall be further developed and evaluated throughout PCF stage 2 to provide the client with a full understanding of the Preferred Route Assessment.

However in addition to providing views on delivery of three offline solutions for the full scheme, Jacobs have been asked to also consider three Black Cat only junctions as part of Phase 1.

The purpose of this addendum is to outline the high level constructability benefits and difficulties of each of the three additional Phase 1 options. The summaries for each of the options will include high level principle quantities and the major activities associated with each option. Each of the options have been assessed on their constructability, highlighting the constraints and challenges that may be encountered as well as a high level phasing strategy that may be adopted.

This addendum should be read in conjunction with the original PCF Stage 1 report and will be included within the final scheme Technical Appraisal Report Annex.

2. Phase 1 Options

The A428 Black Cat to Caxton Gibbet project is currently in Stage 2 – Option Selection, of the Highways England Project Control Framework (PCF) lifecycle. During this stage, options will be evaluated and sifted in preparation for the Preferred Route Assessment. However in addition to the three full scheme offline options 1, 5 and 6, three additional phase 1 Black Cat junction only options have been identified for further assessment, which are as follows:

Consultation Reference	Option Description	Previous Reference
Option A	The construction of two roundabouts to the west of the current roundabout and slip roads for drivers to get from the A421 to the A1, and from the A1 to the A421. The new A421/A428 Expressway would pass over the top of the junction.	Option 1AC
Option B	Keeps the current Black Cat roundabout, a new free-flow continuous link from the A421 eastbound towards the A1 northbound. A1 to remain as existing with the addition of slip roads to provide a free flow link bypassing the roundabout for traffic moving southbound onto the A421. The new A421/A428 Expressway would pass over the top of the junction.	Option 3
Option C	Enlarging of the existing Black Cat roundabout, The A1 would become a continuous free-flow road under the widened Black Cat roundabout. Slip roads would be built from the A421 to the A1 and from the A1 to the A421. The new A421/A428 Expressway would pass over the top of the junction.	Option 2

This addendum provides an outline assessment of the constructability of each of the three Phase 1 options for inclusion in the Preferred Route Assessment.

3. Construction Delivery

3.1 Consultation Option A (previously Option 1)

3.1.1 Description of Option A

Option A includes construction of two new roundabouts to the west of the existing roundabout which would be removed. A new free-flow continuous link would be provided from the A421eastbound towards the A1 northbound. New slip roads to and from would connect the A421 and A1 and new A428 which would pass over the top of both the A1 and new slip roads. The A1 would become a free-flow continuous road going under the new slip roads.

Option 1 would also include construction of an offline section of new mainline carriageway (A421/A428 Expressway) to chainage 2250m from Black Cat towards Caxton Gibbet junction up to the new River Great Ouse crossing.

Given that construction of the new offline Expressway section needs to coincide with construction of the remaining offline A428 bypass, a phased delivery of the Black Cat junction has been assumed.

Stage 1 provides for the structures, earthworks and pavement necessary to form a working interchange to replace the existing junction and **stage 2** includes the A421/A428 new offline Expressway link.

See Appendix A of this document for the phasing sketch for Option A. For all other drawings refer to Appendix A of the TAR Stage 2 Annex.

Existing structures in Option A:

- There is one structure (BE14) over Roxton road. At this bridge location the new A428 D2AP is proposed together with new slip roads to the north and south. Hence the structure will be demolished and replaced with a new overbridge (BN08) to span over the entire A428 carriageway and both slip roads.
- The A1 Tempsford Bridge over the River Great Ouse would be retained.
- Three existing culverts need to be realigned and or extended – CE01, CE02 & CE09

New structures to be built in Option A:

- Five new bridges are required in stage 1 – BN01, BN03, BN06, BN07 & BN08
- Three new bridges are required in stage 2 – BN02, BN04 & BN05

Refer to Structures Report HE551495-JAC-SGN-BCJN-RP-S-0001 for full details.

In stage 1, the existing A421online bridge over Roxton road is to be demolished and replaced with a wider viaduct (BN08) to carry the new A421 Expressway link as well as new on and off slip roads. Two of the other new bridges are situated offline (BN01 & BN07) however they are in close proximity to the existing road. The

remaining two bridges (BN03 & BN06) are both partially online. Hence construction of all of the bridges in stage 1 will require local temporary diversions, lane closures and full closures hence significant disruption to current traffic on the existing roads would be expected. Careful planning and phasing will therefore be required to ensure that multiple structures can be constructed simultaneously such that effective delivery of a realistic construction programme can be achieved.

Three existing culverts need to be realigned or widened as part of stage 1 works. The A1 Brookhouse Chawson culvert @ Ch. 115m (CE01) needs to be increased from 28m to 100m. The A1 Black Cat culvert @ Ch. 530m (CE02) needs to be increased from 40m to 85m. The A428 culvert @ Ch. 945m (CE09) remains at 114m but needs to be realigned. All three culverts will need to be structurally assessed to check their suitability for retention.

An extensive phased road traffic management plan should be developed in conjunction with the construction programme and implemented in advance of construction of the overbridges and culverts. Construction work on multiple structures should also be coordinated during any road closures to maximise productivity and mitigate programme delays and risk.

Stage 1 would require placement of enough fill for multiple embankments as well as to raise the levels sufficient for construction of the elevated slip roads to the east of the roundabouts however it would not be necessary to import the entire fill necessary for the A421/A428 Expressway link at this stage which would reduce the replacement interchange programme duration.

Other than removal of topsoil for reuse on verges and new embankments, there is no cut material to be won.

This is particularly significant because all earthworks fill will therefore need to be imported from offsite which will dictate programme durations and have a significant disruptive impact on local traffic due to increased lorry numbers and vehicle movements during the construction phase.

Stage 2 would involve import and placement of the remaining fill material necessary for the A421/A428 Expressway link, both within the boundary of the new interchange as well as across the floodplain to the new River Great Ouse crossing, together with construction of the three remaining new bridges.

After stage 1 is complete and the road opened, the new and improved interchange will facilitate quicker, more effective construction vehicle movements which will in turn positively impact construction of stage 2 works.

The three remaining bridge structures are only necessary as part of the new Expressway link and hence their construction naturally fits in with formation of the embankments during stage 2. This logic is further reinforced because all three are situated on the existing road interchange. Hence to include their construction in stage 1 introduces significant complexities and programme phasing issues and will otherwise naturally extend the stage 1 programme.

However in the final road layout, construction will require new structures over new roads built in stage 1 which will have become operational, thereby requiring further inevitable disruption, lane closures and full closures for beam lifts.

Hence there is a third possibility whereby the earthworks, foundations and abutments for the three remaining bridges are also constructed towards the end of stage 1 when the new links are formed but the interchange not fully operational. Stage 2 works would therefore comprise just placing the deck and completing the pavement over. This would subsequently reduce the amount of construction in close proximity to the new live roads during stage 2, mitigate risk, reduce traffic disruption and cut programme durations.

As the new embankments for the Expressway link cross the flood plain adjacent to the River Great Ouse, the presence of underlying compressible alluvium material is likely which could result in consolidation and excessive settlement of any overlying embankment construction. Various techniques can be employed to overcome this constraint including bulk excavation and replacement, soil mixing, piling, geotextile fabrics and Controlled Modulus Columns. However some of these may be not be commercially viable.

If the ground material is suitable and sufficient time is available, one cost effective method of mitigating/overcoming much of the problem would be to surcharge the overlying ground over the footprint of the embankment for an extended period prior to construction and in advance of the main works by placement of bulk fill. Alternatively, construction of stage 2 works could begin at the start of the project and would comprise placement of embankment fill in layers (possibly combined with vertical band drains) over a long and protracted period of time thereby allowing for accelerated consolidation and sufficient increase in soil shear strength sufficient to support the new embankment without significant further settlement.

However the absence of suitable embankment fill material let alone additional surcharge material may preclude these options.

Given the huge quantities of fill required to form the proposed A421/A428 Expressway link embankment across the floodplain, options would need to be explored during the detailed design stage to reduce the size of the embankment by refining the embankment profile as well as potential lowering of the vertical alignment of the new road; however this would probably require a departure. Alternatively, high level viaducts could be introduced to replace the embankment and to support the new A421/A428 Expressway link in its entirety together with associated slip roads thereby eliminating the embankment altogether.

An existing high pressure gas main crosses the A1 to the south and the A421 to the west of the current Black Cat roundabout. Both locations would require extensive new roadworks and almost certainly the gas main will need to be diverted. It is recommended that these diversionary works are undertaken prior to commencement of the main contract as they can have exceptionally long lead in times which could otherwise delay the main works.

There is an existing National Cycle route, Public Rights of Way routes and Non-Motorised User routes that intersect or cross the proposed new works and access or alternative diversions will have to be maintained for all throughout construction.

It is assumed that a single Principal Contractor would undertake both stages of the contract due to the necessary interface between earthworks and structures relative to the new interchange.

Overall construction duration for **Option A stage 1** is anticipated to last approximately **21 months** excluding any initial enabling works such as site clearance, utility diversions, floodplain surcharging or any environmental constraints or mitigation measures necessary. Validity of these durations would be dependent on the outcomes of Geotechnical investigation, the statutory undertaker C3 notices and any environmental site surveys. **Option A stage 2** construction cannot be properly assessed without further detailed design. Current significant volumes of imported fill requirements to form the proposed embankment are untenable as a standalone Phase 1 delivery as they would significantly disrupt the supply chain over an extended period of years.

3.1.2 Works Specific – Major Activities Option A

The following are the key activities required for Option A **stage 1**:

- Diversion of existing HP Gas main in advance of main contract;
- Site clearance works and top soil strip;
- Bulk fill import for construction of both new roundabouts and slip road embankments;
- Note that spur connections should be constructed on both roundabouts for future connection to new A421/A28 Expressway links;
- Demolition of existing bridge BE14 and construction of new online viaduct BN08;
- Partial online construction of two new overbridges BN06 and BN03;
- Offline construction of two new overbridges BN01 and BN07;
- Online widening of A1 north south throughout interchange;
- Online widening/realignment of three existing culverts CE01, CE02 and CE09;
- Note that construction of the A1 southbound A421 westbound link embankment will sever the existing roundabout and it will be necessary to maintain a local diversion to provide access for southbound vehicles approaching the existing roundabout onto the western section of new link until such time the new overbridge and adjacent new link is completed. This will therefore best be undertaken towards the end of stage 1.
  Alternatively, consideration could be given to forming the central section of A1 southbound A421 westbound link as an elevated viaduct with supporting columns positioned in such a way so as to minimise impact on the existing road structure thereby enabling the road to remain open (excepting occasional night closures) during construction and thereby minimising disruption;
- Significant temporary traffic management, lane closures and localised diversions will be required to facilitate the simultaneous construction of these new structures and road widening;
- The opportunity should also be taken to provide temporary vehicle access for future construction traffic movements for the import of bulk fill to the area contained within the interchange;
- Installation of new drainage;
- New connection to Bedford road;
- Continuous link and slip road tie-ins between A421, A1 northbound and A1 southbound;

- Once all stage 1 links and tie-ins have been completed the existing roundabout and associated roads can be permanently closed thereby providing access for safe offline construction of the remaining pavement and structures.

The following are the additional key activities required for Option A **stage 2**:

- Divert existing services and decommission services within area;
- Demolish existing redundant pavement, roundabout and any substructures;
- Site clearance works and topsoil strip;
- Bulk fill import for new A421/A428 Expressway embankment and associated slips within interchange area;
- Online construction of offline underbridge BN05;
- Partial online construction of remaining two overbridges BN02 and BN04;
- Bulk fill import of fill across floodplain for new offline Expressway link up to Great River Ouse crossing;
- Installation of new highway drainage;
- Construction of new Expressway and slip road pavement including connection to roundabout spurs;
- Once this section of new Expressway has been completed it can be utilised by construction traffic (only) for safe effective site access for construction of the new Great River Ouse bridge and remaining offline Expressway to Caxton Gibbet.
  Existing traffic will continue to use the enhanced new junction layout until such time the remaining Expressway has been completed.

3.1.3 Key Quantities – Option A

Element of Works	Approximate Quantity
Drainage	
Pipework (Length) – Mainline	TBA *
Pipework (Length) – Junctions and slip roads	TBA *
Surface water pumping stations	TBA *
Earthworks	-
Stage 1 Cut	167,304 m^3 **
Stage 1 Fill	507,530 m^3 **
Stage 1 imported material to make up shortfall	340,226 m^3 **
Stage 2 Cut	16,856 m^3 **
Stage 2 Fill	973,649 m^3 **
Stage 2 imported material to make up shortfall	956,793 m^3 **
Total Cut	184,160 m^3 **
Total Fill	1,481,179 m^3 **
Total imported material to make up shortfall	1,297,019 m^3 **
Pavement	-
Pavement (asphalt) – Online construction	47,523 m^2
Pavement (asphalt) – Offline construction	95,051 m^2
Structures	-

Existing bridges to be retained (No works proposed)	1 No. ***
Existing culverts to be realigned or extended	3 No. ***
New Over/Under bridges to be built	8 No. ***
New NMU Footbridges to be built	0 No. ***
New Culverts to be built	0 No. ***

* = The pipework length is assumed to be in the verge on both sides of the carriageway running the full length that is being widened in each stage. It is anticipated that surface water pumping stations will be required to overcome vertical alignment/elevation issues.

** = The earthworks quantities do not take into account the suitability of site material, possible contamination or topsoil component.

*** = The material quantities for the structures, such as concrete and steel, will be provided following detailed design.

3.2 Consultation Option B (previously Option 3)

3.2.1 Description of Option B

Option B retains the existing Black Cat roundabout and north south A1. A new free-flow continuous link would be provided from the A421eastbound towards the A1 northbound. Two additional new free-flow continuous links bypassing the roundabout to be provided for both A1 southbound traffic and A421 westbound traffic and the new A421/A428 Expressway link would also pass over the top of the existing A1 and new slip roads.

Option B would also include construction of an offline section of new mainline carriageway (A421/A428 Expressway) to chainage 2250m from Black Cat towards Caxton Gibbet junction up to the new River Great Ouse crossing.

Given that construction of the new offline Expressway section needs to coincide with construction of the remaining offline A428 bypass, a phased delivery of the Black Cat junction has been assumed.

Stage 1 provides for the structures, earthworks and pavement necessary to form a more effective interchange and **stage 2** includes the A421/A4289 new offline Expressway link.

See Appendix A of this document for the phasing sketch for Option B. For all other drawings refer to Appendix A of the TAR Stage 2 Annex.

Existing structures in Option B:

- There is one structure (BE14) over Roxton road. At this bridge location the new A428 D2AP is proposed together with new slip roads to the north and south. Hence the structure will be demolished and replaced with a new overbridge (BN03) to span over the entire A428 carriageway and both slip roads.

- The A1 Tempsford Bridge over the River Great Ouse would also require widening
- Three existing culverts need to be realigned and or extended – CE01, CE02 & CE09

Existing structures to be built in Option B:

- Two new bridges are required in stage 1 – BN01 & BN03
- One new bridge is required in stage 2 – BN02

Refer to Structures Report HE551495-JAC-SGN-BCJN-RP-S-0001 for full details.

In stage 1 both new bridges are offline however both cross existing infrastructure. The existing A421 bridge over Roxton road is to be demolished and replaced with a 140m wide viaduct (BN03) that can accommodate the new A428 D2AP and associated new slip roads. The second new 225m long structure (BN01) passes over the existing Black Cat roundabout which is to be retained. Construction of these structures would therefore require local temporary diversions, lane closures and full closures. Hence disruption to current traffic on the existing roads and roundabout would be highly expected.

However the majority of new link roads are located offline and it will be possible to construct these embankments and pavements with minimal impact upon the existing roads.

Stage 1 would require placement of enough fill for multiple embankments as well as to raise the levels sufficient for construction of the elevated slip road links to the east of the existing A1 including Connector Road 3. However it would not be necessary to import the entire fill necessary for the full A421/A428 Expressway link to the Great River Ouse at this stage, which would reduce the programme duration.

As with Option A, the shortfall in fill material means that all fill will need to be imported from offsite which will dictate programme durations and impact on traffic disruptions during the construction phase. Topsoil won from initial site clearance should be stockpiled for re-use on verges and new embankments.

Three existing culverts need to be realigned or widened as part of stage 1 works and construction should be sequenced to align with the associated earthworks, The A1 Brookhouse Chawson culvert @ Ch. 115m (CE01) needs to be increased from 28m to 100m. The A1 Black Cat culvert @ Ch. 530m (CE02) needs to be increased from 40m to 80m. The A428 culvert @ Ch. 945m (CE09) remains at 114m but needs to be realigned. All three culverts need to be structurally assessed to check their suitability for retention.

Stage 2 would involve import and placement of the remaining fill material necessary for the A421/A428 Expressway link, both within the boundary of the new A421 slip roads as well as across the floodplain to the new River Great Ouse crossing, together with construction of the remaining new bridge (BN02). 229m (subject to confirmation) of this structure crosses over the new A1 southbound link as well as much of the existing roundabout and approach roads and construction will cause considerable disruption to traffic on both the existing A1 interchange and new A1 southbound links. Construction work for this structure will therefore require careful planning to ensure delivery is effective and disruption to traffic minimised.

After stage 1 is complete and operational, the enhanced interchange will facilitate quicker, more effective construction vehicle movements which in turn will lesson disruption to existing traffic during stage 2 works. Provision of the new A1 southbound continuous link in particular will provide network resilience and afford opportunities for local lane closures and diversions to facilitate quicker overhead bridge construction.

As with Option A, construction of bridge BN02 is for the A421/A428 Expressway link and hence naturally fits in stage 2 for similar reasons. Hence as with Option A, consideration should be given to construction of the earthworks, foundations and abutments towards the end of stage 1 leaving the deck structure for stage 2.

The new Expressway link extends across the flood plain as Option A, hence the same concerns, opportunities and mitigation measures with regards soft alluvial soils and long term settlement apply. Refer section 3.1.1 above.

As with Option A, there are huge quantities of imported fill required to form the proposed embankment across the floodplain for the A421/A428 Expressway link and slip roads. Hence the opportunity should be taken to revisit the profile of the embankment and reduce it to a minimum, or alternatively to utilise viaducts to support the carriageways instead.

Similarly, the existing high pressure gas main should be diverted prior to the main contract and the National Cycle route, Public Rights of Way routes and Non-Motorised User routes all maintained throughout construction.

It is assumed that a single Principal Contractor will undertake both stages of the contract due to the necessary interface between earthworks and structures relative to the new interchange.

Overall construction duration for **Option B stage 1** is anticipated to last approximately **18 to 21 months** excluding any initial enabling works such as site clearance, utility diversions, floodplain surcharging or any environmental constraints or mitigation measures necessary. Validity of these durations would be dependent on the outcomes of Geotechnical investigation, the statutory undertaker C3 notices and any environmental site surveys. **Option B stage 2** construction cannot be properly assessed without further detailed design. Current significant volumes of imported fill requirements to form the proposed embankment are untenable as a standalone Phase 1 delivery as they would significantly disrupt the supply chain over an extended period of years.

3.2.2 Works Specific – Major Activities Option B

The following are the key activities required for **Option B stage 1**:

- Diversion of existing HP Gas main in advance of main contract;
- Site clearance works and top soil strip;
- Bulk fill import for construction of the continuous link and slip road embankments;
- Construction of three new overbridges – BN01, BN03 and part construction of BN02;
- Online widening of the A1 Tempsford bridge;

- Online widening/realignment of three existing culverts CE01, CE02 and CE09;
- Significant temporary traffic management, lane closures and localised diversions will be required to facilitate the simultaneous construction of these new structures;
- The opportunity should also be taken to provide temporary vehicle access for future construction traffic movements for the import of bulk fill to the area contained within the interchange
- Installation of new drainage;
- New A421 eastbound and westbound slip road connections to Black Cat roundabout;
- Continuous link and slip road tie-ins between A421, A1 northbound and A1 southbound;
- Once the A1 southbound continuous link and tie-in has been completed, opportunity exists to phase and alternate local diversion of A1 southbound traffic to suit stage 2 construction works thereby providing improved access for safe offline construction of the remaining pavement and structure.

The following are the additional key activities required for **Option B stage 2**:

- Divert any remaining existing services and decommission services within area;
- Demolish existing redundant pavement to west of Black Cat roundabout and any substructures;
- Site clearance works and topsoil strip;
- Bulk fill import for new A421/A428 Expressway embankment within interchange area;
- Offline construction of remaining 219m overbridge structure (BN02);
- Bulk fill import of fill across floodplain for new offline Expressway link up to Great River Ouse crossing;
- Installation of new highway drainage;
- Construction of new Expressway and Connector Road 2 pavement including tie-ins to A421 and A1;
- Once this section of new Expressway has been completed it can be utilised by construction traffic (only) for safe effective site access for construction of the new Great River Ouse bridge and remaining offline Expressway to Caxton Gibbet.
  Existing traffic will continue to use the enhanced new junction layout until such time the remaining Expressway has been completed.

3.2.3 Key Quantities – Option B

Element of Works	Approximate Quantity
Drainage	
Pipework (Length) – Mainline	TBA*
Pipework (Length) – Junctions and slip roads	TBA*
Surface water pumping stations	TBA
Earthworks	-
Stage 1 Cut	70,946 m^3 **
Stage 1 Fill	367,988 m^3 **
Stage 1 imported material to make up shortfall	297,042 m^3 **
Stage 2 Cut	13,660 m^3 **

Stage 2 Fill	797,434 m^3 **
Stage 2 imported material to make up shortfall	783,774 m^3 **
Total Cut	84,606 m^3 **
Total Fill	1,165,423 m^3 **
Total imported material to make up shortfall	1,080,817 m^3 **
Pavement	-
Pavement (asphalt) – Online construction	27,099 m^2
Pavement (asphalt) – Offline construction	84,091 m^2
Structures	-
Existing bridges to be retained (No works proposed)	0 No. ***
Existing bridges to be widened	4 No. ***
Existing culverts to be realigned or extended	3 No. ***
New Over/Under bridges to be built	3 No. ***
New NMU Footbridges to be built	0 No. ***
New Culverts to be built	0 No. ***

* = The pipework length is assumed to be in the verge on both sides of the carriageway running the full length that is being widened in each stage. It is anticipated that surface water pumping stations will be required to overcome vertical alignment/elevation issues.

** = The earthworks quantities do not take into account the suitability of site material, possible contamination or topsoil component.

*** = The material quantities for the structures, such as concrete and steel, will be provided following detailed design.

3.3 Consultation Option C (previously Option 2)

3.3.1 Description of Option C

Option C includes replacing the existing Black Cat junction with an enlarged 3 tier roundabout. The A1 would become a continuous free-flow road under the widened Black Cat roundabout. A continuous link would be formed from the A421 eastbound to A1 northbound and additional slip roads would be built from the A421 and A1 connecting to the new elevated roundabout. The new A421/A428 Expressway link would pass over the top of both the roundabout and A1.

Option C would also include construction of an offline section of new mainline carriageway (A421/A428 Expressway) to chainage 2250m from Black Cat towards Caxton Gibbet junction up to the new River Great Ouse crossing.

Given that construction of the new offline Expressway section needs to coincide with construction of the remaining offline A428 bypass, a phased delivery of the Black Cat junction has been assumed.

Stage 1 provides for the structures, earthworks and pavement necessary to form a working interchange to replace the existing junction and **stage 2** includes the A421/A428 new offline Expressway link.

See Appendix A of this document for the phasing sketch for Option C. For all other drawings refer to Appendix A of the TAR Stage 2 Annex.

Existing structures in Option C:

- There is one structure (BE14) over Roxton road. At this bridge location the new A428 D2AP is proposed together with new slip roads to the north and south. Hence the structure will be demolished and replaced with a new overbridge (BN04) to span over the entire A428 carriageway and both slip roads.
- The A1 Tempsford Bridge over the River Great Ouse would be retained.
- Three existing culverts need to be realigned and or extended – CE01, CE02 & CE09

New structures to be built in Option C:

- Three new bridges are required in stage 1 – BN02, BN03 & BN04
- One viaduct is required in stage 2 – BN01

Refer to Structures Report HE551495-JAC-SGN-BCJN-RP-S-0001 for full details.

In stage 1 all three new bridges are partially online. One is over existing Roxton road. The two new overbridges for the elevated roundabout are located partially over the existing A1 and existing roundabout. Construction of these structures will need to coincide with realignment and widening of the relevant section of A1 and will therefore require substantial local diversions, lane closures and full closures with long term Traffic Management throughout construction. Hence significant disruption to current traffic on the existing roads and roundabout is unavoidable. Careful planning and phasing will therefore be required to ensure that these two structures can be constructed simultaneously and integrated with realignment of the A1 such that effective delivery of a realistic construction programme can be achieved.

Stage 1 would require placement of enough fill for the new roundabout embankments as well as to raise the levels sufficient for construction of the elevated continuous link and A1 slip roads. However as with options A and B it would not be necessary to import the entire fill necessary for the A421/A428 Expressway link at this stage.

Three existing culverts need to be realigned or widened as part of stage 1 works. The A1 Brookhouse Chawson culvert @ Ch. 115m (CE01) needs to be increased from 28m to 60m. The A1 Black Cat culvert @ Ch. 530m (CE02) needs to be increased from 40m to 80m. The A428 culvert @ Ch. 945m (CE09) remains at 114m but needs to be realigned. All three culverts need to be structurally assessed to check their suitability for retention.

Stage 2 would involve import and placement of the remaining fill material necessary for the A421/A428 Expressway link across the flood plain to the new River Great Ouse crossing, together with construction of the single remaining viaduct (BN01) over the new roundabout.

The new viaduct is only necessary as part of the new Expressway link and hence construction naturally fits in with formation of the floodplain embankment in stage 2. Furthermore, the location of the new viaduct is over much of the existing roundabout. Hence to include full construction in stage 1 introduces substantial

complexities and additional constraints thereby introducing yet more complexity and programme phasing issues that will significantly extend the stage 1 programme.

However as is the case with Option A, there is an opportunity to undertake an element of advanced works such that the earthworks, foundations and the abutments for the viaduct are also constructed towards the end of stage 1. Stage 2 works would then comprise completing the columns and forming the high level deck structure over the interchange.

However the complexity, technical challenge and risk that remains in constructing the high level viaduct structure during stage 2 should not be underestimated. Careful thought and planning through detailed design should be utilised to consider all possible alternative construction methodologies, technologies, phasing and sequencing to mitigate technical, programme and construction risk. The use of precast concrete deck sections or incremental launch of a new deck from outside of the roundabout, are both worthy of detailed consideration.

The new Expressway link extends across the flood plain as Option A, hence the same concerns, opportunities and mitigation measures with regards soft alluvial soils and long term settlement apply. Refer to Section 3.1.1 above.

As with Option A and Option B, the volume of imported fill required to construct the proposed embankments to support the A421/A428 Expressway link are not tenable. Options to reduce the embankments or replace them altogether with viaducts should be explored during detailed design.

Similarly, the existing high pressure gas main should be diverted prior to the main contract and the National Cycle route, Public Rights of Way routes and Non-Motorised User routes all maintained throughout construction.

It is assumed that the same Principal Contractor will undertake both stages of the contract due to the necessary interface between earthworks and structures relative to the new interchange.

Overall construction duration for **Option C stage 1** is anticipated to last approximately **21 to 24 months** excluding any initial enabling works such as site clearance, utility diversions, floodplain surcharging or any environmental constraints or mitigation measures necessary. Validity of these durations would be dependent on the outcomes of Geotechnical investigation, the statutory undertaker C3 notices and any environmental site surveys. **Option C stage 2** construction cannot be properly assessed without further detailed design. Current significant volumes of imported fill requirements to form the proposed embankment are untenable as a standalone Phase 1 delivery as they would significantly disrupt the supply chain over an extended period of years.

3.3.2 Works Specific – Major Activities Option C

The following are the key activities required for **Option C stage 1**:

- Diversion of existing HP Gas main in advance of main contract;

- Site clearance works and top soil strip;
- Bulk fill import for construction new elevated roundabout and slip road embankments;
- Note that spur connections should be constructed on the roundabout for future connection to new A421/A28 Expressway links;
- Partial online construction of two new overbridges – BN02 and BN03;
- Offline construction of new overbridge (BN04) and partial construction of the new viaduct (BN01);
- Online widening/realignment of three existing culverts CE01, CE02 and CE09;
- Online realignment/widening of A1 north south throughout interchange;
- Significant temporary traffic management, lane closures and localised diversions will be required to facilitate the simultaneous construction of these new structures and road widening;
- The opportunity should also be taken to provide temporary vehicle access for future construction traffic movements for the elements of stage 2 contained within the interchange;
- Installation of new drainage;
- New connection to Bedford road;
- Continuous link and slip road tie-ins between A421, A1 northbound and A1 southbound;
- Northbound and southbound slip roads between the A1 and new elevated roundabout.

The following are the additional key activities required for **Option C stage 2**:

- Divert existing services and decommission services within area;
- Demolish existing redundant pavement, roundabout and any substructures;
- Site clearance works and topsoil strip;
- Bulk fill import for new A421/A428 Expressway embankment approaching the viaduct;
- Partial online construction (or completion of construction) of viaduct structure over roundabout (BN01);
- Bulk fill import of fill across floodplain for new offline Expressway link up to Great River Ouse crossing;
- Installation of new highway drainage;
- Construction of new Expressway and slip road pavement including connection to roundabout spurs;
- Once this section of new Expressway has been completed it can be utilised by construction traffic (only) for safe effective site access for construction of the new Great River Ouse bridge and remaining offline Expressway to Caxton Gibbet.
  Existing traffic will continue to use the enhanced new junction layout until such time the remaining Expressway has been completed.

3.3.3 Key Quantities – Option C

Element of Works	Approximate Quantity
Drainage	
Pipework (Length) – Mainline	TBA*
Pipework (Length) – Junctions and slip roads	TBA*

Surface water pumping stations	TBA
Earthworks	-
Stage 1 Cut	98,843 m^3 **
Stage 1 Fill	462,000 m^3 **
Stage 1 imported material to make up shortfall	363,157m^3 **
Stage 2 Cut	12,942 m^3 **
Stage 2 Fill	2,465,481 m^3 **
Stage 2 imported material to make up shortfall	2,452,539 m^3 **
Total Cut	111,786 m^3 **
Total Fill	2,927,481 m^3 **
Total imported material to make up shortfall	2,815,695 m^3 **
Pavement	-
Pavement (asphalt) – Online construction	48,726 m^2
Pavement (asphalt) – Offline construction	83,924 m^2
Structures	-
Existing bridges to be retained (No works proposed)	1 No. ***
Existing culverts to be realigned or extended	3 No. ***
New Over/Under bridges to be built	4 No. ***
New NMU Footbridges to be built	0 No. ***
New Culverts to be built	0 No. ***

* = The pipework length is assumed to be in the verge on both sides of the carriageway running the full length that is being widened in each stage. It is anticipated that surface water pumping stations will be required to overcome vertical alignment/elevation issues.

** = The earthworks quantities do not take into account the suitability of site material, possible contamination or topsoil component.

*** = The material quantities for the structures, such as concrete and steel, will be provided following detailed design.

4. Conclusions & Recommendations

The above assessments of the options have led to the following rankings with 1st Choice being most preferred from a **construction** perspective.

The ranking contemplates the ease of construction with regard to consideration for worker safety, prospects for efficient productive sequencing, opportunity to apply lean construction to maximise productivity and minimise construction and programme risk.

The main influencing factors are whether construction is online or offline, simplicity of design, volumes of earthworks, geology and environmental factors, structures and pavement metrics, number and span of bridges, traffic disruption and opportunities to improve stakeholder experience during construction.

The following table provides details of the ranking process for each of the options and resultant score.

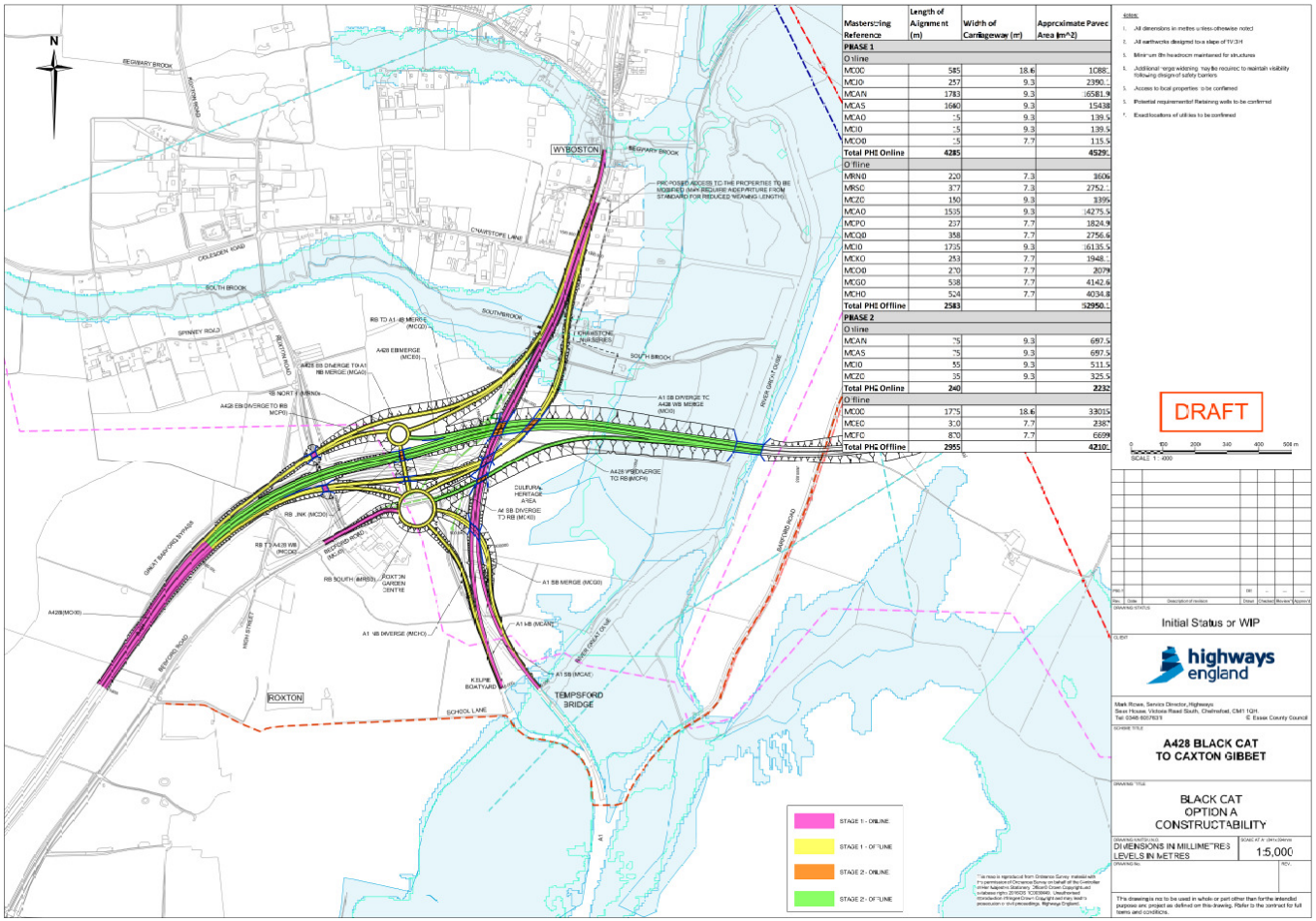
Item	Influencing factor on construction	Option A	Option B	Option C
1	**Ratio Online/Offline road construction**	33% online / 67% offline	24% online / 76% offline	37% online / 63% offline
		Median proportion online	Least proportion online	Greatest proportion online
	Rank	2	1	3
2	**Simplicity of design**	New twin dumbell roundabouts	Existing roundabout retained	New three tier roundabout at location of existing
		Multiple slips	Minimal slips	Multiple slips
		Elevated contiuous flow link	Three continuous flow links (1 elevated)	Single continuous flow link
		Expressway passes over 2 levels	Expressway passes over 1 level	Expressway passes over 2 levels
	Rank	3	1	2
3	**STAGE 1 Earthworks Volumes**	166,000 m3 cut	71,000 m3 cut	99,000 m3 cut
		508,000 m3 fill	368,000 m3 fill	462,000 m3 fill
		342,000 m3 shortfall in stage 1	297,000 m3 shortfall in stage 1	363,000 m3 shortfall in stage 1
		Median amount of imported earthworks	Least amount of imported earthworks	Most amount of imported earthworks
	Rank	2	1	3
4	**Geotechnical concerns and risk**	Least amount of construction on floodplain	Most amount of construction on floodplain	Median amount of construction on floodplain
	Rank	1	3	2
5	**Impact of Environmental mitiagtion**	Least amount of construction on floodplain	Most amount of construction on floodplain	Median amount of construction on floodplain
		1	3	2
6	**New pavement metrics**	47,523 m2 online pavement	27,099 m2 online pavement	48,726 m2 online pavement
	Rank	95,051 m2 offline pavement	84,091 m2 offline pavement	83,924 m2 offline pavement
		Most amount of new pavement	Least amount of new pavement	Median amount of new pavement
	Rank	3	1	2
7	**New and Existing Bridge structures & Culverts**	BE14 - Demolished and replaced by BN08	BE14 - Demolished and replaced by BN03	BE14 - Demolished and replaced by BN04
		BN01 - 3 or 4 span, total span 48m	BE01/02/03/04 - Widened	BN01 - 5 span viaduct, total span 230m
		BN02 - 3 or 4 span, total span 110m	BN01 - 5 span viaduct, total span 225m	BN02 - Single or 3 span, total span 72m
		BN03 - 3 or 4 span, total span 110m	BN02 - TBA, total span 229m (TBC)	BN03 - Single or 3 span, total span 72m
		BN04 - 3 or 4 span, total span 85m	BN03 - 4 span viaduct, total span 140m	BN04 - 4 span viaduct, total span 140m
		BN05 - Single span, total span 25m	CE01 - Increase length from 28m to 100m	CE01 - Increase length from 28m to 60m
		BN06 - Single or 3 span, total span 85m	CE02 - Increase length from 40m to 120m	CE02 - Increase length from 40m to 80m
		BN07 - Single span, total span 20m	CE09 - Realign existing 114m long	CE09 - Realign existing 114m long
		BN08 - 4 span viaduct, total span 140m		
		CE01 - Increase length from 28m to 100m		
		CE02 - Increase length from 40m to 85m		
		CE09 - Realign existing 114m long		
	Rank	3	1	2
8	**New online/partial online bridge construction**	BN02, BN03, BN04, BN06, BN08	BN01, BN02, BN03, BE01/02/03/04	BN01, BN02, BN03, BN04
	Rank	3	2	1
9	**Traffic disruption and opportunies to improve local stakeholder experience during consruction**	Large proportion of new slips and links can be constructed offline	Virtually all new slips and links can be constucted offline	The least proportion of new slips and links can be constructed offline
		Section of A1 can be widened offline	Majority of A1 can be widened offline	Section of A1 can be widened offline
		Opportunity to maintain traffic flow around existing roundabout during initial part of stage 1	Opportunity to maintain traffic flow around existing roundabout throughout stage 1	It will not be possible to maintain traffic flow around the existing interchange during stage 1 and long term temporary diversions will be required
		Completion of stage 1 works will cause significant traffic disruption	Completion of stage 1 works will cause least traffic disruption	Completion of stage 1 works will cause maximum traffic disruption
	Rank	2	1	3
	Cumulative Score	60	76	50
Preference		**Second choice**	**First choice**	**Third choice**

The following table shows the result of the ranking process and the primary reasons:

Option	In order of preference	Primary Reasons
Option B	1st Choice (Score 76%)	• Least proportion of online construction • Greatest simplicity of design • Least imported material (for stage 1) • Most amount of construction on flood plain • Least amount of new pavement • Least new complex bridge structures • Median amount of new online bridge construction • Greatest opportunity to minimise traffic disruption and enhance local stakeholder experience during construction • Stage 1 construction duration would be approximately 18 to 21 months
Option A	2nd Choice (Score 60%)	• Median proportion of online construction • Least simplicity of design • Median imported material (for stage 1) • Least amount of construction on flood plain • Most amount of new pavement • Most new complex bridge structures • Most amount of new online bridge construction • Median opportunity to minimise traffic disruption and enhance local stakeholder experience during construction • Stage 1 construction duration would be approximately 21 months
Option C	3rd Choice (Score 50%)	• Greatest proportion of online construction • Median simplicity of design • Most imported material (for stage 1) • Median amount of construction on flood plain • Median amount of new pavement • Median new complex bridge structures • Least amount of new online bridge construction • Least opportunity to minimise traffic disruption and enhance local stakeholder experience during construction • Stage 1 construction duration would be approximately 21 to 24 months

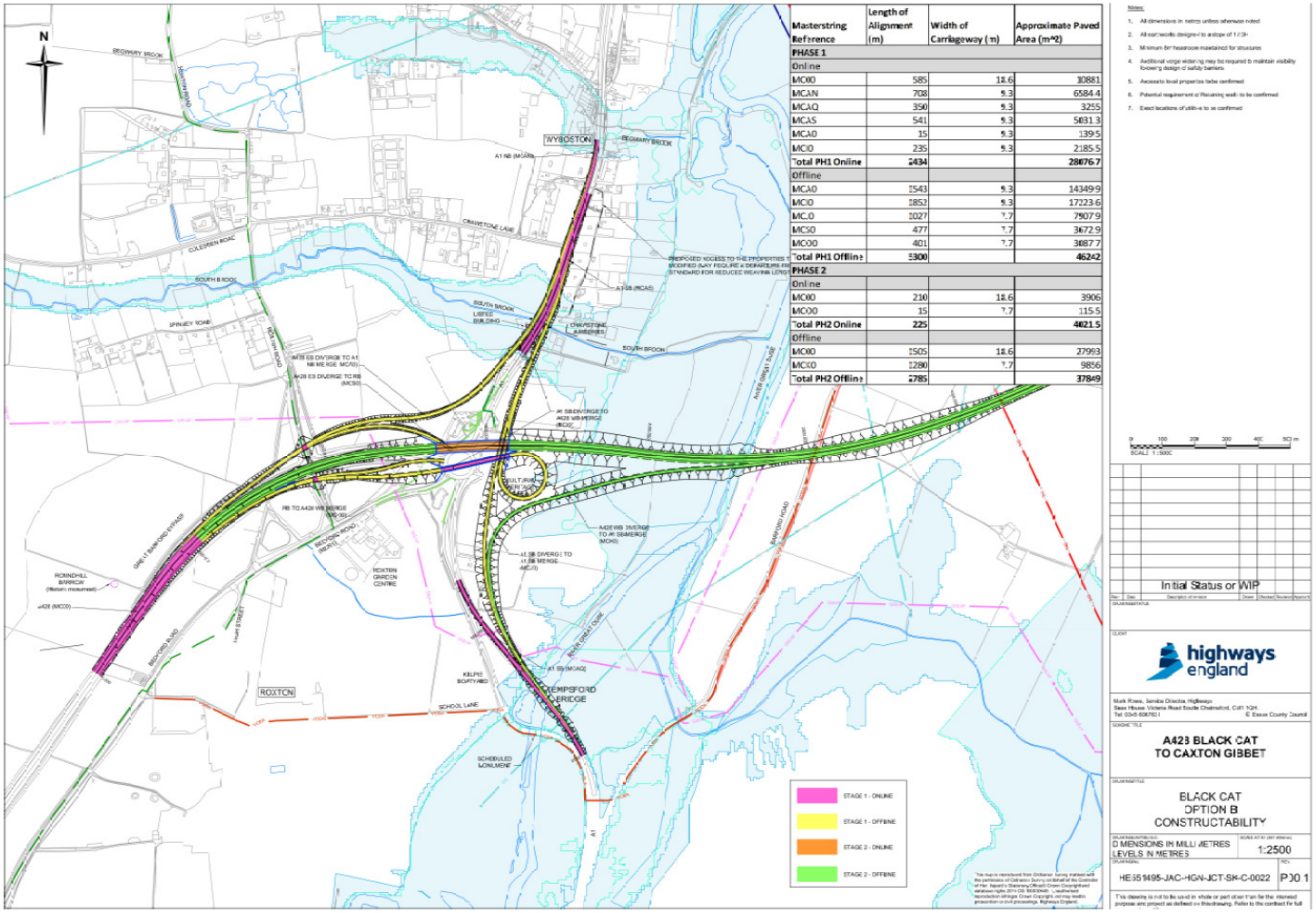
Appendix A. Phasing Sketches

Option A Phase Sketch



Mastersizing Reference	Length of Alignment (m)	Width of Carriageway (m)	Approximate Paved Area (m^2)
PHASE 1			
Offline			
MC00	585	18.6	1088.
MC10	257	9.3	2390.
MCAN	1783	9.3	16581.9
MCAS	1660	9.3	15438
MCA0	15	9.3	139.5
MC10	15	9.3	139.5
MCQ0	15	7.7	115.5
Total PHE Online	4285		4529.
Offline			
MRN0	220	7.3	3606
MR50	377	7.3	2752.
MCZ0	150	9.3	1395
MCA0	1535	9.3	14275.5
MCP0	237	7.7	1824.9
MCQ0	358	7.7	2756.6
MC10	1735	9.3	16135.5
MCK0	253	7.7	1948.
MCQ0	270	7.7	2079
MCG0	538	7.7	4142.6
MCH0	524	7.7	4034.8
Total PHE Offline	2583		52950.
PHASE 2			
Offline			
MCAN	75	9.3	697.5
MCAS	75	9.3	697.5
MC10	55	9.3	511.5
MCZ0	35	9.3	325.5
Total PHE Online	240		2232
Offline			
MC00	1775	18.6	33015
MCEC	310	7.7	2387
MCFC	870	7.7	6699
Total PHE Offline	2955		42101

Option B – Phasing Sketch



Masterstring Reference	Length of Alignment (m)	Width of Carriageway (m)	Approximate Paved Area (m^2)
PHASE 1			
Online			
MC00	585	18.6	10881
MCAN	708	9.3	6584.4
MCAQ	350	9.3	3255
MCAS	541	9.3	5031.3
MCA0	15	9.3	139.5
MC10	235	9.3	2185.5
Total PH1 Online	2434		28076.7
Offline			
MCA0	1543	9.3	14349.9
MC10	1852	9.3	17223.6
MC.0	1027	7.7	7907.9
MCS0	477	7.7	3672.9
MCO0	401	7.7	3087.7
Total PH1 Offline	5300		46242
PHASE 2			
Online			
MC00	210	18.6	3906
MCO0	15	7.7	115.5
Total PH2 Online	225		4021.5
Offline			
MC00	1505	18.6	27993
MCI0	1280	7.7	9856
Total PH2 Offline	2785		37849

Notes:
1. All dimensions in metres unless otherwise noted
2. All earthworks designed to a slope of 1 in 3
3. Minimum 6m headroom maintained for structures
4. Additional verge widening may be required to maintain visibility following design of safety barriers
5. Access to local properties to be confirmed
6. Potential requirement of Retaining wall to be confirmed
7. Exact locations of utilities to be confirmed

SCALE 1:5000

Initial Status or WIP

highways england

A423 BLACK CAT TO CAXTON GIBBET

BLACK CAT OPTION B CONSTRUCTABILITY

DIMENSIONS IN MILLIMETRES LEVELS IN METRES

1:2500

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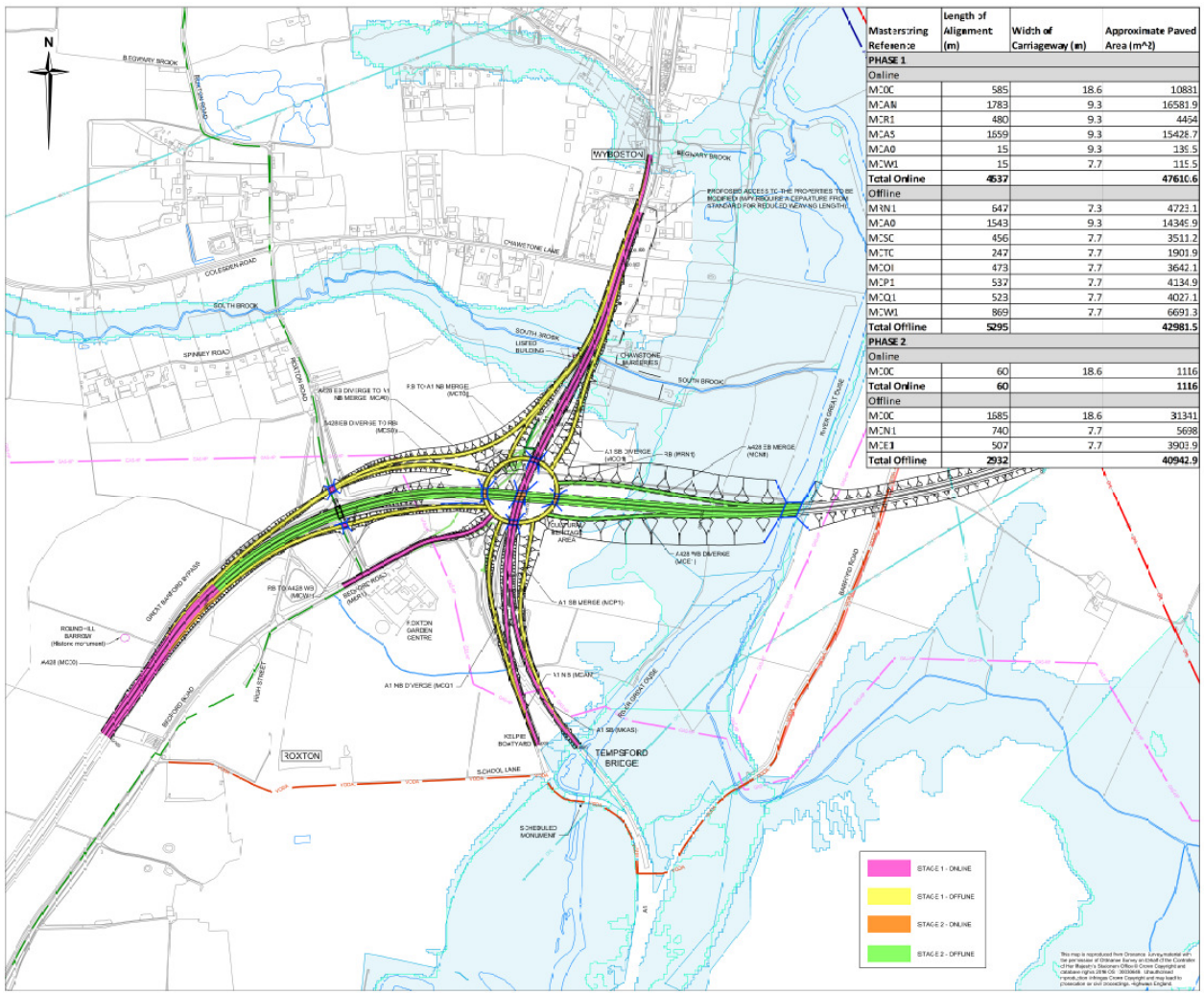
JACOBS

Option C – Phasing Sketch



Mastersring Reference	Length of Aligament (m)	Width of Carriageway (m)	Approximate Paved Area (m^2)
PHASE 1			
Online			
MC0C	585	18.6	10831
MCAN	1783	9.3	16581.9
MCR1	480	9.3	4454
MCA5	1659	9.3	15428.7
MCA0	15	9.3	139.5
MCW1	15	7.7	115.5
Total Online	**4537**		**47610.6**
Offline			
MRN1	647	7.3	4723.1
MCA0	1543	9.3	14345.9
MCSC	456	7.7	3511.2
MCTC	247	7.7	1901.9
MCOI	473	7.7	3642.1
MCP1	537	7.7	4134.9
MCQ1	523	7.7	4027.1
MCW1	869	7.7	6691.3
Total Offline	**5295**		**42981.5**
PHASE 2			
Online			
MC0C	60	18.6	1116
Total Online	**60**		**1116**
Offline			
MC0C	1685	18.6	31341
MCN1	740	7.7	5698
MCE1	507	7.7	3903.9
Total Offline	**2932**		**40942.9**

Notes:
1. All dimensions in metres unless otherwise noted
2. All earthworks designed to a slope of 1V:3H
3. Minimum 5m headroom maintained for structures
4. Additional verge widening may be required to maintain visibility following design of safety barriers
5. Access to local properties to be confirmed
6. Potential requirement of Retaining walls to be confirmed
7. Exact locations of utilities to be confirmed

0 100 200 300 400 500 m
SCALE 1 : 5 000 at A3

highways england

Mark Rees, Service Director, Highways
Spatial House, Victoria Road South, Chelmsford, CM1 1QH
Tel: 0345 6031931 © Essex County Council

A428 BLACK CAT TO CAXTON GIBBET

BLACK CAT OPTION C CONSTRUCTABILITY

DIMENSIONS IN MILLIMETRES
LEVELS IN METRES
1:2500

This drawing is not to be used in whole or part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full

Appendix E. **Highways Design**

Table E1.1 – Option A Connector Road Design Values

Table E2.1 – Option B Connector Road Design Values

Table E3.1 – Option C Connector Road Design Values

Table E1.1 - Option A Connector Road Design Values

Design Parameters	Slip Road/ Interchange Links							
	Diverges		Merges		A428 EB to A1 NB (Roundabout Bypass)		A1 SB to A428 WB (A1 SB diverge Link)	
	A428 WB	A1 NB	A428 EB	A1 SB				
Length	872m	424m	313m	538m	1547m		1746m	
Slip or Link	Link	Slip	Slip	Slip	Link		Link	
Design Speed	85kph	70kph	70kph	70kph	85kph		85kph	
Near straight length	70m	70m	85m	0m*	70m	75m	70m	85m
Minimum horizontal radius	540m	360m	360m	180m	510m		360m	
Maximum Superelevation	5.00%	5.00%	5.00%	5.00%	5.00%		5.00%	
Minimum Crest K Value	100	50	17	30	55		30	
Minimum Sag K Value	N/A	25	20	20	20		20	
Maximum Gradient	2.00%	2.00%	4.00%	5.00%	4.90%		1.18%	
Verge Widening length	N/A	N/A	N/A	250m	N/A		610m	
Verge Widening Max. Width	N/A	N/A	N/A	8.4m	N/A		6.9m	

Design Parameters	Links to/from Roundabouts			
	Diverges		Merges	
	A428 EB to RB	A1 SB to RB	RB to A1 NB	RB to A428 WB
Length	237m	253m	358m	284m
Slip or Link	Slip	Slip	Slip	Slip
Design Speed	70kph	70kph	70kph	70kph
Near straight length	52m*	70m	75m	75m
Minimum horizontal radius	360m	510m	510m	532m
Maximum Superelevation	5.00%	5.00%	5.00%	5.00%
Minimum Crest K Value	55	31	30	55
Minimum Sag K Value	N/A	20	31	20
Maximum Gradient	N/A	2.00%	N/A	3.50%
Verge Widening length	N/A	N/A	N/A	N/A
Verge Widening Max. Width	N/A	N/A	N/A	N/A

Table E2.1 - Option B Connector Road Design Values

Design Parameters	Slip Road/ Interchange Links							
	A428 EB to A1 NB (Connector Road 1)		A428 WB to A1 SB (Connector Road 2)		A1 SB to A428 WB (Connector Road 3)		Connector Road 3 to A1 SB	
Length	1558m		1280m		2087m		1027m	
Slip or Link	Link		Link		Link		Link	
Design Speed	85kph		85kph		85kph		85kph	
Near straight length	70m	75m	70m	75m	0m	85m	70m	75m
Minimum horizontal radius	360m		180m		75m (Loop)		540m	
Maximum Superelevation	5.00%		5.00%		7.00%		5.00%	
Minimum Crest K Value	60		60		55		60	
Minimum Sag K Value	20		50		25		25	
Maximum Gradient	0.86%		3.62%		4.50%		3.00%	
Verge Widening length	N/A		N/A		N/A		N/A	
Verge Widening Max. Width	N/A		N/A		N/A		N/A	

Design Parameters	Links to/from	
	Diverges	Merges
	A428 EB to RB	RB to A428 WB
Length	477m	416m
Slip or Link	Slip	Slip
Design Speed	70kph	70kph
Near straight length	70m	75m
Minimum horizontal radius	360m	360m
Maximum Superelevation	5.00%	5.00%
Minimum Crest K Value	12	55
Minimum Sag K Value	50	27
Maximum Gradient	N/A	1.50%
Verge Widening length	N/A	N/A
Verge Widening Max. Width	N/A	N/A

Table E3.1 - Option C Connector Road Design Values

Design Parameters	Slip Road/ Interchange Links							
	Diverges			Merges			A428 EB to A1 NB (Roundabout Bypass)	
	A428 WB	A1 NB	A1 SB	A428 EB	A1 SB	A428 WB		
Length	507m	523m	473m	741m	537m	883m	1558m	
Slip or Link	Slip	Slip	Slip	Slip	Slip	Link	Link	
Design Speed	70kph	70kph	70kph	70kph	70kph	85kph	85kph	
Near straight length	70m	70m	70m	85m	0m*	85m	70m	75m
Minimum horizontal radius	510	360m	360m	1020m	360m	720m	360m	
Maximum Superelevation	3.50%	5.00%	5.00%	2.50%	5.00%	3.50%	5.00%	
Minimum Crest K Value	30	40	30	55	30	40	55	
Minimum Sag K Value	20	30	25	20	20	30	20	
Maximum Gradient	6.00%	2.00%	6.00%	4.00%	6.00%	2.00%	4.00%	
Verge Widening length	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Verge Widening Max. Width	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Design Parameters	Links to/from	
	Diverges	Merges
	A428 EB to RB	RB to A1 NB
Length	456m	247m
Slip or Link	Slip	Slip
Design Speed	70kph	70kph
Near straight length	70m	75m
Minimum horizontal radius	538m	510m
Maximum Superelevation	5.00%	5.00%
Minimum Crest K Value	60	30
Minimum Sag K Value	657	N/A
Maximum Gradient	0.50%	4.10%
Verge Widening length	N/A	N/A
Verge Widening Max. Width	N/A	N/A

Notes:

1. Verge widenings have only been undertaken where there is a requirement for a bridge structure in order to approximate the maximum structure width.

2. A428 and A1 are designated a rural roads with a speed limit of 120kph and the 100kph respectively

3. Superelevation limited to 5.00% maximum other than where a loop section occurs

4. *Indicates a Departure from Standard. Only singular departures are shown in these tables. For a detailed Departure from Standard list, refer to the PCF Stage 2 Departure from Standard Checklist.

Appendix I - Stage 1 Environmental Assessment Report (December 2016)

AS14 (RIS) Schemes

A428 Black Cat to Caxton Gibbet

Stage 1 Environmental Assessment Report

December 2016

Contents

Executive Summary

Introduction

Highways England is the new government company charged with driving forward our motorways and major A roads (the strategic road network – SRN). This includes modernising and maintaining the highways, as well as running the network and keeping traffic moving. The Roads Investment Strategy (RIS) sets out the funding for major road schemes and includes funding to improve the A428 to the south of St Neots, in Cambridgeshire.

This is the Environmental Assessment Report (EAR) for the A428 Black Cat to Caxton Gibbet Scheme (hereafter referred to as the Proposed Scheme). It has been produced to support the Technical Appraisal Report (TAR) in the scheme assessment process. The EAR identifies the key environmental opportunities and constraints that would need to be considered in taking forward the Proposed Scheme, it summarises the baseline data gathered from a desk top review, and identifies the potential environmental risks that could be encountered. It also assesses the proposed options in terms of whether they are likely to have significant environmental effects.

The A428 section between the A1 at Wyboston and the A1198 at Caxton Gibbet is the sole remaining single carriageway section between the M1 at Milton Keynes and the M11 to the east. The existing road suffers from congestion, particularly around the Black Cat Junction, but also at the Wyboston, Barford Road, Cambridge Road (St Neots) and Caxton Gibbet junctions. The aim of the Proposed Scheme is to address strategic issues along the A428 corridor between Black Cat and Caxton Gibbet, and will contribute to the Highways England strategic outcomes including:

- Supporting economic growth
- A safe and serviceable network
- A more free flowing network
- An improved environment
- An accessible and integrated network

The Proposed Scheme is looking at offline and online options to improve the A428 between the A1/ A428 Black Cat junction and the Caxton Gibbet junction with the A1198.

Baseline environment

The existing A428 passes through a mainly rural area to the south of St Neots. This is characterised by agricultural fields and small areas of woodland. The A1 and East Coast Main Line lie to the west of the study area and the villages of Croxton and Eltisley lie just to the south of the existing road. There are a number of smaller settlements and individual business and residential properties which also front onto the road.

A 1km wide corridor study area was used around the existing A428 in general for the baseline review. This was widened to include a buffer around the options identified at the start of Stage 1. Data collection at Stage 1 has included obtaining the historic environment record and data from the local ecological records centres. An Extended Phase 1 habitat survey has also been completed. Key environmental designations and features are summarised in table A1.

Stage 1 options appraisal

Stage 0 identified a long list of 48 options that would meet the overall objective of improving access along the A428 between Black Cat and Caxton Gibbet. These fell into categories including lane widening, junction improvements, offline alignment and public transport improvements. The Options Appraisal Report (Jacobs, 2016a) identified options that warranted further considerations in Stage 1. Option C1 / C2 (full offline dualling between Black Cat and Caxton Gibbet) was considered to be the best performing option against the scheme objectives at Stage 0.

Table A.1: Key environmental designations and features

Topic	Sensitive designations and features within the study area
Air quality	• Nearest air quality management area is within St Neots town centre. • Residential property along the existing A428 carriageway and A1/A428 junction, particularly at Eynesbury Manor (south St Neots), Croxton and Eltisley.
Cultural heritage	• High value assets within the 1km buffer include 11 scheduled monuments, 7 grade II* and one registered park and garden (Croxton Park). • Medium value assets within300m of the A428 include 41 grade II listed buildings, four conservation areas, two non-designated historic buildings and three archaeological areas.
Landscape	• Away from the A1 corridor and St Neots, it is a quiet rural landscape of good quality with, a coherent, unspoiled, homogenous character. Significant features include woodlands, mature hedgerows and small-scale stream valleys with attractive open views. This area includes frequent historic landscape features and is of high sensitivity to intrusive development and changes to the landform. The area between Black Cat and Potton Road is sensitive to intrusive development and changes to landform due to the visual open character. • There is significant woodland cover, including ancient woodland (e.g. Eltisley Wood and Sir John's Wood) and numerous non-designated small and medium-sized deciduous woodlands throughout the farmland to the east of the River Great Ouse, including woodlands on the National Forestry Inventory. Croxton Park is includes numerous mature trees and woodlands, many of which are covered by tree preservation orders, including along the existing A428. • Key visual receptors include scattered rural properties and farms with residential clusters at Croxton, Abbotsley, Eltisley and Caxton Gibbet. Users of the Ouse Valley Way national trail have views of the A1 between Tempsford and the southern edge of St Neots at Wyboston.
Ecology and nature conservation	• The closest statutory designated wildlife site is Elsworth Wood Site of Special Scientific Interest (SSSI), approximately 1.1km from the A428 close to the junction at Caxton Gibbet. Eversden and Wimpole Woods Special Area of Conservation (SAC) is designated for bats and is 8.5km from the A428. In addition four county wildlife sites (CWS) and one protect road verge are located within 1 km of the A428. Croxton Park CWS and River Great Ouse CWS are directly adjacent to the existing A428. • There is ancient woodland within 1km of the existing A428, as well as Biodiversity Action Plan priority habitats including deciduous woodland, parkland, hedgerows, and an area of floodplain grazing marsh. The landscape also has potential to support other notable habitats, such as species rich hedgerows, arable margins, and aquatic habitats (including River Great Ouse). • The landscape includes habitat suitable for bats, badgers, breeding and wintering birds, great crested newts, reptiles, otter, and water vole.
Geology and soils	• The area east of Black Cat is classified as a mineral safeguarding area and strategic mineral site. There is an existing quarry immediately adjacent to Black Cat. • Soils are mostly grade 2 (very good), with pockets of grade 1 (excellent) and grade 3 (good) at Wyboston. • The majority of the superficial deposits in the area are classified as a secondary (undifferentiated) aquifer. In the west of the study area, along the A1, deposits are classified as secondary A aquifers. • Potential contamination sources include authorised and historic landfills, fuel stations and highway services, a railway line and associated made ground and Little Barford Power Station.
Noise and vibration	• Existing noise important areas are located 0.3km north of Black Cat junction on the Great North Road (A1), and to the west of Cambourne on the existing A428. • There are residential properties along the A1 and to the south of St Neots along the A428.
People and communities	• There are community and private assets within St Neots, Croxton, Eltisley, Wyboston, and Abbotsley. • The East Coast Main Line runs north-south through the study area. • There are a number of public rights of way, including national cycle route 12 and the Ouse Valley Way regional trail.
Road drainage and the water environment	• The existing A428 and A1 cross two main rivers, the River Great Ouse and Hen Brook, as well as a number of their associated tributaries. Their floodplains are classed as predominantly flood zone 3. • There are five Water Framework Directive water bodies including the Ouse (Roxton to Earith), Stone Brook, West Brook, Begwary Brook and Abbotsley and Hen. These are classified as achieving moderate potential, except for the Begwary Brook which is currently classified as achieving good potential. • There are 11 surface water abstraction licenses, which are clustered around Black Cat and Wyboston.

Stage 1 has involved identifying two additional offline options to the south of the A428 (options 5 and 6) and two lower cost options (options 7 and 8) that could be delivered alone or as part of a phased full scheme. The following options were considered during the Stage 1 environmental assessment:

- Option 1: full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet junctions.
- Option 2: minor junction improvements along the A428 at Wyboston, Cambridge Road, Croxton and Eltisley. Grade separation of both Black Cat and Caxton Gibbet junctions.
- Option 3: A428 bypass between Black Cat and Cambridge Road junctions. No widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet junctions.
- Option 4: offline dual carriageway bypass between Black Cat and Cambridge Road and online widening between Cambridge Road and Caxton Gibbet junctions. Grade separation of both Black Cat and Caxton Gibbet junctions.
- Option 5: full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.
- Option 6: full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.
- Option 7: dualling between Wyboston and the River Great Ouse crossing and a new roundabout at Wyboston. Minor junction improvements at Barford Road and Cambridge Road. Grade separation at Black Cat junction and a signalised junction at Caxton Gibbet.
- Option 8: grade separation of both Black Cat and Caxton Gibbet junctions.

These options were considered within an Options Appraisal Matrix, which has assessed the environmental impacts of each option against the different environmental topics. The assessment concluded that Option 1 is environmentally preferred out of the full scheme options, as this reduces impacts to Croxton Park. It would also allow the existing A428 to be retained as a separate non-motorised user (NMU) route. Option 4 is considered to be the least favourable from an environmental perspective, as this would involve two additional lanes being added directly adjacent to Croxton Park, impacting the setting of the site and increasing noise and air pollution levels.

Recommendations

The Proposed Scheme, regardless of which option is selected, is likely to generate significant effects on the environment and is therefore likely to require a statutory Environmental Impact Assessment (EIA).

The preferred option will be selected following the non-statutory consultation in February 2017 and when the traffic modelling results are available. The preferred option will be assessed in more detail at Stage 2, and will include identification of potential mitigation areas. This design iteration will inform the Preferred Route Announcement and the redline boundary for the scoping stage, at the start of Stage 3.

At Stage 3, the EAR will be developed into an environmental Scoping Report, which will include a summary of the assessment methodology that will be employed to assess potential significant effects. The scoping report will be issued to the Planning Inspectorate as part of the Development Consent Order process. It can also be used to provide background information to the Secretary of State as part of obtaining a screening and scoping opinion and as part of confirming whether the schemes require a statutory EIA.

1. Introduction

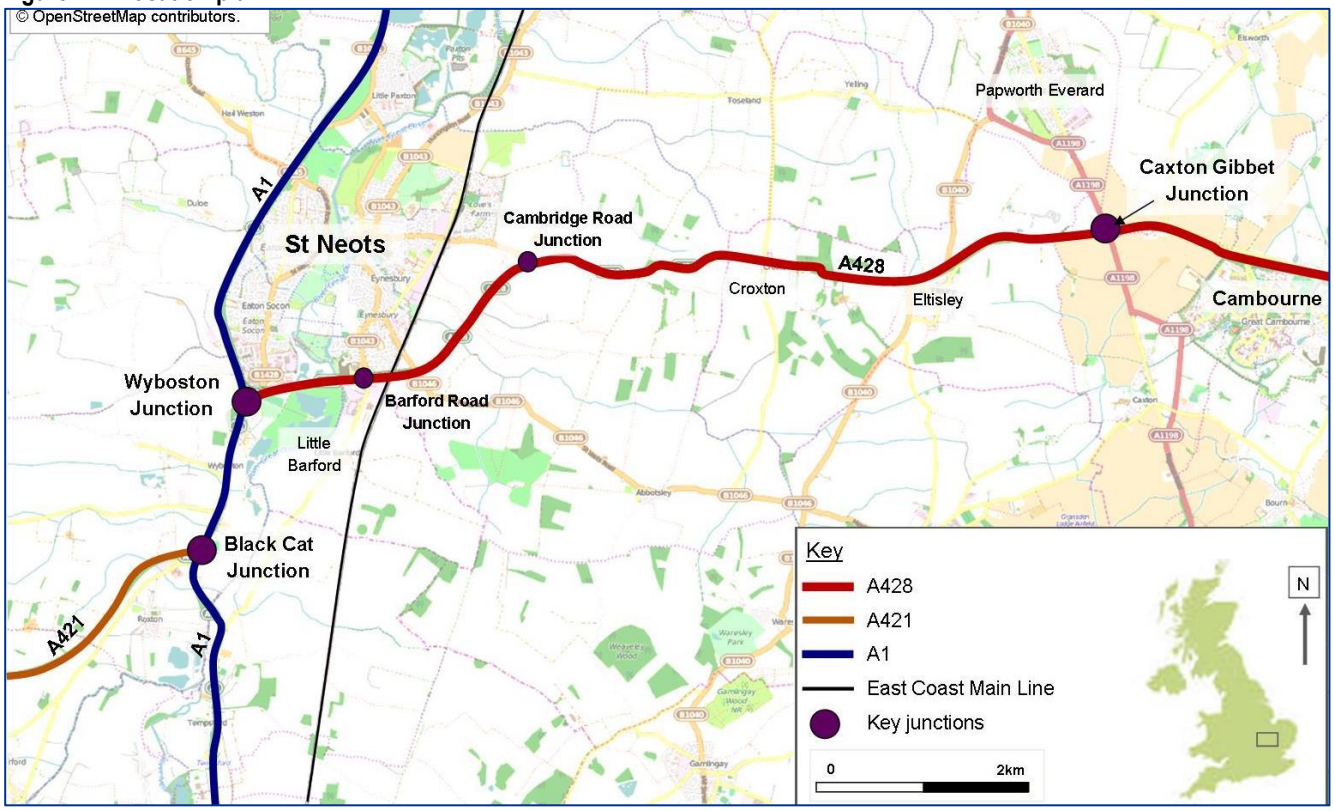
1.1 Background to the scheme

Highways England is the new government company charged with driving forward our motorways and major A roads (the strategic road network – SRN). This includes modernising and maintaining the highways, as well as running the network and keeping traffic moving. The Roads Investment Strategy (RIS) sets out the funding for major road schemes across England. The RIS for the East of England Area outlines the case to dual the 'missing link' of the A428 and to grade separate Black Cat junction.

The A428 Black Cat to Caxton Gibbet Scheme (hereafter referred to as the Proposed Scheme) includes the section between the A1 Black Cat junction (TL 159553) and the Caxton Gibbet junction with the A1198 (TL 296606), a distance of approximately 17km. This section of the A428 is located to the south of St Neots, in South Cambridgeshire, Huntingdonshire, and Bedfordshire. The A428 contributes to an east-west connection between Milton Keynes, Bedford and the M1 to the west and Cambridge and the M11 to the east (figure 1.1).

The route is the sole remaining single carriageway section in an otherwise dual carriageway corridor. There is congestion at the existing junctions and the route also passes through two rural settlements. Congestion along the route and at its junctions is predicted to increase over time, leading to further road safety problems and less reliable journey times. The traffic issues along this route are likely to inhibit future growth in homes and jobs along the St Neots / Cambridge corridor.

Figure 1.1: Location plan



1.2 Need for the scheme

The A428 is an important part of the SRN forming an important east-west corridor between the Midlands and East Anglia along with the A14 and A421. It is an important regional route linking Milton Keynes and Bedford to Cambridge. It also provides a diversion route for incidents on the A14, A1, M11 and M1. The A428 also provides a local benefit, through a bypass around St Neots and linking local villages including Caxton, Papworth and Eltisley. There are also direct accesses to the frontages of private dwellings off the existing A428.

The A428 section between the A1 at Wyboston and the A1198 at Caxton Gibbet is the sole remaining single carriageway section between the M1 at Milton Keynes and the M11 to the east. The existing road suffers from congestion particularly around the Black Cat junction but also at the Wyboston, Barford Road, Cambridge Road (St Neots) and Caxton Gibbet junctions. The route is considered to be one of the least reliable journey time sections for the whole of the country (Highways England, 2014). The lack of capacity along the route is likely to inhibit future growth in homes and jobs within the corridor. Further details can be found in the Options Appraisal Report (OAR) (Jacobs, 2016a).

A recent pinch point improvement scheme has been implemented at Black Cat junction. The aim of this scheme was to relieve existing problems at the junction but not address long term capacity issues along the route associated with proposed development.

Strategic plans including the Cambridgeshire Local Transport Plan (LTP3) identify major growth planned along the A428 corridor, including at West/ North West Cambridge, Cambourne, Bourne Airfield, and the St Neots Eastern Expansion (Cambridgeshire County Council, 2015). Significant traffic growth is predicted, with up to 100,000 new houses planned to be built in surrounding areas and over 70,000 jobs provided. A 40% increase in traffic flows on the A428 is forecast by 2039.

During the Stage 1 forum on the A428 scheme, stakeholders expressed concerns about the lack of resilience of the existing road. This is compounded by the River Great Ouse corridor, as there the next nearest bridge over the river is through the centre of St Neots. The existing single lane carriageway is at risk of being closed during an accident, and the lack of alternative routes causes heavy congestion in the town centre, which is also an air quality management area (AQMA).

1.3 Aims and objectives

The aim of the Proposed Scheme is to address strategic issues along the A428 corridor between Black Cat and Caxton Gibbet. The scheme specific objectives are based on the overarching RIS objectives (table 1.1). There is also an opportunity to contribute to wider objectives in line with key performance indicators (KPI) and the RIS designated funds. Further details can be found in section 3.10.

Table 1.1: Scheme specific objectives

Highways England Strategic Outcome	Scheme specific objective
Supporting economic growth	Supports planned economic and housing growth in Bedford, Cambridge and the surrounding sub region.
	Supports spatial and strategic transport policies including Local Plans for Cambridge and the surrounding sub-region by reducing congestion related delay, improve journey time reliability and increase the overall transport capacity.
	Promotes use of the strategic route by strategic traffic, and local routes by local traffic.
A safe and serviceable network	Improves road user safety at the A421 / A1 Black Cat junction and on the A428 corridor between Wyboston and Caxton.
	Improves road worker safety.

Highways England Strategic Outcome	Scheme specific objective
A more free flowing network	Provides significant capacity improvements to the Black Cat junction where the A1 currently meets the A421.
	Helps to create an Expressway standard link between the A421 and the existing dual carriageway section of the A428 to Cambridge.
	Increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather.
An improved environment	Improves the environmental impact of transport on communities along the existing A428 corridor.
	Reduces the impact of new infrastructure on the natural and built environment.
A more accessible and integrated network	Provides a safe alternative non-motorised user route between communities and seeks to address severance.
	Improves safety and access for public transport users.
Customer satisfaction	Reduces traffic congestion delays and improves journey time reliability.
	Improves driver information.

1.4 Purpose of the Environmental Assessment Report

The Environmental Assessment Report (EAR) outlines the environmental opportunities and constraints that have been identified during Stage 1 of the scheme development (section 2). It then describes the options that have been considered and how the environment has been considered within the appraisal process (section 3). Finally it outlines the scope of environmental work that is proposed during Stage 2 and 3 of the project development (section 4). The EAR includes the topics covered within the Design Manual for Roads and Bridges (DMRB) guidance and Interim Advice Note (IAN) 125/15 (Highways Agency, 1993a; 2015). The structure of the report is set out in table 1.2.

Table 1.2: Structure of the EAR

Section	Contents
1. Introduction	This provides an explanation of the need for the scheme, a description of the works and an overview of the existing environment at the site.
2. Baseline environment	This sets out the baseline environment including the study area used and the value of existing receptors at the site. There is a sub-section for each of the DMRB topics.
3. Consideration of alternatives	This includes a description of the development of the scheme and the various options considered during the design process. This also includes consideration of how the environmental assessment has influenced the option selection process.
4. Conclusions and next steps	This summarises the conclusions and proposed next steps including work proposed at the next stage.
Acronyms, Glossary, References	A description of the acronyms and definitions of technical terms. There is also a reference list of document sources.
Appendices	Figures and supporting information are provided in the appendices.

1.5 Plan, policy and programme review

1.5.1 National policy

In March 2012, the Department for Communities and Local Government (DCLG) published the National Planning Policy Framework (NPPF), which sets out the Government's economic, environmental and social planning policies (DCLG, 2012). The NPPF aims to reform the planning system and is underpinned by a presumption in favour of sustainable development. There is a focus on planning for prosperity, people and places, promoting increased levels of development and supporting infrastructure, whilst also protecting and enhancing the natural and historic environment. It is designed, however, to be interpreted and implemented locally; and delegates responsibility for achieving this vision to local planning authorities.

The National Networks National Policy Statement (NNNPS) was designated on 14 January 2015 (DfT, 2014). Sections 104 (2) and (9) of the Planning Act 2008 require applications to be decided in accordance with the relevant National Policy Statement. The NNNPS sets out principles by which applications or road and rail schemes should be assessed. Paragraph 4.3 states that:

'In considering any proposed development and in particular when weighing its adverse impacts against its benefits, the Examining Authority and the Secretary of State should take into account:

- *Its potential benefits including the facilitation of economic development, including job creation, housing and environmental improvement, and any long-term or wider benefits;*
- *Its potential adverse impacts, including any longer-term and cumulative adverse impacts, as well as any measure to avoid, reduce or compensate for any adverse impacts.'*

1.5.2 Local policy

Cambridgeshire County Council has delegated responsibility for local planning policy to the relevant district councils. Bedfordshire County Council ceased to exist in April 2009 and local planning policy is now the responsibility of the unitary councils. Table 1.3 details the current local planning policy documents relevant to the Proposed Scheme. Further details can be found in the planning review in Appendix A. Huntingdonshire District Council, Bedford Borough Council, and Central Bedfordshire Council are all in the process of producing new local plans, which will replace the policies set out in current documents.

Table 1.3: Local planning policy documents relevant to A428 scheme

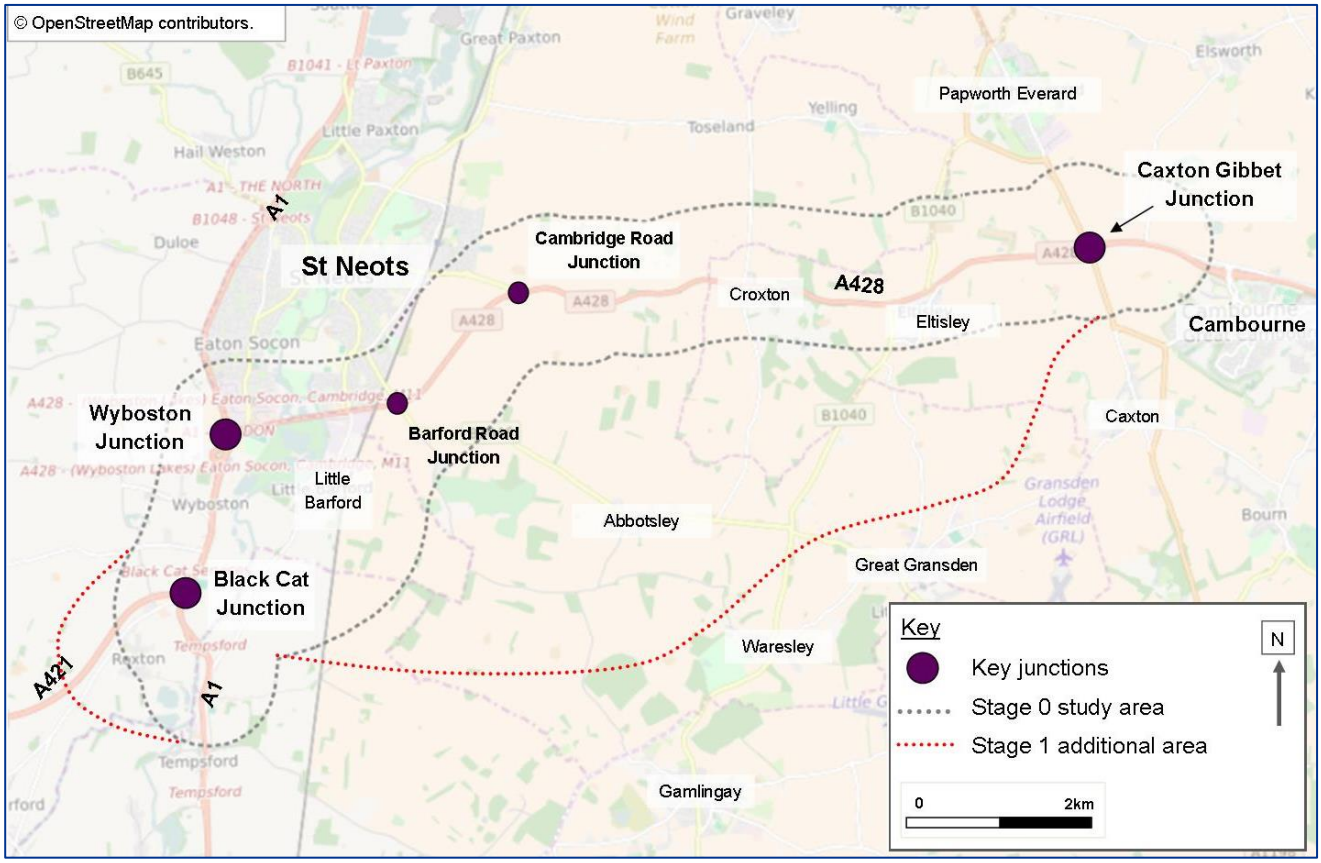
Council	Planning policy document
Huntingdonshire District Council	Core Strategy (2009) Local Plan (1995) including Proposals Map Local Plan Alteration (2002) Huntingdon West Area Action Plan (2011)
South Cambridgeshire District Council	Core Strategy Development Plan Document (2007) Development Control Policies Development Plan Document (2007) Northstowe Area Action Plan (2007) Cambridge East Area Action Plan (2008) Cambridge Southern Fringe Area Action Plan (2008); North-West Cambridge Area Action Plan (2009) Site Specific Policies Development Plan Document (2010)
Bedford Borough Council	Saved Local Plan 2002 policies (2013) Bedford Borough Core Strategy and Rural Issues Plan (2008) The Bedford Town Centre Area Action Plan (2008) The Allocations & Designations Local Plan (2013)
Central Bedfordshire Council	Core Strategy and Development Management Policies Development Plan Document (2009) Adopted Site Allocations Development Plan Document (2011)

1.6 Geographical scope

A 1km wide corridor study area was used around the existing A428 for the initial baseline review. This included a buffer around the options identified at Stage 0 (figure 1.2). A 30km study area was also used to check for special areas of conservation, designated for bats, as recommended by current guidance set out in the DMRB HD 44/09 (Highways Agency, 2009a). This study area was used for the data collection requests (Historic Environment Record and local record centre requests). This was also used as the study area for the Extended Phase 1 habitat survey.

At Stage 1, two additional options were identified outside of the Stage 0 study area and some of the junction options at Black Cat extend beyond the existing junction. The desk top study area has been extended to include these options. However, the data requests and the Extended Phase 1 habitat survey do not cover the extended study area at this stage. The data gaps would need to be filled if these options proceed to Stage 2. Figure 1.2 shows the Stage 1 additional area.

Figure 1.2: Study area



1.7 Limitations and assumptions

We are at an early stage in the scheme development; there are no detailed designs and the construction methodology is not defined at this stage. The environmental risks have been identified based on the desk top review and knowledge of similar schemes. The only surveys that have taken place at this stage are an Extended Phase 1 habitat survey and baseline landscape survey.

The Proposed Scheme may be delivered in phases or over successive RIS periods. It is assumed that construction would start in 2020, but the end construction date would depend on the option chosen and the delivery method.

For now, it is assumed that the existing A428 would remain open during construction. It is assumed that the information provided by the third party public sources is accurate at the time of preparing this report.

References are included to provide details of relevant sources.

2. Baseline environment

A desk based assessment has been undertaken to identify the baseline conditions. The baseline conditions have been used to identify environmental constraints and opportunities associated with the Proposed Scheme. The baseline assessment is based on readily available data, as well as additional data requests and specific surveys, detailed in the relevant receptor sections. Some of the key environmental constraints are included in the environmental constraints plan in Appendix B and on the figures in the following sections.

2.1 Air quality

2.1.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- Department for the Environment Food and Rural Affairs (Defra) background mapping data for local authority (Defra, 2013)
- Defra Interactive Monitoring Networks Map (Defra, 2016a)
- Huntingdonshire District Council Local Air Quality Management Progress Report (2014)
- Bedford Borough Council Local Air Quality Management Updating and Screening Assessment Report (2015)
- South Cambridgeshire District Council Local Air Quality Management Updating and Screening Assessment Report (2015)
- Air Pollution Information System for critical loads and background NO_x and N-depositions for designated sites (APIS, 2016)
- Environment Agency interactive map – 'What's in Your Back Yard' (Environment Agency, 2016)

2.1.2 Geographical scope

The air quality study area should be the 200m boundary of roads affected by the scheme and human health sensitive receptor and designated sites within. However the traffic data is not available for screening and defining the study area at this stage. Therefore the Stage 1 baseline assessment has considered the immediate area within 200m of the A428 and it's on and off slip roads at the A1 junction. The desk study has also considered key features within the wider environment to support the options appraisal.

2.1.3 Baseline conditions

There are no AQMAs within the immediate study area (200m of the existing A428). The nearest AQMA is located in St Neots' High Street, approximately 2km to the north of A428, which is declared for nitrogen dioxide (NO_2) by Huntingdonshire District Council. The AQMA is adjacent to a bridge crossing over the River Great Ouse. This bridge is used as an alternative route for traffic when the A428 crossing at Wyboston is closed due to accidents.

There is no local monitoring in the immediate area along A428. Huntingdonshire District Council operates a continuous monitoring station at Huntingdon, 12km north. The council also monitors NO_2 at 34 locations across the district, using NO_2 diffusion tubes (Huntingdonshire District Council, 2014). A monitoring site at The Paddocks, St Neots (517869, 260132) is the nearest monitoring location to the A428, and is located 2km to the north of the A428. The 2013 annual mean NO_2 concentration at this location was 20.6µg/m³, which is within the relevant air quality objective (AQO) of 40µg/m³.

Traffic from the A428 is the dominant source of emissions within the study area. Little Barford Power Station is within 500m to the south of the A428 and is also a key emission source for carbon dioxide (CO_2), nitrogen oxides (NO_x) and particulate matter (PM_{10}) in the area.

Human health receptors along the existing roads include those in towns and villages such as Chawston, Wyboston, Eynesbury, Croxton and Eltisley. There are no statutory designated sites (sites of special scientific interest (SSSI), SACs, special protected areas (SPA) or Ramsar sites) located within 200m of the existing A428.

2.1.4 Value of receptors

For operational impacts, all receptors (human health receptors and designated ecological sites susceptible to changes in air quality) are treated as equally sensitive where they are within 200m of “affected” roads. Sensitivity is identified as locations representative of exposure to the averaging periods of relevant air quality objectives / critical loads, e.g., annual, daily and hourly exposure.

2.2 Cultural heritage

2.2.1 Baseline sources

The following sources of data were used during the Stage 1 data gathering to establish the environmental baseline:

- National Heritage list for information on statutory designated cultural heritage assets (World Heritage Sites, Scheduled Monuments, Listed Buildings, Registered Battlefields and Registered Parks and Gardens) (Historic England, 2016a).
- English Heritage archive for information on undesignated cultural heritage assets (Historic England, 2016b).
- Cultural heritage assets recorded on the Cambridgeshire Historic Environment Record (HER) were provided by Cambridgeshire County Council (12 April 2016) and on the Bedfordshire HER from Bedford Borough Council (15 April 2016). This data has not currently been obtained for the two southern options, which were identified after the data request was made; this information will be obtained at the next stage if these options are taken forward.
- Information on Conservation Areas from South Cambridgeshire District Council, Huntingdonshire District Council, Central Bedfordshire Council and Bedford Borough Council websites.

2.2.2 Geographical scope

The Stage 1 assessment has considered a study area of 1km from the existing A428, extending to the south to incorporate possible southern alignments (see section 1.6), for World Heritage Sites, Scheduled Monuments, Registered Battlefields, Registered Parks and Gardens, and Grade I and Grade II* listed buildings (figure 2.1). These are all designated assets assessed as being of high value.

A 300m study area has been used for all other designated and non-designated cultural heritage assets. HER data was not available for the southern extent of the study area. This information has been requested and the EAR will be updated when it has been received. All heritage assets are detailed in Appendix D.

2.2.3 Baseline conditions

There are no World Heritage Sites, Registered Battlefields or Grade I listed buildings within the 1km study area.

A total of 188 heritage assets have been identified using the HER information and other sources based on the Stage 0 study area (which does not cover the southern options). These heritage assets are listed in Appendix D. Each has been given an individual number from 1 to 188.

High value assets within the 1km buffer

There are 11 Scheduled Monuments within the 1km buffer (table 2.1). These include:

- A Moated Enclosure at Wyboston (Asset 14) which dates to the medieval period and comprises a clearly defined moat with adjacent house platforms. The moat would have defined the site of a small manor house.
- Deserted Medieval Villages at Weald (Asset 120) and Croxton (Asset 138) both have visible earthworks. The Deserted Medieval Village of Weald was finally abandoned within the last 200 years. The earthworks showing the site of the manor and church are clearly visible, and there is ridge and furrow visible in the fields to the south of the scheduled area.
- A Moated Site at Pond Farm (Asset 165) is defined on three sides by a water filled moat which would have enclosed a medieval manor.

Croxton Park is a Registered Park and Garden (Asset 137). It is a mid-18th century house and garden set within an early 16th century deer park, located adjacent to the A428 in Croxton. The park incorporates some traces of 16th century garden features, and was extended and landscaped in the 19th century.

Figure 2.1: Cultural heritage features

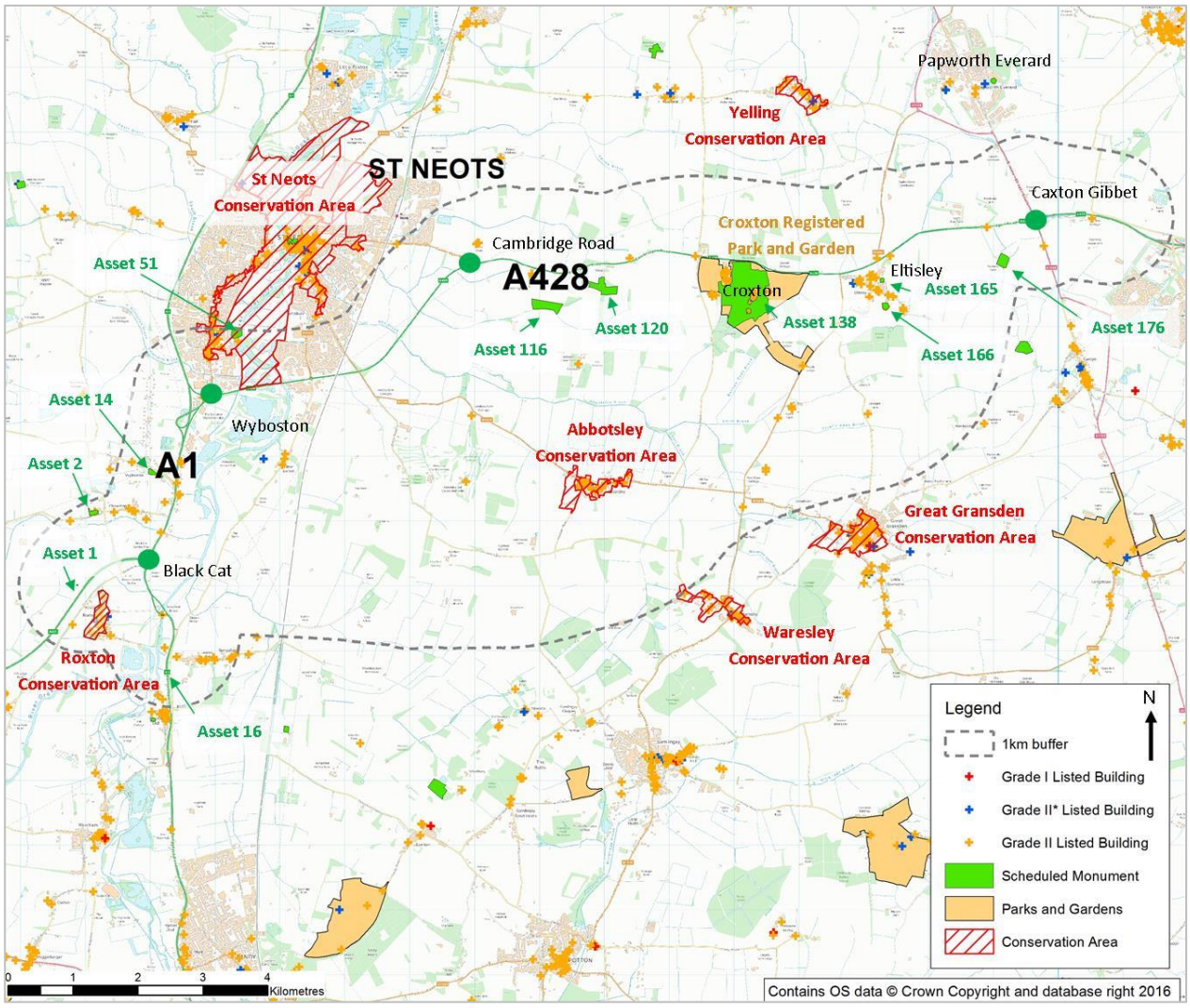


Table 2.1: High value assets within the 1km buffer

Asset no.	High value asset	Grid reference
Scheduled Monuments		
1	Bowl Barrow, known as 'Round Hill', 440m WNW of College Farm	TL 148550
2	Chawston Manor moated site and associated fishpond (asset 2)	TL 151561
14	Moated enclosure and associated building platforms, The Lane, Wyboston	TL 161567
16	Tempsford Bridge	TL 161545
51	The Hillings, Castle Hills. A Norman ringwork castle overlying a late Saxon vill and deserted medieval village	TL 173589
116	Deserted village at Wintringham	TL 221593
120	Deserted village (site of) at Weald	TL 229596
138	Croxton deserted medieval village and 16th-17th century garden visible as earthworks	TL 252597
165	Moated site at Pond Farm	TL272597
166	Moated site at Manor Farm	TL 273593
176	Moated site at Pastures Farm	TL 291600

Asset no.	High value asset	Grid reference
Grade II* Listed Buildings		
3	Congregational Chapel, Roxton	TL 227565
4	Church of St Mary Magdalen, Roxton	TL 252592
45	Church of St Mary, Eaton Scotton	TL 252593
119	Church of St Margaret, Abbotsley	TL 268596
139	St James Church, Croxton, with 13th century origins	TL 153545
140	Croxton Park House	TL 151544
149	Church of St John the Baptist and St Pandionia which dates from the late 12th and early 13th centuries and was restored in 1875	TL 170588
Registered Park and Garden		
137	Croxton Park	TL 151544

Medium value assets within 300m of the A428

The following provides a summary of the medium value heritage assets identified within the 300m study area:

- 41 Grade II Listed Buildings (details in Appendix D);
- Two non-designated buildings, Wintringham Hall (Asset 113) and the Old House in Eltisley (Asset 151). These are non-designated buildings of medieval origin which have been altered but still have a contribution to make to the objectives of the East of England Regional Research Framework, particularly understanding the origins and characterisation of Medieval rural settlement (East Anglian Archaeology, 2011).
- The partially excavated Roman site at Priors Gate (Asset 34) is a rural site occupied between the 2nd and 4th centuries. The excavated area comprised a range of industrial features such as quarry pits and agricultural features such as stock enclosures. The settlement is thought to be to the south of the excavated area. Priors Gate, and in particular the unexcavated settlement as the potential to contribute to the objectives of the East of England Regional Research Framework, particularly understanding the development of rural settlement in the Roman period.
- Eltisley Abbey (Asset 148) is the traditional site of a 9th century Benedictine nunnery comprising a moat, earthwork and St Pandionia's Well (Asset 150), which may have been the site of the original nunnery's water garden. Religion and settlement in the Anglo Saxon period and the transition to the medieval period are important areas of research in East of England Regional Research Framework.
- Conservation Areas at Roxton (Asset 185), St Neots (Asset 186), Croxton (Asset 187) and Eltisley (Asset 188).

Low and negligible value assets within 300m of the A428

A further 13 historic buildings and 31 archaeological remains have been assessed to be of low value, and 75 archaeological remains have been assessed to be of negligible value in the 300m study area. These are detailed in Appendix D.

Archaeological potential

There is the potential for unknown archaeology throughout the study area, particularly within areas where limited or no development has taken place. Based on the baseline information assessed, there is evidence for human activity within the study area from the prehistoric period through to the present day; with particular evidence relating to prehistoric settlement and funerary remains, early medieval and medieval settlement activity and post-medieval settlement and agricultural activity.

Known archaeological remains include a range of settlement sites, funerary sites, and archaeological findspots and scatters of prehistoric to post-medieval date, as well as areas of cropmarks which are indicative of human occupation activity from the prehistoric period through to the present day. There is therefore the potential for the proposed scheme to disturb unknown buried archaeology.

2.2.4 Value of receptors

An assessment of the value of identified cultural heritage assets was undertaken based on criteria provided in HA208/07 Vol 11, Section 3, Part 2 (Highways Agency, 2007) and as summarised in Appendix C. Table 2.2 summarises the value of the receptors assessed as being of high, medium and low value identified within the study area.

Table 2.2: Value of cultural heritage receptors

Value / sensitivity	Examples within the study area
High	**Archaeological remains**: One Registered Park and Garden (Croxton Park), 11 Scheduled Monuments (five of which are within 300m of the existing A428, including: the moated enclosure at Wyboston; Tempsford Bridge; the deserted medieval villages at Weald and Croxton; and the moated site at Pond Farm). **Historic buildings**: Seven Grade II* Listed Buildings (three of which are within 300m of the existing A428, including: Croxton Park House, St James Church, Croxton; and the Church of St John the Baptist and St Pandionia).
Medium	**Archaeological remains**: Three archaeological remains including the partially excavated Roman site at Priors Gate, Eltisley Abbey, and St Pandionia's Well. **Historic buildings**: 41 Grade II listed buildings, two non-designated historic buildings (Wintringham Hall and the Old House in Eltisley), and four Conservation Areas (Roxton, St Neots, Croxton and Eltisley).
Low	**Archaeological remains**: 31 remains including partially excavated sites such as the prehistoric ring ditch at Eynesbury (Asset 74) or the possible enclosure at Abbotsley (Asset 103) visible as cropmarks. **Historic buildings**: 13 undesignated historic buildings ranging from small cottages such as the Thatch Cottage in Wyboston (Asset 24) to distinctive local features such as a cast iron mile post in Caxton (Asset 173)

2.3 Landscape

2.3.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- Ordnance Survey (2015) Explorer Map 208 (1:25,000 scale)
- Designated sites and features identified on Multi-Agency Geographic Information for the Countryside (MAGIC) (Defra, 2016b)
- Cambridgeshire County Council. (1991). The Cambridgeshire Landscape Guidelines
- Huntingdonshire Landscape and Townscape Assessment (Huntingdon District Council, 2007)
- Central Bedfordshire Landscape Character Assessment (Central Bedfordshire Council, 2016)
- Bedford Borough Landscape Character Assessment (Bedfordshire County Council and Bedford Borough Council, 2007)
- Core Strategy and Rural Issues Plan (Bedford Borough Council, 2008)
- Core Strategy and Development Management Policies (Central Bedfordshire Council, 2009)
- Policy Proposals Map (side B) and related insets (Central Bedfordshire Council, 2011)
- Adopted Proposals Map and inset maps 24 Croxton and 29 Eltisley (South Cambridgeshire District Council, 2012)

2.3.2 Geographical scope

The Stage 1 assessment has considered a study area covering a buffer of approximately 2km. Landscape and visual effects beyond this distance are likely to be negligible. The envelope for the final visual assessment is likely to vary dependent on topography and the potential visual prominence of proposed structures.

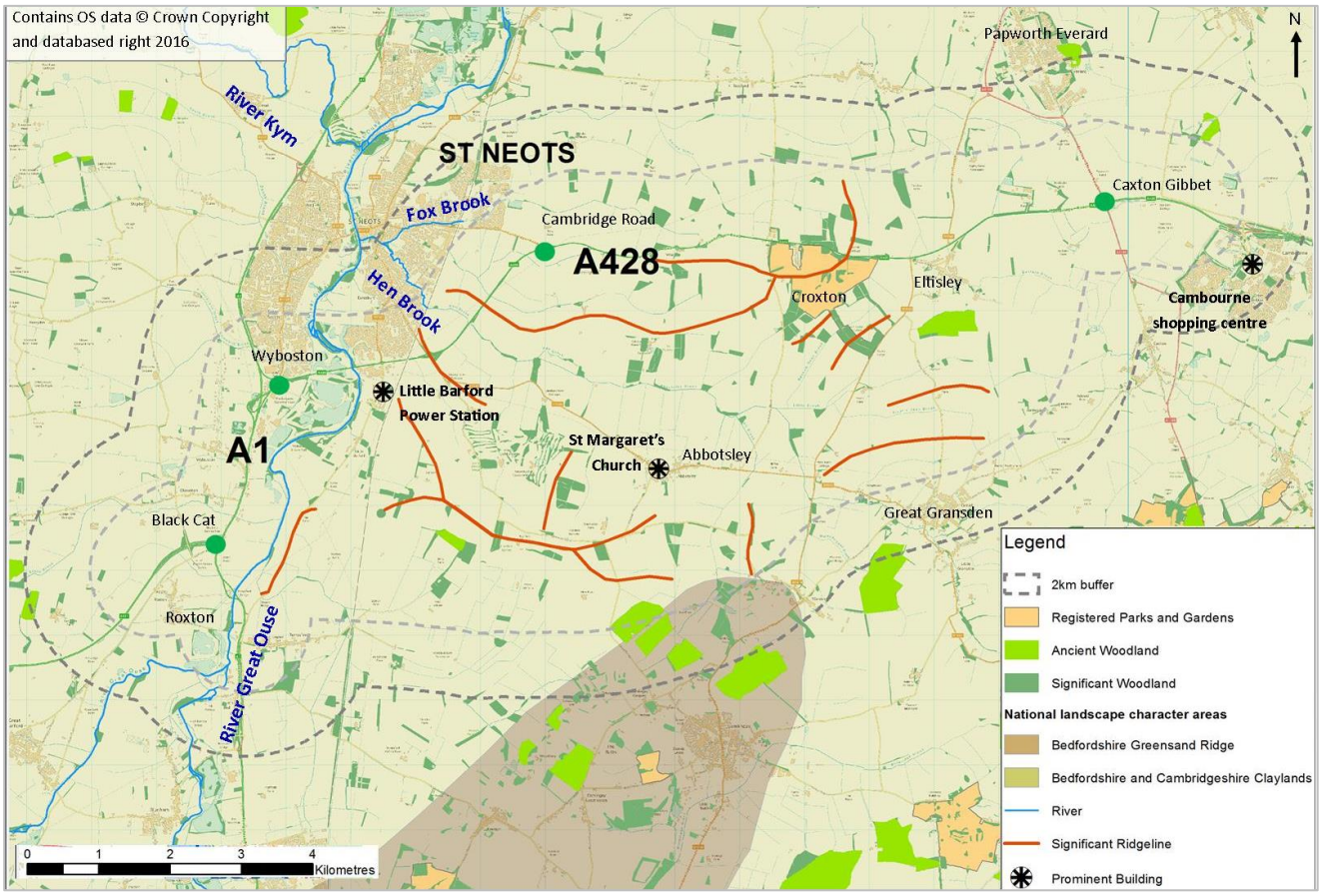
2.3.3 Baseline conditions

There are no areas of outstanding natural beauty (AONB) or national parks within 5km of the study area, and the area does not fall within a greenbelt. Croxton Park, located south of the A428 at Croxton, is registered as an historic park and garden (figure 2.2). There are numerous listed buildings in the study area (see section 2.2, cultural heritage). There are no other landscape designations within the study area.

The study area lies within the southern part of National Character Area (NCA) 88: Bedfordshire and Cambridgeshire Claylands (figure 2.2). The A428, along with the A1, M1, and A421, is recognised as having an impact on the local landscape character (Natural England, 2014a). Some of the key characteristics of the Claylands landscape are:

- Gently undulating topography and plateau areas, divided by broad shallow valleys.
- Predominantly an open and intensive arable landscape. Fields bounded by either open ditches or sparse closely trimmed hedges (with some locally well-developed hedges), both containing variable number and quality of hedgerow trees.
- River corridors of Great Ouse and Ivel compose cohesive sub-areas characterised by flood plain grassland, riverine willows and larger hedges.
- Woodland cover variable. Clusters of ancient deciduous woods on higher plateau area. Smaller plantations and secondary woodland within river valleys.
- Settlement pattern clusters around major road (A1) and rail corridors many with raw built edges. Smaller, dispersed settlements elsewhere. Village edge grasslands and small pastures an important feature.
- Restored gravel working lakes adjacent to River Great Ouse.

Figure 2.2: Key landscape features and views



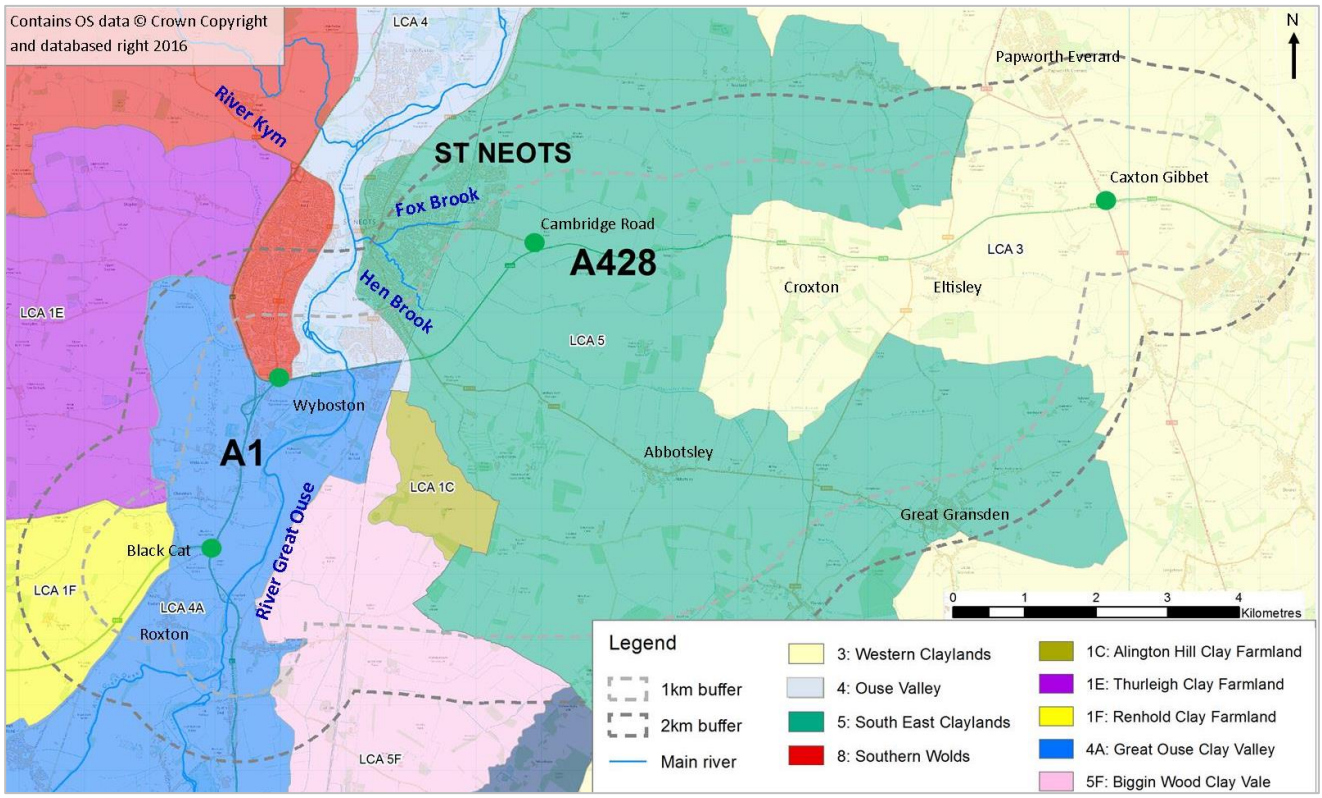
At a county level, Cambridgeshire County Council's publication, 'The Cambridgeshire Landscape Guidelines' (1991), indicates that the study area mainly lies within two landscape character areas; the 'Western Claylands' and 'Ouse Valley'. The underlying clay geology influences the whole study area with subtle variations locally at a district level.

The local landscape character areas (LCA) are as set out in table 2.3 and figure 2.3. For consistency the LCA references have been retained as per the original publications references, which are also given in the third column.

Table 2.3: Landscape character areas

Reference	LCA name	Local authority and landscape assessment publication reference
LCA 1C	Alington Hill Clay Farmland	Bedfordshire County Council and Bedford Borough Council: Bedford Borough Landscape Character Assessment (2007).
LCA 1E	Thurleigh Clay Farmland	
LCA 1F	Renhold Clay Farmland	
LCA 3	Western Claylands	South Cambridgeshire District: Cambridgeshire Landscape Guidelines, Cambridgeshire County Council (1991).
LCA 4	Ouse Valley	Huntingdon District Council: Huntingdonshire Landscape and Townscape Assessment (2007).
LCA 4A	Great Ouse Clay Valley	Central Bedfordshire Council: Central Bedfordshire Landscape Character Assessment (2016).
LCA 5F	Biggins Wood Clay Vale	
LCA 5	South East Claylands	Huntingdon District Council: Huntingdonshire Landscape and Townscape Assessment (2007).
LCA 8	Southern Wolds	

Figure 2.3: Local landscape character areas



The landscape character areas are described from west to east across the study area:

To the west of the study area, within Bedford Borough, two broadly similar areas of clay farmland provide the contextual setting of the Black Cat junction; these are LCA 1E Thurleigh Clay Farmland and 1F Renhold Clay Farmland. These clay farmland areas are characterised by the gently undulating landform and flatter, elevated plateaux with an underlying geology of Oxford Clay, overlain with Boulder Clay. This supports a large-scale, open landscape of intensive arable farmland with a pattern of fragmented hedges and remnant, mature hedgerow trees and some scattered woodlands. Shallow valleys formed by small tributaries of the River Great Ouse are tree-lined, with clustered rural settlements which are generally of low density.

The Great Ouse Clay Valley (LCA 4A) is characterised by the broad, meandering course of the River Great Ouse within the low-lying floodplain with a mixed pattern of land use. Within the floodplain, worked out gravel pits form a series of lakes interspersed with a few pastures, wet meadows and large-scale arable fields, dissected by drainage ditches and hedgerows. Reclaimed former mineral workings provide public recreational areas. At the southern edge of St Neots and Eaton Socon, retail business, leisure and recreational developments strongly influence the character along the A428 on either side of the floodplain. At Wyboston there are extensive areas of horticultural nurseries with glass houses on the west side of the A1 and some to the east, north of the Black Cat junction.

Visually this is a fairly open landscape, with views across the Ouse valley from properties along the A1 and from Tempsford to the south, and from the A428 where it crosses the valley. However, there are stands of mature trees within the flood plain which restrict views locally, particularly in relation to flooded gravel pits.

Biggin Wood Clay Vale (LCA 5F) has a gently undulating landform and gradually rising ground towards the more elevated clayland plateau to the north. This area has large open arable fields with some hedgerows, a few scattered, isolated farms, and long views to distant wooded ridges. Overhead power lines form visually dominant features and the area is severed by the north-south route of the East Coast Main Line (ECML) railway.

Alington Hill Clay Farmland (LCA 1C) is characterised by its gently undulating clay plateau landform, large geometric arable fields with dense hedges and a few hedgerow trees. The scattered woods on the low escarpment slopes surrounding the plateau are prominent in views from the west and there are mixed and coniferous woodland blocks within the farmland. Settlement is sparse. The woodland at Alington Hill is a prominent feature on the ridgeline, and Sir John's Wood (replanted ancient woodland and county wildlife site) lies on the edge of LCA 5F and LCA 1C, situated on the south-facing escarpment.

The South East Claylands (LCA 5) shares many characteristics of the previously described Clay Farmland character areas, including the gently undulating landform, heavy clay soils supporting intensive arable farming and a pattern of large fields. LCA 5 is strongly influenced by extensive woodland cover and tall hedgerows with frequent mature hedgerow trees. The southern part of LCA 5 includes the broad valley of Hen Brook and its tributaries Abbotsley Brook, Small Brook, Barham Dean Brook, Little Brook College Dean Brook and Vicar's Dean Brook. This area has a quiet unspoiled character and comprises a coherent, unspoiled, homogenous landscape of good quality; significant features include numerous woodlands, mature hedgerows and the gently undulating valleys with attractive open views framed by woodland blocks.

There are scattered, nucleated villages centred on village greens or of a linear pattern, with widespread evidence of the area's medieval history in the form of deserted villages, frequent moated sites and green lanes. The villages and farms within this part of the study area have associated smaller-scale fields and small pastures which are notable in an otherwise extensively arable farmland setting.

The Western Claylands (LCA 3) of South Cambridgeshire District shares the general clay farmland character of the adjoining LCA5, with scattered historic landscape features set within the pattern of large scale arable fields. The historic parkland landscape of Croxton Park with extensive woodland blocks occupies a significant area south of the existing A428. The villages of Croxton and Eltisley are located to the south of the A428, with occasional scattered properties and farmsteads along the A428 and in the wider countryside. There are remnant patterns of smaller fields and pastures around Eltisley.

Landscape features

Woodland and trees

Woodland blocks are small and infrequent within the Ouse valley and west of the ECML railway, but occur as frequent scattered features in the central and eastern areas. Ancient woodland - replanted, includes Sir John's Wood situated approximately 3.5 km due east of the Black Cat junction and Eltisley Wood, just south of Eltisley village.

Significant strips of riparian woodland occur along the east bank of the River Great Ouse and along a small tributary immediately east of the Black Cat junction. Riparian woodland also forms locally important features and occurs intermittently along lesser watercourses such as Hen Brook and its tributaries Little Brook and College Dean Brook. There are several larger areas of broad-leaved and mixed woodland close within the A428 corridor including Boys Wood, near Alington Hill, North Lodge Plantation, north of Croxton and recent planting at Northeast Farm and Pembroke Farm, near Caxton Gibbet.

There are two trees with veteran status located immediately adjacent to Cambridge Road between Wintringham and Croxton (The Woodland Trust, 2016). A 'veteran tree' is usually old, or displays signs of premature ageing, and has important wildlife and habitat features.

Tree protection orders

Partial information is available on publicly accessible sites for trees covered by tree protection orders (TPO) (i.e. for South Cambridgeshire district only). This includes numerous TPOs related to Croxton Park with a significant number of tree groups covered by TPOs on land along the existing A428 through Croxton, a linear tree belt north of Eltisley and several small groups and scattered individual trees along Little Brook on the district's southern boundary, near Abbotsley Road.

Information regarding TPOs in other administrative districts will be updated in subsequent consultation with local authorities as the scheme develops.

Hedgerows

The study area includes extensive tracts of rural countryside with numerous fields and a network of rural lanes, tracks and footpaths, most of which are bounded by hedgerows in various conditions. Hedges tend to be denser and with more frequent hedgerow trees east of the ECML railway. Good quality hedgerows with significant numbers of mature hedgerow trees, and of significance in terms of species diversity, are a notable feature within the southern part of the study area.

Agricultural land

Intensively farmed arable land makes up the majority of the study area. Permanent pastures are scarce and infrequent within the study area but occur as smaller-scale, irregular fields clustered around villages and some farmsteads and also occur as a small pocket of pastures at Leycourt, south of Eltisley. There is an extensive area of pasture land at Croxton Park.

Grassland

Other areas of grassland within the study area include recreational land and flood meadows within the River Great Ouse Valley, golf courses, and parkland and meadows at Croxton Park. Grassland within existing road verges and hedgerow bottoms and vegetation associated with minor watercourses and ditches, also occurs throughout the study area.

Waterbodies and watercourses

The most significant water course within the study area is the River Great Ouse which flows south to north in a meandering course more or less paralleling the A1. Lesser water courses include Hen Brook and its tributaries Little Brook and College Dean Brook, which flow from east to west through the centre of the study area, and Fox Brook and Gallow Brook which also flow east to west, just north of the existing A428. A further unnamed tributary brook flows in to the River Great Ouse just north of Tempsford. There are numerous field drainage ditches which lead into these streams and brooks throughout the study area.

Large waterbodies occur within the Ouse Valley in the form of flooded former gravel pits; several of these have been adopted for recreational activities including fishing. There is also a lake within Croxton Park. Other water bodies occur as modern agricultural irrigation reservoirs.

There are a number of historic moats within the study area east of the Ouse Valley; these occur at Abbotsley Golf and Country Club, Caldecote, Wintringham, Westbury Farm at Croxton, Manor Farm and Jesus College Farm at Eltisley and Pastures Farm near Croxton. There are also several old farm ponds scattered through the study area and other ponds associated with the medieval sites and villages of Wintringham and Weald.

Public rights of way

The Ouse Valley Way regional trail follows a meandering course roughly south-north along the Ouse Valley; along the river and valley floor west of Tempsford in the south, crossing the A1 at Wyboston to follow the east side of the main road into Eaton Socon, north of the A428. Further details on rights of way can be found in section 2.7.

Visual receptors

Potential visual receptors include residential and business properties within the study area including at Roxton, Wyboston, Eaton Socon, Croxton, Eltisley and Caxton Gibbet. Further visual receptors include travellers using the A428 and surrounding road network, the ECML or people using existing rights of way or open spaces and outdoor workers and visitors to Begwary Brook Local Nature Reserve and Croxton Park.

2.3.4 Value of receptors

The determination of value of landscape and visual receptors has been broadly based on the methodology set out within IAN 135/10 (Highways Agency, 2010a), as summarised in Appendix C.

The attribution of sensitivity to separate landscape character areas in table 2.4 includes the consideration of potential changes to landform as a large-scale and underlying component of local landscape character. The level of sensitivity attributed to LCAs reflects the relative proportion of any character area potentially affected by the scheme, local variations in the landscape character, and whether or not the LCA is already affected by the existing road network; e.g. the southern part of LCA 5 is currently unaffected by any major road and has a more secluded, unspoiled character and has a higher sensitivity than the northern and eastern parts which are already influenced by the existing A428.

Table 2.4 summarises the value of landscape and visual receptors according to their sensitivity (i.e. sensitivity to changes to perceived landscape character and views from residential properties, views from footpaths, etc.).

Table 2.4: Value of landscape and visual receptors

Sensitivity	Landscape and visual receptor description	Examples within the study area
Landscape receptors		
High	Landscapes which would be unable to accommodate change of the type proposed. Typically these would be of high quality with distinctive elements and features making a positive contribution to character and sense of place and / or likely to contain features and elements that are rare and could not be replaced.	LCA 4 Ouse Valley / LCA 4A Great Ouse Clay Valley and LCA 3 Western Claylands & LCA 5 South East Claylands Croxton Park Registered Park and Garden. Landscape features including woodland, trees and grassland.
Moderate	Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Generally unremarkable character but with some sense of place, locally designated and / or likely to contain some features and elements that could not be replaced.	LCA 1C Alington Hill Clay Farmland, LCA 1E Thurleigh Clay Farmland & LCA 1F Renhold Clay Farmland, LCA 5F Biggins Wood Clay Vale and LCA 8 Southern Wolds Landscape features including hedges, agricultural land, water bodies and rights of way.
Visual receptors		
High	Views from residential properties, PRoW, public open space and recreational areas.	Domestic premises on the northern edge of Abbotsley, within Croxton, at Eltisley and scattered farm houses, etc. Walkers on the Roman road at Potton Road/Drewels Lane, Ouse Valley Way and other footpaths. People using Wyboston Leisure Park, Abbotsley Golf and Country Club, visitors to Croxton Park.
Medium	Views experienced by people working outdoors, views from scenic roads and from schools.	Workers / volunteers at Begwary Brook Nature Reserve and Sir John's Wood Local Nature Reserve. Travellers on Barford Road, Potton Road, minor roads around Abbotsley, Croxton, Great Gransden and Eltisley.
Low	Views experienced by people at their place of work, from non-scenic roads and sports facilities.	Workers at facilities at Caxton Gibbet, businesses at Eltisley Business Park, businesses along the existing A428, businesses, hotels at Wyboston, and travellers on East Coast Mainline railway and A1.

2.4 Ecology and nature conservation

2.4.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- Biological data and records and the locations of non-statutory wildlife sites were sourced from Cambridgeshire and Peterborough Environmental Records Centre (CPERC). Bat records were sourced from Cambridgeshire Bat Group and mammal records from Cambridgeshire Mammal Group.
- Ordnance Survey (OS) maps were examined to locate ponds and wet ditches which might provide suitable habitat for amphibians, notably great crested newts (GCN) *Triturus cristatus*. In addition, OS maps were used to identify the locations of public rights of way (PRoW) that could be used to survey land where access permission was not granted by landowners.
- MAGIC was used to identify the locations of statutory designated wildlife sites, ancient woodland, and any European Protected Species Mitigation (EPSM) licences issued by Natural England (Defra, 2016b).
- The results of Extended Phase 1 habitat survey, GCN habitat suitability index assessment (HSI), and GCN environmental DNA (eDNA) surveys of all accessible areas within the study area were reviewed as part of the baseline assessment.
- A review of standard data forms and conservation objectives (JNCC, 2015; Natural England, 2014b) was undertaken for all European sites within the study area. This information supported an Assessment of Implications on European Sites (AIES, Appendix G), the results of which were reviewed as part of the baseline assessment.

2.4.2 Geographical scope

A study area around the existing A428 of 5km for statutory designated wildlife sites, 1km for non-statutory designated sites (including ancient woodlands), and 1km for protected/notable species (including a search for all EPSM licences granted by Natural England, as shown on MAGIC), was assessed. In addition a 30km search radius for SACs designated for bats was also considered (Highways Agency, 2009a).

The biological data records were gathered for the Stage 0 study area, which included a broad corridor extending from the existing A428, between its junction with the A1 and the Caxton Gibbet junction. The data search was undertaken to identify records of protected/notable habitats and species, and designated sites.

The Extended Phase 1 habitat 'survey area' comprises a 1.2km wide corridor centred on the alignment of the 'announced solution' from Stage 0, which captures both the online and offline options identified at the start of Stage 1. A further two options were identified during Stage 1, which lay outside of the Stage 0 study area. The background data requests and the Extended Phase 1 habitat survey do not cover the extended study area at this stage. These data and survey gaps would need to be filled if these options proceed to Stage 2.

2.4.3 Baseline conditions

There are no SPA, SAC, Ramsar, national nature reserves (NNR), or local nature reserve (LNR) sites located within the 5km study area. There is one SAC designated for bats within the 30km study area: Eversden and Wimpole Woods SAC lies approximately 8.5km to the south east of the existing A428 and is primarily designated for barbastelle bats *Barbastella barbastellus*.

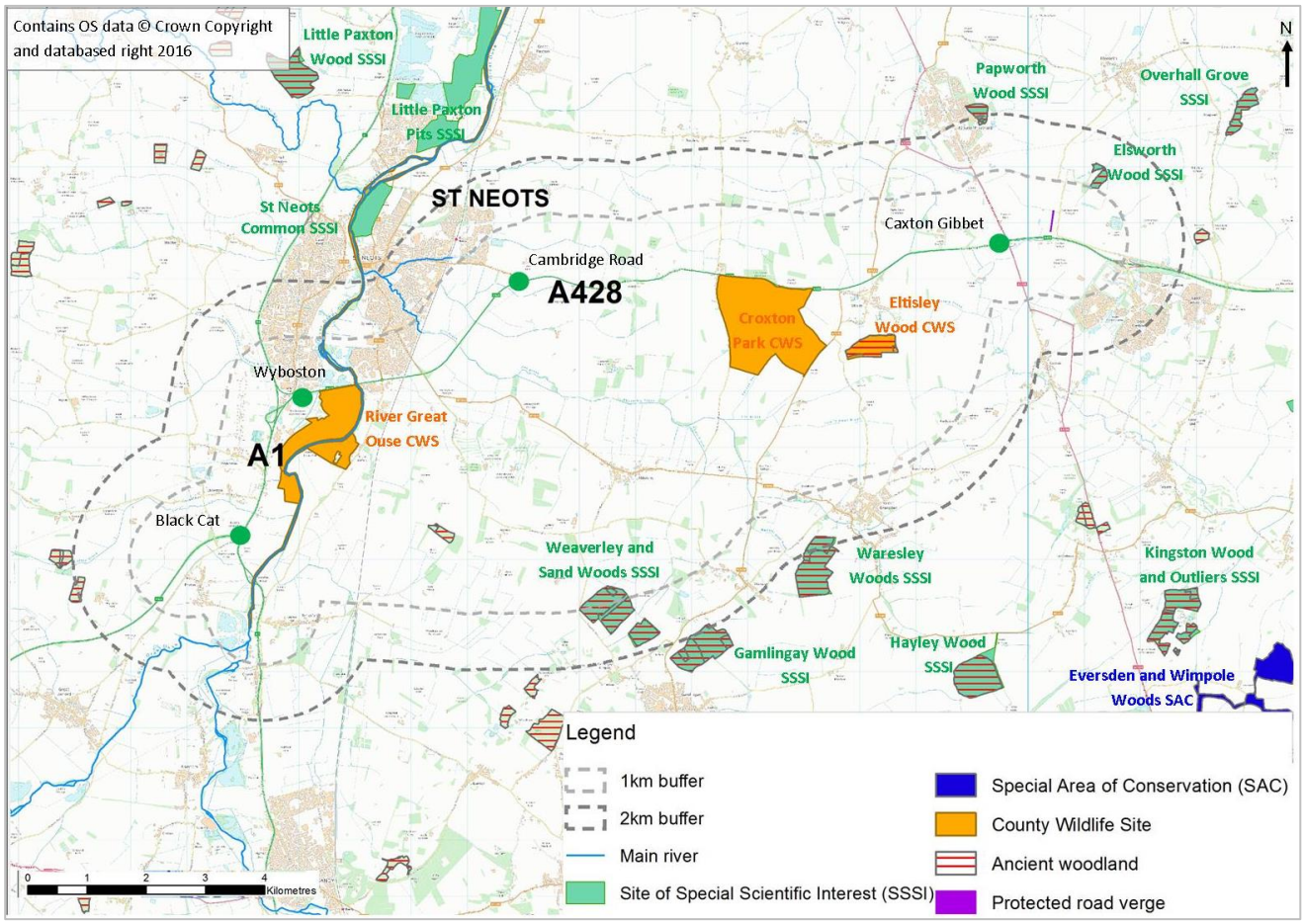
There are eight SSSIs within the 5km study area with the closest being Elsworth Wood SSSI, located approximately 1.1km north-east of the existing A428 at Caxton Gibbet (figure 2.4). This SSSI is designated for its nationally uncommon woodland, which is of importance to its invertebrate community, and nationally uncommon beetle species. Details of the designated sites are provided in table 2.5.

There are four non-statutory designated wildlife sites within the 1km study area; three are CWS and one is a protected road verge (PRV). There is one block of ancient woodland within the 1km study area.

Table 2.5: Designated sites within the study area

Site Name	Grid reference	Distance from A428	Reason for designation
Eversden and Wimpole Woods SAC	TL 340 526	8.5km southeast	Primarily designated for barbastelle bats.
Elsworth Wood SSSI	TL 313 617	1.1km northeast	Designated for its nationally uncommon woodland, which is of importance to its invertebrate community, and nationally uncommon beetle species.
Papworth Wood SSSI	TL 291 630	2km north	Papworth Wood is known to be one of the oldest secondary woods in Cambridgeshire. Although originally a coppice-with-standards woodland of ash *Fraxinus excelsior,* field maple *Acer campestre* and hazel *Corylus avellana* the site is now dominated by invasive small-leaved elm *Ulmus minor* and represents a woodland type scarce in the British Isles.
St Neots Common SSSI	TL 183 613	2.4km northwest	This riverside common holds alluvial grassland and associated ponds, ditches and willow carr which together provide an area of diverse wildlife habitat supporting a variety of species.
Little Paxton Pits SSSI	TL 200 637	2.8km northwest	Little Paxton Pits is an extensive area of flooded gravel workings of varied age, with a correspondingly diverse vegetation structure. The pits are of national importance for wintering wildfowl and an important stopping point for migrants. The invertebrate fauna is extremely rich and includes a number of national rarities.
Overhall Grove SSSI	TL 337 630	4.2km east	Overhall Grove is an ancient secondary woodland now dominated by small-leaved elm and represents a woodland type which is nationally restricted in its distribution.
Waresley Wood SSSI	TL 262 548	4.4km south	This woodland is of ancient origin and of the ash-maple community type which has a national distribution restricted to lowland England. The ground flora is essentially of dog's mercury *Mercurialis perennis* and bluebell *Hyacinthoides non-scripta* with distinct areas of primrose *Primula vulgaris* on the drier greensand areas and a notable population of oxlip *Primula elatior* on the wetter boulder clay areas. Early-purple orchid *Orchis mascula* and early and common dog violet *Viola reichenbachiana* and *V. riviniana* are also frequent.
Weaverley and Sand Woods SSSI	TL 226 542, TL 232 538	4.8km southeast	The woodland is ancient in origin and of the ash-maple type which is restricted to lowland England and is a declining habitat.
Little Paxton Wood SSSI	TL 170 635	5km northwest	The site is situated on heavy calcareous boulder clay and represents a typical example of wet ash-maple woodland, which is found over such soils in lowland England. This type of woodland has undergone a significant decline over recent years.
Croxton Park CWS	TL 252 598	Immediately adjacent	Parkland with groups of 5 – 19 veteran trees associated with other semi-natural habitat. Also supports a population of nationally scarce vascular plant species Oxslip and qualifies for habitat mosaic.
Eltisley Wood CWS and ancient woodland	TL 272 588	900m south	An ancient woodland over 75% replanted which supports more than 40 woodland species, and also supports a population of a nationally scarce vascular plant species.
River Great Ouse CWS	TL 37	Immediately adjacent	A major river not grossly modified by canalisation or poor water quality; supports >0.5 ha national vegetation community (NVC) S6 swamp; >0.5 ha S4 swamp; >0.05 ha MG13 grassland; a nationally scarce vascular plant and a breeding population of a nationally rare dragonfly.
Elsworth (A428 to Common Farm) PRV	TL 305 610	Immediately adjacent	Neutral/ calcareous grassland, presence of a local red data book species.

Figure 2.4: Key habitats and features



The majority of habitat coverage across the survey area comprises arable fields with small and localised blocks of semi-natural and plantation woodland. Most field boundaries support hedgerows, some of which support mature trees. The study area supports a number of Cambridgeshire BAP priority habitats including farmland (arable); deciduous woodland; grazing marsh; wood pasture and parkland; traditional orchards; ponds; hedgerows; and rivers and streams. Other potentially notable habitats recorded during the Extended Phase 1 habitat survey include unimproved neutral grassland and arable margins. The Extended Phase 1 habitat survey report is provided in Appendix E.

Invasive species in the form of Himalayan balsam *Impatiens glandulifera* and Japanese knotweed *Fallopia japonica* were recorded within the survey area during the Extended Phase 1 habitat survey.

There are several records of notable animal and plant groups within the 1km study area. There are 57 species listed on Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006; 33 species listed under the Wildlife and Countryside Act 1981 (as amended) (including four species listed on the Conservation of Habitats and Species Regulations 2010 (as amended)); 57 species listed under the UK Biodiversity Action Plan (BAP); nine local BAP species; and seven birds listed under Annex 1 of the Birds Directive Annex 1.

The species that receive full legal protection that have been recorded within the study area comprise badger *Meles meles*; GCN; water vole *Arvicola amphibius*; otter *Lutra lutra*; bats; grass snake *Natrix natrix*; and common lizard *Zootoca vivipara*. Habitats considered suitable to support all of these species were recorded during the Extended Phase 1 habitat survey, along with habitats suitable for various species listed on Section 41 of the NERC Act and the UK and Cambridgeshire BAPs.

2.4.4 Value of receptors

The value of each receptor was determined based on a geographical scale, following the approach described in DMRB IAN 130/10 Ecology and Nature Conservation (Highways Agency, 2010b) and the Guidelines for Ecological Impact Assessment (CIEEM, 2016). An overview of the criteria used to determine the value of the receptors is provided in Appendix C.

The receptors included in table 2.6 are based on species recorded during the surveys or with the potential to be present on the scheme based on habitat suitability and known range (i.e. background data search and known habitats). For the purpose of this document, the list of receptors and the respective values should be treated as provisional and may change based on the outcome of more detailed surveys, assessments and consultation during future stages of the project. As a full baseline has yet to be established, a precautionary approach to assigning receptor valuations has been taken.

Table 2.6: Value of receptors for nature conservation

Receptor	Description	Examples within the study area
Habitats and sites		
Very high	Very high importance and rarity, international scale and very limited potential for substitution. Includes Ramsar and European designated sites, or sites that meet the published selection criteria but not designated as such.	Eversden and Wimpole Woods SAC
High	High importance and rarity, national scale, and limited potential for substitution. Includes statutory designated sites such as SSSIs and NNRs, as well as ancient woodland and sites that meet published criteria for selection. Key / priority habitats.	Elsworth Wood SSSI, Papworth Wood SSSI, St Neots Common SSSI and Elsworth Wood Ancient Woodland
Medium	High or medium importance and rarity regional scale, moderate potential for substitution. Non-statutory designated wildlife sites such as CWSs designated in the county or unitary authority area context. LNRs. Includes key / priority habitats identified in local or Highways BAP. Habitats listed in accordance with the requirements of Section 41 of the NERC Act.	Eltisley Wood CWS, River Great Ouse CWS and Croxton Park CWS Veteran trees and habitats listed on Section 41 of the NERC Act or Cambridgeshire LBAP e.g. wood pasture and parkland
Low	Medium and low importance and rarity, local and site scale, higher potential for substitution. Receptor is relatively common and widespread but has elevated conservation status, e.g. is listed in accordance with the requirements of Section 41 of the NERC Act, LBAP.	Elsworth (A428 to Common Farm) PRV, hedgerows and semi-natural woodland
Species		
Very high	Sites with resident or regularly occurring population/s of species at an international or European level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.	Species listed on Annex I and Annex II of the Conservation of Habitats and Species Regulations 2010 (as amended) with functional linkages to SACs, SPAs or Ramsar sites
High	Sites with resident or regularly occurring population of species at UK or national level where loss would affect the conservation status or distribution at this geographic scale. Where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale. Species recorded as 'critically endangered' under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2016).	GCN, bats and otter
Medium	Resident or regularly occurring populations of species which may be considered at a regional, county or district level, or key / priority species where loss of these species would affect the conservation status or distribution at this geographic scale, or the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale. Species listed in accordance with the requirements of Section 41 of the NERC Act.	Water vole

Receptor	Description	Examples within the study area
Low	Areas of habitat or populations / communities of species valued at a local or site level. Receptor is relatively common and widespread but has elevated conservation status, e.g. is listed in accordance with the requirements of Section 41 of the NERC Act, local BAP, Birds of Conservation Concern Red or Amber listed (Eaton et al., 2015), Red Data Book listed and/or is legally protected.	Reptiles, badger and abundant Section 41 species such as brown hare *Lepus europaeus*

2.5 Geology and soils

2.5.1 Baseline sources

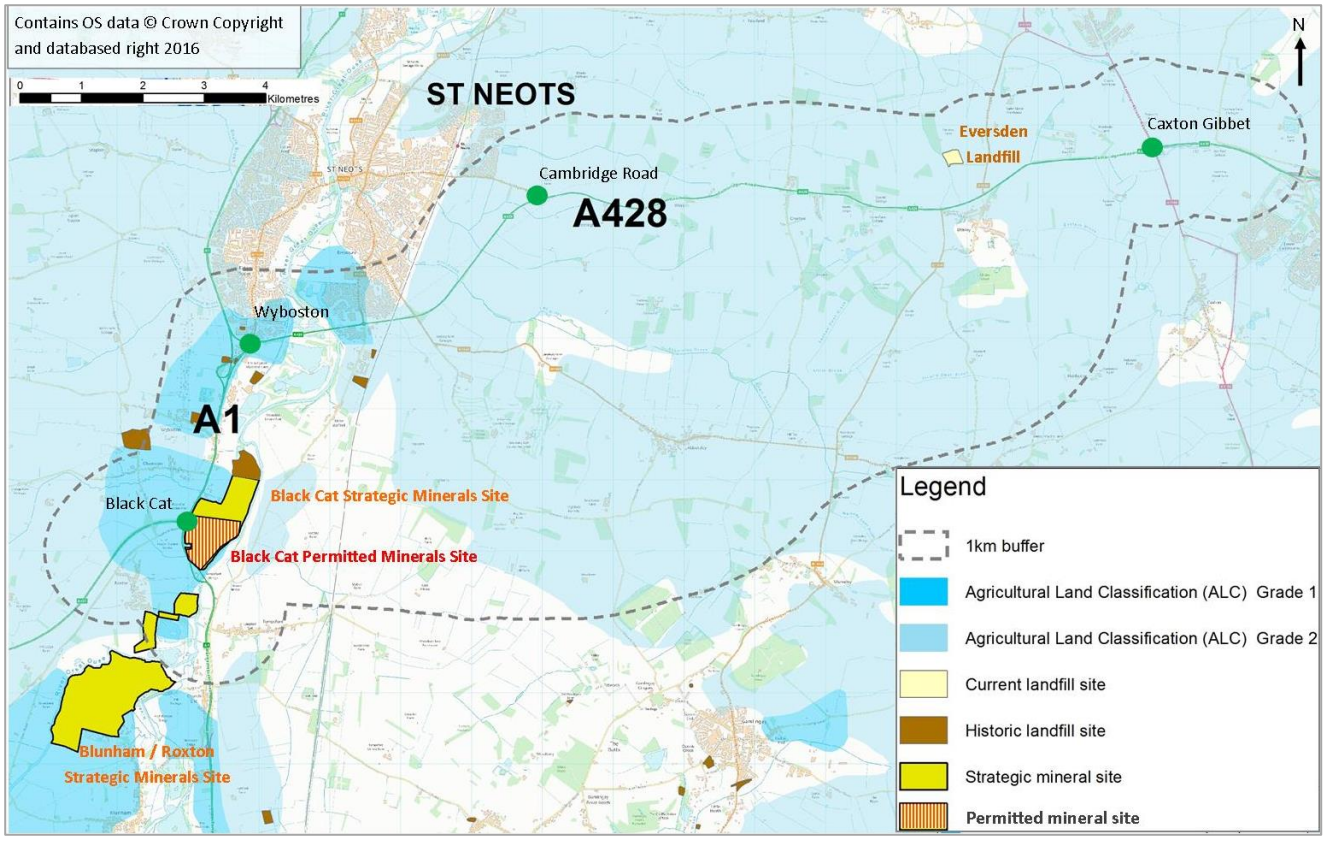
The following baseline sources have been used during the Stage 1 data gathering:

- Land use has been assessed by review of open map data and aerial photography including Google Earth[1] and Old-Maps[2]
- British Geological Survey (BGS) website (BGS, 2016) and BGS printed drift map, Sheet 187 (Huntingdon), and 207 (Biggleswade), 1:50,000 scale (1975)
- Bedfordshire (BGS, 1995) and Cambridgeshire (BGS, 2003) BGS Mineral Resources maps, 1: 100 000 scale
- Council mineral policy maps (Cambridge County Council and Peterborough City Council, 2010; Bedfordshire County Council, 2005; Central Bedfordshire Council, 2013 and 2014)
- The Environment Agency (2016) website, using the “What’s in Your Backyard” series of interactive maps and the EA Catchment Data Explorer
- Designated sites and features identified on the MAGIC website (Defra, 2016b)
- Cambridgeshire Geological Society website (2016) and the Bedfordshire Geology Group website (2016)
- Zetica Free Risk Map for unexploded ordnance, Map for Cambridgeshire and Bedfordshire (Zetica, 2016)

2.5.2 Geographical scope

A 1km wide corridor study area was used for the baseline review around the existing A1 and A428.

Figure 2.5: Key geology and soils features



[1] https://www.google.co.uk/earth/
[2] https://www.old-maps.co.uk/#/

2.5.3 Baseline conditions

Geology

The bedrock in the west of the study area and underlying the majority of the existing A428 is the Oxford Clay Formation, formed of silicate mudstone, with sporadic limestone beds. The unit is estimated to be over 13.6m thick, as recorded in BGS borehole TL15NE2, with thicknesses of 58-69m typical for the unit (BGS, Sheet 187). The Oxford Clay dips towards the east, exposing the overlying West Walton and Ampthill Clay Formation in the east of the study area. The West Walton Formation comprises calcareous mudstones, silty mudstones and siltstone with fine grained sandstone and limestone. The Ampthill Clay Formation comprises predominantly smooth, slightly silty, grey mudstone with some limestone nodules. Typical thickness for the units combined is 20-52m (BGS, Sheet 187).

The superficial geology is predominantly the Oadby Member (grey, weathering brown, diamicton till). In the western part of the study area, along the A1 and western-most part of the existing A428, the superficial deposits are river terrace deposits, comprised of sand and gravel; and alluvium, comprised of clay, silt, sand and gravel, deposited within the valley of the River Great Ouse. In some isolated parts of the study area there are no superficial deposits recorded.

There are no geological faults anticipated within the study area. Made ground is expected beneath and surrounding the main roads in the area, including the A1 and A428. The soil in the majority of the study area is considered ‘lime-rich loamy and clayey soils with impeded drainage’. In the west of the study area, either side of the River Great Ouse, the soil is described as ‘freely draining, slightly acid loamy soils’, with soils comprising ‘Loamy and clayey floodplain soils with naturally high groundwater’ directly adjacent to the watercourse.

No local geological sites, geological SSSIs, world heritage sites or national parks have been identified within the study area.

Soils

The study area includes agricultural land classification (ALC) grade 2 (very good) quality agricultural land (figure 2.5). In some localised parts of the study area (predominantly towards the western end of the study area) the soil is classified as grade 1 (excellent) and grade 3 (good). This high grade land should be considered a high sensitivity receptor. In the east of the study area, just south of Eltisley, the land is considered ‘non-agricultural’ with a grade 3 classification. Part of this area of land corresponds with designated ancient woodland areas.

Mining, quarrying and mineral resources

The wider corridor of the River Great Ouse is a mineral consultation area. This extends on both sides of the existing A428 and includes the area around Wyboston junction. Within the consultation area, there are four mineral safeguard areas (MSA) for river valley/glacial sand and gravel including two small areas to the west of the A1 Wyboston junction, an MSA extending southeast of St Neots along the Hen Brook and the River Great Ouse corridor. Within the River Great Ouse MSA, there are two strategic mineral sites involving the extraction of sand and gravel in the area around and to the south of Black Cat junction:

- The Black Cat site is approximately 36.5ha in area and is located immediately east of the A1-A421 Black Cat junction. There is one active quarry (permitted minerals site) located within this site operated by Breedon Aggregates (formerly Hope Construction Minerals).
- The Blunham/Roxton site is approximately 145ha in area and is located south of the A1-A421 Black Cat junction. There is a haul road running from the latter site to the Bedford Road.

A number of inactive, filled or flooded sand and gravel pits can be identified from the BGS Mineral Resources Maps (Cambridgeshire and Bedfordshire). All of these are in the Wyboston and Eaton Socon areas in the west of the study area.

Landfills

There are nine historic landfills identified within the study area (figure 2.5). These were used for a range of wastes including commercial, industrial, inert, household and special wastes. There is one authorised landfill (Eversden Landfill) in the study area located approximately 1km north of Eltisley. The landfill is operated by Eversden Landfill, with an A6 'Landfill taking other wastes' licence. Waste management facilities can represent potential sources of ground gases as well as soil and groundwater contamination.

Groundwater and hydrogeology

Surface water receptors are detailed in section 2.8, road drainage and the water environment. To avoid duplication this section only covers groundwater receptors.

The majority of the superficial deposits in the area are classified as a secondary (undifferentiated) aquifer, corresponding with the diamicton till (Oadby Member). In the west of the study area, along the A1, where the superficial deposits on the surface are formed from Alluvial and River Terrace Deposits, the deposits are classified as secondary A aquifers. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The bedrock across the majority of the study area is designated as unproductive strata. This is due to its low permeability and lack of importance to water supplies and base river flow. A designated bedrock aquifer (principal aquifer) lies to the south east of the study area, within the Woburn Sands formation. Some of the western parts of the study area are in minor aquifer intermediate and high vulnerability zones (corresponding with the River Terrace Deposits and Alluvium); however, the majority of the study area is not in groundwater vulnerability zones.

The Environment Agency website "What's in your backyard" indicates that there are multiple groundwater abstraction licences identified within the study area. These are indicated for irrigation, general farming and domestic use. The level of detail on the website makes it difficult to determine the precise location, number and types of abstractions within the study area. More detailed studies at the next stage of assessment will be undertaken to determine this information. A groundwater source protection zone (total catchment Zone SPZ3) is present in the south eastern boundary of the study area (Environment Agency, 2015).

Potential sources of contamination

The study area is predominantly in a rural setting consisting of mostly agricultural land use. The historical land use of the study area can be summarised as follows:

- The area is comprised predominantly agricultural, undeveloped land and woodland and the existing Great North Road (western half) and Cambridge Road (eastern half) in 1884. Residential buildings are concentrated within villages at either side of roads, whereas farms are set back from the roads via access routes. The ECML is present in the west of the study area.
- Between 1945 and 1950 there where road developments towards the eastern end of the area with a new roundabout built to replace the intersection between Cambridge Road and Ermine Street (A1198). Residential areas and roads were developed at various locations in the study area.
- There are no significant changes until 1958 to 1970 when new roads where constructed in the western end of the study area. Development increased either side of the roads and within the villages.
- Between 1974 and 1979 there were significant road developments in the study area, particularly west of St. Neots, east of Little End and north of Eltisley. There were also noticeable building developments across the study area especially south of St. Neots.
- In 1979 a new road was built north of Eltisley, connecting Cambridge Road to bypass the village centre.
- There are no significant changes until 2003 to 2008 when new roads were built in the east of the study area.

Four significant pollution events were recorded towards the north of the study area in 2002, 2003 and two in 2007, impacting water (with minor impacts to air and land), land (with no impact to air or water), water and water (with minor impact to land) respectively. One major water pollution incident was recorded just over 1km north of

the existing A428 near Eaton Socon. There are also two expired discharge consents recorded by the Environment Agency located immediately east of the River Great Ouse, 1km north of Little Barford, These are associated with air and water releases from the Little Barford Generating Station.

Unexploded ordinance (UXO)

Risk maps from Zetica (Cambridgeshire and Bedfordshire) suggest that the study area is in a low risk zone. Low risk equates to up to 10 bombs per 1000 acres. The Zetica regional unexploded bomb risk map states that readily available records indicate that a density of approximately 156 high explosive bombs were encountered within the St. Neots borough.

2.5.4 Value of receptors

An overview of the criteria used to determine the value of the receptors is provided in Appendix C. Table 2.7 summarises the value of the receptors identified within the study area.

Table 2.7: Value of receptors for geology and soils

Receptor	Description	Examples within the study area
Geology, soils and hydrogeology		
High	Nationally designated sites of geological value. Agricultural land of grade 1 (excellent), grade 2 (very good) or grade 3a (good) quality. Principal Aquifer with or without local abstractions, or secondary A aquifer with abstractions. Proven mineral reserves and sites with extraction permits.	Grade 1 and 2 ALC soils, e.g. around Black Cat (grade 1) and along the majority of the study area (grade 2). Minerals safeguarding areas around Black Cat and Wyboston. Groundwater within the superficial deposits such as the river terrace deposits secondary A aquifer where abstractions are present.
Medium	Grade 3b (moderate) agricultural land. Secondary A aquifer, no abstraction. Minerals sites identified for future extraction e.g. mineral consultation areas.	Surface water of the River Great Ouse, Abbotsley Brook, Vicar Dean Brook and any ponds located in the study area. Groundwater within the superficial deposits such as the diamicton till secondary (undifferentiated) aquifer.
Contaminated land receptors in addition to those above		
Very high	High impacts due to potential for exposure to contaminated land or landfill materials in the ground.	Construction workers / below ground workers during the works.
Medium	Medium impacts where industrial use is prevalent.	Risks to current and future highways and associated infrastructure, including nearby residential and commercial buildings from ground gas and contaminated land. Undeveloped land dominates the majority of the study area.
	Medium impact due to potential for limited temporary exposure where mitigation is undertaken.	Current and future highways users and nearby site users (commercial / industrial land use).

2.6 Noise and vibration

2.6.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- England noise map viewer (Extrium, no date)
- Google Maps[3]

2.6.2 Geographical scope

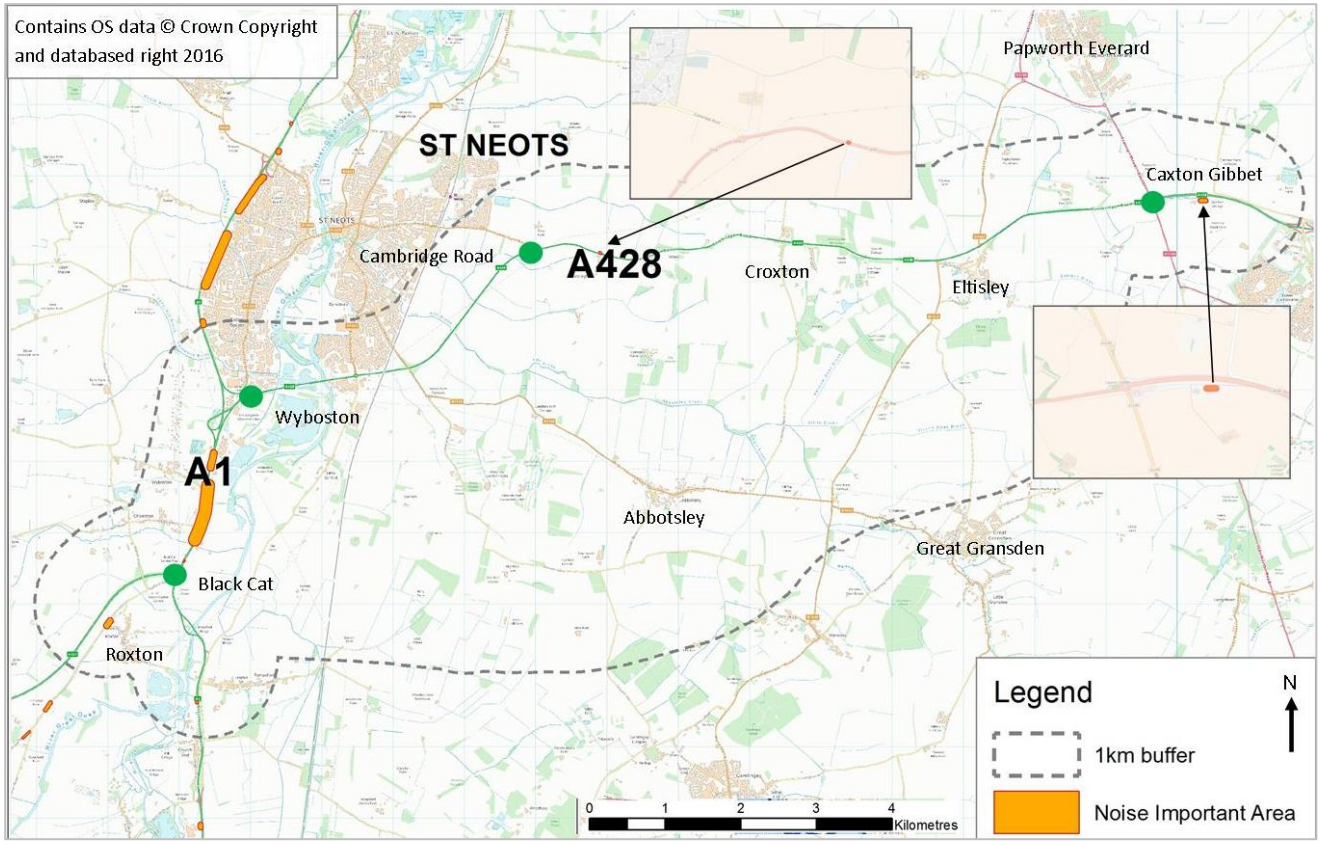
The Stage 1 assessment has considered a study area of 1km from the A428.

2.6.3 Baseline conditions

The existing noise climate in the vicinity of the scheme is dominated by road traffic noise, predominantly from the A1, A428, A1198 and associated junctions. Other significant sources of road traffic noise include the B1428, B1043, B1046, B1428, and B1040. There are also a number of minor roads, in particular in St Neots, which contribute to the local soundscape.

In addition, rail noise from the ECML could dominate in some locations and contribute in general to the local soundscape. Recreational aircraft flying out of Bourn, Gransden Lodge and Little Gransden airfields may also contribute to the noise environment on occasion. Other noise sources will include road traffic noise from local roads and noise associated with general urban and rural activities.

Figure 2.6: Key noise and vibration features



[3] https://www.google.co.uk/maps/

There are five noise important areas (NIA) in the study area (figure 2.6). Three are located on the A1, north of the Black Cat junction; one is located on Bedford Road (minor road); and two on the A428, one lies 1km east of the A428/B1428 Cambridge Road junction and the other lies 0.7km east of the A428/A1198 Caxton Gibbet junction. NIA are considered to be where the top 1% of the population experience the highest noise levels (Defra, 2014). There are no railway NIAs in the study area.

Sensitive receptors for humans include residential properties in: St Neots; Eaton Socon; Tempsford; Eynesbury; Roxton; Chawston; Wyboston and properties along Rookery Road; Little Barford; Croxton; Eltisley; Caxton; and Cambourne. There are also individual dwellings in the countryside, including some located immediately adjacent to the A428. A Travelodge hotel is located immediately adjacent to the Black Cat junction.

There are a number of schools in the study area including: Roxton VA (Church of England) Lower School; Middlefield Community Primary School; Ernulf Academy; Newton Primary School; Monkfield Park Primary School; Cambourne Village College; and Hardwick and Cambourne Community Primary School.

Other sensitive noise sensitive receptors include Croxton Park Registered Park and Garden, which is located adjacent to the existing A428. The park is also a CWS. Wyboston Lakes Golf course is located in Little Barford and the Abbotsley Golf Club approximately 2km west of Abbotsley are both recreation areas. There are numerous footpaths and other PRoW in the area.

2.6.4 Value of receptors

DMRB states that a methodology has not yet been developed to assign significance of effects according to both the value of a resources and the magnitude of an impact. However, the considered value for some examples of potential receptors within the study area are provided in table 2.8 based on the criteria set out in Appendix C.

Table 2.8: Value of receptors for noise and vibration

Value	Receptor
High	Residential areas, individual residential property, educational receptors (schools, pre-schools)
Medium	Public footpaths, golf courses / clubs, parks, recreational ground / playing fields

2.7 People and communities

2.7.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- Ordnance survey mapping data
- Site visit and aerial photographs

2.7.2 Geographical scope

The Stage 0 study area for people and communities encompasses a 1km buffer either side of the existing A428. During Stage 1 additional offline options have been considered to the south of the existing A428. The desktop study area has considered a 1km buffer around all the Stage 1 options.

2.7.3 Baseline conditions

Private and community assets are considered within DMRB, Land Use (Volume 11, Section 3, Part 6 and part 8) and with consideration of IAN 125/09 (Highways Agency, 2001; 1993b; 2009b). DMRB outlines four subsidiary topics:

- Private property including the demolition of property or any associated loss of land which may result in the loss of facilities, quality of life, services or employment.
- Community land including land used by the public that is town or village green, a public park or land used for public and private recreation amenity, or land that is a disused burial ground.
- Development land including future land-use changes that are likely to occur independently of the Proposed Scheme, including land covered by land use planning designations and any planning proposals lodged with the planning authorities (this is covered in section 4.4).
- Agricultural land including agricultural land take, type of husbandry, severance of agricultural holdings, major accommodation works, access, water supply and drainage. This has links with section 2.5 (geology and soil).

In addition, there is guidance set out in the DMRB covering Pedestrians, Cyclists, Equestrians and Community Effects and Vehicle Travellers (Volume 11, Section 3, Parts 8 and 9) (Highways Agency, 1993b; 1993c).

Private property

St Neots is located along the existing A428 to the north west of the study area, and is the largest built up area in the area. Other residential areas include Wyboston, Roxton, Little Barford, Abbotsley, Croxton and Eltisley. There are also a number of farms and isolated property in the open countryside.

There are a number of commercial assets within the study area that also provide benefit to the community, the majority of which are located along the A428 corridor. Assets within 100m of the A428 include:

- Service areas at Black Cat junction (including Travelodge hotel), and at Caxton Gibbet junction (including McDonalds, Shell garage, and Costa cafe)
- Whitehall Industrial Estate in Croxton; Little End Road and Howard Road industrial estates in St Neots; and an industrial estate along Alington Road, south of St Neots
- Papworth Hotel on Ermine Street, where the A1198 meets the A428
- Kelpie Marine boat yard by Tempsford Bridge
- Little Barford electricity generating power station, south-east of St Neots
- Businesses, including Cemex cement plant located within Wyboston Leisure Park
- Roxton Garden Centre, approximately 300m south-west of the Black Cat junction

- Business (including McDonalds, BP garage, and independent retailers) adjoining the Great North Road in Wyboston
- St Neots Autograss Club motor sports circuit, located adjacent to the A428 immediately south of Black Cat
- Premier Inn and other businesses at Wyboston interchange
- Tesco superstore south of St Neots
- Abbotsley Golf Club, located approximately 2km west of Abbotsley
- Various farms, plantations, and associated businesses located in the countryside

Community land

There are a number of community receptors in the study area, including:

- The Robinson College, located on Great North Road south of Little End
- St Neots Community College, located approximately 600m north of the A428 in St Neots
- Middle Field Community primary school, located approximately 400m north of the A428 in St Neots
- Barford Road Pocket Park, located approximately 300m from the A428 in St Neots
- Wyboston Leisure Park, located south of St Neots
- Places of worship in St Neots, Abbotsley, Croxton, Eltisley, and Little Barford
- Newton Primary School in Eltisley

Agricultural land

The majority of the study area is classed as ALC grade 2 (very good) agricultural land (see section 2.5 - geology and soils). Remaining areas are classed as grade 1 (excellent) around Black Cat and grade 3 (good and moderate) to the south of Cambridge Road. There are a number of large commercial plots (over 100ha in size) around the middle sections of the existing A428. There are smaller plots located around Black Cat and around the fringes of St Neots.

Transport and non-motorised users

The ECML runs north-south through the study area, parallel to the A1 and east of St Neots. The line links London to Edinburgh, via Peterborough, Doncaster, Wakefield, Leeds, York, Darlington and Newcastle.

The A1 and A421 meet at the Black Cat junction with the A1 continuing north from Black Cat as the Great North Road, joining the A428 south of St Neots at the Wyboston interchange. The A428 runs east towards Cambridge, joining the A1198 at the Caxton Gibbet interchange. There are a number of B roads and minor roads which cross or adjoin the existing road network in the study area:

- Bedford Road feeding into the Black Cat junction
- Colesden Road and The Lane, both joining the Great North Road in Wyboston
- B1428 at the Wyboston interchange and east of St Neots at the Tithe Farm junction
- B1043 connecting St Neots to the A428, continuing south towards Black Cat as Barford Road
- B1046 from St Neots over the A428 travelling south east towards Abbotsley Golf Club
- Drewels Lane which joins with the B1046 to the north west of Abbotsley Golf Club
- St Neots Road connecting Abbotsley with the B1046
- Abbotsley Road which joins the A428 west of Croxton, and continues south sown the study area towards Abbotsley, and north towards Toseland
- B1040 joins the A428 at Eltisley, continuing north to Papworth Everard and south towards Great Gransden

There are numerous PRoW within the study area, which are clustered around Black Cat junction and Wyboston; south-east of St Neots, between Hen Brook and Wintringham; and the settlements of Weald, Croxton, and Eltisley. The Ouse Valley Way regional trail runs adjacent to and crosses the Great North Road in Wyboston, and crosses the A428 going into St Neots at the Wyboston Interchange. National cycle route 12 (the Bedford Green-Wheel Cycle Network) runs north-south through the study area to the west of the Great North Road, crossing the A1 to the west of Black Cat junction.

2.7.4 Value of receptors

Receptors have been assigned a value for sensitivity based on professional judgement, taking into consideration the importance of receptors to the community and scale of use (local, regional, national, etc.). For descriptions of sensitivity values, refer to Appendix C. Table 2.9 summarises the value of the receptors identified within the study area.

Table 2.9: Value of receptors for people and communities

Value / sensitivity	Examples within the study area
High	**Private and community assets:** Schools, places of worship, Croxton Park Registered Park and Garden, Little Barford Power Station. **Traffic and transport:** A428, A1, A421, and the ECML. **Public rights of way**: National cycle route 12.
Medium	**Private and community assets**: Residential property, country parks, individual businesses, services, hotels including Wyboston Leisure Park, Abbotsley Golf Club, Black Cat services. **Traffic and transport**: A1198, B roads including B1428, B1043, B1046 and B1040. **Public rights of way**: Ouse Valley Way regional trail.
Low	**Private and community assets**: Playing fields / recreational ground, commercial grounds. **Traffic and transport**: Local roads including Bedford Rd, Barford Road, Colesden Road, The Lane, St Neots Road, Abbotsley Road, Drewels Lane. **Public rights of way**: Local PRoW, footpaths, and cycleways.

2.8 Road drainage and the water environment

2.8.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- Environment Agency interactive map - 'What's in Your Backyard' (Environment Agency, 2016)
- Anglian River Basin Management Plan (Environment Agency, 2009)
- Detailed river network and national receptor dataset (geospatial data available from the government's open data website[4])
- Environment Agency 'Flood Map for Planning' (Environment Agency, 2016)
- Updated flood map for surface water (available from Government open data website)
- Environment Agency 'Risk of Flooding from Reservoirs' (Environment Agency, 2016)
- Groundwater flood risk (available from Government open data website)
- British Geological Survey geology map (BGS, 2016)
- South Cambridgeshire and Cambridge City Level 1 Strategic Flood Risk Assessment (South Cambridgeshire District Council and Cambridge City Council, 2010)
- The Upper Ouse and Bedford Ouse Abstraction Licensing Strategy (Environment Agency, 2013)
- Cambridgeshire Preliminary Flood Risk Assessment (Cambridge County Council, 2011)
- Catchment data explorer (Environment Agency, 2016)

2.8.2 Geographical scope

The study area considered for the Stage 1 assessment has been defined using a 1km buffer around all surrounding the Stage 1 options (figure 2.7).

2.8.3 Baseline conditions

Two main rivers (the River Great Ouse and Hen Brook) are located within the study area. The River Great Ouse is designated as a main river throughout the entirety of the study area, whereas Hen Brook is classified briefly as a main river within the study area, although the majority is classified as 'ordinary watercourse'. The River Great Ouse runs in a northerly then southerly direction and is fed by numerous tributaries along its length. The Hen Brook is one of the tributaries that feeds into the River Great Ouse and runs in a north-westerly direction.

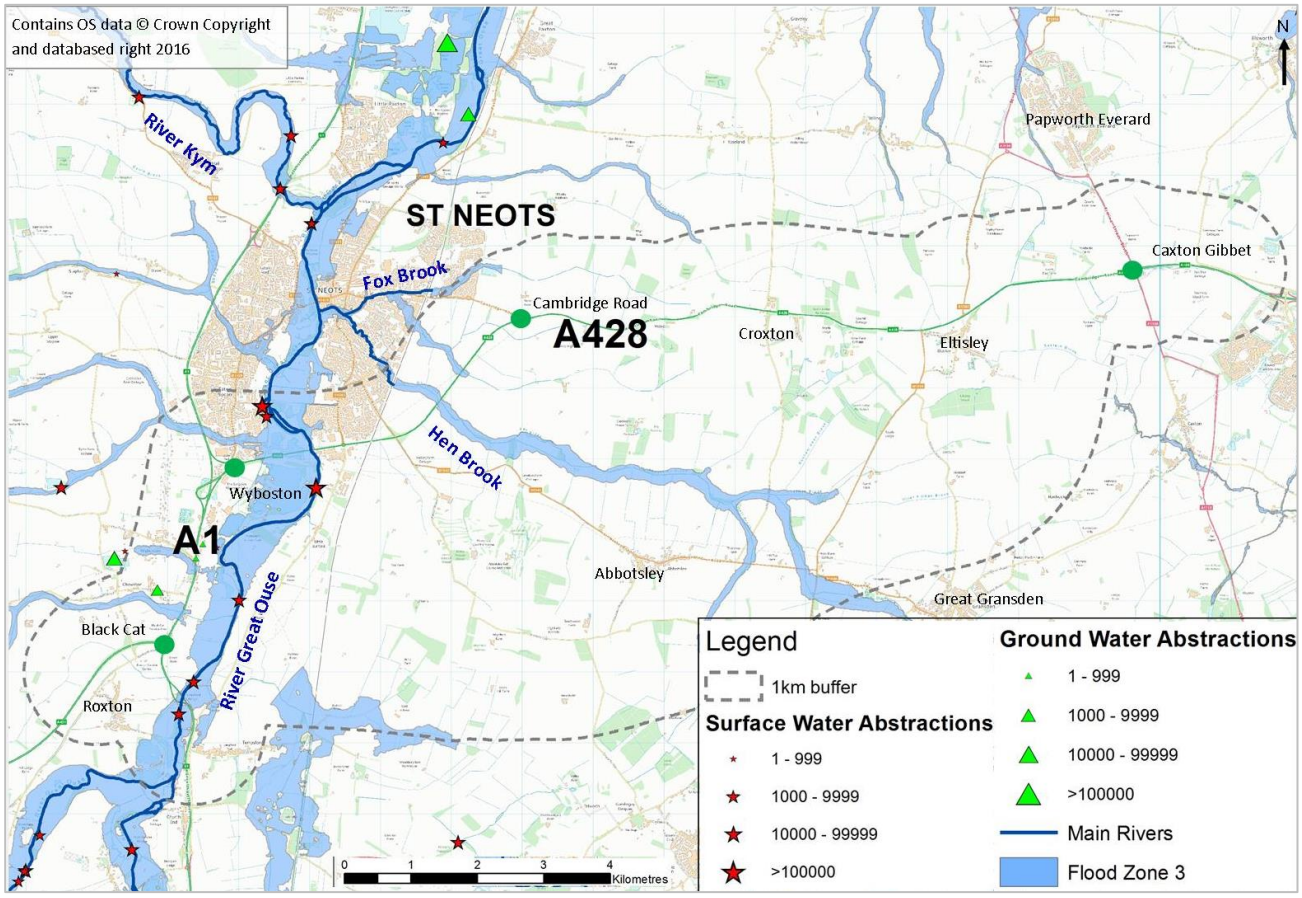
There are also a number of ordinary watercourses within the study area including Rockham Ditch (west of Black Cat junction), Hen Brook (downstream of the main river designation), Fox Brook, Gallow Brook, Abbotsley Brook, Vicar's Dean Brook, which is located east of the B1040. There are also a number of smaller unnamed tributaries.

There are also a number of surface water ponds and lakes in the west of the study area such as the 'Wyboston Lake', 'Gingerbread Lake' and 'Links Pool' which are all within 250m of the existing A1 and A428 roads. There are two other unnamed surface water ponds in the west of the study area located east of the existing A1.

There are 11 surface water abstraction licenses listed in the study area. These are abstractions for spray irrigation, evaporative cooling, process water use and hydroelectric power generation. These all lie around Black Cat and Wyboston and there are no abstractions in the central and eastern part of the study area.

[4] https://data.gov.uk/publisher/environment-agency

Figure 2.7: Key road drainage and the water environment features



Flood risk

The Environment Agency flood map for planning indicates that The River Great Ouse is associated with an extensive floodplain (predominantly flood zone 3). The Hen Brook also has a small associated functional floodplain. Similar to the Great Ouse, the Hen Brook floodplain is predominantly classed as flood zone 3.

Surface water flood risk is classified as 'high' immediately adjacent to all of the watercourses with varying extents of 'medium' and 'low' risk, depending on the size of the watercourse. No major surface water flows could be identified away from the watercourse channels within the study area.

Environment Agency mapping shows there is a risk of flooding within the study area along the River Great Ouse should a failure in reservoir defences occur upstream on the River Great Ouse or the River Ivel. The flood risk mapping shows the maximum extent of flooding to cover the floodplain adjacent to the River Great Ouse with few properties at risk within the study area.

The majority of the study area is covered by superficial deposits of River Terrace Deposits and Oadby Member type, which are underlain by Mudstone (Oxford Clay Formation and Peterborough Member) based on BGS mapping. The Cambridgeshire Preliminary Flood Risk Assessment (PFRA) (2011) and South Cambridgeshire and Cambridge City Strategic Flood Risk Assessment (SFRA - 2010) identify locations with reports of groundwater flooding. None of these areas are located within the 1km study area.

According to the Cambridgeshire PFRA, no historical flood incidents from other sources have been recorded within the study area. There are flood defences in place to the east of the Riverside Park, located south of the B1428 near Eaton Ford, with the area to the east benefiting from these defences.

Geomorphology, WFD and water quality

There are five Water Framework Directive (WFD) water bodies within the study area, including the Ouse (Roxton to Earith), Stone Brook, West Brook, Begwary Brook and Abbotsley and Hen. Each of these is classified as achieving moderate potential, except for the Begwary Brook which is currently achieving good potential (Environment Agency, 2016). The water bodies are within the Upper and Bedford Ouse catchment, forming part of the Anglian River Basin Management Plan. The study area falls within the Upper Ouse and Bedford Ouse Catchment Abstraction Management Strategy (CAMS) area, covered within Area A lying between AP3-AP5 (assessment points within Environment Agency, 2013).

Within the study area there are also a number of smaller watercourses (including the Fox Brook, Eastern Brook and Stone Brook) and smaller drainage channels. These form part of the main river catchments, with the smaller drainage channels typically draining the surrounding agricultural land.

There are a number of surface water ponds/lakes to the south of the Black Cat junction and in the vicinity of the Wyboston Leisure Park. There are three surface water abstractions within 1km of the scheme, located adjacent to the River Great Ouse. The study area also falls within a surface water safeguard zone (ID: SWSGZ1012) for pesticides, and is within a nitrate vulnerable zone (NVZ) for both surface waters and groundwater.

2.8.4 Value of receptors

An initial assessment of the water environment including flood risk, geomorphology and WFD, water quality and groundwater has been made using desk based information. The assessment of the water environment has been carried out in accordance with guidance contained in DMRB, Volume 11 Section 3: HD45/09: Road Drainage and the Water Environment (Highways Agency, 2009c). Where appropriate, informed professional judgement is also used to inform the assessment methodology, primarily in geomorphology, where there is a lack of guidance to date. Flood risk has been assessed in accordance with the requirements of the NPPF of 2012 and the accompanying online flood risk guidance.

An overview of the criteria used to determine the value of the receptors is provided in Appendix C. Table 2.10 summarises the value of the receptors identified within the study area.

Table 2.10: Value of receptors for road drainage and the water environment

Value / sensitivity	Examples within the study area
High	**Flood risk**: None identified. **Geomorphology and water quality**: River Great Ouse (main river with moderate potential under WFD and recreational value). **Groundwater**: Secondary A aquifer (superficial deposits).
Medium	**Flood risk**: None identified. **Geomorphology and water quality**: Hen Brook (main river with moderate potential under WFD). **Groundwater**: Secondary A aquifers (both bedrock and superficial) and secondary undifferentiated aquifer (superficial deposits).
Low	**Flood risk**: Ordinary watercourse fluvial flood risk receptors; surface water flood risk receptors; groundwater flood risk receptors; reservoir flood risk receptors e.g. residential properties in the floodplain by the River Great Ouse. **Geomorphology and water quality**: Other watercourses (small watercourses with sinuous planforms, but some are likely to be artificial); drainage channels (small modified channels, likely to be man-made); ponds and lakes. **Groundwater**: None identified.

3. Consideration of alternatives

3.1 Stage 0 options appraisal

The OAR (Jacobs, 2016a) set out a long list of 48 options that would meet the overall objective of improving access along the A428 between Black Cat and Caxton Gibbet. These fell into categories including lane widening, junction improvements, offline alignment and public transport improvements. Most of the options were dismissed early on in the process where it was clear that they were unlikely to pass key viability and acceptability criteria. Sixteen options were taken forward for further assessment using the Department for Transports' Early Assessment and Sifting Tool (EAST) (DfT, 2013). This included a qualitative review of potential environmental impacts including air quality, noise, and the built and natural environment.

The sifting process and the OAR identified eight options that warranted further considerations (table 3.1). Option C1 / C2 were considered the best performing option against the scheme objectives. The next best performing option is considered to be either option C7 or C16 while the low cost solution to problems on the route is considered to be either C10 or C11, which would meet a limited number of the scheme objectives.

Table 3.1: Summary of shortlisted options from Stage 0

Option number	Option	Junction improvement
C1	A428 full offline dualling retaining connection to the A428 at Cambridge Road junction	Grade separation of Black Cat and Caxton Gibbet
C2		Grade separation of Black Cat and signalisation of Caxton Gibbet
C5	A428 bypass between Black Cat junction and Cambridge Road junction. No widening between Cambridge Road junction and Caxton Gibbet junction	Grade separation of Black Cat and Caxton Gibbet
C6		Grade separation of Black Cat and signalisation of Caxton Gibbet
C7	A428 single lane carriageway bypass to Cambridge Road junction with online dualling between Cambridge Road junction and Caxton Gibbet junction	Grade separation of Black Cat and Caxton Gibbet
C10	Local junction widening with channelisation at existing A428 junctions and upgrades to existing A1 junctions	Grade separation of Black Cat and Caxton Gibbet
C11		Grade separation of Black Cat and signalisation of Caxton Gibbet
C16	Offline dual carriageway bypass between Black Cat and Cambridge Road junctions and online widening between Cambridge Road junction and Caxton Gibbet junction	Grade separation of Black Cat and Caxton Gibbet

3.2 Stage 1 options appraisal

The Stage 0 options were taken forward into Stage 1 and considered in the environmental appraisal. Further options were identified as part of the Stage 1 options identification process including two offline options to the south of the existing A428 and two lower cost options that could be done alone or as part of a phased full scheme. A full description of each option can be found in the Technical Appraisal Report (TAR) (Jacobs, 2016b). Table 3.2 summarises the options considered as part of the Stage 1 environmental assessment.

Table 3.2: Options considered in the Stage 1 EAR

OAR ref.	Description	New ref.
C1 / C2	Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 1
C10 / C11	Minor junction improvements along the A428 at Wyboston, Cambridge Road, Croxton and Eltisley. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 2
C5 / C6	A428 bypass between Black Cat and Cambridge Road junctions. No widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 3

OAR ref.	Description	New ref.
C16 / C7	Offline dual carriageway bypass between Black Cat and Cambridge Road and online widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 4
New	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.	Option 5
New	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.	Option 6
New	Dualling between Wyboston and the River Great Ouse crossing and a new roundabout at Wyboston. Minor junction improvements at Barford Road and Cambridge Road. Grade separation at Black Cat junction and signalised junction at Caxton Gibbet.	Option 7
New	Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 8

3.3 Design and construction considerations

There are some design and construction assumptions that are relevant to the environmental assessment. These include:

- Any options that cross the railway would require Network Rail possessions that would have long lead in periods (approximately two years for abnormal possessions).
- Options crossing the floodplain between the Black Cat junction and the ECML would require either a viaduct structure or ground treatment works on which an embankment can be constructed. The latter would have an impact on the construction programme, as allowance would need to be made for a consolidation period. Additional land may also need to be purchased to provide floodplain compensation.
- Construction works at Black Cat, Cambridge Road and Caxton Gibbet junctions would require lane closures and traffic management phasing. These closures are likely to be undertaken at night to minimise disruption, but could create light and noise pollution. Option 4 would also require traffic management, with narrow running lanes and speed restrictions likely over a sustained period.
- Offline construction would require significant amounts of additional road material which would subsequently increase the number of lorry movements to and from site.
- The high pressure gas main at Black Cat junction may need to be diverted for some options. This would have a significant impact on the construction programme (potential two year lead in period).

3.4 Environmental appraisal process

The environmental appraisal has been carried out by a team of specialists working in close iterative collaboration with the engineers responsible for the design of each alternative option. Each option has been appraised on whether it is likely to have significant effects on the different environmental topics. These are documented in the Options Appraisal Matrix (OAM) in Appendix F.

The environmental appraisal considered whether there was likely to be a significant effect, both positive and negative, for each of the environmental topics. The significance of the effect of an impact was derived through consideration of the sensitivity of a receptor (sometimes referred to as its value or importance) and the likely magnitude of the impact. The specialists considered the following criteria as part of their professional judgement decision:

- It leads to an exceedance of defined guidelines or widely recognised levels of acceptable change (which will be different for different topics within the environmental assessment, as set out in the relevant section).
- It is likely that the consenting authority will reasonably consider applying a planning condition, requirement or legal agreement to the consent to require specific mitigation to reduce or overcome the effect.
- It threatens or enhances the viability or integrity of a receptor or receptor group of concern.
- It is likely to be material to the ultimate decision about whether or not the consent application should be approved.

As this appraisal is at an early stage in the project development, the options were evaluated for potential environmental effects using the scoring scale set out in table 3.3. Mitigation measures were recorded along with risks and issues associated with the options.

Table 3.3: Environmental effects scoring scale

Score colour code	6 point effect scale
Red	Significant adverse effect – unlikely to be able to mitigate.
Red / Amber	Potential significant adverse effect – mitigation maybe possible.
Amber	Slight adverse effect. Effect not significant with typical mitigation.
Amber / Green	Slight beneficial effect. Effect not significant.
Green	Significant beneficial effect.
No effect / neutral	No effect or a neutral effect due to the balancing out of positive and negative effects.

Table 3.4 summarises how the designs have evolved and been influenced by the environmental assessment through Stage 1. This is classed as 'primary' or 'built in' mitigation. Options 7 and 8 are online options and there has been no primary mitigation associated with realignment of these options identified at Stage 1. This is because the online options are fixed by existing constraints along the existing A428, which limit realignment opportunities.

Further design iterations will be undertaken in Stages 2 and 3, to maximise the amount of primary mitigation included within the designs. This will involve further refinement of the alignments to take into account additional site features and proposed mitigation areas. Assumed tertiary mitigation (standard good practice) will also be documented at Stage 2.

Table 3.4: Primary mitigation identified at Stage 1

Topic	Primary mitigation (built into final designs)
Option 1	
Water	**Black Cat**: Alignment follows an easterly direction over River Great Ouse and Barford Road, minimising the construction area within the flood-zone and avoiding structure curvatures over the River Great Ouse/Barford Road.
Ecology, landscape, community, water	**Barford Road to Cambridge Road junction:** The final alignment was chosen to avoid woodland areas (including Boys Wood and Alington Hill), two residential buildings, the Abbotsley Golf Club and a number of watercourses.
Cultural heritage, community, water, ecology, landscape	**Cambridge Road Junction to Toseland Road:** The route is aligned to the north of the existing A428 to avoid running adjacent to Croxton Park, minimising impacts to residential, industrial and historic buildings to the south of the A428, and maintaining the existing A428 route as an access road for local villages. The alignment corridor diverts northwards between Croxton and Eltisley to avoid the woodland area 50m north-west of Eltisley Manor and avoid intersecting Fox Brook. The alignment was also modified to avoid the White Hall Industrial Estate and farm.
Ecology, landscape	**Toseland Road to B1040:** The preferred alignment was chosen to avoid intersecting a woodland area east of the White Hall Industrial Estate and woodland towards the end of Gallow Brook.
Community	**B1040 to Caxton Gibbet Junction:** Design considered how this section would tie into the existing junction and minimise land take. It also considered how alternative access could be provided to North East Farm.
Option 2	
Community, cultural heritage	**Eltisley to Caxton Gibbet:** Designs include maintaining access to the private access roads for North East Farm and Pembroke Farm. The position of the new roundabout replacing the Eltisley Cambridge Road and B1040 junctions has been moved north and offline of the existing A428, moving the junction away from cultural heritage assets in Eltisley and minimising disruption to road users during construction.
Option 3 and 4 (same primary mitigation as Option 1 at Black Cat – no further primary mitigation identified at this stage)	

Topic	Primary mitigation (built into final designs)
Option 5 (same primary mitigation as Option 1 at Black Cat)	
Community, water, ecology, landscape	**East Coast Main Line to Drewels Lane:** Alignment avoids Abbotsley Golf Club and ancient woodland. The alignment clears the ancient woodland by 100m and an area of woodland 150m north of the ancient woodland.
Water, community, ecology, landscape	**Drewels Lane to B1046:** Alignment designed to avoid a brook immediately north of the proposed road at Drewels Lane, Abbotsley Golf Club, and woodland areas south-east of Abbotsley Golf Club. To avoid these constraints a small section of woodland east of the golf club is intersected and split by the alignment, which then continues to curve right on approach to the B1046, reducing the distance to the village of Abbotsley.
Water, cultural heritage, community, ecology, landscape	**B1046 to Eltisley Road:** Alignment designed to minimise footprint in flood zone area, and reduce proximity to residential and historical buildings and woodland areas near Hill Top Farm. The alignment was moved to avoid coming into close proximity with the Croxton Park. Alignment designed to avoid the large woodland area south of Eltisley.
Option 6 (same primary mitigation as Option 1 at Black Cat, and as Option 5 between the B1046 and Eltisley Road)	
Ecology, landscape	**East Coast Main Line to Tetworth Hill:** Alignment designed to sever an area of woodland approximately 1.35km east of the point the proposed alignment intersects the ECML at a point which is narrow and the plantation relatively young.
Water	**Tetworth Hill to B1046:** Alignment takes the shortest route whilst minimising footprint in Small Brook floodplain and avoiding Hill Top Farm. An alignment further to the east was avoided to reduce the proximity to Great Gransden and remove the requirement for an additional three culverts.

3.5 Results of the Stage 1 environmental assessment

The OAM (Appendix F) summarises the potential environmental effects associated with each of the options based on the baseline study and a high level consideration of the potential effects. Table 3.5 provides a summary of the conclusions of the environmental appraisal at Stage 1. The overall environmental impact for each option is given in table 3.5 in accordance with the six point scale.

The text in table 3.5 shows that Option 1 is the environmentally preferred options at Stage 1. This is because it would meet the objectives to reduce congestion along the whole route. Although it has the same overall score as the other offline options, it has fewer effects to designated sites including Croxton Park, and could benefit this feature by moving traffic away from the designated site, unlike Option 4 (online). It would also have less of an impact on the landscape and wider habitats than option 5 and 6 (offline southern options).

Option 8 has a low environmental effect, as it involves less impact on green field sites. Option 4 is least preferred, as this would extend the road into the footprint of Croxton Park and is likely to result in significant effects to the site that would be difficult to mitigate. Options 5 and 6 would affect large areas of the open landscape and would take the route closer to designated sites to the south.

3.6 Phasing

The budget allowance from the Department of Transport (DfT) may not cover the construction costs for implementing the full scheme during the RIS 1 Road Period. Therefore, the full scheme may be delivered using a phased delivery approach over successive RIS periods. The phasing could include just undertaking improvements at the junctions or trying to improve sections of the route but not to full expressway standards. The later environmental assessment would need to consider the impacts associated with each phase in isolation as well as the effects of the scheme as a whole.

3.7 Recommendations of options for consultation

An options appraisal workshop was held in October 2016 to appraise the eight options against how they met the scheme objectives (see section 1.4). The environmental assessment against the objectives was based on table 3.5. The workshop identified that Option 1 was the best performing option against all objectives. This is documented in more detail in the TAR (Jacobs, 2016b).

Table 3.5: Summary of the environmental appraisal

Option	Overall environmental score	Conclusions of the environmental appraisal (This is based on a high level assessment of the current designs, the likely significant effects could change as more information comes to light or through future iterations of the designs where effects are designed out)
Do nothing	Not assessed.	Air quality and noise would get worse over time as congestion increases. Doing nothing would also affect the regional economy, if congestion deters businesses from investing in the area.
1	Potential significant adverse effect – mitigation maybe possible.	This option has an offline footprint that has been designed to avoid sensitive features. This option would provide an opportunity to move adverse effects associated with the existing road away from Croxton Park, potentially enhancing this feature. There are potential significant effects to the landscape that would need further design inputs at Stage 2. However, overall this is considered to be the environmentally preferred offline option as it would provide opportunities for improvement to the NIA, non-motorised user access and to Croxton Park.
2	Potential significant adverse effect – mitigation maybe possible.	This option has a smaller footprint than Option 1 but would require widening of the A428 in vicinity of Croxton Park. Online widening is likely to result in significant effects to the designated site, in terms of visual and setting and through changes to noise and air quality, which may be difficult to mitigate.
3	Potential significant adverse effect – mitigation maybe possible.	This option has a smaller footprint than Option 1, with less visual and land take impacts. This could help improve the NIA to the north of Black Cat. This option would not provide all of the benefits of Option 1, including reducing the impact of the road on Croxton Park. If this was undertaken as a phased part of a longer term scheme, it could lead to significant effects to Croxton Park if it was taken forward as part of an online widening option (see Option 4). It would have similar effects to Option 1 if taken forward as a phased approach to an Option 1 alignment.
4	Significant adverse effect – unlikely to be able to mitigate.	This option is likely to have significant effects around Croxton Park due to the road widening extending immediately adjacent to the designated site and increases to noise and air quality impacting the feature. This is likely to be very difficult to mitigate given the proximity of the option to the designated site.
5	Potential significant adverse effect – mitigation maybe possible.	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 5km to the south of the route. This option is likely to require an Assessment of Implications to European Sites (AIES) assessment due to the proximity to the Eversden and Wimpole Woods SAC, which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than Option 1, as it would require more mitigation to offset potentially significant effects. It would create another major road within the landscape and create additional barriers to protected species migration within the study area.
6	Potential significant adverse effect – mitigation maybe possible.	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 3km to the south of the route. This option is likely to require an AIES assessment due to the proximity to the Eversden and Wimpole Woods SAC, which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than Option 1 and Option 5, as it would require more mitigation to offset potentially significant effects. It would create another major road within the landscape and create additional barriers to protected species migration within the study area.
7	Potential significant adverse effect – mitigation maybe possible.	This option is similar to Option 2. However, this would have limited benefit to the NIA and could make noise levels worse in this area. It would also extend the footprint of the road into the nature reserve and conservation area, with impacts on the setting, recreation benefits and ecosystem value of this area. If this was undertaken as a phased part of a longer term scheme, it could lead to significant effects to Croxton Park if it was taken forward as part of an online widening option (see Option 4).
8	Slight adverse effect. Effect not significant with typical mitigation.	The junction improvements are likely to have lower risk of significant effects than the widening options. However, further design iterations would be required at Stage 2 to design out potential significant effects associated with landscape of the structures.

3.8 Consultation to date

Consultation workshops were undertaken during the development of the East of England Route Strategy Evidence Report (Highways Agency 2014). This included a number of local stakeholders including representatives from the local councils and transport groups. Stakeholders strongly supported improvements to the route and there was a strong desire to see the Black Cat junction upgraded to a fully grade separated junction. Stakeholders recommended that there was a need to undertake a comprehensive upgrade along the whole route rather than addressing it as a series of 'pinch point' schemes in isolation.

Stakeholders also identified the following issues:

- There are flooding issues along the A1 between the Black Cat and Wyboston junctions.
- Black Cat, Wyboston, Caxton Gibbet junctions, and the A428 link between Wyboston and Caxton have all been identified as having issues regarding cycling and pedestrian provision. In particular, Stakeholders identified that non-motorised user (NMU) provision between the Phoenix Park triangle and the Eaton Socon urban area is currently poor.
- There are areas of cultural heritage importance near the Caxton Gibbet junction and along the A428 link between Wyboston and Caxton.
- The A1 Tempsford flood arches are a registered scheduled monument.
- There is a need for greater provision of driver information along the A428 between Wyboston and Caxton Gibbet and a need for intelligent technology along the whole route.

Stage 2 will also involve further consultation with statutory bodies to define the scope of the potential environmental assessment. Table 3.6 documents the consultation that has occurred to date on the project during the July 2016 consultation forums.

Table 3.6: Stakeholder comments received to date relating to the environmental appraisal (July 2016 forums)

Comment	Scheme response
The Forums noted that Government policy identifies a duty to protect and enhance the environment. Key priority concerns include noise, air quality, soil, wildlife, flood risk and contaminated land.	Highways England is looking at ways to further enhance the environment. Opportunities will be identified and discussed with stakeholders during stage 2. The Environmental Impact Assessment (EIA) will cover these topics.
Noise and air quality: there are concerns about noise/ air quality impacts associated with the road and any improvements. A village to north already suffers from poor air quality due to strong north easterly winds. Raising / enlarging Black Cat will make this worse.	A noise and air quality assessment will be undertaken as part of the EIA. Highways England is looking at ways to reduce the impacts of noise and air quality through improvements at NIAs around Wyboston and at the AQMA in St Neots.
Landscape: landscaping should be higher south of the A428 compared to the northern area. The A14 is visibly intrusive over the Great Ouse and the railway. It was noted that this should be avoided on the A428.	Highways England recognises that the landscape to the south of the A428 is much more sensitive than the area to the north. Sensitive landscape design is needed for the crossing of the Great Ouse and the railway.
Nature conservation and landscape: the Greensand Ridge and the habitats along the River Great Ouse floodplain are sensitive features and will need to be carefully considered in the designs and assessment. There will be a need for wildlife transit and crossings over the road. The Proposed Scheme should consider whether to apply a natural capital approach and ecosystem services assessment for the route.	These sensitive features will need sensitive design and wildlife crossings included at Stage 2. The Proposed Scheme will consider whether a natural capital approach and ecosystem services assessment is required for the route.
Geology and soils: need to avoid best and most versatile land, including grade 1 and 2 farming land. There were also concerns about severance of land and businesses.	The areas of grade 1 and 2 have been identified across most of the study area. There will be conversations with landowners at the next stage to identify impacts and mitigation associated with severance and affects to businesses.
Materials: there are opportunities to source local materials using the mineral extraction sites around Black Cat.	Local materials will be considered as part of the sustainable procurement process.

Comment	Scheme response
Traffic and transport: lorries and peak traffic currently use local villages as rat runs during peak times including Great Barford, Little Barford and Tempsford. The Proposed Scheme should consider adding another bridge across the Great Ouse to improve resilience of the route and avoid traffic diverting through St Neots during an incident.	The Proposed Scheme is seeking ways to reduce congestion and therefore rat running through the local villages. A number of the options include an additional bridge across the Great Ouse as part of improving resilience.
Traffic and transport: traffic along the A428 will increase during construction of the A14.	This needs to be factored into short and long term traffic forecasts.
Public transport and rights of way: there is an opportunity on the offline options to use the old A428 as a bus / NMU route or to improve it or other routes as dedicated cycle ways. There are also opportunities to develop or tie in with strategic routes for public transport.	The Proposed Scheme will include improvements to rights of way and NMU access as part of the designs. This will include opportunities for diverting NMU access along the A428 if an offline option is taken forward.
Many people commute from St Neots to Cambridge and use the railway station. There is also a challenge to integrate the Proposed Scheme with the East West railway.	Links with current and future public transport links will be considered as park of the development of the Proposed Scheme.
Communities and planning: there is a large amount of development planned in the region including an area to the south of St Neots, Wyboston Garden Village, West Cambourne and an Enterprise Zone southeast of Caxton Gibbet. There is also development proposed in the wider region at Bedford and Cambridge. The EIA will need to consider the effects on local businesses.	The traffic model will factor in estimates of additional traffic as a result of future development. The EIA will consider cumulative effects with adjacent developments (section 4.4).
Road drainage and water: there is a need for sustainable drainage to be considered as part of the designs. There is also an opportunity to enhance river navigation.	The Proposed Scheme will include sustainable drainage and will be designed to meet current recommendations for climate change.

3.9 Meeting the project objectives

The Proposed Scheme could help meet wider Highways England KPI. There are two KPIs relevant to the environmental assessment. These are:

- Delivering better environmental outcomes:
  - Number of noise important area mitigated
  - Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan (Highways England, 2015)
- Helping cyclists, walkers and other vulnerable users:
  - The number of new or upgraded crossings

The DfT has also set aside designated funds to further improve the environment as part of its implementation plan. There are three funding streams relevant to the environment. These are summarised in table 3.7. These are all designed to deliver specific enhancements to the network and improved environmental outcomes. The options appraisal identifies where options could contribute to these wider RIS objectives. The opportunities must be a defined project, which is achievable within the RIS 1 period (1 April 2015 to 31 March 2020) and would provide a measurable net gain.

Table 3.7: Description of RIS designated funds

Title of fund	Description	Opportunities identified for A428
Environment Fund £300m	This is designed to tackle parts of the road network where road design has led to environmental problem. It also provides funding for Highways England to reduce its carbon emissions from transport, and adaptation to a changing climate.	There is an opportunity to reduce noise impacts at the NIA at Black Cat, Wyboston and in the wider study area. We are proposing to work with Bedford Council and Cambridge County Council to reduce noise levels within the NIA as part of the scheme through the provision of noise barriers and resurfacing. There are opportunities to create additional areas of habitat in the study area, over and above the required scheme mitigation. The habitat creation would have to maximise habitat connectivity and / or contribute towards the National Pollinator Strategy to benefit from the funds. It would also require support from landowners. Examples could include creation of new habitats, such as woodland, hedgerow and grassland; supplementary planting of defunct and gappy hedgerows with a range of native species, to increase overall species diversity and improve landscape connectivity; sympathetic management of the existing Highways estate to enhance biodiversity value; create new wetland habitats including ponds, ditches and scrapes, where appropriate; and installation of underpasses to facilitate animal dispersal across existing or proposed highways infrastructure.
Cycling, safety and integration fund £250m	This is designed to improve connectivity between the SRN and local networks and other forms of transport. This includes provision for the needs of cyclists and redressing community severance caused by the SRN.	Undertake cycling improvement schemes. Improve accessibility along the SRN including pedestrian crossings, bridges and access for all. Provide better links with local networks through provision of part and ride and links to stations.
Air quality fund £100m	This is designed to specifically target air quality improvements. Highways England will need to work with Local Authorities to identify how to address this issue.	No opportunities identified along the A428 as the nearest AQMA is located approximately 2km away, in St Neots.

4. Conclusions and next steps

4.1 Potential effects and mitigation associated with the Proposed Scheme

The Stage 1 EAR has assessed the potential significant effects associated with each of the eight options. Table 4.1 summarises the potential effects that may result from the Proposed Scheme and potential secondary mitigation that could be employed. Secondary mitigation is the additional bespoke mitigation that is needed to offset potential significant effects resulting from the scheme. Stage 2 will include the identification of locations where secondary mitigation is likely to be required. This will allow these areas to be included in land estimates and within the footprint of the scheme boundary.

Table 4.1: Potential impacts and mitigation

Potential impact	Mitigation opportunities (P = primary mitigation, S = secondary mitigation, T = tertiary mitigation)
During construction	
Air quality – potential decrease in air quality during construction due to additional construction vehicles and site machinery.	Employ good site practices to minimise dust and fumes (T). Avoid site traffic using routes through residential areas (T).
Cultural heritage – risk of disturbing archaeology during construction.	Avoid areas of known archaeology as identified in the desk based assessment (P).
Landscape – construction could result in the loss of vegetation or other landscape features.	Avoid sensitive areas (P) and replace any vegetation removed as a result of the scheme (S). Employ root protection zones to protect adjacent trees during construction (T).
Nature conservation – construction works could result in the loss and/or fragmentation of habitat, mortality and injury to protected/notable species from vegetation removal and/or hydrological changes and disturbance to protected/notable species due to noise, vibration and lighting. Construction works could also spread invasive species.	Avoid known sensitive sites (P). Reinstate habitats following construction or offer compensatory habitat (S). Employ specific mitigation depending on species present (S).
Geology and soils – there is the potential for contaminated land along the footprint of the scheme. Land take associated with scheme may result in loss of proven mineral resources. There may be the need for temporary land take which could affect the use of adjacent land parcels or quality of land e.g. ALC grade.	Avoid known sensitive areas (P) and develop a methodology for dealing with contamination during construction (T). Undertake a materials management strategy (T). Early consultation with landowners to identify concerns and to put in place specific mitigation e.g. providing temporary sites and accesses during construction (S).
Noise and vibration generated during construction works.	Employ low noise and vibration piling methods (S / T).
People and communities –there may be disturbance to community services during construction e.g. through traffic management. Construction works may require closures or diversions to existing routes for both vehicles and NMU.	Early consultation with third parties to identify concerns and to put in place specific mitigation e.g. providing alternative sites or access during construction (S). Apply footpath diversions where possible and offer alternative crossing points (S / T).
Road drainage and water environment – there is the potential for pollution from site activities into adjacent watercourses.	Comply with pollution prevention guidance (T).
During operation	
Air quality - changes to the configuration of the road network could affect traffic patterns and local air quality. Easing congestion is likely to have a beneficial impact overall.	None identified at this stage.
Cultural heritage – new road layout could result in loss of a cultural heritage asset or affect the setting.	Avoid sensitive features where possible (P).
Landscape – new road layout could affect the landscape character of the area and impact on important viewpoints.	Avoid sensitive features (P) and consider additional screening to reduce the impact (S).

Potential impact	Mitigation opportunities (P = primary mitigation, S = secondary mitigation, T = tertiary mitigation)
Nature conservation – potential permanent loss of habitat or severance due to footprint of the scheme. Potential impacts of changes to road lighting on sensitive species, such as bats. Road mortalities for protected species as a result of increased vehicle movements at new junctions or offline sections. Changes to water quality and air quality affecting sensitive receptors.	Avoid known sensitive sites (P). Reinstate habitats following construction or offer compensatory habitat (S).
Geology and soils – there may be permanent land take which could affect the use of adjacent land parcels or quality of land e.g. ALC grade.	Early consultation with landowners and other third parties to identify concerns and to put in place specific mitigation (S).
Noise and vibration – changes to the road layout could increase traffic noise to sensitive receptors.	Avoid known sensitive sites (P). Consider the need for noise fencing (S).
People and communities – the scheme may increase severance of rights of ways.	Provide new crossings to replace those lost (S / T).
Road drainage and water environment – new crossings over watercourses could affect flood flows and result in the loss of functional floodplain. River crossings could also involve engineering to water bodies and result in changes to the geomorphological status.	Structures to be designed outside of the floodplain where possible (P), where this is not possible, open span structures should be considered to minimise effects (S). Floodplain compensation may be required to offset floodplain losses (S). Culverts and crossings should be designed following geomorphology principles to ensure no deterioration in status of the water body (T), bespoke mitigation or compensatory actions may be required for some crossings (S).

The options will be taken forward to consultation when the public and stakeholders will be able to comment on the Proposed Scheme. Feedback from the engagement events will be used to inform the option selection process alongside a review of the traffic modelling results and economic appraisal. The Stage 2 environmental appraisal will review whether there are likely to be significant effects associated with the preferred option and will help inform the Preferred Route Announcement (PRA) for the Proposed Scheme.

4.2 Recommendations

Table 4.2 outlines a number of environmental surveys and further assessments for future stages in the project.

Table 4.2: Proposed further environmental surveys and assessments

Topic	Potential further study / survey	Timing / stage
Air quality	Analysis of the traffic modelling results	Stage 2
	Air quality modelling	Stage 3
	Air quality monitoring	Stage 2 and 3
Cultural heritage	Desk based assessment	Stage 3
	Non-intrusive surveys	Stage 3
Landscape	Winter survey	Stage 2
	Summer survey	Stage 3
	Tree survey (alongside topographical survey)	Stage 3
Nature conservation	Further habitat surveys including hedgerow surveys, ponds and a Phase 2 habitat survey of high quality habitats	See Extended Phase 1 habitat survey report for proposed timetable and locations for each survey (Appendix E)
	Aquatic surveys including river habitat survey, fish survey (including European eel) and white clawed crayfish	
	Terrestrial species surveys including for badgers, bats, breeding birds, GCN, reptiles, water vole and otter	

Topic	Potential further study / survey	Timing / stage
Geology and soils	Detailed risk assessment of contaminated land risks to relevant receptors	Stage 2
	Soil testing as part of ground investigations	Stage 3
Noise and vibration	Analysis of the traffic modelling results	Stage 2
	Noise modelling	Stage 3
	Noise monitoring	Stage 3
People and communities	Review of right of way surveys	Stage 3
	Analysis of the traffic modelling results	Stage 3
Road drainage and the water environment	Flood risk assessment	Stage 3
	Water Framework Directive screening	Stage 3

4.3 Potential approvals and consents

Statutory Environmental Impact Assessment (EIA)

The Proposed Scheme lies outside of the existing highways corridor and therefore would not fall within permitted powers. The Proposed Scheme would involve construction and alteration of a highway where the speed limit for any class of vehicle is expected to be 50 miles per hour or greater and the scheme is greater than 12.5ha. The scheme also has the potential for significant environmental effects and therefore is likely to be classed as a Nationally Significant Infrastructure Project under the Planning Act (2008), and will require a Development Consent Order (DCO).

The scheme will require a statutory EIA and a screening opinion should be obtained at the next stage. A Record of Determination will be produced for the scheme in accordance with Highways England guidelines. This will be followed by the Secretary of State publishing a Notice of Determination to confirm whether the scheme requires a formal EIA.

The Proposed Scheme may be phased over two or more RIS periods. The DCO and Environmental Statement will cover the full scheme but will outline the implications of the phasing in terms of any short term or temporary impacts that would occur prior to the full scheme being implemented.

Assessment of the Implications on European Sites (AIES)

The Proposed Scheme will require an AIES as per the Conservation of Habitats and Species Regulations 2010 (as amended). A Stage 1 AIES has been completed based on Option 1 (Appendix G), which was deemed to be the most representative option at Stage 1. This preliminary Stage 1 AIES identified possible source-receptor pathways to three European sites: Eversden and Wimpole Woods SAC; Portholme SAC; and Ouse Washes SAC/SPA/Ramsar. Based on the level of detail available at this stage, the AIES concluded that none of the anticipated elements of the proposed Option 1 route alignment, or combination of elements, are expected to lead to a likely significant effect on any of the identified European sites. However, a more detailed assessment would be required once the design details are known. Consultation will be required with Natural England at the next stage to confirm this decision, and the requirement to undertake Stage 2 of the Habitats Regulation Assessment process, Appropriate Assessment.

Potential consents and approvals

The Proposed Scheme may require other consents including listed building consent, scheduled monument consent, flood defence consent, ordinary watercourse consent, and rights of way closures and diversions, depending on the work to be undertaken. It is also likely that protected species licences will be required.

4.4 Consideration of adjacent development and cumulative effects

Stage 3 will need to consider adjacent developments and whether these are likely to have cumulative effects with the Proposed Scheme. The assessment will cover proposed developments with a ‘committed consent’ including developments with full or outline planning permission, developments yet to be implemented, or

developments already under construction but yet to be completed or occupied. It will also include developments where land is allocated in an adopted local plan or in a finalised draft local plan.

The adjacent developments will be identified through a review of planning documents, submitted and approved planning applications and discussions with the local planning authorities. The following developments have been identified in close proximity to the scheme and will be considered in further detail at Stage 2:

- **Huntingdonshire District Council**
  - Planning Application ref 1300388OUT: Loves Farm Eastern Expansion Development Area Cambridge Road St Neots. Outline application for the development of up to 1020 dwellings, up to 7.6ha of mixed use development, pedestrian/cycle routes, open space and other related infrastructure.
  - Planning Application ref 1300178OUT: Wintringham Park Cambridge Road St Neots. Development of mixed use urban extension to include; residential development of up to 2,800 dwellings, up to 63,500m^2 of employment development, district centre including shops, services, community and health uses, two primary schools, open space and recreation facilities.
  - Emerging Policy - St Neots Eastern Expansion: 226ha of land allocated for mixed use development in accordance with the St Neots Eastern Expansion Urban Design Framework 2010 to comprise: approximately 3,820 homes, approximately 22ha of employment land, 4,000m^2 of retail floorspace including a supermarket and other retail uses, a care home, educational and community facilities and strategic green space and open space.
- **South Cambridgeshire District Council**
  - Planning Application ref S/2903/14/OL West Cambourne: development of up to 2,350 residential units; retail up to 1.04ha; offices/light industry up to 5.66ha; community and leisure facilities up to 0.92ha; two primary schools and one secondary school (up to 11.28ha).
  - Emerging Policy SS/8 Cambourne West: allocated for the development of a sustainable, fourth linked village to Cambourne of approximately 1,200 dwellings by 2031.

The above developments will be included in the baseline traffic model and therefore cumulative effects relating to traffic and transport, noise and air quality from these developments will be considered within the assessment.

In addition, consultation will be undertaken with the East West Rail Consortium to discuss the proposed reopening of the Varsity Line between Oxford and Cambridge. This is currently at the options appraisal stage and is considering options along the central section of the route between Bedford and Cambridge. DfT confirmed its commitment to the creation of a new railway between Bedford and Cambridge in 2013.

4.5 Future stages

The environmental assessment will continue to feed into the design process as part of identifying opportunities for further primary (built in) mitigation and to minimise the scope of the future EIA. Further consultation will also be undertaken with environmental stakeholders to scope out the potential significant effects and mitigation. An environmental Scoping Report will be produced during Stage 3 of the Project Control Framework (PCF) process for the option selected under the PRA. The scoping report will summarise the baseline assessments and identify whether the scheme is likely to have a significant effect on each receptor. The scoping report will include a summary of the assessment methodology that will be employed to assess potential significant effects. The scoping report can be used to provide background information to the Secretary of State as part of obtaining a screening and scoping opinion.

A mitigation and commitments tracker will be developed at Stage 2 and will be used to document both the mitigation in relation to likely significant effects and commitments to manage any other residual environmental risks. This will be developed into a Construction Environmental Management Plan (CEMP) during the later stages of the scheme development to manage general actions for mitigating environmental impacts.

Abbreviations

Abbreviation	Term
$\mu g/m^3$	Micrograms per metre squared
AIES	Assessment of the Implications on European Sites
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BAP	Biodiversity Action Plan
BGS	British Geological Society
CAMS	Catchment Abstraction Management Strategy
CEMP	Construction Environmental Management Plan
CIEEM	Chartered Institute of Ecology and Environmental Management
CO_2	Carbon Dioxide
CPERC	Cambridgeshire and Peterborough Environmental Records Centre
CWS	County Wildlife Site
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
Defra	Department for the Environment, Food, and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EAST	Early Assessment and Sifting Tool
EAR	Environmental Assessment Report
eDNA	Environmental DNA
EIA	Environmental Impact Assessment
EPSM	European Protected Species Mitigation
GCN	Great Crested Newt
HER	Historic Environment Record
HSI	Habitat Suitability Index
IAN	Interim Advice Note
IUCN	International Union for Conservation of Nature
JNCC	Joint Nature Conservation Committee
KPI	Key Performance Indicator
LCA	Landscape Character Area
LGS	Local Geologic Site
LNR	Local Nature Reserve
LTP	Local Transport Plan
MAGIC	Multi Agency Geographic Information for the Countryside
MSA	Mineral Safeguarding Area
NCA	National Character Area
NERC	Natural Environment Research Council

Abbreviation	Term
NIA	Noise Important Area
NMU	Non-Motorised User
NNNPS	National Networks National Policy Statement
NNR	National Nature Reserve
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
NPPF	National Planning Policy Framework
NVZ	Nitrate Vulnerable Zone
OAM	Options Appraisal Matrix
OAR	Options Appraisal Report
OS	Ordnance Survey
PCF	Project Control Framework
PFRA	Preliminary Flood Risk Assessment
PM_{10}	Particulate matter less than or equal to 10 micrometres in diameter
PRA	Public Route Announcement
PRoW	Public Rights of Way
PRV	Protected Road Verge
RIGS	Regionally Important Geologic Site
RIS	Road Investment Strategy
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPZ	Source Protection Zone
SRN	Strategic Road Network
SSSI	Site of Special Scientific Interest
TAR	Technical Appraisal Report
TPO	Tree Preservation Order
UXO	Unexploded Ordinance
WFD	Water Framework Directive

Glossary

Glossary	Definition
Abstraction point	An area or point where water is extracted from either surface water or pumped up from groundwater.
Air quality management area	Area defined by the local authority as an area requiring management because air quality levels do not meet national air quality objectives.
Air quality objective	National and European Directive limit and target values for substances released to the atmosphere for the protection of human health and ecosystems.
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Biodiversity action plan	An agreed plan for a habitat or species, which forms part of the UK's commitment to biodiversity in response to the Convention on Biological Diversity, Rio de Janeiro 1992.
Character area	An area of land with distinctive landscape features resulting from an interaction of wildlife, landforms, geology, land use and human activity as defined by the Countryside Agency.
Conservation area	An area designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being an area of 'special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance'.
Construction environmental management plan	Document setting out the roles and responsibilities, control measures, training and briefing procedures, risk assessments and monitoring systems to be employed during planning and construction of the works for all relevant environmental topic areas.
County / local wildlife site	Non-statutory designated sites of county importance for wildlife that are protected through planning policy.
Cumulative effects	Effects upon the environment that result from the incremental impact of an action when added to other past, present or reasonably foreseeable actions. Each impact by itself may not be significant but can become a significant effect when combined with other impacts.
Design Manual for Roads and Bridges	Provides standards, advice notes and other documents relating to the design, assessment and operation of trunk roads, including motorways in the United Kingdom.
Development Consent Order	Introduced by the Planning Act in 2008, a Development Consent Order (DCO) is the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIP).
Drainage network	The streams, rivers, lakes and other water bodies that form a particular drainage basin.
Ecological potential	The status of a heavily modified or an artificial body of water, so classified in accordance with the relevant provisions of Annex V of the River Basin Management Plan.
Ecological status	WFD term denoting a slight deviation from 'Reference Conditions' in a water body, or the biological, chemical and physico-chemical and hydromorphological conditions associated with little or no human pressure.
eDNA survey	A survey technique using analysis of water samples collected in the field to determine the presence of great crested newts from a waterbody.
Environmental Impact Assessment	Environmental Impact Assessment. A process by which information about environmental effects of a proposed development is collected, assessed and used to inform decision making. For certain projects, EIA is a statutory requirement.
Environmental Statement	A document produced in accordance with the EIA Directive as transported into UK law by the EIA Regulations to report the results of an EIA.
Existing extraction site	An area currently being exploited for its mineral resources.
Extended Phase 1 habitat survey	A classification system used to record semi-natural vegetation, notable/protected habitats, and habitats with the potential to support notable/protected species. Each habitat type/feature is defined by way of a brief description and is allocated a specific name, an alpha-numeric code, and unique mapping colour.
Flood risk	The exposure, vulnerability and hazard associated with flooding.

Glossary	Definition
Flood zone	Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. Flood zone 3 shows the area that could be affected by a 1 in 100 year (1% chance) flood event. Flood zone 2 shows the area that could be affected by a major flood (1 in 1000, or 0.1% chance). Flood zone 1 shows areas that are very unlikely to experience flood (<0.1%).
Floodplain	A floodplain is flat or nearly flat land adjacent to a stream or river, stretching from the banks of its channel to the base of the enclosing valley walls and (under natural conditions) experiences periods of flooding.
Geomorphology	The study of landforms and the processes that create them.
Habitat Suitability Index	A habitat assessment technique used to evaluate the suitability of a waterbody for great crested newts.
Heritage assets	The historic environment assets such as archaeological remains, historic buildings and historic landscapes which have archaeological, architectural, artistic or historic value.
Local nature reserve	Nature reserves designated under the National Parks and Countryside Act (1949) for locally important wildlife or geological features. They are controlled by local authorities in liaison with English Nature.
Listed building	A building or structure designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being of 'special architectural or historic interest'.
Main river	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers. N.B. Main River designation is not an indication of size, although it is often the case that they are larger than Ordinary Watercourses.
Mineral consultation area	An area identified in order to ensure consultation between the relevant local authorities and the minerals industry before certain non-mineral planning applications made within the area are determined.
Mineral safeguarding area	An area which covers known deposits of minerals which are desired to be kept safeguarded from unnecessary changes by non-mineral development.
Mitigation	The action of reducing the severity and magnitude of change (impact) to the environment. Measures to avoid, reduce, remedy or compensate for significant adverse effects.
Nationally Significant Infrastructure Project	Major infrastructure developments in England and Wales, such as proposals for power plants, large renewable energy projects, new airports and airport extensions, and major road projects, as set out in the Planning Act (2008). See entry for Development Consent Order.
Nitrate vulnerable zone	A designation required under the Nitrates Directive (91/676/EEC) for all land draining to and contributing to the nitrate pollution in "polluted" waters. Polluted waters are those where nitrate levels exceed, or are likely to exceed, the levels set in the Directive.
Noise important area	The top 1% of noisiest locations adjacent to major roads.
Non-motorised user	A term to describe users of the highway who do not travel by motorised vehicles e.g. pedestrians, cyclists or horse riders.
Ordinary watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards. Note that Ordinary Watercourse does not imply a "small" river, although it is often the case that Ordinary Watercourses are smaller than Main Rivers.
Potential effect	The predicted consequential change may occur upon the environment as a result of a development, in the absence of mitigation.
Preferred extraction site	Areas of known resources where planning permission might reasonably be anticipated.
Principal aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
Public right of way	A widely known right to cross private land is known as a 'right of way'. If this is a right granted to everyone it is a 'public right of way'.
Ramsar	Ramsar sites are wetlands of international importance designated under the Ramsar Convention.
Receptor	A defined individual environmental feature usually associated with population, fauna and flora that have potential to be impacted by a development.
Registered park and garden	Gardens, grounds and other planned open spaces with historical significance. Registration is a 'material consideration' in the planning process.

Glossary	Definition
Residual effect	The predicted consequential change on the environment from the impacts of a development after mitigation.
Secondary A aquifer	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Secondary B aquifer	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
Secondary (undifferentiated) aquifer	Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type.
Scheduled monument	Scheduled Monuments are protected by law designated under the Ancient Monuments and Archaeological Areas Act 1979 and are, by definition, of national importance.
Scoping	The process of identifying the issues to be addressed by an environmental impact assessment process. It is a method of ensuring that an assessment focuses on the important issues and avoids those that are considered unlikely to be significant.
Setting	The setting of an asset is the surroundings in which a place is experienced, while embracing an understanding of perceptible evidence of the past in the present landscape.
Significance	A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic.
Site of special scientific interest	A site of national importance due to its wildlife or geological value that is protected by the Wildlife and Countryside Act 1981 (as amended).
Site Waste Management Plan	A tool for detailing the amount and type of waste that will be produced on a construction site and how it will be eliminated, reduced, re-used, recycled and disposed of and to help meet regulatory controls and reduce the costs of waste.
Source protection zone	These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. Divided into three main zones (inner, outer and total catchment).
Special area of conservation	A site designated under the Habitats Directive due to its international value for certain habitats and species of conservation importance (those listed on Annex I and II of the Directive).
Special protection area	A site designated under Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive') due to its international importance for birds.
Tree preservation order	A Tree preservation order is an order made by a local planning authority in England to protect specific trees, groups of trees or woodlands in the interests of amenity. An Order prohibits the: cutting down; topping lopping; uprooting; wilful damage or destruction of trees without the local planning authority's written consent. If consent is given, it can be subject to conditions which have to be followed. In the Secretary of State's view, cutting roots is also a prohibited activity and requires the authority's consent.
Water body	Discrete section of a river, groundwater area, lake or coast that is a defined management unit under the WFD.
Water Framework Directive	A substantial piece of EU water legislation that came into force in 2000, with the overarching objective to get all water bodies in Europe to attain Good or High Ecological Status. River Basin Management Plans (RBMP) have been created which set out measures and potential mitigation to ensure that water bodies in England and Wales achieve 'Good Ecological Status'.

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Appendix A. Development plan and policy review

Appendix B. Environmental constraints plan

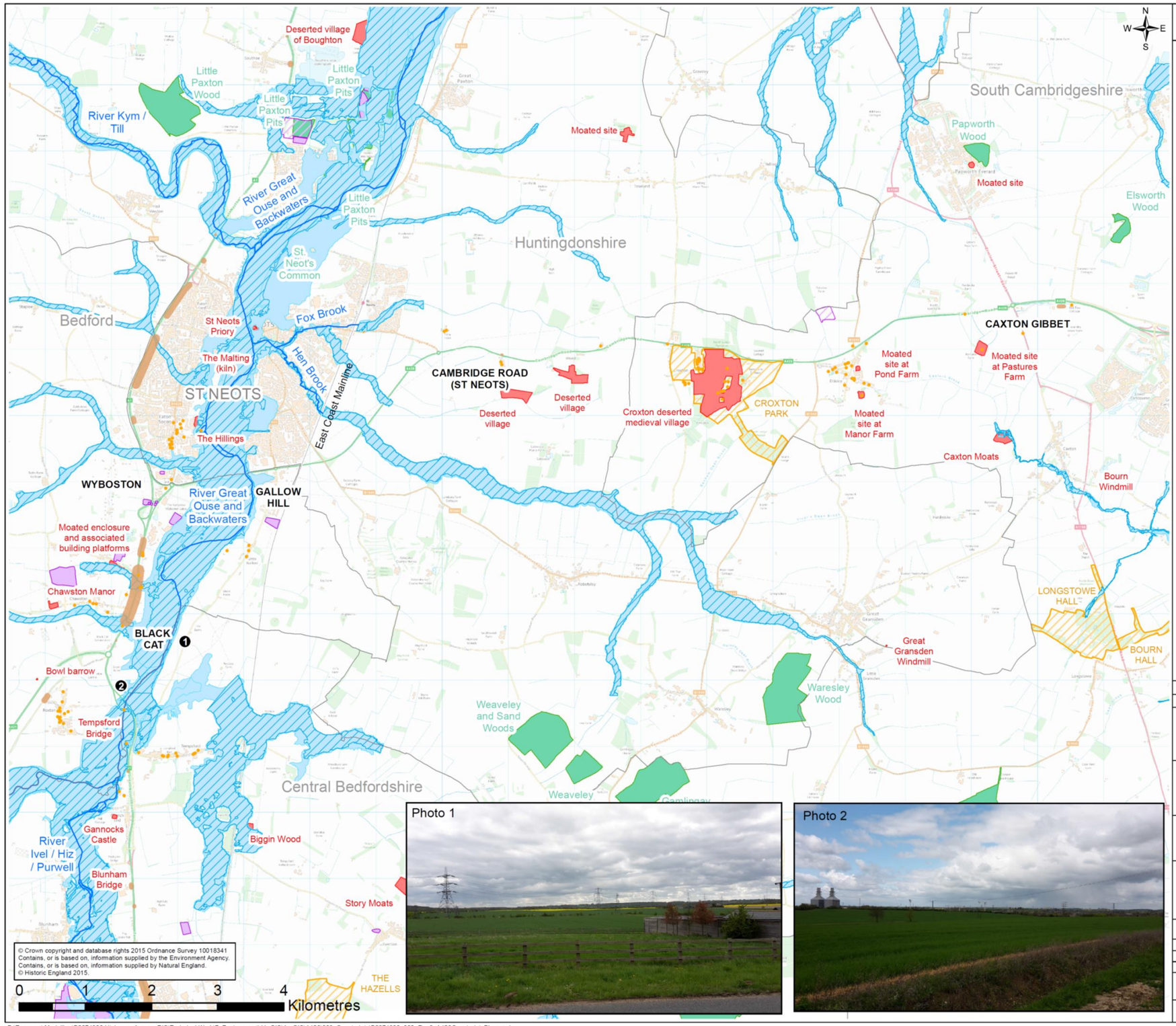

Photo 1

Photo 2

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	10/11/2016	Initial Issue	LM	CB	IC	SB

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Drawing Title: A428 CONSULTATION CONSTRAINTS PLAN

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Appendix C. Criteria for assessing sensitivity

This tabulates how the baseline has been assessed in terms of its value and sensitivity. The assessment was based on table 2.1 from the DMRB Appendix 11 Section 2 (recreated in table C.1). It has then been interpreted by technical specialists for each receptor in table C.2. The majority of topics have four levels of value in accordance with DMRB. Where there are only three, this has been explained in the relevant box. Additional notes are also added under the topic heading where applicable. The table is used as guidance for the assessment and is not designed to be prescriptive. Technical judgement will be used to provide the final value.

Table C.1: Guidance for assessing value (sensitivity) taken from DMRB Appendix 11 Section 2

Value (sensitivity)	Typical descriptors
Very high	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale and limited potential for substitution.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.
Low (or lower)	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

Table C.2: Topic specific interpretation of the DMRB guidance for the Proposed Scheme

Value (sensitivity)	Typical Descriptors
Air quality	
Notes	All receptors are treated as equally sensitive, with sensitivity being identified as locations representative of exposure to the averaging periods of relevant air quality objectives, e.g., annual, daily and hourly exposure.
Cultural heritage (using the criteria set out in DMRB Volume 11 Environmental Assessment Section 3, Part 2, HA 208/07,Cultural Heritage)	
Very high	**Archaeological remains:** World Heritage Sites (including nominated sites). Assets of acknowledged international importance. Assets that can contribute significantly to acknowledged international research objectives. **Historic buildings:** Structures recognised as of universal importance as World Heritage Sites. Other buildings of recognised international importance. **Historic landscapes** World Heritage Sites recognised for their historic landscape qualities. Historic landscapes of international value, whether designated or not. Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factor(s).

Value (sensitivity)	Typical Descriptors
High	**Archaeological remains:** Scheduled monuments (including proposed sites). Undesignated assets of schedulable quality and importance. Assets that can contribute significantly to acknowledged national research objectives. **Historic buildings:** Scheduled monuments with standing remains. Grade I and Grade II* listed buildings. Other listed buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the listing grade. Conservation areas containing very important buildings. Undesignated structures of clear national importance. **Historic landscapes:** Designated historic landscapes of outstanding interest. Undesignated landscapes of outstanding interest. Undesignated landscapes of high quality and importance, and of demonstrable national value. Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factor(s).
Medium	**Archaeological remains:** Designated or undesignated assets that contribute to regional research objectives. **Historic buildings:** Grade II listed buildings. Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations. Conservation areas containing buildings which contribute significantly to their historic character. Historic townscape or built-up areas with important historic integrity in their buildings, or built settings (e.g. including street furniture and other structures). **Historic landscapes**: Designated special historic landscapes. Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value. Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor(s).
Low	**Archaeological remains:** Designated and undesignated assets of local importance. Assets compromised by poor preservation and/or poor survival of contextual associations. Assets of limited value, but with potential to contribute to local research objectives. **Historic buildings:** 'Locally listed' buildings. Historic (unlisted) buildings of modest quality in their fabric or historical association. Historic townscape or built-up areas of limited historic integrity in their buildings, or built settings (e.g. including street furniture and other structures). **Historic landscapes**: Robust undesignated historic landscapes. Historic landscapes with importance to local interest groups. Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations.
Landscape (using the criteria set out in Interim Advice Note 135/10 Landscape and visual effects assessment, Highways England, 2010)	
Notes	IAN135/10 does not include for a very high category in landscape and visual assessment.
High	**Landscape:** Landscapes which by nature of their character would be unable to accommodate change of the type proposed. Typically these would be of high quality with distinctive elements and features making a positive contribution to character and sense of place, likely to be designated, but the aspects which underpin such value may also be present outside designated areas, especially at the local scale, areas of special recognised value through use, perception or historic and cultural associations and / or likely to contain features and elements that are rare and could not be replaced. **Visual:** Residential properties, users of Public Rights of Way or other recreational trails (e.g. National Trails, footpaths, bridleways etc.) and users of recreational facilities where the purpose of that recreation is enjoyment of the countryside (e.g. Country Parks, National Trust or other access land etc.).

Value (sensitivity)	Typical Descriptors
Medium	**Landscape:** Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Typically these would be comprised of commonplace elements and features creating generally unremarkable character but with some sense of place, locally designated, or their value may be expressed through non-statutory local publications, containing some features of value through use, perception or historic and cultural associations and / or likely to contain some features and elements that could not be replaced. **Visual:** Outdoor workers, users of scenic roads, railways or waterways or users of designated tourist routes and schools and other institutional buildings, and their outdoor areas.
Low	**Landscape:** Landscapes which by nature of their character would be able to accommodate change of the type proposed. Typically these would be comprised of some features and elements that are discordant, derelict or in decline, resulting in indistinct character with little or no sense of place, not designated, containing few, if any, features of value through use, perception or historic and cultural associations and / or likely to contain few, if any, features and elements that could not be replaced. **Visual:** Indoor workers, users of main roads (e.g. trunk roads) or passengers in public transport on main arterial routes and users of recreational facilities where the purpose of that recreation is not related to the view (e.g. sports facilities).
Nature conservation (Bespoke criteria using DMRB and IEEM guidance)	
Very high	**Habitats**: Very high importance and rarity, international scale and very limited potential for substitution. Includes Ramsar and European designated sites, or sites that meet the published selection criteria but not designated as such. **Species**: Sites with resident or regularly occurring population/s of species at International or European level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.
High	**Habitats**: High importance and rarity, national scale, and limited potential for substitution. Includes Sites of Special Scientific Interest, National Nature Reserves and sites that meet published criteria for selection. Key/priority habitats important at a national scale. **Species**: Sites with resident or regularly occurring population of species at International, European, UK or National level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.
Medium	**Habitats**: High or medium importance and rarity, regional scale, moderate potential for substitution. Includes key/priority habitats identified in Section 41 of the NERC Act 2006 and/or County or Highways BAP that are important at a regional, county or district scale. Sites of Nature Conservation Importance, Local Wildlife Sites and Local Nature Reserves designated in the county or unitary authority area context. **Species**: Resident or regularly occurring populations of species which may be considered at a regional, county or district scale, where loss of these species would affect the conservation status or distribution at this geographic scale, or the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale. Includes key/priority species listed in accordance with the requirements of Section 41 of the NERC Act and/or the County or Highways BAP that are important at this scale.
Low	**Habitats**: High importance and rarity, national scale, and limited potential for substitution. Includes Sites of Special Scientific Interest, National Nature Reserves and sites that meet published criteria for selection. Key/priority habitats important at a national scale. **Species**: Sites with resident or regularly occurring population of species at International, European, UK or National level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.

Value (sensitivity)	Typical Descriptors
Geology and soils (Bespoke criteria using DMRB guidance)	
Very high	**Geology and soils:** World Heritage Sites, sites protected under EU legislation (SAC, SPA, Ramsar Site) for geological reasons. Earth Heritage Sites (designated for their geological importance/geodiversity), Designated European GeoParks. Agricultural land with an ALC grade 1 (excellent). Nationally important mineral sites for energy such as coal, oil and gas. **Groundwater**: Principal aquifer with local (<1km) abstraction wells **Land contamination:** Construction workers and very sensitive land uses such as residential housing with gardens, allotments, schools and nursing homes, essential public buildings such as hospitals and fire stations and sites of international Importance e.g. World Heritage Sites, SAC, SPA.
High	**Geology and soils**: Sites protected under UK wildlife legislation for their geological value (SSSI, NNR, WCA, LNR). Sites protected by a Limestone Pavements Order. Agricultural land of Grade 2 (very good) or Grade 3a (good) quality. Existing mineral extraction sites. Minerals sites with poor quality energy minerals or silica (industrial) sand for use in glass making. **Groundwater**: Principal Aquifer with no local abstractions or secondary A aquifer with abstractions. **Land contamination:** Future site users and sensitive land uses proposed such as residential housing without gardens, open spaces, nationally important designated sites, significant transport links e.g. railway, airport, significant utilities (e.g. high pressure gas main, sewage works).
Medium	**Geology and soils:** Regionally Important Geological Sites (RIGS). Agricultural land of Grade 3b (moderate) quality. Mineral sites for construction aggregates – minerals used in building and engineering or to manufacture building and engineering products such as concrete. Minerals sites identified for future extraction e.g. Minerals consultation areas. **Groundwater**: Secondary A aquifer, no abstraction **Land contamination:** Moderately sensitive land uses such as commercial developments.
Low	**Geology and soils:** Agricultural land with an ALC grade of 4 (poor) or 5 (very poor). Inferred mineral resource or reconnaissance mineral resource e.g. Minerals Safeguarding Areas. **Groundwater**: Secondary B aquifer. **Land contamination:** Low sensitivity land use such as Industrial Sites and local transport links and services.
Noise and vibration (using the criteria set out in the Scottish Governments Technical Advice Note Assessment of Noise)	
Additional notes	This table sets out a guide for determining the sensitivity of a receptor. However, for assessment purposes, the variation in the sensitivity of receptors in terms of noise impact is taken into account by applying different scales to classify magnitude of impact (e.g. by using different scales for daytime and night-time) rather than by varying the assignment of sensitivity to specific types of receptors.
Very high	**Noise and vibration:** None identified.
High	**Noise and vibration:** Receptors where people or operations are particularly susceptible to noise for example residential, including private gardens where appropriate, quiet outdoor areas used for recreation, conference facilities, theatres/auditoria/studios, schools during the daytime, hospitals/residential care homes and places of worship.
Medium	**Noise and vibration:** Receptors moderately sensitive to noise, where it may cause some distraction or disturbance for example offices, bars/cafes/restaurants where external noise may be intrusive, sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls)
Low	**Noise and vibration:** Receptors where distraction or disturbance from noise is minimal for example buildings not occupied during working hours, factories and working environments with existing high noise levels, sports grounds when spectator noise is a normal part of the event, night clubs

Value (sensitivity)	Typical Descriptors
People and communities (Bespoke criteria using DMRB guidance)	
Additional notes	No very high receptors have been identified, as the people and community features are all of national importance or less and are likely to have some way to substitute.
Very high	**Land use and businesses:** None identified **Traffic and transport:** None identified **Public rights of way:** None identified
High	**Land use and businesses:** A highly or frequently accessed resource. No alternative facilities, access arrangements or opportunities are available within an easily accessible distance. **Traffic and transport:** Roads comprising of part of the Strategic Road Network (SRN). **Public rights of way:** National trails and Sustrans routes.
Medium	**Land use and businesses:** A limited range of alternative facilities, access arrangements or opportunities are available within an easily accessible distance. A moderately, or-semi-frequently accessed resource. **Traffic and transport:** Roads of regional importance including A roads not part of the SRN. **Public rights of way:** Regionally important rights of way.
Low	**Land use and businesses:** A wide range of alternative facilities, access arrangements or opportunities are available within an easily accessible distance. An infrequently accessed resource. **Traffic and transport:** Local roads. **Public rights of way:** Local importance rights of way.
Road drainage and the water environment (using the criteria set out in DMRB Volume 11 Section 3 Part 10 HD 45/09 - Table A4.3 Estimating the Importance of Water Environment Attributes)	
Very high	**Flood risk and drainage:** Floodplain or defence protecting more than 100 residential properties from flooding. **Geomorphology and water quality:** WFD overall status of 'High'. A watercourse that appears to be in complete natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, free from any modification or anthropogenic influence. An EC Designated Salmonid / Cyprinid fishery. Site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, Water Protection Zone, Ramsar site, salmonid water) and or species protected by EC legislation. Watercourse widely used for recreation, directly related to watercourse quality (e.g. swimming). **Groundwater:** Principal aquifer providing a valuable resource because of its high quality and yield, or extensive exploitation for public and/or agricultural and/or industrial supply. Source Protection Zone (SPZ) 1 (Inner Protection Zone). Designated sites of nature conservation dependant on groundwater.

Value (sensitivity)	Typical Descriptors
High	**Flood risk and drainage:** Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding. **Geomorphology and water quality:** WFD overall status of 'Good'. A watercourse that appears to be in natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, with very limited signs of modification or other anthropogenic influences. Major Cyprinid fishery. Species protected under EC or UK legislation. Watercourse used regionally for recreation. **Groundwater:** Secondary A aquifer capable of supporting water supplies at a local scale and forming an important source of base flow to significant surface waters. SPZ2 (Outer Protection Zone). Local areas of nature conservation known to be sensitive to groundwater impacts.
Medium	**Flood risk and drainage:** Floodplain or defence protecting 10 or fewer industrial properties from flooding. **Geomorphology and water quality:** WFD overall status of 'Moderate'. A watercourse showing signs of modification, recovering to a natural equilibrium, and exhibiting a limited range of morphological features (such as pools and riffles). The watercourse is one with a limited range of fluvial processes and is affected by modification or other anthropogenic influences. Watercourse not widely used for recreation or limited local use, or recreation use not directly related to watercourse quality. **Groundwater:** Secondary B aquifer and/or poor groundwater quality and/or low permeability make exploitation of groundwater unlikely. SPZ3 (Source Catchment Protection Zone). Changes to groundwater not expected to have an impact on local ecology.
Low	**Flood risk and drainage:** Floodplain with limited constraints and a low probability of flooding of residential and industrial properties. **Geomorphology and water quality:** WFD overall status of 'Poor' or 'Bad'. A highly modified watercourse that has been changed by channel modification or other anthropogenic pressures. The watercourse exhibits no morphological diversity and has a uniform channel, showing no evidence of active fluvial processes and not likely to be affected by modification. Highly likely to be affected by anthropogenic factors. Heavily engineered or artificially modified and could dry up during summer months. Fish sporadically present or restricted; no species of conservation concern. Not used for recreation purposes. **Groundwater:** Very poor groundwater quality and/or very low permeability make exploitation of groundwater unfeasible. No known past or existing exploitation of this water body. Changes to groundwater are irrelevant to local ecology.

Appendix D. Cultural heritage assets

Asset	HER Ref or Historic England Ref. No	Description	Value
1	1013521	Bowl Barrow, north west of College Farm, a Scheduled Monument	High
2	11531	Chawston Manor moated site, a Scheduled Monument	High
3	36545	Congregational Chapel, Roxton, a Grade II* Listed Building	High
4	36551	Church of St Mary Magdalen, Roxton, a Grade II* Listed Building	High
5	8810	Site of a milepost, Roxton	Low
6	MBB19824	Roxton (known as)	Negligible
7	17182	Wall foundations, South East of Chawston	Low
8	MBB19827	Stray finds from the Roxton Area (3)	Negligible
9	MBB19828	Stray finds from the Roxton Area (2)	Negligible
10	MBB19829	Stray finds from the Roxton Area (1)	Negligible
11	8808	Milestone at Roxton	Low
12	MBB20032	North Bedfordshire (known as)	Negligible
13	2025	Finds bought up by dredging from the Great Ouse	Low
14	1012076	Moated Enclosure, Wyboston, a Scheduled Monument	High
15	1311862	Brook Cottages, a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
16	1005393	Tempsford Bridge, Roxton, a Scheduled Monument	High
17	1321633	Tempsford Bridge, a Grade II Listed Building, Roxton	Medium
18	12460	Cottage south of Scuttle Cottage Nags Head Lane, Wyboston	Low
19	1114092	The Old Anchor, a Grade II Listed Building, Tempsford	Medium
20	1321208	Scuttle Cottage, a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
21	18001	A WW2 tank trap, Wyboston	Low
22	12456	Little Thatch, Nags Head Lane, Wyboston	Low
23	8809	Site of a milestone, Wyboston	Low
24	12457	Thatch Cottage, Nags Head Lane, Wyboston	Low
25	880	Timber framed cottage, Wyboston	Low
26	12473	20 High Street, Wyboston, Chawston and Colesden	Low
27	1146418	Forty Farmhouse, a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
28	1321213	Dovecote at Forty Farmhouse (Asset 27), a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
29	MCB18207	Partially excavated Saxon settlement features, Alpha Park, Eaton Socon	Low
30	MCB18768	Ridge and furrow, St Neots	Negligible
31	MCB18208	Partially excavated medieval and post medieval remains, Alpha Park, Eaton Socon	Low
32	MCB18206	Neolithic features partially excavated at Alpha Park, Eaton Socon	Low
33	MCB16788	Roman Bronze Bracelet, Eaton Socon	Negligible
34	MCB16504	Partially excavated Roman rural site, Priors Gate	Medium
35	1146453	The Crown Inn, a Grade II Listed Building, Wyboston	Medium
36	00369	Neolithic hearth, Little End, Eaton Socon	Low

Asset	HER Ref or Historic England Ref. No	Description	Value
37	MCB16505	Roman features partially excavated at Alpha Park, Eaton Socon	Low
38	MCB18769	Possible enclosure, St Neots	Low
39	11778	Cropmarks North of 'The Bell' Public House, St. Neots	Negligible
40	1321214	Bell Farmhouse, a Grade II Listed Building, St Neots	Medium
41	MCB20473	Roman and Post-medieval activity: Land at 21 to 35 Great North Road, Eaton Socon, Cambridgeshire: an archaeological trial	Low
42	MCB15261	Post-medieval and undated features, Priors Gate, St. Neots	Negligible
43	00511	Palaeolithic finds, Eaton Socon	Negligible
44	11779	Roman pottery scatter and Saxon brooch, St. Neots	Negligible
45	1127971	Church of St Mary, Eaton Scotton, Grade II* Listed Building	High
46	MCB18770	Ditches, St Neots	Negligible
47	11777	Roman pottery scatter, St. Neots	Negligible
48	MCB16709	Neolithic pits, Colmworth Business Park, Eaton Socon	Low
49	MCB16710	Romano-British and undated remains, Colmworth Business Park, Eaton Socon	Low
50	479	ROMAN POTTERY found 1960	Negligible
51	1009629	The Hillings, Castle Hill, Scheduled Monument	High
52	10064	Conjoined square enclosures, St. Neots	Low
53	MCB18771	Track, St Neots	Negligible
54	00376	Fully excavated ring ditch, Eynesbury	Negligible
55	MCB17706	Fully excavated Early Saxon sunken-featured buildings, Eynesbury	Negligible
56	00377	Mesolithic flints, Eynesbury	Negligible
57	00447	Neolithic-Bronze Age flint scatter, Eynesbury	Negligible
58	10198C	Iron Age pottery, Eynesbury Hardwicke	Negligible
59	10198D	Romano-British pottery, Eynesbury Hardwicke	Negligible
60	10198G	Post-medieval finds, Eynesbury Hardwicke	Negligible
61	10198A	Fully excavated Mesolithic flint working site, Eynesbury	Negligible
62	10198E	Fully excavated Saxon settlement and cemetery, Eynesbury Hardwicke	Negligible
63	10198B	Fully excavated Neolithic site, Eynesbury Hardwicke	Negligible
64	10198F	Fully excavated ridge and furrow, Eynesbury Hardwicke	Negligible
65	10198	Fully excavated Bronze Age ring ditch, Eynesbury Hardwicke	Negligible
66	MCB17676	Fully excavated south cursus, Eynesbury	Negligible
67	MCB17705	Romano-British agricultural ditches and droveway, Eynesbury	Low
68	00378	Cropmark complex, Eynesbury Fields	Low
69	MCB15825	Iron Age features, Tesco Extension, Barford Road	Low
70	01308	Undated lithic implement, Eynesbury Hardwicke	Negligible
71	06150	Eastern cursus, Eynesbury	Low
72	MCB15950	Trackway and ditches, Barford Road, Eynesbury	Negligible
73	MCB15951	Prehistoric ditch and recent features, Barford Road, Eynesbury	Low
74	MCB15828	Ring ditch and associated features, Barford Road, Eynesbury	Low

Asset	HER Ref or Historic England Ref. No	Description	Value
75	03542	Lithic implements, Eynesbury	Negligible
76	11496	Saxon finds, Barford Road	Negligible
77	05689	Multi-phase enclosure system and possible hengiform monument, Eynesbury Fields	Low
78	05690	Sub Rectangular Enclosure at Gallow Hill	Low
79	10065	Cropmark enclosure and linear feature, St. Neots	Low
80	03543	Flint scraper, Eynesbury Hardwicke	Negligible
81	MCB17211	Undated and medieval features, Potton Lane, Eynesbury Hardwicke	Negligible
82	01307	Flint core, Eynesbury Hardwicke	Negligible
83	01562	Flint implements, Eynesbury Hardwicke	Negligible
84	MCB18836	Ditches, Eynesbury Hardwicke	Negligible
85	01319	Flint blade, Eynesbury Hardwicke	Negligible
86	MCB18832	Pits, Eynesbury Hardwicke	Negligible
87	MCB18831	Possible ditches, Eynesbury Hardwicke	Negligible
88	02388	Roman road, Eynesbury Hardwicke	Low
89	MCB18833	Ditches, Eynesbury Hardwicke	Negligible
90	MCB18835	Ridge and furrow, Eynesbury Hardwicke	Negligible
91	03532	Flint scraper, St. Neots	Negligible
92	MCB15791	Iron Age coin, E of St. Neots	Negligible
93	MCB18834	Ditches, Eynesbury Hardwicke	Negligible
94	MCB18821	Ridge and furrow, St Neots	Negligible
95	MCB18823	Cropmark ditches inSt Neots Parish	Negligible
96	04064	Pit, St. Neots Bypass	Negligible
97	MCB 18824	Cropmark ditches in Abbotsley Parish	Negligible
98	MCB18822	Pit, St Neots Rural	Negligible
99	MCB18830	Circular enclosure and adjacent ditches	Low
100	04062	Undated ditches, St. Neots bypass	Negligible
101	03535	Flint flake, St. Neots Rural	Negligible
102	03539	Prehistoric flint flake, St. Neots	Negligible
103	MCB19042	Possible enclosure, Abbotsley	Low
104	04063	Pit, St. Neots Bypass	Negligible
105	1211327	FARMBUILDINGS AT TITHE FARM	Medium
106	MCB19041	Cropmark ditches in Abbotsley Parish	Negligible
107	1211328	TITHE FARMHOUSE ABOUT 1 MILE EAST OF RAILWAY BRIDGE	Medium
108	01270b	Moat and Medieval chapel site, Wintringham	Low
109	02385	Tanning vat, Wintringham	Negligible
110	MCB19038	Cropmark ditches in Abbotsley Parish	Negligible
111	1290056	GRANARY SOUTH WEST OF WINTRINGHAM HALL	Medium
112	1211324	BARN ABOUT 100 YARDS SOUTH OF WINTRINGHAM HALL	Medium
113	01270a	Wintringham Hall	Medium

Asset	HER Ref or Historic England Ref. No	Description	Value
114	MCB1640	Moated Site at Wintringham Hall excavated	Low
115	02406	Searchlight cropmark, Wintringham	Low
116	1006815	Deserted Medieval Village, Wintringham, a Scheduled Monument	High
117	MCB19040	Cropmark ditches in Abbotsley Parish	Negligible
118	MCB19044	Metalled track and ditches cropmark in Abbotsley Parish	Negligible
119	395444	Church of St Margaret, Abbotsley, a Grade II* Listed Building	High
120	1006849	Deserted Medieval Village, Weald, a Scheduled Monument	High
121	1210919	North Farmhouse, a Grade II Listed Building, Abbotsley	Medium
122	1331371	Grade II Listed mile post to the north west of the Spread Eagle Public House, Croxton	Medium
123	02451	White Hall, Croxton	Low
124	02517	Ridge and furrow, Croxton	Negligible
125	02329	The Downs, Croxton	Low
126	1163272	The House on the Hill, a Grade II Listed Building, Croxton	Medium
127	1127172	Rose Cottage, a Grade II Listed Building, Croxton	Medium
128	1331392	Orchard Cottage and two further cottages, a Grade II Listed Building, Croxton	Medium
129	1163289	Forge Cottage and Ivy Cottage, a Grade II Listed Building on High Street, Croxton	Medium
130	1127171	The Downs, a Grade II Listed Building, Croxton	Medium
131	1127174	A Grade II Listed village pump outside Chef's Cottage (Asset 135), Croxton	Medium
132	1163314	Lindsey Cottage, a Grade II Listed Building, Croxton	Medium
133	1331393	Myrune Cottage, a Grade II Listed Building, Croxton	Medium
134	1127173	The Manor House, a Grade II Listed Building, Croxton	Medium
135	1163308	Chef's Cottage, a Grade II Listed Building, Croxton	Medium
136	1127175	Gatehouse Lodge, a Grade II Listed Building, Croxton	Medium
137	1127163	Croxton, Registered Park and Garden II*	High
138	1006849	Deserted Medieval Village, Croxton, a Scheduled Monument	High
139	1127168	Church of St James, Croxton, a Grade II* Listed Building	High
140	100491	Croxton Park, a Grade II* Listed Building, Croxton	High
141	02387	Bronze Age rapier, Croxton Park	Negligible
142	1309225	Well head, north of Croxton Park, a Grade II Listed Building, Croxton	Medium
143	1210921	Grade II Listed milestone, Great Gransden	Medium
144	MCB18911	Ridge and furrow, Croxton	Negligible
145	MCB18912	Ditches, Croxton	Negligible
146	02403	Pit alignments, Eltisley	Negligible
147	MCB17254	Ridge and furrow, Church End, Eltisley	Negligible
148	MCB19662	Ditches and mounds as part of garden at Old House, Eltisley	Medium
149	1127179	The Parish Church of St John the Baptist and St Pandionia, a Grade II* Listed Building, Eltisley	High
150	02380	Eltisley Abbey, St. Pandionia's Well (site of)	Medium
151	02380a	Post Medieval house and moat, The Old House, Eltisley	Medium

Asset	HER Ref or Historic England Ref. No	Description	Value
152	1127180	Grade II Listed Lych gate to the north east of the Parish Church (Asset 149), Eltisley	Medium
153	1163524	52, The Green, Grade II Listed Building, Eltisley	Medium
154	1163469	The Old House, Grade II Listed Building, Eltisley	Medium
155	MCB17175	Primitive Methodist chapel, Eltisley	Low
156	1290148	Grade II Listed Barn to the East of Leycourt Farmhouse, Great Gransden	Medium
157	1127181	Kent Cottage, Grade II Listed Building, Eltisley	Medium
158	1331396	Green Farmhouse, Grade II Listed Building, Eltisley	Medium
159	1163501	Pond Farmhouse, Grade II Listed Building, Eltisley	Medium
160	1163520	South View, Grade II Listed Building, Eltisley	Medium
161	1331397	The Old Post Office, Grade II Listed Building, Eltisley	Medium
162	1223662	A Grade II Listed K6 telephone box at Eltisley	Medium
163	1163534	A Grade II Listed mile stone at Eltisley	Medium
164	02317	The Leeds Arms, Eltisley	Low
165	1019176	Moated site at Pond Farm, a Scheduled Monument	High
166	1019177	Moated site at Manor Farm, a Scheduled Monument	High
167	1331394	A Grade II Listed mile post at Eltisley	Medium
168	05753	Ridge and furrow, Eltisley	Negligible
169	02463	Windmill (site of), Eltisley	Negligible
170	02541	Probable windmill mound, Papworth Everard	Negligible
171	02350	Ridge and furrow, Eltisley	Negligible
172	MCB17322	Hare Park, Eltisley	Negligible
173	MCB18044	Cast Iron Milepost, Cambridge Road, Caxton	Low
174	1162760	A Grade II Listed mile post south of Pembroke Farm, Caxton	Medium
175	MCB19627	Group of rectilinear enclosure cropmarks	Low
176	n/a	Moated site at Pastures Farm, a Scheduled Monument	High
177	02494	Neolithic findspot, north west of Caxton Gibbet	Negligible
178	11873	Bronze Age flints, Swansley Wood	Negligible
179	02470	Site of Caxton Gibbet	Low
180	MCB16333	Ridge and furrow, Elsworth	Negligible
181	MCB15131	World War Two Airfield at RAF Caxton Gibbet	Low
182	03515	Linear cropmarks, Elsworth	Negligible
183	1331369	A Grade II Listed mile post near the junction with Elsworth Road, Caxton	Medium
184	CB15017	Ridge and furrow, Cambourne Elsworth Turn	Negligible
185	n/a	Roxton Conservation Area	Medium
186	n/a	St Neots Conservation Area	Medium
187	n/a	Croxton Conservation Area	Medium
188	n/a	Eltisley Conservation Area	Medium

Appendix E. Extended Phase 1 habitat survey report

Appendix F. Options Appraisal Matrix

Options considered	Existing baseline	Do nothing	Option 1 – full offline option	Option 2 – junction improvements
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.	Minor junction improvements along the A428 at Wyboston, Cambridge Road, Croxton and Eltisley. Grade separation of both Black Cat and Caxton Gibbet.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment	Qualitative assessment
Receptors				
Air quality	There are no air quality management areas (AQMA) within 200m boundary of the study area. The nearest AQMA is within St Neots High Street. Existing sensitive receptors are the residential areas including towns and villages such as Chawston, Wyboston, Eynesbury, Croxton and Eltisley.	Sensitive receptors are likely to experience a worsening of air quality in the future due to increased congestion under the do nothing scenario.	Sensitive receptors along the existing A428 at Eynesbury Manor, Croxton and Eltisley are likely to experience slight beneficial effects of air quality due to reduced traffic on the existing A428 that would reduce the pollutant emissions.	Sensitive receptors along the existing A428, especially Croxton, are likely to experience slight adverse effects of air quality. The local junction widening would likely increase the traffic capacity as well as reduce the distance between the emission source and receptors, which would give raise to pollutant emissions.
Cultural heritage	Within the study area are 11 scheduled monuments, ranging in date from a Prehistoric bowl barrow to an early 19th century bridge at Tempsford. There are earthworks relating to three deserted medieval villages at Croxton, Weald and Wintringham, four medieval moated sites and at Castle Hills the remains of a Norman ringwork castle. Croxton Park, immediately south of the existing A428, is a mid-18th century house and garden set within a 16th century deer park. Croxton Park is a grade II* registered park and garden. There are seven grade II* listed buildings in the study area, comprising five parish churches, a non-conformist chapel and the house at Croxton Park; a further 41 grade II listed buildings and four conservation areas are within 300m of the A428.	The do nothing baseline is unlikely to result in significant effects to cultural heritage.	**Designated sites**: There is the potential to adversely impact the setting of two deserted medieval villages at Weald and Wintringham, both of which are scheduled monuments. There is the potential for adverse effects on the setting of a scheduled monument near the junction with the A1198 and a grade II listed farmhouse and barn to the east of Cambridge Road. There is the potential to take traffic (and noise and air quality impacts) away from Croxton Park, which may bring benefits to the setting of this site. **Archaeological remains:** There is a potential for adverse impacts on prehistoric archaeological remains near to the B1046 during construction. There is the potential for unknown archaeology along a predominantly offline route.	**Designated sites:** The online improvements run parallel and less than ten metres from the northern boundary of the scheduled monument and grade II* registered park and garden at Croxton, which have the potential to have significant adverse effects that may be difficult to mitigate. There is the potential to adversely impact on the setting of two scheduled monuments and grade II listed buildings at Eltisley and a scheduled monument at Caxton Gibbet. There is also the potential for a slight adverse impact on the setting of a grade II listed farmhouse and barn near Cambridge Road. This option could potentially result in temporary and permanent effects to the setting of the St Neots Conservation Area, which it borders. **Archaeological remains:** There is low potential to impact unknown archaeology compared to Option 1 due to online improvements.
Landscape	Croxton Park, located south of the A428 at Croxton, is registered as a historic park and garden. Mature woodland and parkland trees, many protected by tree preservation orders (TPO) are associated with the park including its boundaries along the existing A428. There are numerous listed buildings in the study area. There is significant woodland cover within the study area, including ancient woodland (e.g. Eltisley Wood and Sir John's Wood) and numerous non-designated small and medium-sized deciduous woodlands throughout the farmland to the east of the river Great Ouse, including woodlands on the National Forestry Inventory. The area to the south of the existing A428 and east of Potton Road is a quiet rural landscape of good quality, with a coherent, unspoiled, homogenous character. Significant features include numerous woodlands, mature hedgerows and small-scale stream valleys with attractive open views. This area includes frequent historic landscape features (Roman road, moated farmhouses, small-scale pastures, etc.) and is of high sensitivity to intrusive development and changes to the landform. Key visual receptors include scattered rural properties and farms with residential clusters at Croxton cross roads, Abbotsley, Eltisley and Caxton Gibbet. Users of the Ouse Valley Way national trail have views of the A1 between Tempsford and the southern edge of St Neots at Wyboston.	The do nothing baseline is unlikely to result in significant effects to landscape and visual.	**Designations:** The route would directly impact on one known TPO north of the existing A428 at Weald. **Character:** There would be direct long-term adverse effects for the Ouse Valley (high sensitivity) and Clayland landscape character areas (LCA) (medium to high sensitivity). There could be permanent, adverse physical effects on the River Great Ouse floodplain from a new road across the valley and improvements south of Black Cat, and to the component landscape features of farmland east of the River Great Ouse including severance and loss of some woodland blocks. The changes to landform in the section east of the Ouse Valley to Potton Road (through Biggins Wood Clay Vale and Alington Clay Farmland LCAs) would cause significant adverse impact on local landscape character due to open views cross undulating farmland. The footprint of the improved Black Cat junction would mean removal of the existing motel to the northwest, and another property to the northeast. The new section on embankment across the valley of Hen Brook east of St Neots, would be very prominent in the wider landscape setting, parallel to the existing A428.The proposed grade-separated junction at Cambridge Road would require substantial earthworks which would be out of character with the surrounding topography and could affect the landscape setting of Wintringham medieval village. The alignment to the north of the existing A428 avoids Croxton Park and medieval villages of Wintringham and Weald and the associated landscape features, and could benefit the setting of these features. **Visual impact:** Significant adverse visual effects would be likely at Black Cat, Cambridge Road and Caxton Gibbet. However, there are few visual receptors at these locations. Scattered rural properties would be adversely affected by visual impacts, some significantly. Users of all public rights of way (PRoW) east of St Neots would likely experience significant adverse effects, although vegetation planting or other screening could mitigate these impacts. Users of local footpaths at Black Cat would experience changes due to the proposed new layout.	**Designations:** There is a potential risk of adverse effects from minor junction improvements within Croxton village on the setting and boundary features of the registered park and garden / scheduled monument at Croxton Park. There would be no impacts on known TPOs. **Character:** There would be direct long-term adverse effects for the Ouse Valley (high sensitivity) from the changes to Black Cat junction but these would be less than for Option 1 as no new crossing of the valley would be required. The effect on Claylands LCAs from this option would be negligible, although some adverse effect would arise from a grade-separated junction at Caxton Gibbet. Junction widening in Croxton would have potential direct short to medium-term adverse impacts on adjacent properties and boundary features, but these could probably be mitigated. Increased traffic volume along the existing A428 would be the same as the 'Do Nothing' scenario. **Visual impact:** Localised adverse visual effects would be likely from the separated grade junction at Black Cat, and a grade-separated junction at Caxton Gibbet. There would be localised, short-term moderate adverse visual effects for receptors close to junction improvements, including residential and business receptors on the southern edge of Eaton Socon and St Neots. Users of all PRoW east of St Neots would not experience any perceivable change. Experiences for users of PRoW at Black Cat junction would be as for Option 1.

Options considered	Existing baseline	Do nothing	Option 1 – full offline option	Option 2 – junction improvements
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.	Minor junction improvements along the A428 at Wyboston, Cambridge Road, Croxton and Eltisley. Grade separation of both Black Cat and Caxton Gibbet.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment	Qualitative assessment
Nature conservation	There is one special area of conservation (SAC) designated for bats within 30km of the study area. Eversden and Wimpole Woods SAC lies 8.5km to the south east of the A428. The nearest site of special scientific interest (SSSI) is Elsworth Wood located approximately 1.1km north-east of Caxton Gibbet junction. There is a cluster of SSSI located less than 5km away from the existing A428. Croxton Park county wildlife site (CWS) is located adjacent to the A428. Eltisley Wood, River Great Ouse and Begwary Brook are all CWSs within the study area. The study area includes a number of biodiversity action plan (BAP) priority habitat including deciduous woodland, wood pasture and parkland, coastal and floodplain grazing marsh, lowland fens, and young trees. There is also the potential for protected species including badgers; great crested newt (GCN); water vole; otter; bats; grass snake; and common lizard.	The do nothing baseline is unlikely to result in significant effects to nature conservation.	**Designated sites:** There are unlikely to be significant effects to SSSIs given the distances involved although the presence of a bat SAC within 10km would need further consideration. The proposed route is located immediately adjacent to the River Great Ouse CWS with the potential for impacts arising due to direct habitat loss, habitat degradation, changes in air/water quality, noise/light disturbance, and severance. **Habitats**: Broadleaved woodland is located at various locations along the proposed route and would be directly affected at Croxton Park. Lowland fen and floodplain grazing marsh is located close to the proposed route at its western end and may be affected by hydrological changes. Compensation habitat creation is likely to be required if impacts are unavoidable resulting in additional land procurement. **Protected and priority species:** The presence of protected species including bats, badgers, GCN and reptiles is probable, although impacts could likely be addressed using standard mitigation.	**Designated sites:** There could be potential impacts to CWS. The proposed works would be immediately adjacent to the Croxton Park CWS and River Great Ouse CWS with the potential for impacts arising due to direct habitat loss, habitat degradation, and disturbance. **Habitats**: Priority habitats located alongside this option include woodland and parkland. Compensation habitat creation is likely to be required if impacts are unavoidable resulting in additional land procurement. This option offers limited opportunities for biodiversity enhancement. **Protected and priority species:** Similar to Option 1.
Geology and soils	The soils are generally grade 2 (very good), with pockets of grade 1 (excellent) around Wyboston. The wider corridor of the River Great Ouse is a mineral consultation area. There are mineral safeguarding areas (MSA) located at the Wyboston interchange, Little Barford, the River Great Ouse, and east of St Neots. There are strategic mineral sites located at Black Cat junction and Blunham / Roxton. Potential contamination sources include authorised and historic landfills, fuel stations and highway services, a railway line and associated made ground, Little Barford Power Station and other land uses including industrial, commercial and agricultural. The majority of the superficial deposits in the area are classified as a secondary (undifferentiated) aquifer. In the west of the study area, along the A1, deposits are classified as secondary A aquifer.	The do nothing baseline is unlikely to result in significant effects to geology and soils.	**Soils:** This option would result in temporary and permanent loss of grades 1, 2 and 3 agricultural land through the footprint of the new alignment. There could be further loss of viable land through the severance of land between the existing A428 and offline sections. This could be minimised through consultation and good design. **Geology**: The western section of construction would cover a mineral consultation area, two MSA, a permitted mineral extraction site, and Black Cat strategic mineral site. The option may result in a loss of access to the minerals in the immediate area of any construction works, therefore reducing the volume of minerals available for extraction. Mineral extraction prior to construction could mitigate the effect; however, the area is covered by the current Black Cat junction, A1 and A421. **Contamination:** Construction of the option could result in disturbing contaminated ground along the route. This could require bespoke mitigation to manage the risk to receptors. **Groundwater**: Construction of the option at Black Cat junction and the western-most part of the option could mobilise contaminants, potentially impacting secondary A and secondary (undifferentiated) aquifers. This could require bespoke mitigation to manage the risk. Any cuttings or discharges to the ground could potentially impact groundwater receptors.	**Soils:** The majority of works for this option are confined to the existing footprint of the highway, and so are unlikely to cause significant effects on soil. This option is likely to result in a lower effect on the 'best and most versatile' soils and less severance. **Geology**: As the majority of the works are confined to the existing highway footprint, this option is unlikely to cause a significant impact or loss of access to the MSAs. **Contamination:** Similar to Option 1. Works for this option are generally closer to a larger number of receptors than the offline options, potentially increasing the likelihood of contaminant linkage, but this could be addressed with standard mitigation. **Groundwater**: Similar to Option 1.
Noise and vibration	There is an existing noise important area (NIA) located along the A1 between Black Cat and Wyboston and one located to the east of Caxton Gibbet on the existing A428. Noise and vibration receptors include residential properties along the A1 and in the south of St Neots on the A428.	Under the do nothing scenario, increased congestion could lead to either marginally increased noise levels for these receptors (due to increased flows) or marginally decreased noise levels (due to decreased line speeds).	**Noise important areas:** Traffic noise would be reduced at NIA located between Black Cat and Wyboston. **Noise sensitive receptors:** Noise would be reduced at residential properties along the A1 and in the south of St Neots on the A428. Properties in Croxton and Eltisley would also experience a decrease in traffic noise. There are various outlying properties in and to the east and southeast of Little Barford that currently experience low levels of traffic noise that would be adversely impacted by this option. Additionally, there are properties along the northern side of the A428 at Cambridge Road that would experience major noise increases at their northern facades (which currently experience low levels of traffic noise). Overall, more properties are considered likely to experience noise decreases than increases.	**Noise important areas**: There would be no traffic noise reduction at the NIA located between Black Cat and Wyboston, or the NIA to the west of Cambourne on the existing A428. **Noise sensitive receptors:** Overall, the option is likely to be relatively neutral in terms of noise impact.

Options considered	Existing baseline	Do nothing	Option 1 – full offline option	Option 2 – junction improvements
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.	Minor junction improvements along the A428 at Wyboston, Cambridge Road, Croxton and Eltisley. Grade separation of both Black Cat and Caxton Gibbet.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment	Qualitative assessment
People and community	Settlements include St Neots, Croxton, Eltisley, Wyboston, and Abbotsley. These contain residential property and community receptors such as schools and places of worship. Receptors adjacent to the A428 include the Wyboston Leisure Park and service stations located at the Black Cat junction and Caxton Gibbet junction. There are further commercial receptors located along Alington Road, Great North Road, and the Abbotsley Golf Hotel. Major roads in the study area include the A428, A1, A421, and A1198. The East Coast Main Line runs north-south parallel to the A1 and east of St Neots. There are 27 PRoW within the study area, which are clustered around Black Cat junction and Wyboston; southeast of St Neots, between Hen Brook and Wintringham; and the settlements of Weald, Croxton, and Eltisley.	The do nothing scenario would result in no traffic improvements on the A428, causing increased congestion and delays. This could also lead to greater access issues for residents in settlements in the vicinity of the A428.	**Land use:** The offline sections of this option would cause land severance, creating small pockets of land between the new alignment and existing A428. This could also affect access routes to isolated properties and farms. This could be mitigated through good design and consultation with landowners. **Property (residential / commercial):** This option could reduce disturbance (cumulative noise, air quality, and visual effects) to residential property along the existing A428/A1. Access to settlements could improve as the existing A428 would be used for local traffic only. This option could physically impact upon commercial assets around Black Cat and Caxton Gibbet junction, requiring their relocation. **Transport:** There would likely be a beneficial effect from traffic using the A428 from reduced congestion and journey times. This option would require one crossing over the railway line, which could result in disruption to rail services during construction. **Rights of way:** Offline sections of this option would dissect PRoW, which would require closure, diversion, or safe crossings. There is an opportunity to improve non-motorised user (NMU) access along the 'old' A428.	**Land use:** This option would result in minimal land severance. **Property (residential / commercial):** Online junction widening could impact settlements along existing A428. There could also be impacts to Wyboston Leisure Park, and commercial assets at Black Cat junction, Caxton Gibbet junction, and Alington Road industrial estate. **Transport:** There would likely be a less beneficial effect to traffic using the A428 compared to Option 1. No railway crossing would be required, so this could result in less disruption to rail services compared to Option 1. **Rights of way:** This option would not dissect any PRoW as it is entirely online improvements. However, it would lead to an increase in traffic along the existing A428 making it less user friendly for NMUs unless an alternative route was provided as mitigation.
Water environment	There are two main rivers within the study area (the River Great Ouse and Hen Brook). The River Great Ouse is associated with an extensive floodplain, while the Hen brook has a considerably less extensive flood plain. There are five Water Framework Directive (WFD) water bodies within the study area, including the Ouse (Roxton to Earith), Stone Brook, West Brook, Begwary Brook and Abbotsley and Hen. All are classified as having moderate potential, except for the Begwary Brook which is currently achieving good potential.	The do nothing baseline is unlikely to result in significant effects to the water environment.	This option would require a new crossing and works within the flood zone of the River Great Ouse. The option would also require the extension of existing structures on three smaller watercourses, with new crossings and potential realignments. The option could alter existing flood risk patterns as a result of new and extended structures and working within the floodplain. Floodplain losses around the River Great Ouse are likely to require compensation. Physical modifications to rivers/watercourse could alter the channel characteristics and water quality and could lead to a change or deterioration in the WFD status of the rivers/watercourses.	This option would require the extension of existing structures on six smaller watercourses and the potential requirement for realignments.
Design considerations				
Waste and materials	There is no existing waste and material baseline applicable to the scheme.	A small amount of materials and a small amount of waste would be generated during the routine maintenance.	This option would require large amounts of raw materials and would generate waste. The impacts can be mitigated by undertaking a materials management strategy from the start of the design process.	This option would require less material and generate less waste than Option 1. The impacts can be mitigated by undertaking a materials management strategy from the start of the design process.
Climate change	Climate change is likely to result in more extreme weather patterns including flash flooding and drought.	There would be no opportunities to make the A428 more resilient to climate change.	This option would allow the A428 to be designed to be more resilient to climate change, including increasing capacity of culverts and drainage systems and providing surfacing more resistant to extreme weather conditions.	There are limited opportunities to design the scheme to be more resilient to climate change.
Resilience to environmental risks, accidents and disaster	There is no evidence of environmental risks that have occurred along the A428.	There would be no opportunities to make the A428 more resilient to environmental risks.	No opportunities have been identified to date to make the option more resilient to environmental risks, accidents and disaster.	Similar to Option 1.
Crosscutting topics				
Health	Existing health receptors include residents in St Neots and the surrounding area, NMU and recreational ground users adjacent to the existing road network, and visitors to the businesses adjoining the road network.	Increases to noise levels and reduction in air quality could affect the health of sensitive receptors near the junction e.g. the community receptors and residential properties.	The new road could reduce driver stress, and have beneficial effects on the health of local residents who use the route. The offline route would also take noise and air quality effects away from a large number of receptors. There is also an opportunity to improve NMU access along the 'old' A428. These could have a positive effect on health.	This option has the potential to increase noise levels within the NIA due to the additional traffic. This could cause stress to the community and, would require mitigation to lessen the effect.

Options considered	Existing baseline	Do nothing	Option 1 – full offline option	Option 2 – junction improvements
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.	Minor junction improvements along the A428 at Wyboston, Cambridge Road, Croxton and Eltisley. Grade separation of both Black Cat and Caxton Gibbet.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment	Qualitative assessment
Ecosystems services	The habitats and landscape around the existing road network provide a value to people who live in St Neots and the surrounding area.	Increases to noise levels and reduction in air quality could affect existing habitats and biodiversity near the junction.	Offline sections have the potential to affect woodland and other habitats, which provide value to the landscape and local amenity. The option would also result in loss of functional floodplain, which acts as a natural flood defence.	This option is unlikely to have any significant effects on ecosystem services.
Socioeconomics	St Neots is an important regional centre for businesses and commercial enterprises. The A428 forms an important part of the strategic route between Milton Keynes and Cambridge, via Bedford.	Increased congestion is likely to deter development within the area and could affect long term economics.	An option that reduces congestion along the A428 is likely to help the local economy in terms of supporting development. There may be minor effects on socio-economics due to disruption during construction and minor adverse effects to businesses along the existing A428 which benefit from passing trade.	This option is unlikely to significantly affect socioeconomics in the long term. There may be minor effects on socioeconomics due to disruption during construction.
Other considerations				
Potential planning route	Not applicable.	No capital works required, therefore no planning permission would be required. Assumes that routine maintenance would fall under permitted development powers.	This option would require a Development Consent Order.	This option would require a Development Consent Order.
Is this likely to require a statutory EIA?	Not applicable.	No planning required and therefore no statutory EIA required.	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.
Is this likely to require an Appropriate Assessment?	Not applicable.	No capital works required and therefore no Appropriate Assessment required.	Initial screening has indicated that this option is unlikely to require an Appropriate Assessment.	Initial screening has indicated that this option is unlikely to require an Appropriate Assessment.
What other environmental consents and approvals may be required?	Not applicable.	Routine maintenance may require consents and approvals under relevant legislation e.g. protected species licences.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work. This option is likely to require listed building and scheduled monument consent regarding the impact at Croxton Park.
Overall summary				
Does this meet the environmental KPIs	Not applicable.	There would be no opportunity to contribute to KPI targets.	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.	This option has limited opportunities to contribute to wider KPI targets.
Does this provide opportunities under the RIS designated funds?	Not applicable.	There would be no opportunity to use RIS designated funds to further improve the environment.	This option has the potential to access designated funds to improve NIAs, reduce historic severance and increase biodiversity along the route.	This option has the potential to access designated funds to improve NIAs, reduce historic severance and increase biodiversity along the route.
Summary of the environmental appraisal	Not applicable.	This is assessed as the baseline to compare other options to. Air quality and noise is likely to get worse at the junction without intervention.	This option has an offline footprint that has been designed to avoid sensitive features. This option would provide an opportunity to move adverse effects associated with the existing road away from Croxton Park, potentially enhancing this feature. There are potential significant effects to the landscape that would need further design inputs at Stage 2. However, overall this is considered to be the environmentally preferred offline option as it would provide opportunities for improvement to the NIA, NMU access and to Croxton Park.	This option has a smaller footprint that Option 1 but would require widening of the A428 in vicinity of Croxton Park. Online widening is likely to result in significant effects to the designated site, in terms of visual and setting and through changes to noise and air quality, which may be difficult to mitigate.

Options considered	Option 3 – Partial offline to Cambridge Road		Option 4 – Offline to Cambridge Road and online widening to Caxton Gibbet		Option 5 – Southern offline alignment to the north of Abbotsley	
Option description	A428 bypass between Black Cat and Cambridge Road junction. No widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet.		Offline dual carriageway bypass between Black Cat and Cambridge Road and online widening between Cambridge Road and Caxton Gibbet.		Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge road Junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.	
Topic	Qualitative assessment		Qualitative assessment		Qualitative assessment	
Receptors						
Air quality	Sensitive receptors along the existing A428 at Eynesbury Manor are likely to experience slight beneficial effects of air quality due to reduced traffic on the existing A428 which would reduce the pollutant emissions. However the sensitive receptors at Croxton and Eltisley would likely experience a slight worsening of air quality due to increased congestion on the local network.		Similar to Option 3. However, the sensitive receptors at Croxton and Eltisley are likely to experience a slight worsening of air quality due to the online widening, which would likely increase the traffic flow as well as reducing the distance between the emission source and the receptors giving rise to pollutant emissions.		Similar to Option 1.	
Cultural heritage	**Designated sites:** There is the potential to adversely impact on the setting of a scheduled monument near Caxton Gibbet and on the setting of a grade II listed farmhouse and barn near Cambridge Road. **Archaeological remains:** There is a potential for adverse impacts on prehistoric archaeological remains near to the B1046 at Eltisley.		**Designated sites:** The scheduled monument and grade II* registered park and garden at Croxton are within the proposed footprint and there is the potential for significant effects on their setting, that would be difficult to mitigate. There is also the potential for adverse effects on the setting of two scheduled monuments and grade II listed buildings at Eltisley, two deserted medieval villages at Weald and Wintringham (both scheduled monuments) and a scheduled monument near the junction with the A1198. **Archaeological remains:** There is a potential for adverse effects on prehistoric archaeological remains near to the B1046 along with impacting other unknown archaeology along a predominantly offline route.		**Designated sites:** There is the potential to adversely impact on the settings of a scheduled monument near the junction with the A1198, and nine grade II listed buildings; these are mostly isolated farmsteads and barns set within open countryside. The option passes within 500m of Abbotsley Conservation Area which contains 17 grade II and one grade II* listed buildings. **Archaeological remains:** There is a higher risk of adverse effects on known and unknown archaeology along the entirely offline footprint.	
Landscape	**Designations:** No impact on national level landscape designations or TPOs, as the route follows the existing A428 east of the proposed Cambridge Road junction. **Character:** Physical impacts for Ouse Valley Similar to Option 1. Physical impacts on the Claylands LCA are substantially less than Option 1, following the existing A428 through Croxton and Eltisley. The proposed location and configuration of earthworks for the Cambridge Road junction, with the re-aligned A428 in cutting, would have significantly less adverse effects than Option 1 with negligible effect on the landscape setting of Wintringham medieval village. **Visual impact:** Visual impacts in the western part of the option, up to Cambridge Road junction, and for Caxton Gibbet, would be the same as for Option 1. There would be no appreciable change for receptors through Croxton and Eltisley.		**Designations:** Potential adverse impact on Croxton Park Registered Park and Garden/scheduled monument, with likely permanent change to the setting of this asset. Online widening along the existing A428 east of the London Road junction would have a potential adverse impact on the roadside features associated with Croxton Park, with likely loss of mature and protected trees, hedges and other boundary features. Likely adverse impact on TPOs through Croxton. **Character:** Physical impacts for Ouse Valley and Caxton Gibbet would be the same as Option 1. Adverse physical impacts on the South East and Western Claylands (LCA 3 & LCA 5) would be slightly less than Option 1. The proposed simple at-grade roundabout at the Cambridge Road junction would have significantly less adverse effects than Option 1 with negligible effect on the landscape setting of Wintringham medieval village and much reduced visual intrusion into the LCA. The more easterly alignment and greater length in cutting on the east side of St Neots would result in an option more readily integrated into the surrounding landscape and with slightly less impact on the Hen Brook valley. **Visual impact:** These would be the same as for Option 1 through the Ouse Valley and at Black Cat junction. To the east of the River Great Ouse adverse visual effects would be significantly less than for Option 1 although users of PRoW would be affected to some extent. There would be some temporary adverse effects during construction and longer term adverse impacts to visual receptors along the route east of Cambridge Road junction, as the new dual carriageway would be closer to residential properties. It would be difficult to mitigate visual impacts through the Croxton section.		**Designations:** No direct adverse physical effect on Croxton Park Registered Park and Garden, but potential effects on the landscape setting to the south. No impact on known TPOs. Alignment passes within approximately 50m of Sir John's Wood and 200m of Eltisley Wood (ancient woodlands). **Character:** Physical impacts for Ouse Valley (LCA 4/4A), Biggin Wood Clay Vale (LCA 5F) and Caxton Gibbet would be the same as Option 1. Adverse physical impacts on the South East and Western Claylands (LCA 3 & LCA 5) would be greater than Option 1 due to the route being unrelated to the existing A428 corridor with the route forming a new intrusive feature in open farmland. There would be significant severance of agricultural land and related hedges and boundary features including small streams. This route would be particularly damaging to the valley landscape north of Abbotsley which has a coherent, unspoiled rural character with attractive views. Changes to landform in this section would create a significant adverse effect. The alignment bisects Long Plantation (priority habitat deciduous woodland) and directly affects the edges of a number of smaller woodlands. There would be significant impact on small-scale pasture and residential properties at Leycourt, south of Eltisley. **Visual impact:** These would be the same as for Option 1 through the Ouse Valley, at Black Cat junction and Caxton Gibbet. To the east of the River Great Ouse adverse visual effects would potentially be experienced by scattered rural houses and farms and residents on the northern edge of Abbotsley and southeast edge of Eltisley and people using Abbotsley Golf Course.	

Options considered	Option 3 – Partial offline to Cambridge Road	Option 4 – Offline to Cambridge Road and online widening to Caxton Gibbet	Option 5 – Southern offline alignment to the north of Abbotsley
Option description	A428 bypass between Black Cat and Cambridge Road junction. No widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet.	Offline dual carriageway bypass between Black Cat and Cambridge Road and online widening between Cambridge Road and Caxton Gibbet.	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge road Junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.
Topic	Qualitative assessment	Qualitative assessment	Qualitative assessment
Nature conservation	**Designated sites:** Similar to Option 1. **Habitats:** Priority habitats likely to be affected include woodland and floodplain grazing pasture. Compensation habitat creation is likely to be required if impacts are unavoidable resulting in additional land procurement. **Protected and priority species:** Similar to Option 1.	**Designated sites:** Similar to Option 1. This option is also immediately adjacent to the Croxton Park CWS. **Habitats:** Similar to Option 3. **Protected and priority species:** Similar to option 1.	**Designated sites:** This option lies closer to the group of SSSIs to the south of the study areas and also lies less than 10km away from a bat SAC. Therefore, further screening is required to understand the effects to these designated sites, notably with respect to habitat severance. The non-statutory data does not cover the full alignment of this option, therefore there may be other non-statutory designated sites affected by the option that are not known at this stage in the assessment. There are unlikely to be impacts to SSSIs given the distances involved although the presence of a bat SAC within 10km may need further consideration. **Habitats:** Priority habitats likely to be affected include woodland and floodplain grazing pasture. The Extended Phase 1 habitat survey does not currently cover the full extent of this alignment. Compensation habitat creation is likely to be required if impacts are unavoidable resulting in additional land procurement. **Protected and priority species**: Similar to Option 1.
Geology and soils	**Soils:** Similar to Option 1, except the option would require less permanent land take. **Geology:** Similar to Option 1. **Contamination:** Similar to Option 1. **Groundwater:** Similar to Option 1.	**Soils:** Similar to Option 3. **Geology**: Similar to Option 1. **Contamination:** Similar to Option 1. **Groundwater:** Similar to Option 1.	**Soils:** Similar to Option 1, except the option would potentially require more permanent land take. **Geology:** Similar to option 1; construction would cover thin strip of MSA north east of Abbotsley village rather than east of St. Neots. **Contamination:** Similar to Option 1. **Groundwater:** Similar to Option 1.
Noise and vibration	**Noise Important areas:** Similar to Option 1. **Noise sensitive receptors:** There would be a reduction of noise levels at residential properties along the A1 and in the south of St Neots on the A428. There are various outlying properties in and to the east and southeast of Little Barford that currently experience low levels of traffic noise that would be adversely impacted.	**Noise Important areas:** Similar to Option 1. **Noise sensitive receptors:** Similar to Option 1. Additionally, properties between Cambridge Road and Caxton Gibbet could experience noise level increases associated with the online widening.	**Noise Important areas:** Similar to Option 1. **Noise sensitive receptors:** Similar beneficial effects as Option 1. There are various outlying properties along the whole alignment that currently experience low levels of traffic noise that would be adversely impacted by this option. Properties on the northern side of Abbotsley would also experience increases in traffic noise.
People and community	**Land use:** Similar to Option1; however, there would be reduced land severance to north of the A428. **Property (residential / commercial):** Similar to Option 1. There would be less beneficial effects to receptors along the existing A428 between Wintringham and Caxton Gibbet, as traffic would not be moved off of the existing A428. **Transport:** Similar to Option 1.However, this option would lead to an increase in traffic along the existing A428 making it less user friendly for NMUs unless an alternative route was provided as mitigation. **Rights of way:** Similar to Option 1.	**Land use:** Similar to Option 3. **Property (residential / commercial):** Similar to Option 3. However online widening would have an impact on settlements and community features along the existing A428. **Transport:** Similar to Option 3. **Rights of way:** Similar to Option 1.	**Land use:** Similar to Option 1. The negative effects from land severance caused by Option 1 would be reduced as the southern offline alignment would avoid creating small land parcels. **Property (residential / commercial):** Similar to Option 1.There could also be greater beneficial effects to settlements along the existing A428 and Croxton Park. This option would impact the grounds of the Abbotsley Golf Club through direct land take, as well as disturbance by noise and visual intrusion if not mitigated. **Transport:** Similar to Option 1. This would result in a continued use of the existing A428 for traffic accessing St Neots, which would not have as much benefit as option 1 as an NMU route. **Rights of way:** Similar to Option 1.
Water environment	Similar to Option 1 except the option would require the extension of existing structures on two smaller watercourses, with new crossings and potential realignments.	Similar to option 1 except the option would require the extension of existing structures on four smaller watercourses, with new crossings and potential realignments. There is also the partial removal of a pond feature.	Similar to Option 1 except the option would require the extension of existing structures on two smaller watercourses, with new crossings and potential realignments.
Design considerations			
Waste and materials	This option would require less material and generate less waste than Option 1. The impacts can be mitigated by undertaking a materials management strategy from the start of the design process.	Similar to Option 3.	Similar to Option 1.
Climate change	Similar to Option 2.	Similar to Option 2.	Similar to Option 1.

Options considered	Option 3 – Partial offline to Cambridge Road	Option 4 – Offline to Cambridge Road and online widening to Caxton Gibbet	Option 5 – Southern offline alignment to the north of Abbotsley
Option description	A428 bypass between Black Cat and Cambridge Road junction. No widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet.	Offline dual carriageway bypass between Black Cat and Cambridge Road and online widening between Cambridge Road and Caxton Gibbet.	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge road Junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.
Topic	Qualitative assessment	Qualitative assessment	Qualitative assessment
Resilience to environmental risks, accidents and disaster	Similar to Option 1.	Similar to Option 1.	Similar to Option 1.
Crosscutting topics			
Health	Similar to Option 1.	This option could result in positive health benefits to drivers by reducing driver stress. However, this is likely to be balanced by negative health impacts to local residents in settlements adjacent to the route caused by online widening, and increased noise and air quality effects.	Similar to Option 1.
Ecosystems services	Similar to Option 1.	Similar to Option 1.	Similar to Option 1. The option would also create an additional manmade feature within the landscape, with potential impacts on views from the Greensand Ridge, affecting the enjoyment of this asset. It would also create another barrier within the landscape scale habitat areas.
Socioeconomics	Similar to Option 1.	Similar to Option 1.	An option that reduces congestion along the A428 is likely to help the local economy in terms of supporting development. However, the bypass away from St Neots could affect the local economy in the town centre, as it benefits less from passing trade. There may be minor effects on socio-economics due to disruption during construction.
Other considerations			
Potential planning route	This option would require a Development Consent Order.	This option would require a Development Consent Order.	This option would require a Development Consent Order.
Is this likely to require a statutory EIA?	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.
Is this likely to require an Appropriate Assessment?	Initial screening has indicated that this option is unlikely to require an Appropriate Assessment.	Initial screening has indicated that this option is unlikely to require an Appropriate Assessment.	Initial screening has indicated that this option could require an Appropriate Assessment due to it lying less than 10km from the SAC and the potential for habitat severance.
What other environmental consents and approvals may be required?	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work. This option is also likely to require scheduled monument consent and significant consultation with heritage stakeholders regarding the potential effects to Croxton Park.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work.
Overall summary			
Does this meet the environmental KPIs	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.
Does this provide opportunities under the RIS designated funds?	This option has the potential to access designated funds to improve NIAs, reduce historic severance and increase biodiversity along the route.	This option has the potential to access designated funds to improve NIAs, reduce historic severance and increase biodiversity along the route.	This option has the potential to access designated funds to improve NIAs and reduce historic severance.
Summary of the environmental assessment	This option has a smaller footprint that Option 1, with less visual and land take impacts. This could help improve the NIA to the north of Black Cat. This option would not provide all of the benefits of Option 1, including reducing the impact of the road on Croxton Park. If this was undertaken as a phased part of a longer term scheme, it could lead to significant effects to Croxton Park if it was taken forward as part of an online widening option (see Option 4). It would have similar effects to Option 1 if taken forward as a phased approach to an Option 1 alignment.	This option is likely to have significant effects around Croxton Park due to the road widening extending immediately adjacent to the designated site and increases to noise and air quality impacting the feature. This is likely to be very difficult to mitigate given the proximity of the option to the designated site.	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 5km to the south of the route. This option could require an Appropriate Assessment due to the proximity to the Eversden and Wimpole Woods SAC, which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than Option 1, as it would require more mitigation to offset potentially significant effects. Compared to Option 1, it would also create another major road within the landscape and create additional barriers to protected species migration within the study area.

Options considered	Option 6 – Southern offline alignment to the south of Abbotsley	Option 7 – Junction improvements and online widening at Wyboston	Option 8 – Junction improvements
Option description	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.	Dualling between Wyboston and the River Great Ouse crossing and a new roundabout at Wyboston. Minor junction improvements at Barford Road and Cambridge Road. Grade separation at Black Cat and signalised junction at Caxton Gibbet.	Grade separation of both Black Cat and Caxton Gibbet.
Topic	Qualitative assessment	Qualitative assessment	Qualitative assessment
Receptors			
Air quality	Similar to Option 1.	Similar to Option 2.	Similar to Option 2, however, effects would be localised around the Black Cat and Caxton Gibbet junctions.
Cultural heritage	**Designated sites:** Similar to Option 5. This option would be slightly further away from the Abbotsley Conservation Area. **Archaeological remains:** Similar to Option 5.	**Designated sites:** This option would have a similar impact to Option 2 at Black Cat, south of St Neots, and Caxton Gibbet. Overall, this option would have a reduced impact compared to Option 2, as there would be no effects to assets at Croxton and Eltisley. **Archaeological remains:** Similar to Option 2.	**Designated sites:** Similar to Option 7, however, impacts would be localised around the Black Cat and Caxton Gibbet junctions. **Archaeological remains:** Similar to Option 2.
Landscape	**Designations:** Similar to Option 5. **Character:** Similar to option 5 for Black Cat, Ouse Valley and Caxton Gibbet. East of the Ouse Valley there would be a greater adverse effect on the open character of Biggin Wood Clay Vale (LCA 5F). There would be no impact on Alington Hill (LCA 1C), but there would be a significant increase in physical and visual impacts within the South East Claylands (LCA 3) due to a long diagonal cut across the southern escarpment and adverse effects on mature woodlands, including Crane Hill, Bushy Common Plantation and Thistle Hill Plantation. There would be a reduced adverse effect on the Hen Brook Valley compared to Option 5, but a significant adverse effect on the secluded, quiet Small Brook valley, southeast of Abbotsley. **Visual impact:** There would be an increased visual impact compared to Option 5, particularly for scattered rural residential receptors with the route running close to a number of farmsteads.	**Designations:** Similar to Option 2. **Character:** Similar to Option 2. Reduced adverse effects at Caxton Gibbet. **Visual impact:** Marginally increased adverse visual effects at Wyboston junction and Barford Road junction.	**Designations:** Similar to Option 2. There would be no impact to receptors at Croxton. **Character:** Similar to Option 2. There would be no impact to character at Croxton. **Visual impact:** Similar to Option 2.
Nature conservation	**Designated sites:** The proposed route is located within 1km of Weaveley and Sand Woods SSSI. At this distance, impacts associated with air quality change, fragmentation, disturbance or habitat degradation could arise. A more detailed assessment with respect to impacts to this site would therefore be required. The proposed route is located within 10km of a bat SAC (Eversden and Wimpole Woods SAC) so an Assessment of Impacts to European Sites would be required to identify any likely significance effects, notably with respect to habitat severance. **Habitats:** Several blocks of deciduous woodland, which is a priority habitat, would be directly affected. The severance and loss of these habitats would require mitigation, and is likely to impact protected species (notably bats). A block of ancient semi-natural woodland and ancient replanted woodland is also located within 200m of the proposed alignment and may be adversely affected. The Extended Phase 1 habitat survey does not currently cover the full extent of this alignment. **Protected and priority species:** Similar to Option 1.	**Designated sites:** There could be potential impacts to CWS. The proposed works would be immediately adjacent to the River Great Ouse CWS with the potential for impacts arising due to direct habitat loss, habitat degradation, and disturbance. **Habitats:** Priority habitats within the immediate vicinity of the existing A428 that may be affected by the proposals include lowland fen, wood-pasture and parkland, and deciduous woodland. Duelling between the B1428 and Barford Road junctions is also likely to require the felling of a large number of trees. **Protected and priority species:** Similar to Option 1.	**Designated sites:** This option would be located approximately 1km from Elsworth Wood SSSI; at this distance adverse effects are unlikely although an assessment to confirm this would be required. There could be an impact to the protected road verge (PRVS8), as it is located immediately adjacent to the Caxton Gibbet construction footprint. **Habitats:** Broadleaved woodland, a priority habitat, is located within the immediate vicinity of Caxton Gibbet and may be affected by the proposals. **Protected and priority species:** Similar to Option 1.
Geology and soils	**Soils:** Similar to Option 5. **Geology:** Similar to Option 5. **Contamination:** Similar to Option 1. **Groundwater:** Similar to Option 1.	**Soils:** Similar to Option 2 but with potentially greater loss of grade 1 agricultural land due to larger junction footprint at Black Cat. **Geology:** Similar to Option 2. **Contamination:** Similar to Option 2. **Groundwater:** Similar to Option 1.	**Soils:** Similar to Option 7. **Geology:** Similar to Option 2. **Contamination:** Similar to Option 2. **Groundwater:** Similar to Option 1.
Noise and vibration	**Noise Important areas:** Similar to Option 1. **Noise sensitive receptors**: Similar to Option 5. Property located at the southern side of Abbotsley would experience increases in traffic noise.	**Noise Important areas:** Similar to Option 2. **Noise sensitive receptors:** Similar to Option 2.	**Noise Important areas:** Similar to Option 2. **Noise sensitive receptors:** Similar to Option 2.
People and community	**Land use:** Similar to Option 5. **Property (residential / commercial):** Similar to Option 5. Impacts to the Abbotsley Golf Club and grounds would be avoided by the more southern alignment. **Transport:** Similar to Option 1. **Rights of way:** Similar to Option 1.	**Land use:** Similar to Option 2. **Property (residential / commercial):** Similar to Option 2 but with less impact to receptors in Croxton and Eltisley, including Croxton Registered Park and Garden. **Transport:** Similar to Option 2. **Rights of way:** Similar to Option 2.	**Land use:** Similar to Option 2. **Property (residential / commercial):** There would be localised impacts to properties and businesses at the Black Cat and Caxton Gibbet junctions. **Transport:** Similar to Option 2. **Rights of way:** Similar to Option 2.

Options considered	Option 6 – Southern offline alignment to the south of Abbotsley	Option 7 – Junction improvements and online widening at Wyboston	Option 8 – Junction improvements
Option description	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.	Dualling between Wyboston and the River Great Ouse crossing and a new roundabout at Wyboston. Minor junction improvements at Barford Road and Cambridge Road. Grade separation at Black Cat and signalised junction at Caxton Gibbet.	Grade separation of both Black Cat and Caxton Gibbet.
Topic	Qualitative assessment	Qualitative assessment	Qualitative assessment
Water environment	Similar to Option 1 except that the option would require the extension of existing structures on 3 smaller watercourses, the crossing of 4 new watercourses and the potential requirement for realignments. Would also require construction in an additional area of flood zone 2.	Similar to Option 1 except that the option would require the extension of existing structures on 4 smaller watercourses, the crossing of 1 main river and the potential requirement for realignments.	Similar to Option 1 except that the option would require the extension of existing structures on 4 smaller watercourses, one extensions on main rivers and the potential requirement for realignments.
Design considerations			
Waste and materials	Similar to Option 1.	Similar to Option 3.	This option would require significantly less material and generate less waste than Option 1. The impacts can be mitigated by undertaking a materials management strategy from the start of the design process.
Climate change	Similar to Option 1.	Similar to Option 2.	Similar to Option 2.
Resilience to environmental risks, accidents and disaster	Similar to Option 1.	Similar to Option 1.	This option has less resilience to risks than the other options, as it provides no increase in lanes, and therefore the A428 would still be susceptible to closures as a result of accidents or other risks.
Crosscutting topics			
Health	Similar to Option 1.	Similar to Option 2.	Similar to Option 2.
Ecosystems services	Similar to Option 5.	Similar to Option 2.	Similar to Option 2.
Socioeconomics	Similar to Option 5.	Similar to Option 2.	Similar to Option 2.
Other considerations			
Potential planning route	This option would require a Development Consent Order.	This option is likely to require a Development Consent Order.	This option is likely to require a Development Consent Order.
Is this likely to require a statutory EIA?	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.	This option would be screened at the scoping stage to confirm whether it is likely to have the potential for significant environmental effects and require an Environmental Statement.
Is this likely to require an Appropriate Assessment?	Initial screening has indicated that this option could require an Appropriate Assessment, as it is within10km from the SAC and has the potential for habitat severance.	Initial screening has indicated that this option is unlikely to require an Appropriate Assessment.	Initial screening has indicated that this option is unlikely to require an Appropriate Assessment.
What other environmental consents and approvals may be required?	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, The proposed works also lie adjacent to a Conservation Area and are likely to require consent.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW,
Overall summary			
Does this meet the environmental KPIs	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.	This option has limited opportunities to contribute to wider KPI targets.	This option has limited opportunities to contribute to wider KPI targets.
Does this provide opportunities under the RIS designated funds?	This option has the potential to access designated funds to improve NIAs and reduce historic severance.	This option has limited potential to access designated funds due to the scale of the works.	This option has limited potential to access designated funds due to the scale of the works.
Summary of the environmental assessment	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 3km to the south of the route. This option could require an Appropriate Assessment due to the proximity to the Eversden and Wimpole Woods SAC, which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than Option 1 and Option 5, as it would require more mitigation to offset potentially significant effects. Compared to Option 1, it would also create another major road within the landscape and create additional barriers to protected species migration within the study area.	This option is similar to Option 2. However, this would have limited benefit to the NIA and could make noise levels worse in this area. It would also extend the footprint of the road into the nature reserve and conservation area, with impacts on the setting, recreation benefits and ecosystem value of this area. If this was undertaken as a phased part of a longer term scheme, it could lead to significant effects to Croxton Park if it was taken forward as part of an online widening option (see Option 4).	The junction improvements are likely to have lower risk of significant effects than the widening options. However, further design iterations would be required at Stage 2 to design out potential significant effects associated with landscape of the structures.

Appendix G. Assessment of the Implications on European Sites

AS14 (RIS) Schemes

A428 Black Cat to Caxton Gibbet

Assessment of the Implications on European Sites

December 2016

Contents

1. Introduction

An Assessment of the Implications on European Sites (AIES) has been conducted as part of the Stage 1 environmental assessment for the A428 Black Cat to Caxton Gibbet Scheme. The AIES is included in Appendix A, and has been undertaken in line with guidance from the Design Manual for Roads and Bridges, Volume 11, Section 4, HD44/09[1], and Interim Advice Note 141/11[2]. Data for European sites has been obtained from the Joint Nature Conservation Committee data sheets (for the respective sites). Information on European site objectives has been obtained from Natural England[3].

The AIES is based on Option 1, which represents a full offline dualling of the A428 between the A1/A421 Black Cat junction and the A428/A1198 Caxton Gibbet junction, a distance of approximately 16.5km. The option includes grade separation of Black Cat junction, Cambridge Road junction and Caxton Gibbet junction. This option was chosen for the AIES as it was deemed to be the most representative of all the options being considered at Stage 1.

At Stage 1 the design drawings are indicative and assumptions are made on the option alignment. Traffic modelling, detailed scheme design, and construction information is not available at this stage.

2. Next steps

Consultation with Natural England will be undertaken at Stage 2 to discuss the conclusions of this document. The AIES will be reviewed and updated at Stage 2, taking into consideration new or updated design information as it becomes available.

[1] Highways Agency. (2009). Design Manual for Roads and Bridges, Volume 11, Section 4, HD44/09, Assessment of Implications (of highways and/or roads projects) on European Sites (including Appropriate Assessment)
[2] Highways Agency. (2011). Interim Advice Note 141/11, Assessment of Implications (of Highways and/or Roads Projects) on European Sites (including Appropriate Assessment) and the Planning Act 2008
[3] Natural England. Conservation Objectives for European Sites. http://publications.naturalengland.org.uk/category/6490068894089216. Accessed November 2016.

Appendix A. Assessment of the Implications on European Sites

Project Name	A428 Option 1 (Stage 1 Assessment)	
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**	
Date: Description of Project/ Plan	**Author (Name/Organisation):**	**Verified (Name/Organisation):**
November 2016	Dave Jones, Technical Director – Ecology, Jacobs	Phil Rogers, Divisional Director, Jacobs
Description of Project/Plan		
Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on the European Site by virtue of:		
Size and scale (road type and probable traffic volume)	Option 1 represents a full offline dualling of the A428 between the A1/A421 Black Cat junction and the A428/A1198 Caxton Gibbet junction, a distance of approximately 16.5km. The option includes grade separation of Black Cat junction, Cambridge Road junction and Caxton Gibbet junction. At Stage 1, the design drawings are indicative and assumptions are made on alignment. Traffic modelling, detailed scheme design, and construction information, are not available at this stage and will require the AIES to be reviewed at future stages. A search for all European sites within 2km of the scheme in line with *DMRB HD44/09* guidance was undertaken to inform this AIES. 2km is considered a precautionary distance for consideration of all European sites as the effects of habitat loss, fragmentation, inappropriate management, air pollution and introduction of invasive species are only likely to occur within less than 1km of the scheme and could therefore not directly affect the sites themselves. However, changes to water levels and water quality could affect sites in hydrological connectivity with the scheme and so, in addition, searches were undertaken for European sites where the scheme crosses/is adjacent to, upstream of, or downstream of, watercourses designated in part or wholly as a European site following guidance in *DMRB HD 44/09*. Sites which are designated for mobile species that travel beyond the boundaries of the designated site, such as bats and birds, could be affected by the scheme if designated species travel within the zone of influence of the impacts of the scheme. A further search was carried out therefore for European sites where bats are a primary qualifying feature within 30km of the scheme in line with *DMRB HD44/09*, which is based on studies of movements of bats between summer and winter roosts. Additionally a search was carried out of European sites where wintering birds are qualifying features within 20km of the scheme. Wintering birds can range several kilometres from the site boundaries but it is considered that past 5km the size of the area potentially available to them is so large that it is highly unlikely that habitat further afield would be critical to the integrity of the site and the population of the species. However, for the purpose of this initial AIES, the search area was extended from 5km to 20km to account for the low risk that some SPA/Ramsar qualifying features may have wintering foraging ranges that extend even further from the respective European site.	

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
	Based on the current scheme assumptions, there are three European sites within the search areas: Eversden and Wimpole Woods SAC; Portholme SAC; and Ouse Washes SAC/SPA/Ramsar.
Land take	At Stage 1 there are no detailed design drawings showing land take, which would include environmental mitigation areas, and the construction works areas are also unknown. The proposed Option 1 route alignment is located 8.2km from Eversden and Wimpole Woods SAC, 9.9km from Portholme SAC, and 16.4km from the Ouse Washes SAC / SPA / Ramsar. Given the distances involved, there would be no land take within Eversden and Wimpole Woods SAC, Portholme SAC, or Ouse Washes SAC / SPA / Ramsar. No land take of habitat which adjoins or acts as a buffer to the habitats within these European sites is likely to be affected. Barbastelle bat *Barbastella barbastellus*, the qualifying feature of the Eversden and Wimpole Woods SAC, may make use of the habitats affected by the proposed Option 1 route alignment, as this species can range up to 20km from maternity colonies using established flightlines to key foraging areas. However, there would be no landtake within the area identified by the *South Cambridgeshire District Council Local Development Framework Supplementary Planning Document* as being of importance for barbastelle bats associated with Eversden and Wimpole Woods SAC. There is potential for the arable habitats affected by the proposed Option 1 route alignment to be utilised by mobile qualifying species of the Ouse Washes SPA / Ramsar, specifically foraging wintering Bewick's swan *Cygnus columbianus bewickii, whooper swan Cygnus cygnus and lapwing Vanellus vanellus.*
Distance from the European Site or key features of the site (from edge of the project assessment corridor)	Eversden and Wimpole Woods SAC is 8.2km to the south-east of the proposed Option 1 route alignment when measured from Caxton Gibbet (the closest point to the current alignment). Portholme SAC is approximately 9.9km north of the proposed Option 1 route alignment when measured from Croxton. The Ouse Washes SAC/SPA/Ramsar is approximately 16.4km north-east of the proposed Option 1 route alignment. The European site is also approximately 42km downstream of the location where the proposed route alignment would cross the River Great Ouse.
Resource requirements (from the European Site or from areas in proximity to the site, where of relevance to consideration of impacts)	The scheme would require no resources from any European site or land/water in proximity to any European site.

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
Emissions (e.g. polluted surface water runoff – both soluble and insoluble pollutants, atmospheric pollution)	Air quality modelling has not yet been undertaken. However, guidance provided in Volume 11, Section 3, Part I *Air Quality*, of the *Design Manual for Roads and Bridges*, recommends that air quality of assessments of impacts to European sites need only be undertaken for designated sites within 200m of a proposed road scheme. As the closest European site to the proposed Option 1 route alignment is 8.2km away, effects as a result of air emissions would not arise. The proposed Option 1 route alignment would cross the River Great Ouse. This watercourse has hydrological connectivity with the Ouse Washes SAC/SPA/Ramsar and supports the site's qualifying feature, spined loach *Cobitis taenia*. However, as the designated site is located approximately 42km downstream of the proposed crossing point, and as construction and operation would adhere to standard best practice pollution prevention guidelines and approved drainage designs, there would be no significant change to the water environment that could cause likely significant effects to the qualifying feature or the Ouse Washes SAC/SPA/Ramsar.
Excavation requirements (e.g. impacts of local hydrogeology)	Details relating to excavations are not yet available. However, no excavation would be required within or adjacent to any European site. As the closest European site to the proposed Option 1 route alignment is 8.2km away, effects as a result of excavations would not arise.
Transportation requirements	Details relating to transportation requirements are not yet available. However, it is assumed that construction vehicles would access the construction site areas via the main road network at points on the existing A428, A421 and A1. However, as none of the European sites are located within 200m of the proposed Option 1 route alignment, impacts associated with air quality change arising from transportation requirements would not arise.
Duration of construction, operation etc.	If the proposed route option is taken forward and consented, the anticipated start of construction would be in 2020. Construction is likely to be phased over successive RIS periods. The exact details of the phasing and the scheme completion date have not yet been determined.
Other	N/A.
Description of avoidance and/or mitigation measures *Describe any assumed (plainly established and uncontroversial) mitigation measures, including information on:*	
Nature of proposals	A Construction Environment Management Plan (CEMP) would be prepared to prescribe appropriate working methodologies and to implement measures to avoid or reduce any adverse impacts to levels which are not significant. The CEMP would require adherence to best practice guidelines with respect to pollution prevention control measures. It is anticipated that the proposed new bridge crossing the River Great Ouse would be a clear span structure and would not directly affect the watercourse or sensitive habitats or species associated with it. It is anticipated that appropriate buffer zones would be implemented to avoid or reduce the effects of disturbance to the River Great Ouse and its associated habitats and species.

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
	It is anticipated that the Option 1 design would incorporate significant habitat enhancements in the form of new woodland, scrub, hedgerow and grassland creation. The landscape design would take account of the presence of any European site qualifying features, such as barbastelle.
Location	Avoidance or alleviation measures contained within the CEMP would be implemented throughout the scheme with specific measures being implemented where required. Mitigation with respect to the Great River Ouse would be restricted to construction and operational areas within the vicinity of this watercourse, or where hydrological connectivity exists. Habitat enhancements would be implemented along the length of Option 1 and would likely also include off-line areas.
Evidence for effectiveness	All measures within the CEMP would be based on construction best practice and on standard measures to avoid or reduce environmental impacts. These would draw on the professional experience of Highways England, the scheme designers, and the contractors to provide the most effective practicable measures available at the time of construction. Clear span bridges are a proven design for protecting riparian habitats and species, and for avoiding or minimising the potential effects of fragmentation. The creation of new habitat is a standard component of infrastructure projects and is routinely used to mitigate or compensate for impacts to valuable or sensitive habitats.
Mechanism for delivery (legal conditions, restrictions or other legally enforceable obligations)	All measures set out in the scheme's Environmental Statement would be captured within the CEMP. Following measures within the CEMP would be a requirement of Highways England during construction of the scheme. Implementation of the CEMP would be monitored by Highways England, the contractor and the Environmental/Ecological Clerk of Works appointed to the scheme. Parts of the scheme would require consents from appropriate statutory agencies; adherence to particular working methods and practices would be a condition of such consents. The scheme design, including details of bridges and landscape creation, would be detailed as part of the scheme's Development Consent Order application and would be secured through appropriate planning conditions.
Characteristics of European Site(s)	
A brief description of the European Site should be produced, including information on:	
Name of European Site and its EU code	Eversden and Wimpole Woods SAC UK0030331 Portholme SAC UK0030054 Ouse Washes SAC UK0013011 Ouse Washes SPA UK9008041

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
Location and distance of the European Site from the proposed works	Eversden and Wimpole Woods SAC is 8.2km to the south-east of the proposed Option 1 route alignment when measured from Caxton Gibbet (closest point to the current alignment). Portholme SAC is approximately 9.9km north of the proposed Option 1 route alignment when measured from Croxton. The Ouse Washes SAC/SPA/Ramsar is approximately 16.4km north-east of the proposed Option 1 route alignment. The European site is also approximately 42km downstream of the location where the proposed route alignment would cross the River Great Ouse.
European Site size	Eversden and Wimpole Woods SAC: 66.22ha Portholme SAC: 91.56ha Ouse Washes SAC: 332.61ha Ouse Washes SPA/Ramsar: 2447.26ha
Key features of the European Site including the primary reasons for selection and any other qualifying interests	**Eversden and Wimpole Woods SAC** The SAC supports a maternity colony of barbastelle, with most roosts within tree cavities. The bats also use the SAC as a foraging area although some bats forage beyond the boundary of the SAC. **Portholme SAC** This site supports lowland hay meadows. It is the largest surviving traditionally-managed meadow in the UK, with an area of 104ha of alluvial flood meadow (7% of the total UK resource). **Ouse Washes SAC** The Ouse Washes SAC represent spined loach populations within the River Ouse catchment. **Ouse Washes SPA** The Ouse Washes SPA supports populations of European importance of the following: • ruff *Philomachus pugnax (*breeding*)* • spotted crake *Porzana porzana (*breeding*)* • black-tailed godwit *Limosa limosa limosa (*breeding*)* • gadwall *Anas strepera (*breeding*)* • shoveler *Anas clypeata (*breeding*)* • Bewick's swan (wintering) • hen harrier *Circus cyaneus* (wintering) • ruff (wintering) • whooper swan (wintering) • black-tailed godwit (wintering) • *gadwall* (wintering) • pintail *Anas acuta* (wintering) • pochard *Aythya ferina* (wintering) • shoveler *Anas clypeata* (wintering) • wigeon *Anas penelope* (wintering)

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
	The SPA also regularly supports at least 20,000 waterfowl and over winter the area regularly supports 64,392 individual waterfowl (5 year peak mean 1991/2 - 1995/6) including: lapwing, coot *Fulica atra*, tufted duck *Aythya fuligula*, mallard *Anas platyrhynchos*, teal *Anas crecca*, cormorant *Phalacrocorax carbo*, black-tailed godwit, pochard, shoveler, pintail, gadwall, wigeon, ruff, whooper swan, and Bewick's swan. **Ouse Washes Ramsar** The site is one of the most extensive areas of seasonally-flooding washland of its type in Britain. The site supports several nationally scarce plants, including small water pepper *Polygonum minus*, whorled water-milfoil *Myriophyllum verticillatum*, greater water parsnip *Sium latifolium*, river waterdropwort *Oenanthe fluviatilis*, fringed water-lily *Nymphoides peltata*, long-stalked pondweed *Potamogeton praelongus*, hair-like pondweed *Potamogeton trichoides*, grass-wrack pondweed *Potamogeton compressus*, tasteless water-pepper *Polygonum mite* and marsh dock *Rumex palustris*. Invertebrate records indicate that the site holds relict fenland fauna, including the British Red Data Book species large darter dragonfly *Libellula fulva* and the rifle beetle *Oulimnius major*. The site also supports a diverse assemblage of nationally rare breeding waterfowl associated with seasonally-flooding wet grassland. The site supports internationally important assemblages of waterfowl during the winter (species as per the SPA).
Vulnerability of the European Site – any information available from the standard data forms on potential effect pathways	All European site vulnerabilities are cited from the respective Natura 2000 standard data form and Conservation Objectives. Eversden and Wimpole Woods SAC is vulnerable to: • forest and plantation management and use • air pollution or air-borne pollutants • changes in biotic conditions Portholme SAC is vulnerable to: • pollution to groundwater (point sources and diffuse sources) • human induced changes to hydraulic conditions Ouse Washes SAC is vulnerable to: • pollution to groundwater (point sources and diffuse sources) • human induced changes to hydraulic conditions The standard data form does not provide details of vulnerabilities of the Ouse Washes SPA/Ramsar. However, it is considered that the site would be sensitive to changes to water quality and quantity and changes to visual or acoustic stimuli resulting in disturbance to breeding or wintering birds.

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
European Site conservation objectives – where these are readily available	**Eversden and Wimpole Woods SAC** Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the favourable conservation status of its qualifying features, by maintaining or restoring: • the extent and distribution of qualifying natural habitats and habitats of qualifying species • the structure and function of the habitats of the qualifying species • the supporting processes on which the habitats of the qualifying species rely • the populations of the qualifying species • the distribution of qualifying species within the site **Portholme SAC** Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the favourable conservation status of its qualifying features, by maintaining or restoring: • the extent and distribution of qualifying natural habitats • the structure and function (including typical species) of qualifying natural habitats • the supporting processes on which qualifying natural habitats rely **Ouse Washes SPA** Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring: • the extent and distribution of the habitats of the qualifying features • the structure and function of the habitats of the qualifying features • the supporting processes on which the habitats of the qualifying features rely • the population of each of the qualifying features • the distribution of the qualifying features within the site **Ouse Washes SAC** Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the favourable conservation status of its qualifying features, by maintaining or restoring: • the extent and distribution of the habitats of the qualifying features • the structure and function of the habitats of the qualifying features • the supporting processes on which the habitats of the qualifying features rely • the population of each of the qualifying features • the distribution of the qualifying features within the site The Ouse Washes SAC Supplementary Advice Note also provides details of specific targets to ensure the conservation objectives are achieved.

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar
Assessment Criteria	
Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the European Site.	
Design and construction details are not currently available. However, reasonable assumptions have been made relating to the likely construction and operational activities and conditions. The screening assessment has concentrated on those issues upon which the integrity of habitats within the European sites or on which their designated species are dependent may be affected, as detailed below: • habitat loss, modification and fragmentation • change in water quantity and quality • change in visual or acoustic stimuli • change in air quality • inappropriate management • introduction of invasive species	
Initial Assessment	
The key characteristics of the site and the details of the European Site should be considered in identifying potential impacts. Describe any likely changes to the site arising as a result of:	
Reduction of habitat area	**Portholme SAC** As there is 9.9km separating the proposed Option 1 route alignment from Portholme SAC, there would be no habitat loss within the SAC. **Eversden and Wimpole Woods SAC** As there is 8.2km separating the proposed Option 1 route alignment from Eversden and Wimpole Woods SAC, there would be no habitat loss within the SAC. Construction of Option 1 could potentially remove habitat used by foraging or commuting barbastelle associated with Eversden and Wimpole Woods SAC. The *South Cambridgeshire District Council Local Development Framework Supplementary Planning Document* has identified areas outside the SAC that are of importance for barbastelle bats associated with the European site. The proposed Option 1 route alignment is located approximately 6km from this area and so it is considered that core barbastelle habitats would not be affected by Option 1. **Ouse Washes SAC/SPA/Ramsar** Due to the distances involved, there would be no habitat loss within Ouse Washes SAC/SPA/Ramsar. Of the numerous qualifying species of Ouse Washes SPA/Ramsar, the arable habitats likely to be affected by the proposed Option 1 route alignment are suitable for foraging wintering Bewick's swan, whooper swan and lapwing, and could conceivably be used by individuals or assemblages with functional links to the European site. However, the landscape within the vicinity of Option 1 is dominated by arable land and construction and operation of the proposed Option 1 route alignment would affect only a small proportion of this habitat when considered in context of the total resource available. As such, it is considered unlikely that Option 1 would result in a reduction in habitat area for mobile qualifying species outside the SPA/Ramsar.

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
Disturbance to key species	**Portholme SAC** Portholme SAC is not vulnerable to disturbance caused by changes in visual or acoustic stimuli and so an assessment of disturbance effects is not applicable **Eversden and Wimpole Woods SAC** As there is 8.2km separating the proposed Option 1 route alignment from Eversden and Wimpole Woods SAC, disturbance to barbastelle within the designated site is not considered likely. Eversden and Wimpole Woods SAC is designated for barbastelle bat which can disperse up to 20km from maternity colonies and so could potentially be disturbed by the proposed Option 1 route alignment if flightlines or foraging habitat outside the SAC were to be affected. The *South Cambridgeshire District Council Local Development Framework Supplementary Planning Document* has identified areas outside the SAC that are of importance for barbastelle bats associated with the European site. The proposed Option 1 route alignment is located approximately 6km from this area and so it is considered that core barbastelle habitats would not be affected by Option 1. Although bat surveys have not yet been undertaken and barbastelle use of the area likely to be affected by construction and operation of Option 1 is currently unknown, there is considered to be a low risk of likely significant effects to the SAC due to the following: the distance between Option 1 and the SAC (8.2km to the SAC and 6km to the area of importance beyond the SAC boundary); the absence of well-established potential commuting habitat (e.g. river corridors, unbroken woodland, tree belts or mature hedgerows) linking the SAC to Option 1; the presence of the existing A428 between Option 1 and the SAC and the possible influence that this may have as a barrier to regular barbastelle commuting activity from the SAC into the area potentially affected by Option 1; and, the generally unsuitable quality of the habitat for barbastelle within the likely footprint of Option 1 (i.e. predominantly arable) making it unlikely to be used by important assemblages of bats with functional links to the SAC. Given the above, there is a low risk of likely significant effects to Eversden and Wimpole Woods SAC. However, a more detailed assessment would be required once the design details are known and on completion of bat surveys that would be required to inform the Habitats Regulations Assessment and Environmental Impact Assessment for the final scheme. **Ouse Washes SAC** As there is 16.4km separating the proposed Option 1 route alignment from Ouse Washes SAC, disturbance to spined loach within the designated site is not considered likely. Spined loach is distributed within the River Great Ouse and so there is potential for a population to be present at the location where Option 1 crosses this watercourse. It is assumed that the proposed new bridge crossing the River Great Ouse would be a clear span structure that could be constructed without directly affecting the watercourse. Changes to noise and visual stimuli arising from construction and operation are considered unlikely to significantly affect spined loach due to the implementation of standard mitigation measures to minimise the effects of disturbance (e.g. directional lighting; visual screens; buffer zones etc). Furthermore, given the likely small area of influence associated with the effects of disturbance and

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
	the distance to the SAC, there is a low risk of disturbing populations of spined loach that have a functional link to the SAC. However, a more detailed assessment would be required once the design details are known and on completion of an aquatic habitat assessment and possible fish surveys that would be required to inform the Habitats Regulations Assessment and Environmental Impact Assessment for the final scheme. **Ouse Washes SPA/Ramsar** Of the numerous qualifying species of Ouse Washes SPA/Ramsar, the arable habitats likely to be affected by the proposed Option 1 route alignment are suitable for foraging wintering Bewick's swan, whooper swan and lapwing, and could conceivably be used by individuals or assemblages with functional links to the European site. The landscape within the vicinity of Option 1 is dominated by arable land and the localised disturbance associated with the construction and operation of the proposed Option 1 route alignment would affect only a small proportion of this habitat when considered in context of the total resource available. Furthermore, the qualifying species that could potentially be present within the zone of influence would have the capacity to move away from sources of disturbance into adjacent undisturbed habitat, if needed; such avoidance behaviour is not considered likely to result in significant energetic burden (and thus an adverse effect to the bird's physical condition) given the propensity of these species to migrate or forage across vast distances. As such, there is a low risk of disturbance to qualifying species that may be present and that may have functional links to the SPA/Ramsar resulting in likely significant effects. However, a more detailed assessment would be required once the design details are known and on completion of a more detailed assessment that takes into account the average foraging ranges of wintering qualifying species, their foraging habitat preferences, and potentially the results of wintering bird surveys within the zone of influence of Option 1.
Habitat or species fragmentation	There would be no habitat fragmentation within any European site as a result of the scheme. Habitat used by barbastelle from Eversden and Wimpole Woods SAC could conceivably be fragmented if bats with functional links to the SAC make use of areas within the zone of influence of the proposed Option 1 route alignment. Although bat surveys have not yet been undertaken and barbastelle use of the area likely to be affected by construction and operation of Option 1 is currently unknown, there is considered to be a low risk of likely significant effects to the SAC due to habitat fragmentation because of: the distance between Option 1 and the SAC (8.2km to the SAC and 6km to the area of importance beyond the SAC boundary); the absence of well-established potential commuting habitat (e.g. river corridors, unbroken woodland, tree belts or mature hedgerows) linking the SAC to Option 1; the presence of the existing A428 between Option 1 and the SAC and the possible influence that this may have as a barrier to regular barbastelle commuting activity from the SAC into the area potentially affected by Option 1; and, the generally unsuitable quality of the habitat for barbastelle within the likely footprint of Option 1 (i.e. predominantly arable) making it unlikely to be used by important assemblages of bats with functional links to the SAC. Habitat used by foraging wintering Bewick's swan, whooper swan or lapwing could conceivably be fragmented if birds with functional links to Ouse Washes SPA/Ramsar make use of areas within the zone of influence of the proposed Option 1 route alignment. Although the use of the affected habitat by these species

Project Name	A428 Option 1 (Stage 1 Assessment)
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
	is not yet known, it is considered unlikely that important assemblages of these species would be present and that any effects of fragmentation would be minimal given the availability of suitable alternative foraging habitat within the local landscape and the mobility of the species concerned.
Reduction in species density	Due to the distance involved and the nature of the qualifying interest features, there would be no reduction in species density within Porthole SAC as a result of the proposed Option 1 route alignment. For the reasons described in the rows above, it is unlikely that barbastelle or the qualifying features of Ouse Washes SAC/SPA/Ramsar would be affected as a result of the proposed Option 1 route alignment. However, a more detailed assessment would be required once the design details are known and on completion of relevant field and desk studies required to inform the Habitats Regulations Assessment and Environmental Impact Assessment for the final design.
Changes in key indicators of conservation value (water quality etc.)	An assessment of changes to key indicators of conservation value can only be undertaken when the final design is known. However, due to the distances between the European sites and Option 1, and the implementation of standard best practice mitigation (e.g. clear span bridges over watercourses; highways standard drainage designs; pollution prevention control measures; buffer zones; visual screens; directional lighting etc.), it is expected that there would be no adverse changes in key indicators of conservation value.
Climate change	Climate change effects on the three designated sites are unknown but the design of the proposed Option 1 route alignment is expected to take account of climate change and so no effects are predicted.
Describe any likely impacts on the European Site as a whole in terms of:	
Interference with the key relationships that define the structure of the site	No Likely Significant Effects anticipated at this design stage.
Interference with key relationships that define the function of the site	No Likely Significant Effects anticipated at this design stage.
Indicate the significance as a result of the identification of impacts set out above in terms of:	
Reduction of habitat area	No Likely Significant Effects anticipated at this design stage.
Disturbance to key species	No Likely Significant Effects anticipated at this design stage.
Habitat or species fragmentation	No Likely Significant Effects anticipated at this design stage.
Loss	No Likely Significant Effects anticipated at this design stage.

Project Name	**A428 Option 1 (Stage 1 Assessment)**
Natura 2000 Site under Consideration	**Eversden and Wimpole Woods Special Area of Conservation (SAC), Portholme SAC, Ouse Washes SAC, Special Protection Area (SPA) and Ramsar**
Fragmentation	No Likely Significant Effects anticipated at this design stage.
Disruption	No Likely Significant Effects anticipated at this design stage.
Disturbance	No Likely Significant Effects anticipated at this design stage.
Change to key elements of the site (e.g. water quality, hydrological regime etc.)	No Likely Significant Effects anticipated at this design stage.
Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	
At this stage, none of the anticipated elements of the proposed Option 1 route alignment, or combination of elements, are expected to lead to a likely significant effect on any European site. However, a more detailed assessment would be required once the design details are known and on completion of relevant field and desk studies required to inform the Habitats Regulations Assessment and Environmental Impact Assessment for the final design.	
Outcome of screening stage (delete as appropriate)	No Likely Significant Effects anticipated at this design stage.
Are the appropriate statutory environmental bodies in agreement with this conclusion (delete as appropriate and attach relevant correspondence)	Consultation will be undertaken at Stage 2 to discuss the conclusions of this document.

Appendix J - Stage 2 Environmental Assessment Report (June 2017)

AS14 (RIS) Schemes

A428 Black Cat to Caxton Gibbet

Stage 2 Environmental Assessment Report

June 2017

Contents

Executive Summary

Introduction

Highways England is the company charged with driving forward our motorways and major A roads (the strategic road network – SRN). This includes modernising and maintaining the highways, as well as running the network and keeping traffic moving. The Roads Investment Strategy (RIS) sets out the funding for major road schemes and includes funding to improve the A428 to the south of St Neots, in Cambridgeshire.

This is the Stage 2 Environmental Assessment Report (EAR) for the A428 Black Cat to Caxton Gibbet Scheme (hereafter referred to as the Proposed Scheme). It has been produced to support the Technical Appraisal Report (TAR) and the Scheme Assessment Report (SAR) in the scheme assessment process. The EAR identifies the key environmental opportunities and constraints that would need to be considered in taking forward the Proposed Scheme, it summarises the baseline data gathered from a desk top review, and identifies the potential environmental risks that could be encountered. It should be read alongside the Stage 2 Scoping Report, which assesses the proposed options in terms of whether they are likely to have significant environmental effects and the scope of the assessment.

The A428 section between the A1 at Wyboston and the A1198 at Caxton Gibbet is the sole remaining single carriageway section between the M1 at Milton Keynes and the M11 to the east. The existing road suffers from congestion, particularly around the Black Cat Junction, but also at the Wyboston, Barford Road, Cambridge Road (St Neots) and Caxton Gibbet junctions. The aim of the Proposed Scheme is to address strategic issues along the A428 corridor between Black Cat and Caxton Gibbet, and will contribute to the Highways England strategic outcomes including:

- Supporting economic growth
- A safe and serviceable network
- A more free flowing network
- An improved environment
- An accessible and integrated network

The Proposed Scheme is looking at options to improve the A428 between the A1/ A428 Black Cat junction and the Caxton Gibbet junction with the A1198.

Baseline environment

The existing A428 passes through a mainly rural area to the south of St Neots. This is characterised by agricultural fields and small areas of woodland. The A1 and East Coast Main Line lie to the west of the study area and the villages of Croxton and Eltisley lie just to the south of the existing road. There are a number of smaller settlements and individual business and residential properties which also front onto the road.

A 1km wide corridor study area was used around the existing A428 in general for the baseline review. This was widened to include a buffer around all options. Data collection has included obtaining the historic environment record and data from the local ecological records centres. An Extended Phase 1 habitat survey has also been completed. Key environmental designations and features are summarised in table A1.

Stage 1 and 2 options appraisal

Stage 0 identified a long list of 48 options that would meet the overall objective of improving access along the A428 between Black Cat and Caxton Gibbet. These fell into categories including lane widening, junction improvements, offline alignment and public transport improvements. The Options Assessment Report identified options that warranted further considerations in Stage 1. Option C1 / C2 (full offline dualling between Black Cat and Caxton Gibbet) was considered to be the best performing option against the scheme objectives at Stage 0.

Table A.1: Key environmental designations and features

Topic	Sensitive designations and features within the study area
Air quality	• Nearest air quality management area is within St Neots town centre. • Residential property along the existing A428 carriageway and A1/A428 junction, particularly at Eynesbury Manor (south St Neots), Croxton and Eltisley.
Cultural heritage	• High value assets within the 1km buffer include 11 scheduled monuments, 7 grade II* and one registered park and garden (Croxton Park). • Medium value assets within300m of the A428 include 41 grade II listed buildings, four conservation areas, two non-designated historic buildings and three archaeological areas.
Landscape	• Away from the A1 corridor and St Neots, it is a quiet rural landscape of good quality with, a coherent, unspoiled, homogenous character. Significant features include woodlands, mature hedgerows and small-scale stream valleys with attractive open views. This area includes frequent historic landscape features and is of high sensitivity to intrusive development and changes to the landform. The area between Black Cat and Potton Road is sensitive to intrusive development and changes to landform due to the visual open character. • There is significant woodland cover, including ancient woodland (e.g. Eltisley Wood and Sir John's Wood) and numerous non-designated small and medium-sized deciduous woodlands throughout the farmland to the east of the River Great Ouse, including woodlands on the National Forestry Inventory. Croxton Park is includes numerous mature trees and woodlands, many of which are covered by tree preservation orders, including along the existing A428. • Key visual receptors include scattered rural properties and farms with residential clusters at Croxton, Abbotsley, Eltisley and Caxton Gibbet. Users of the Ouse Valley Way national trail have views of the A1 between Tempsford and the southern edge of St Neots at Wyboston.
Biodiversity	• The closest statutory designated wildlife site is Elsworth Wood Site of Special Scientific Interest (SSSI), approximately 1.1km from the A428 close to the junction at Caxton Gibbet. Eversden and Wimpole Woods Special Area of Conservation (SAC) is designated for bats and is 8.5km from the A428. In addition four county wildlife sites (CWS) and one protect road verge are located within 1 km of the A428. Croxton Park CWS and River Great Ouse CWS are directly adjacent to the existing A428. • There is ancient woodland within 1km of the existing A428, as well as Biodiversity Action Plan priority habitats including deciduous woodland, parkland, hedgerows, and an area of floodplain grazing marsh. The landscape also has potential to support other notable habitats, such as species rich hedgerows, arable margins, and aquatic habitats (including River Great Ouse). • The landscape includes habitat suitable for bats, badgers, breeding and wintering birds, great crested newts, reptiles, otter, and water vole.
Geology and soils	• The area east of Black Cat is classified as a mineral safeguarding area and strategic mineral site. There is an existing quarry immediately adjacent to Black Cat. • Soils are mostly grade 2 (very good), with pockets of grade 1 (excellent) and grade 3 (good) at Wyboston. • The majority of the superficial deposits in the area are classified as a secondary (undifferentiated) aquifer. In the west of the study area, along the A1, deposits are classified as secondary A aquifers. • Potential contamination sources include general agricultural activities, authorised and historic landfills, fuel stations and highway services, tanks, sewage works, a railway line and associated made ground and Little Barford Power Station.
Noise and vibration	• Existing noise important areas are located 0.3km north of Black Cat junction on the Great North Road (A1), and to the west of Cambourne on the existing A428. • There are residential properties along the A1 and to the south of St Neots along the A428.
People and communities	• There are community and private assets within St Neots, Croxton, Eltisley, Wyboston, and Abbotsley. • The East Coast Main Line runs north-south through the study area. • There are a number of public rights of way, including national cycle route 12 and the Ouse Valley Way regional trail.
Road drainage and the water environment	• The existing A428 and A1 cross two main rivers, the River Great Ouse and Hen Brook, as well as a number of their associated tributaries. Their floodplains are classed as predominantly flood zone 3. • There are five Water Framework Directive water bodies including the Ouse (Roxton to Earith), Stone Brook, West Brook, Begwary Brook and Abbotsley and Hen. These are classified as achieving moderate potential, except for the Begwary Brook which is currently classified as achieving good potential. • There are 11 surface water abstraction licenses, which are clustered around Black Cat and Wyboston.

Three options were taken forward from Stage 1 into Stage 2 and were presented at the non-statutory engagement events in March and April 2017:

- Option 1 (Orange): full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet junctions.
- Option 5 (Purple): full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.
- Option 6 (Pink): full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.

These options were considered within the Stage 1 Options Appraisal Matrix, which has assessed the environmental impacts of each option against the different environmental topics. This has not been updated for Stage 2, as no further design changes have occurred to date.

The Stage 1 assessment concluded that Option 1 is environmentally preferred out of the full scheme options, as this reduces impacts to Croxton Park. It would also allow the existing A428 to be retained as a separate non-motorised user (NMU) route. Options 5 and 6 would have similar effects on the landscape as they would be located closer to the Greensand Ridgeline and to four SSSIs to the south. These options are likely to require more mitigation to offset potentially significant effects than Option 1, as they would create another major road within the landscape and create additional barriers to protected species migration.

In addition, three Black Cat options were presented at the non-statutory engagement events. These were:

- Option A: Dumbbell roundabouts near the existing Black Cat junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.
- Option B: Eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.
- Option C: One roundabout at existing Black Cat junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.

All Black Cat options have a similar environmental effect. Option B is considered to be the environmentally preferred option, as it is two tiers instead of three and is likely to have a lower landscape and visual effect. There is little to distinguish between Options A and C at this stage from an environmental point of view. All options are likely to benefit Wyboston, in terms of noise and air quality effects, assuming that the option is implemented as part of a full scheme rather than as a standalone junction option.

Recommendations

The Proposed Scheme, regardless of which option is selected, would involve the construction of a new expressway, and is likely to generate significant effects on the environment. For these reasons a statutory Environmental Impact Assessment (EIA) would be required.

The preferred option will be selected following the analysis of the non-statutory consultation in June 2017. The Scoping Report would then be updated to outline the preferred scheme and the proposed assessment methodology that would be employed to assess potential significant effects. The scope of the Proposed Scheme is likely to include further work which would include but not limited to surveys for protected species, a desk based assessment for cultural heritage and a landscape and visual impact assessment.

The scoping report would be issued to the Planning Inspectorate as part of the Development Consent Order process. It can also be used to provide background information to the Secretary of State as part of obtaining a scoping opinion outlining the topics to be covered within the Environmental Statement.

1. Introduction

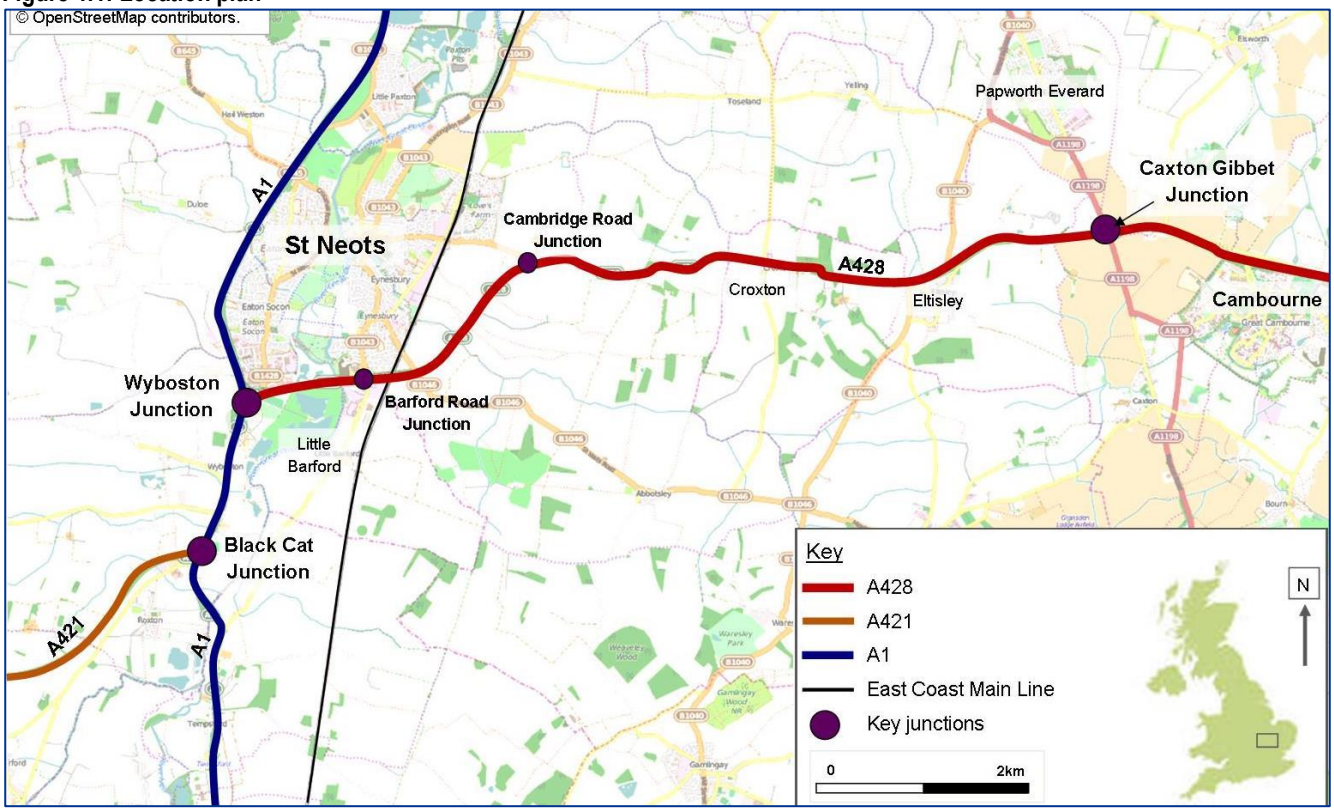
1.1 Overview of the project

Highways England is the company charged with driving forward our motorways and major A roads (the strategic road network – SRN). This includes modernising and maintaining the highways, as well as running the network and keeping traffic moving. The Roads Investment Strategy (RIS) sets out the funding for major road schemes across England. The RIS for the East of England Area outlines the case to dual the 'missing link' of the A428 and to grade separate Black Cat junction. Further details on RIS can be found within the A428 Options Appraisal Report.

The A428 Black Cat to Caxton Gibbet Scheme (hereafter referred to as the Proposed Scheme) includes the section between the A1 Black Cat junction (TL 159553) and the Caxton Gibbet junction with the A1198 (TL 296606), a distance of approximately 17km. This section of the A428 is located to the south of St Neots, in South Cambridgeshire, Huntingdonshire, and Bedfordshire. The A428 contributes to an east-west connection between Milton Keynes, Bedford and the M1 to the west and Cambridge and the M11 to the east (figure 1.1).

There is congestion at the existing junctions and the route also passes through two rural settlements. Congestion along the route and at its junctions is predicted to increase over time, leading to further road safety problems and less reliable journey times. The traffic issues along this route are likely to inhibit future growth in homes and jobs along the St Neots / Cambridge corridor.

Figure 1.1: Location plan



1.2 Legislative framework

1.2.1 Need for the scheme

The A428 is an important part of the SRN forming an important east-west corridor between the Midlands and East Anglia along with the A14 and A421. It is an important regional route linking Milton Keynes and Bedford to Cambridge. It also provides a diversion route for incidents on the A14, A1, M11 and M1. The A428 also provides a local benefit, through a bypass around St Neots and linking local villages including Caxton, Papworth and Eltisley. There are also direct accesses to the frontages of private dwellings off the existing A428.

The A428 section between the A1 at Wyboston and the A1198 at Caxton Gibbet is the sole remaining single carriageway section between the M1 at Milton Keynes and the M11 to the east. The existing road suffers from congestion particularly around the Black Cat junction but also at the Wyboston, Barford Road, Cambridge Road (St Neots) and Caxton Gibbet junctions. The route is considered to be one of the least reliable journey time sections for the whole of the country (Highways Agency, 2014). The lack of capacity along the route is likely to inhibit future growth in homes and jobs within the corridor. Further details can be found in the Options Appraisal Report (OAR) (Jacobs, 2016a).

A recent pinch point improvement scheme has been implemented at Black Cat junction. The aim of this scheme was to relieve existing problems but not address long term capacity issues along the route associated with proposed development.

Strategic plans including the Cambridgeshire Local Transport Plan (LTP3) identify major growth planned along the A428 corridor, including at West/ North West Cambridge, Cambourne, Bourne Airfield, and the St Neots Eastern Expansion (Cambridgeshire County Council, 2015). Significant traffic growth is predicted, with up to 100,000 new houses planned to be built in surrounding areas and over 70,000 jobs provided. A 40% increase in traffic flows on the A428 is forecast by 2039.

During the Stage 1 forums on the A428 scheme, stakeholders expressed concerns about the lack of resilience of the existing road. This is compounded by the River Great Ouse corridor, as the next nearest bridge over the river is through the centre of St Neots. The existing single lane carriageway is at risk of being closed during an accident, and the lack of alternative routes causes heavy congestion in the town centre, which is also an air quality management area (AQMA).

1.2.2 Aims and objectives

The aim of the Proposed Scheme is to address strategic issues along the A428 corridor between Black Cat and Caxton Gibbet. The scheme specific objectives are based on the overarching RIS objectives (table 1.1). There is also an opportunity to contribute to wider objectives in line with key performance indicators (KPI) and the RIS designated funds. Further details can be found in sections 1.2.3 and 1.2.4.

Table 1.1: Scheme specific objectives

Highways England Strategic Outcome	Scheme specific objective
Supporting economic growth	Scheme supports planned economic and housing growth in Cambridge and the surrounding sub-region.
	Scheme supports spatial and strategic transport policies including Local Plans for Bedford, Cambridge and the surrounding sub-region by reducing congestion related delay, improve journey time reliability and increase the overall transport capacity.
A safe and serviceable network	Scheme improves road user safety at the A421 / A1 Black Cat Junction and on the A428 corridor between Wyboston and Caxton.
	Scheme improves road worker safety.

Highways England Strategic Outcome	Scheme specific objective
A more free flowing network	Provide significant capacity improvements to the Black Cat Junction where the A1 currently meets the A421.
	To create an Expressway standard link between the A421 and the existing dual carriageway section of the A428 to Cambridge.
	Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather.
An improved environment	Improve the environmental impact of transport on communities along the existing A428 corridor between Wyboston and Caxton.
	Reduce the impact of new infrastructure on the natural and built environment.
A more accessible and integrated network	Scheme provides a safe alternative non-motorised user (NMU) route between communities and seeks to address severance.
	Improve safe and effective access for public transport users.
Customer satisfaction	Reduce traffic congestion delays and improve journey time reliability.
	Improve driver information.

1.2.3 Meeting the project objectives

The Proposed Scheme could help meet wider Highways England KPIs. There are two KPIs relevant to the environmental assessment. These are:

- Delivering better environmental outcomes:
  - Number of noise important areas mitigated
  - Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan (Highways England, 2015)
- Helping cyclists, walkers and other vulnerable users:
  - The number of new or upgraded crossings

In addition to these KPIs Highways England also use Performance Indicators (PI) to measure performance in key areas. PIs of relevance to the environmental and Proposed Scheme include:

- The number of flooding hotspots and culverts (high risk and very high risk) mitigated
- The number of outfalls and soakaways (high risk and very high) mitigated

1.2.4 Environmental opportunities

The Department for Transport (DfT) has also set aside designated funds to further improve the environment as part of its implementation plan. There are three funding streams relevant to the environment. These are summarised in table 1.2. These are all designed to deliver specific enhancements to the network and improved environmental outcomes. The opportunities must be part of a defined project, which is achievable within the RIS 1 period (1st April 2015 to 31st March 2020) and will provide a measurable net gain.

Table 1.2: Description of RIS designated funds

Title of fund	Description	Opportunities identified for A428
Environment Fund £300m	This is designed to tackle parts of the road network where road design has led to environmental problems. It also provides funding for Highways England to reduce its carbon emissions from transport, and adaptation to a changing climate.	There is an opportunity to reduce noise impacts at the noise important areas (NIA) at Black Cat, Wyboston and in the wider study area. We are proposing to work with Bedford Council and Cambridge County Council to reduce noise levels within the NIA as part of the scheme through the provision of noise barriers and resurfacing. There are opportunities to create additional areas of habitat in the study area, over and above the required scheme mitigation. The habitat creation would have to maximise habitat connectivity and / or contribute towards the National Pollinator Strategy to benefit from the funds. It would also require support from landowners. Examples could include creation of new habitats, such as woodland, hedgerow and grassland; supplementary planting of defunct and gappy hedgerows with a range of native species, to increase overall species diversity and improve landscape connectivity; sympathetic management of the existing Highways estate to enhance biodiversity value; create new wetland habitats including ponds, ditches and scrapes, where appropriate; and installation of underpasses to facilitate animal dispersal across existing or proposed highways infrastructure.
Cycling, safety and integration fund £250m	This is designed to improve connectivity between the strategic road network (SRN) and local networks and other forms of transport. This includes provision for the needs of cyclists and redressing community severance caused by the SRN.	Undertake cycling improvement schemes. Improve accessibility along the SRN including pedestrian crossings, bridges and access for all. Provide better links with local networks through provision of part and ride and links to stations.
Air quality fund £100m	This is designed to specifically target air quality improvements. Highways England will need to work with Local Authorities to identify how to address this issue.	No opportunities identified along the A428 as the nearest air quality management area (AQMA) is located approximately 2km away, in St Neots.

1.2.5 Plan, policy and programme review

National policy

In March 2012, the Department for Communities and Local Government (DCLG) published the National Planning Policy Framework (NPPF), which sets out the Government's economic, environmental and social planning policies (DCLG, 2012). The NPPF aims to reform the planning system and is underpinned by a presumption in favour of sustainable development. There is a focus on planning for prosperity, people and places, promoting increased levels of development and supporting infrastructure, whilst also protecting and enhancing the natural and historic environment. It is designed, however, to be interpreted and implemented locally, and delegates responsibility for achieving this vision to local planning authorities.

The National Networks National Policy Statement (NNNPS) was designated on 14 January 2015 (DfT, 2014). Sections 104 (2) and (9) of the Planning Act 2008 require applications to be decided in accordance with the relevant National Policy Statement. The NNNPS sets out principles by which applications or road and rail schemes should be assessed. Paragraph 4.3 states that:

'In considering any proposed development and in particular when weighing its adverse impacts against its benefits, the Examining Authority and the Secretary of State should take into account:

- *Its potential benefits including the facilitation of economic development, including job creation, housing and environmental improvement, and any long-term or wider benefits;*

- *Its potential adverse impacts, including any longer-term and cumulative adverse impacts, as well as any measure to avoid, reduce or compensate for any adverse impacts.'*

Local policy

Cambridgeshire County Council has delegated responsibility for local planning policy to the relevant district councils. Bedfordshire County Council ceased to exist in April 2009 and local planning policy is now the responsibility of the unitary councils. Table 1.3 details the current local planning policy documents relevant to the Proposed Scheme. Further details can be found in the planning review in Appendix A. Huntingdonshire District Council, Bedford Borough Council, and Central Bedfordshire Council are all in the process of producing new local plans, which will replace the policies set out in current documents.

Table 1.3: Local planning policy documents relevant to A428 scheme

Council	Planning policy document
Huntingdonshire District Council	Core Strategy (2009) Local Plan (1995) including Proposals Map Local Plan Alteration (2002) Huntingdon West Area Action Plan (2011)
South Cambridgeshire District Council	Core Strategy Development Plan Document (2007) Development Control Policies Development Plan Document (2007) Northstowe Area Action Plan (2007) Cambridge East Area Action Plan (2008) Cambridge Southern Fringe Area Action Plan (2008); North-West Cambridge Area Action Plan (2009) Site Specific Policies Development Plan Document (2010)
Bedford Borough Council	Saved Local Plan 2002 policies (2013) Bedford Borough Core Strategy and Rural Issues Plan (2008) The Bedford Town Centre Area Action Plan (2008) The Allocations & Designations Local Plan (2013)
Central Bedfordshire Council	Core Strategy and Development Management Policies Development Plan Document (2009) Adopted Site Allocations Development Plan Document (2011)

1.3 Demonstration of competent expertise

Highways England is the developer, acting on behalf of the DfT, implementing the Proposed Scheme in accordance with the Government commitments outlined within the RIS (DfT, 2015).

Jacobs is currently the designer and is a registered consultant holding the Institute of Environmental Management and Assessment (IEMA) Quality Mark. The Environmental Impact Assessment (EIA) has been produced by staff competent in their fields and holding appropriate qualifications and levels of professional membership.

1.4 Purpose of the Environmental Assessment Report

The Proposed Scheme is being progressed through the Highways England Project Control Framework (PCF). This is the Stage 2 Environmental Assessment Report (EAR) that has been prepared as part of a suite of documents to support the approval gateway at the end of Stage 2, prior to the Government making a Preferred Route Announcement (PRA). The aim of the Stage 2 EAR is to build upon the Stage 1 EAR and to describe the environmental baseline, and potential impacts and mitigation associated with the options under consideration. The structure of the report is set out in table 1.4. The EAR includes the topics covered within the Design Manual for Roads and Bridges (DMRB) guidance and Interim Advice Note (IAN) 125/15 (Highways Agency, 1993a; 2015).

Table 1.4: Structure of the EAR

Section	Contents
1. Introduction	This provides an overview of the scheme, including the aims and objectives, purpose of this report, and links to relevant plans and policies.
2. The project	This includes a description of the scheme location, the options currently under consideration, and current design assumptions.
3. Consideration of alternatives	This includes a description of the development of the scheme and the various options considered during the design process. This also includes consideration of how the environmental assessment has influenced the option selection process.
4. Environmental assessment methodology	This provides an overview of the environmental assessment methodology, including significance criteria and the approach to mitigation.
5. Topic assessments	This sets out the baseline environment including the study area used and the value of existing receptors at the site. There is a sub-section for each of the DMRB topics.
6. Assessment of cumulative effects	Provides a summary of how the cumulative effects assessment will be undertaken.
7. Conclusions	This summarises the conclusions and proposed next steps including work proposed at the next stage.
Acronyms, Glossary, References	A description of the acronyms and definitions of technical terms. There is also a reference list of document sources.
Appendices	Figures and supporting information are provided in the appendices.

1.5 Scope and content

The scope and content is set out as per the headings within DMRB and assessed to a level appropriate for Stage 2. This report should be read in conjunction with the A428 Stage 2 Scoping Report.

1.5.1 Limitations and assumptions

The Proposed Scheme is at an early stage in its development. There are no detailed designs and the construction methodology is not defined at this stage. The environmental risks have been identified based on a desk top review and knowledge of similar schemes. The only surveys that have taken place at this stage are an extended Phase 1 habitat survey, great crested newt habitat suitability survey, and baseline landscape survey. Further surveys will be undertaken during summer 2017, as set out in section 7.2, recommendations.

For the purposes of the Stage 2 assessment, it is assumed that the existing A428 would remain open during construction. It is also assumed that the information provided by the third party public sources is accurate at the time of preparing this report. Data sources may require verification at the next stage. It is assumed that construction would start in 2020, but the end construction date would depend on the option chosen and the delivery method.

References are included to provide details of relevant sources.

2. The Project

2.1 Project location

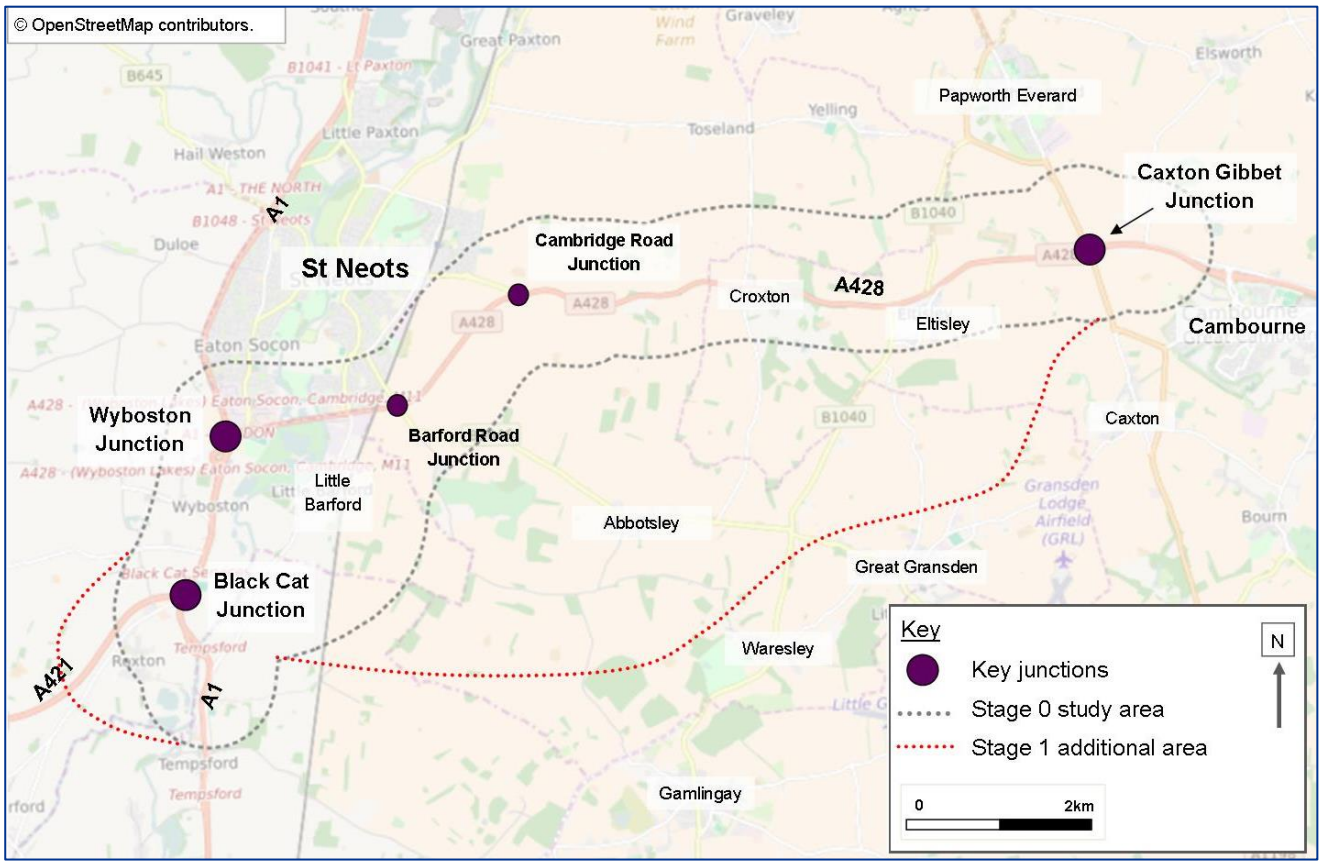
The A428 route connects the Borough of Bedford and the Central Bedfordshire unitary authorities with the districts of South Cambridgeshire and Huntingdonshire in the county of Cambridgeshire. The Scheme study area includes a section of the A1 between A1/A421 Black Cat Junction and the A1/A428 Wyboston Junction, and the length of the A428 running between Wyboston Junction and the A1198 at Caxton Gibbet.

The A1 is situated along the western edge of the study area and lies roughly parallel with the River Great Ouse floodplain and the East Coast Main Line (ECML). The existing A428 passes through a mainly rural area, characterised by agricultural fields and small areas of woodland. The villages of Croxton and Eltisley lie to the south of the existing road. There are a number of small settlements and individual business and residential properties which also front onto the road.

A 1km wide corridor study area was used around the existing A428 for the initial baseline review. This included a buffer around the options identified at Stage 0 (figure 2.1). This study area was used for the data collection requests (Historic Environment Record and local record centre requests). This was also used as the study area for the Extended Phase 1 habitat survey.

At Stage 1, the study area was extended to cover all identified options and this revised study area was used for further data collection including additional gaps in the ecology record request, the envirocheck data and as an updated survey outline. The existing Extended Phase 1 habitat survey only covers Option 1 due to the survey area completed at the end of the surveying season last year. However, the data gaps for the other options are being filled with a programme of surveys to be undertaken over summer 2017.

Figure 2.1: Study area differences between Stage 0 and the latter part of Stage 1



2.2 Project description

There are currently three route alignment options being considered:

- Option 1 (Orange) - full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.
- Option 5 (Purple) - full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge road Junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.
- Option 6 (Pink) - full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.

In addition, there are three options for the Black Cat junction:

- Option A - dumbbell roundabouts near the existing Black Cat junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.
- Option B - eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.
- Option C - one roundabout at existing Black Cat junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.

A full description of each of these options can be found within the Technical Appraisal Report (TAR) and the Annex to the TAR (Jacobs 2016b; 2017a).

There are some design assumptions that are relevant to the environmental assessment. These include:

- The route would be upgraded to an expressway to improve safety performance along the corridor. This is similar to a motorway in terms of the features and is based on the following assumptions:
  - The route would need to meet high standards of design, including improving the geometric alignment to remove any sharp bends, removing all at grade accesses along the route and providing grade separated junctions (where traffic uses slip roads from the main carriageway to enter / exit the route).
  - New technology would be provided along the entire route corridor. This would include additional signage to provide information to drivers and additional CCTV coverage. This would need to be supported by improvements to the communication network including new cables and the need for a transmission station located within the corridor.
  - The designs would need to include a number of elements designed to facilitate future maintenance. This would include installing a concrete barrier to reduce the risk to road workers during maintenance and designing structures and the soft estate to have safe access arrangements for inspections and repairs. It would also include designing emergency and maintenance bays into the scheme designs.
- Options crossing the floodplain between the Black Cat junction and the ECML would require either a viaduct structure or ground treatment works on which an embankment can be constructed. The latter would have an impact on the construction programme, as allowance would need to be made for a consolidation period. Additional land may also need to be purchased to provide floodplain compensation.

2.3 Land use setting and land take

There are no current details available regarding the land take of the different options. This would need to be estimated as part of the development of the redline boundary once a preferred route has been selected.

2.4 Construction, operation and long term management

No details are currently available regarding the construction and operation of the scheme. However, there are some design and construction assumptions that are relevant to the environmental assessment and have been assumed throughout the options appraisal to date. These include:

- Construction works at Black Cat, Cambridge Road and Caxton Gibbet junctions would require lane closures and traffic management during construction. These closures may include night closures to minimise disruption, but could create light and noise pollution.
- Offline construction would require significant amounts of additional road material which would subsequently increase the number of lorry movements to and from site. Stage 3 should include whether there are opportunities to generate material locally in the form of borrow areas, to minimise the need to import material or for alternative travel methods such as boat or rail. A materials and waste management plan should also be developed during Stage 3 to identify opportunities for using secondary material sources and minimising waste.
- The high pressure gas main at Black Cat junction may need to be diverted for some options. This would have a significant impact on the construction programme (potential two year lead in period). There would also be working beneath overhead powerlines requiring additional health and safety measures during construction.

2.5 Decommissioning

Decommissioning has not been considered within this EAR, as it is assumed that the road will remain in place in the future.

3. Alternatives considered

3.1 Stage 0 options appraisal

The OAR set out a long list of 48 options that would meet the overall objective of improving access along the A428 between Black Cat and Caxton Gibbet. These fell into categories including lane widening, junction improvements, offline alignment and public transport improvements. Most of the options were dismissed early on in the process where it was clear that they were unlikely to pass key viability and acceptability criteria. Sixteen options were taken forward for further assessment using the Department for Transports' Early Assessment and Sifting Tool (EAST) (DfT, 2013). This included a qualitative review of potential environmental impacts including air quality, noise, and the built and natural environment.

The sifting process and the OAR identified eight options that warranted further considerations. Option C1 / C2 (both covering a full offline dualing option) were considered the best performing option against the scheme objectives. The next best performing option is considered to be either option C7 or C16 (both covering an offline option to Cambridge Road and widening along the existing A428 for the rest of the route) while the low cost solution to problems on the route is considered to be either C10 or C11 (both looking at local junction improvements), which would meet a limited number of the scheme objectives.

3.2 Stage 1 options appraisal

The Stage 0 options were taken forward into Stage 1 and considered in the environmental appraisal. Further options were identified as part of the Stage 1 options identification process including two offline options to the south of the existing A428 and two lower cost options that could be done alone or as part of a phased full scheme. A full description of each option can be found in the TAR. Table 3.1 summarises the options considered as part of the Stage 1 environmental assessment.

Table 3.1: Options considered in the Stage 1 EAR

OAR ref.	Description	Stage 1 ref.
C1 / C2	Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 1
C10 / C11	Minor junction improvements along the A428 at Wyboston, Cambridge Road, Croxton and Eltisley. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 2
C5 / C6	A428 bypass between Black Cat and Cambridge Road junctions. No widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 3
C16 / C7	Offline dual carriageway bypass between Black Cat and Cambridge Road and online widening between Cambridge Road and Caxton Gibbet. Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 4
New	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.	Option 5
New	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet junctions.	Option 6
New	Dualling between Wyboston and the River Great Ouse crossing and a new roundabout at Wyboston. Minor junction improvements at Barford Road and Cambridge Road. Grade separation at Black Cat junction and signalised junction at Caxton Gibbet.	Option 7
New	Grade separation of both Black Cat and Caxton Gibbet junctions.	Option 8

The environmental appraisal was carried out by a team of specialists working in close iterative collaboration with the engineers responsible for the design of each alternative option. Each option was appraised on whether it was likely to have significant effects on the different environmental topics. These were documented in an Options Appraisal Matrix (OAM) included in the Stage 1 EAR.

As the appraisal was at an early stage in the project development, the options were evaluated for potential environmental effects using the scoring scale set out in table 3.2. Mitigation measures were recorded along with risks and issues associated with the options.

Table 3.2: Environmental effects scoring scale

Score colour code	6 point effect scale
Red	Significant adverse effect – unlikely to be able to mitigate.
Red / Amber	Potential significant adverse effect – mitigation maybe possible.
Amber	Slight adverse effect. Effect not significant with typical mitigation.
Amber / Green	Slight beneficial effect. Effect not significant.
Green	Significant beneficial effect.
No effect / neutral	No effect or a neutral effect due to the balancing out of positive and negative effects.

3.3 Results of the Stage 1 environmental assessment

The Stage 1 OAM summarised the potential environmental effects associated with each of the options based on the baseline study and a high level consideration of the potential effects.

The environmental assessment concluded that Option 1 was the environmentally preferred option at Stage 1. This is because it would meet the objectives to reduce congestion along the whole route. Although it had the same overall score as the other offline options, it had fewer effects to designated sites including Croxton Park, and could benefit this feature by moving traffic away from the site. Option 4 (online) was least preferred, as it would extend the road into the footprint of Croxton Park and would likely result in significant effects to the site that would be difficult to mitigate. Options 5 and 6 would affect large areas of the open landscape and would take the route closer to designated sites to the south.

An options appraisal workshop was held in October 2016 to appraise the eight options against how they met the scheme objectives (see section 3.2). The workshop identified that Option 1 was the best performing option against all objectives. Options 5 and 6 were also recommended for taking forward into Stage 2 (options selection).This is documented in more detail in the TAR.

3.4 Stage 2 options appraisal

The three best performing options in Stage 1 were taken forward into stage 2. They were renamed for the purposes of the consultation to avoid the risk of the numbering indicating preference:

- Option 1 became the Orange Option
- Option 5 became the Purple Option
- Option 6 became the Pink Option

In addition three options were also considered for the Black Cat junction. These were:

- Option A: Dumbbell roundabouts near the existing Black Cat junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.
- Option B: Eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.
- Option C: One roundabout at existing Black Cat junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.

3.5 Results of the Stage 2 environmental assessment

No further options assessment has been undertaken on the three route alignment options. Therefore the assessment summary in table 3.3 is based on the conclusions presented in both the Stage 1 EAR and TAR.

Table 3.3: Summary of the environmental appraisal

Option	Overall environmental score	Conclusions of the environmental appraisal (This is based on a high level assessment of the current designs, the likely significant effects could change as more information comes to light or through future iterations of the designs where effects are designed out)
Route alignment options		
Option 1 (Orange)	Potential significant adverse effect – mitigation maybe possible.	This option has an offline footprint that has been designed to avoid sensitive features. This option would provide an opportunity to move adverse effects associated with the existing road away from Croxton Park, potentially enhancing this feature. There are potential significant effects to the landscape that would need further design inputs if taken forward to Stage 3. However, overall this is considered to be the environmentally preferred offline option as it would provide opportunities for improvement to the NIA, NMU access, and to Croxton Park.
Option 5 (Purple)	Potential significant adverse effect – mitigation maybe possible.	This option is located closer to the Greensand Ridgeline and also to four sites of special scientific interest (SSSI) located within 5km to the south of the route. This option is likely to require a Habitats Regulations Assessment (HRA) Assessment due to the proximity to the Eversden and Wimpole Woods Special Area of Conservation (SAC), which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than the Option 1, as it would require more mitigation to offset potentially significant effects. It would create another major road within the landscape and create additional barriers to protected species migration within the study area.
Option 6 (Pink)	Potential significant adverse effect – mitigation maybe possible.	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 3km to the south of the route. This option is likely to require HRA due to the proximity to the Eversden and Wimpole Woods SAC, which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than Option 1 or 5, as it would require more mitigation to offset potentially significant effects. It would create another major road within the landscape and create additional barriers to protected species migration within the study area.
Black Cat options		
All options	Potential significant adverse effect – mitigation maybe possible.	All options are likely to improve noise and air quality around Wyboston, as a proportion of the through traffic gets diverted onto the bypass. All options have the potential for impacts to a Grade II listed building to the north of Black Cat and potential impacts to unknown buried archaeology. All options encroach into the River Great Ouse corridor and have the potential to impact habitats and species. The area is a habitat enhancement area and additional habitat creation could be undertaken as part of the options to meet Highways England targets for improving biodiversity. All options have a footprint within the floodplain, which will require compensation. All options have a significant footprint within the minerals working area, which could have programming risks and implications.
A	Potential significant adverse effect – mitigation maybe possible.	A three tier junction will have greater landscape and visual impact. There will also be an increased perception of noise impacts, which may be more difficult to mitigate due to the additional junction height.
B	Potential significant adverse effect – mitigation maybe possible.	A two tier junction would have a lower landscape and visual impact than the other two options and be potentially easier to mitigate in terms of noise impacts compared to the other two options. There could be effects to the setting of the scheduled monument at Tempsford Bridge, depending on the extent of the works to the south.
C	Potential significant adverse effect – mitigation maybe possible.	A three tier junction will have greater landscape and visual impact. There will also be an increased perception of noise impacts, which may be more difficult to mitigate due to the additional junction height.

Further assessment has been undertaken on the three Black Cat options and this is presented in Appendix F and summarised in table 3.3. This shows that all Black Cat options have a similar environmental effect. Option B is considered to be the environmentally preferred option, as it is two tiers instead of three and will have less of a landscape and visual effect. There is little to distinguish between Options A and C at this stage from an environmental point of view. All options are likely to benefit Wyboston, in terms of noise and air quality effects, assuming that the option is implemented as part of a full scheme rather than as a standalone junction option.

4. Environmental assessment methodology

4.1 Scoping (including a summary of consultation)

This section provides an overview of the approach that has been taken for the Stage 2 environmental assessment. The environmental appraisal has been carried out by a team of specialists working in collaboration with the engineering team responsible for the design of each option. The EAR includes the topics covered within the DMRB guidance and IAN 125/15 (Highways Agency, 1993a; 2015). At this stage a simple assessment has been undertaken for each of the environmental topics (table 4.1).

The aim of the Stage 2 EAR is to provide an overview of the environmental baseline, and potential effects and mitigation associated with the options. Impacts have not therefore been scoped in or out of the assessment at this stage. A Stage 2 Scoping Report has been produced and would be updated following the selection of the preferred option. This would be submitted to the Planning Inspectorate as part of obtaining a formal Scoping Opinion, which would set out what impacts should be assessed in the Environmental Statement.

Table 4.1: Stage 2 level of assessment

Environmental topic	Level of assessment
Air quality	High level preliminary assessment based on DMRB HA 207/07 - Air Quality (Highways Agency, 2007a); IAN 174/13 Updated advice for evaluating significant local air quality effects (Highways Agency, 2013); and the Institute for Air Quality Management (IAQM), Guidance on the Assessment of dust from demolition and construction (IAQM, 2014).
Cultural heritage	High level preliminary assessment based on DMRB HA 208/07 – Cultural Heritage (Highways Agency, 2007b); and Historic Environment Good Practice Advice in Planning Note 3 (Historic England, 2015).
Landscape	High level preliminary assessment based on DMRB Volume 11, Section 3, Part 5 – Landscape Effects (Highways Agency, 1993b); IAN 135/10 Landscape and Visual Effects Assessment (Highways Agency, 2010a); and the Guidelines for Landscape and Visual Impact Assessment (GLVIA) (3rd Edition) (The Landscape Institute and Institute of Environmental Management and Assessment, 2013).
Biodiversity	High level preliminary assessment based on DMRB Volume 11, Section 3, Part 4 – Ecology & Nature Conservation (Highways Agency, 1993c); IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment (Highways Agency, 2010b); and the guidelines for Ecological Impact Assessment (CIEEM, 2016).
Geology and soils	High level preliminary assessment based on DMRB Volume 11, Section 3, Part 11 - Geology and Soils (Highways Agency, 1993d); and CIRIA C552: Contaminated Land Risk Assessment – A Guide to Good Practice (Rudland et al., 2001).
Materials	High level preliminary assessment based on the guidance within DMRB Volume 11, Section 3, Part 6, Materials guidance (HD 212/11) (Highways Agency et al., 2011) and IAN 153/11 Guidance on the Environmental Assessment of Material Resources (Highways Agency, 2011b).
Noise and vibration	High level qualitative assessment of noise and vibration impacts in accordance with DMRB HD 213/11 – Noise and Vibration (Highways Agency, 2011); and BS5228 1 and 2; and qualitative assessment of operational phase impacts following guidance in DMRB.
People and communities	Combined high level preliminary assessment of Land Use, Pedestrians, Cyclists, Equestrians and Community Effects, and Vehicle Travellers (as per IAN 125/15) based on DMRB Volume 11, Section 3, Parts 6, 8, and 9 respectively (Highways Agency, 2001; 1993e; 1993f).
Road drainage and the water environment	High level preliminary assessment based on DMRB HD 45/09 – Road Drainage and the Water Environment (Highways Agency, 2009b).

Consultation workshops were undertaken during the development of the East of England Route Strategy Evidence Report (Highways Agency, 2014). This included a number of local stakeholders including representatives from the local councils and transport groups. Stakeholders strongly supported improvements to the route and there was a strong desire to see the Black Cat junction upgraded to a fully grade separated junction. Stakeholders recommended that there was a need to undertake a comprehensive upgrade along the whole route rather than addressing it as a series of ‘pinch point’ schemes in isolation.

Stakeholders also identified the following issues:

- There are flooding issues along the A1 between the Black Cat and Wyboston junctions.
- Black Cat, Wyboston, Caxton Gibbet junctions, and the A428 link between Wyboston and Caxton have all been identified as having issues regarding cycling and pedestrian provision. In particular, Stakeholders identified that non-motorised user (NMU) provision between the Phoenix Park triangle and the Eaton Socon urban area is currently poor.
- There are areas of cultural heritage importance near the Caxton Gibbet junction and along the A428 link between Wyboston and Caxton.
- The A1 Tempsford flood arches are a registered scheduled monument.
- There is a need for greater provision of driver information along the A428 between Wyboston and Caxton Gibbet and a need for intelligent technology along the whole route.

Stage 3 would involve consultation with statutory bodies to define the scope of the potential environmental assessment. Table 4.2 documents some of the key response relating to the environment from the consultation forums.

Table 4.2: Stakeholder comments received to date relating to the environmental appraisal

Comment	Scheme response
The Forums noted that Government policy identifies a duty to protect and enhance the environment. Key priority concerns include noise, air quality, soil, wildlife, flood risk and contaminated land.	Highways England is looking at ways to further enhance the environment. Opportunities will be identified and discussed with stakeholders during Stage 3. The EIA will cover these topics.
Noise and air quality: there are concerns about noise/ air quality impacts associated with the road and any improvements.	A noise and air quality assessment will be undertaken as part of the EIA. Highways England is looking at ways to reduce the impacts of noise and air quality through improvements at NIAs around Wyboston and at the AQMA in St Neots.
Landscape: landscaping should be higher south of the A428 compared to the northern area. The A14 crossing (further north) is visibly intrusive over the Great Ouse and the railway. It was noted that this should be avoided on the A428.	Highways England recognises that the landscape to the south of the A428 is much more sensitive than the area to the north. Sensitive landscape design is needed for the crossing of the Great Ouse and the railway.
Nature conservation and landscape: the Greensand Ridge and the habitats along the River Great Ouse floodplain are sensitive features and will need to be carefully considered in the designs and assessment. There will be a need for wildlife transit and crossings over the road. The Proposed Scheme should consider whether to apply a natural capital approach and ecosystem services assessment for the route.	These sensitive features will need sensitive design and wildlife crossings included at Stage 3. The Proposed Scheme will consider whether a natural capital approach and ecosystem services assessment is required for the route.
Geology and soils: need to avoid best and most versatile land, including grade 1 and 2 farming land. There were also concerns about severance of land and businesses.	The areas of grade 1 and 2 have been identified across most of the study area. There will be conversations with landowners at the next stage to identify impacts and mitigation associated with severance and affects to businesses.
Materials: there are opportunities to source local materials using the mineral extraction sites around Black Cat.	Local materials will be considered as part of the sustainable procurement process.
Traffic and transport: lorries and peak traffic currently use local villages as rat runs during peak times including Great Barford, Little Barford and Tempsford. The Proposed Scheme should consider adding another bridge across the Great Ouse to improve resilience of the route and avoid traffic diverting through St Neots during an incident.	The Proposed Scheme is seeking ways to reduce congestion and therefore rat running through the local villages. A number of the options include an additional bridge across the Great Ouse as part of improving resilience.
Traffic and transport: traffic along the A428 will increase during construction of the A14.	This needs to be factored into short and long term traffic forecasts.

Comment	Scheme response
Public transport and rights of way: there is an opportunity on the offline options to use the old A428 as a bus / NMU route or to improve it or other routes as dedicated cycle ways. There are also opportunities to develop or tie in with strategic routes for public transport.	The Proposed Scheme will include improvements to rights of way and NMU access as part of the designs. This will include opportunities for diverting NMU access along the A428 if an offline option is taken forward.
Many people commute from St Neots to Cambridge and use the railway station. There is also a challenge to integrate the Proposed Scheme with the East West railway.	Links with current and future public transport links will be considered as park of the development of the Proposed Scheme.
Communities and planning: there is a large amount of development planned in the region including an area to the south of St Neots, Wyboston Garden Village, West Cambourne and an Enterprise Zone southeast of Caxton Gibbet. There is also development proposed in the wider region at Bedford and Cambridge. The EIA will need to consider the effects on local businesses.	The traffic model will factor in estimates of additional traffic as a result of future development. The EIA will consider cumulative effects with adjacent developments (section 6).
Road drainage and water: there is a need for sustainable drainage to be considered as part of the designs. There is also an opportunity to enhance river navigation.	The Proposed Scheme will include sustainable drainage where required and will be designed to meet current recommendations for climate change.

4.2 Surveys and predictive techniques, methods and constraints

A 1km wide corridor study area was used around the existing A428 for the initial desk top review. This was extended to incorporate the new options identified during Stage 1. A 30km study area was also used to check for special areas of conservation (SAC), designated for bats, as recommended by current guidance set out in the DMRB HD 44/09 (Highways Agency, 2009a). Specific study areas are outlined in the individual topic chapters. Some of the key environmental constraints are included in the environmental constraints plan in Appendix B and on the figures in Sections 5.

The baseline assessment is based on a review of available information using a desk top review, site surveys and investigations and other methods outlined within the individual chapters.

Appendix C contains a table summarising the criteria used for assessing values which is based on the guidance within DMRB or other sources. This is interpreted within each individual chapter to identify the specific features within the study area for each value.

4.3 Significance criteria

Significance is derived through a combination of the sensitivity of a receptor (value or importance) and the magnitude of the effect. The significance of an effect is influenced by both of these variables. A typical matrix is provided in DMRB Volume 11, Section 2, Part 5 (Highways Agency *et al*., 2008). This would be adapted, as appropriate to include professional judgement. Where technical judgement is used, this would be accompanied with text to explain the reasons and justification.

Certain disciplines do not use a matrix-based approach, because they use calculations to assess effects in numerical terms. This includes noise, air quality and flood risk. In all cases, professional judgement will be applied to the assessment to underpin the outcomes identified through the matrix or calculation assessments and the topic-specific guidance would be referenced and followed if there is any discrepancy.

Significance categories are described in table 2.3 in Volume 11 Section 2, Part 5 of DMRB. This describes effects with a very large or a large significance as being ‘key factors in the decision making process’ and ‘likely to be material in the decision making process’ respectively. Therefore, large and very large effects are considered ‘significant’ for the purposes of the EIA regulations.

4.4 Mitigation, monitoring and enhancement measures

Mitigation measures aim to avoid effects at their source, perhaps through amendments to the Proposed Scheme design or by regulating the timing or location of activities. If effects cannot be avoided or reduced, it may be appropriate for compensatory measures to be taken, for example to provide replacement habitat.

Potential enhancement opportunities have been identified in section 1.2.4. These should be reviewed once a preferred option is selected.

Monitoring would be identified in Stage 3, once the likely significant effects have been determined.

5. Topic assessments

The relevant regulatory and policy framework is set out in Appendix A and is not duplicated in the following sections. The following sections indicate at a high level whether there are likely to be significant effects and what the appropriate mitigation may be. A detailed consideration of the magnitude of effects and the design of mitigation and enhancement measures would be developed once a preferred option has been selected. Likewise, monitoring requirements have not been developed at this stage and would need to be reviewed alongside the development of the EIA at Stage 3. The scope of assessment is documented within the Stage 2 Scoping Report and is not repeated here to avoid duplication.

An environmental report was produced for the Black Cat pinch point scheme (WSP, 2013). This contains baseline data relevant to Black Cat and has been referenced in the topic sections where data was relevant to the baseline of this report.

5.1 Air quality

5.1.1 Baseline sources

The following baseline sources have been used during the data gathering:

- Department for the Environment Food and Rural Affairs (Defra) background mapping data for local authority (Defra, 2013)
- Defra Interactive Monitoring Networks Map (Defra, 2016a)
- Huntingdonshire District Council Local Air Quality Management Progress Report (2014)
- Bedford Borough Council Local Air Quality Management Updating and Screening Assessment Report (2015)
- South Cambridgeshire District Council Local Air Quality Management Updating and Screening Assessment Report (2015)
- Air Pollution Information System for critical loads and background NO_x and N-depositions for designated sites (APIS, 2016)
- A1-A421 Black Cat Roundabout Tip Further Works Report (Carillion WSP, 2013)
- Environment Agency interactive map – 'What's in Your Back Yard' (Environment Agency, 2016)

5.1.2 Geographical scope

The air quality study area should be the 200m boundary of roads affected by the scheme and human health sensitive receptor and designated sites within. However the traffic data is not available for screening and defining the study area at this stage. Therefore the Stage 2 baseline assessment has considered the immediate area within 200m of the A428 and it's on and off slip roads at the A1 junction, as well as the offline area within 200m of the proposed alignments for all route options and Black Car Junction options. The desk study has also considered key features within the wider environment to support the options appraisal.

5.1.3 Baseline conditions

There are no AQMAs within the immediate study area (200m of the existing A428). The nearest AQMA is located in St Neots' High Street, approximately 2km to the north of A428, which is declared for nitrogen dioxide (NO_2) by Huntingdonshire District Council. The AQMA is adjacent to a bridge crossing over the River Great Ouse. This bridge is used as an alternative route for traffic when the A428 crossing at Wyboston is closed due to accidents.

There is currently limited monitoring data within the immediate area along the A428. Huntingdonshire District Council operates a continuous monitoring station at Huntingdon, 12km north. The council also monitors NO_2 at 34 locations across the district, using NO_2 diffusion tubes (Huntingdonshire District Council, 2014). A monitoring site at Arundel Crescent, St Neots (518423, 258573) is the nearest monitoring location to the A428, and is

located approximately 390m to the north of the A428. The 2013 annual mean NO_2 concentration at this location was 21.4µg/m³, which is within the relevant air quality objective (AQO) of 40µg/m³. In addition, Bedford Borough Council has three diffusion tubes along A1 Great North Road and Wyboston, approximately 1.2 - 1.3km to the north of the Black Cat roundabout. The annual mean NO_2 concentrations at these three locations were below the objective in 2015. The monitoring results at DT21 at A1 Great North Road northbound were close to exceedences of annual mean objective. Detailed results of local monitoring are provided in Table 5.1.

Table 5.1: Local Authorities Air Quality Monitoring Data

Site ID	Location	Distance to Scheme	2011 Annual Mean NO_2 (µg/m³)	2012 Annual Mean NO_2 (µg/m³)	2013 Annual Mean NO_2 (µg/m³)	2014 Annual Mean NO_2 (µg/m³)	2015 Annual Mean NO_2 (µg/m³)
Huntingdon District Council							
Eynesbury	Arundel Crescent	390m to A428/B1043	23	22	21	-	-
Bedford Borough Council							
DT12	The Lane, Wyboston	1.3km to Black Cat Roundabout	25	25	23	23	21
DT13	20 Great North Road	1.2km to Black Cat Roundabout	32	36	31	26	27
DT21	Great North Road	1.2km to Black Cat Roundabout	50	47	45	45	37

Traffic from the A428 is the dominant source of emissions within the study area. Little Barford Power Station is within 500m to the south of the A428 and is also a key emission source for carbon dioxide (CO_2), nitrogen oxides (NO_x) and particulate matter (PM_{10}) in the area.

Human health receptors along the existing roads include those in towns and villages such as Chawston, Wyboston, Eynesbury, Croxton and Eltisley. There are no statutory designated sites (sites of special scientific interest (SSSI), SACs, special protected areas (SPA) or Ramsar sites) located within 200m of the existing A428.

5.1.4 Value of receptors

For operational air quality impacts, all receptors (human health receptors and designated ecological sites susceptible to changes in air quality) are treated as equally sensitive where they are within 200m of “affected” roads. Sensitivity is identified as locations representative of exposure to the averaging periods of relevant air quality objectives / critical loads, e.g. annual, daily and hourly exposure.

5.1.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.1.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3.

There is the potential for significant effects for air quality during both the construction and operation phase from traffic. Effects from construction activities would not likely be significant, as they would generally be managed through good site practices. The magnitude of the air quality effects would be determined when the traffic modelling results are available.

5.1.7 Assumptions and limitations

No traffic modelling data has been made available at the time of this study.

5.2 Cultural heritage

5.2.1 Baseline sources

The following sources of data were used during the data gathering to establish the environmental baseline:

- National Heritage list for information on statutory designated cultural heritage assets (World Heritage Sites, Scheduled Monuments, Listed Buildings, Registered Battlefields and Registered Parks and Gardens) (Historic England, 2016a).
- English Heritage archive for information on undesignated cultural heritage assets (Historic England, 2016b).
- Cultural heritage assets recorded on the Cambridgeshire Historic Environment Record (HER) were provided by Cambridgeshire County Council (12 April 2016) and on the Bedfordshire HER from Bedford Borough Council (15 April 2016). This data has not currently been obtained for the two southern options, which were identified after the data request was made;
- Cultural heritage assets recorded on the Cambridgeshire HER were identified using the Heritage Gateway, (16 May 2017).
- Information on Conservation Areas from South Cambridgeshire District Council, Huntingdonshire District Council, Central Bedfordshire Council and Bedford Borough Council websites.
- A1-A421 Black Cat Roundabout Tip Further Works Report (Carillion WSP, 2013)
- A drive through survey was carried out (13 October 2016) which was used to assess those cultural heritage assets visible from the highway or other public rights of way. Additionally views to and from known, accessible cultural heritage assets were considered.

5.2.2 Geographical scope

The Stage 1 assessment has considered a study area of 1km from the existing A428, extending to the south to incorporate possible southern alignments, for World Heritage Sites, Scheduled Monuments, Registered Battlefields, Registered Parks and Gardens, and Grade I and Grade II* listed buildings. These are all designated assets assessed as being of high value. This study area was additionally used to identify designated and undesignated assets of medium, low and negligible value.

HER data was not available for the southern extent of the study area, but on-line sources were used to identify and assess the value of cultural heritage assets. All heritage assets are detailed in Appendix D.

5.2.3 Baseline conditions

An Archaeological Desk-Based Assessment (DBA) was undertaken as part of the Black Cat pinch point scheme (WSP, 2013). This identified a moderate-high potential for archaeological deposits existing on the site, where not truncated by previous construction work. The DBA recommended a programme of field evaluation to determine the presence / absence of archaeological remains present.

The drive through survey identified two distinct landscapes, a more open landscape to the north of the existing A428 and a more intimate landscape, with historic features such as parkland, earthworks and hedgerows to the south.

There are no World Heritage Sites, Registered Battlefields or Grade I listed buildings within the study area. A total of 188 heritage assets have been identified using the HER information and other sources based on the Stage 0 study area (which does not cover the southern options). These heritage assets are listed in Appendix D. Each has been given an individual number from 1 to 254

High value assets within the 1km buffer

There are 11 Scheduled Monuments within the 1km buffer (table 5.2). These include:

- A Moated Enclosure at Wyboston (Asset 14) which dates to the medieval period and comprises a clearly defined moat with adjacent house platforms. The moat would have defined the site of a small manor house.
- Deserted Medieval Villages at Weald (Asset 120) and Croxton (Asset 138) both have visible earthworks. The Deserted Medieval Village of Weald was finally abandoned within the last 200 years. The earthworks showing the site of the manor and church are clearly visible, and there is ridge and furrow visible in the fields to the south of the scheduled area.
- A Moated Site at Pond Farm (Asset 165) is defined on three sides by a water filled moat which would have enclosed a medieval manor.

Croxton Park is a Registered Park and Garden (Asset 137). It is a mid-18th century house and garden set within an early 16th century deer park, located adjacent to the A428 in Croxton. The park incorporates some traces of 16th century garden features, and was extended and landscaped in the 19th century.

Figure 5.1: Cultural heritage features

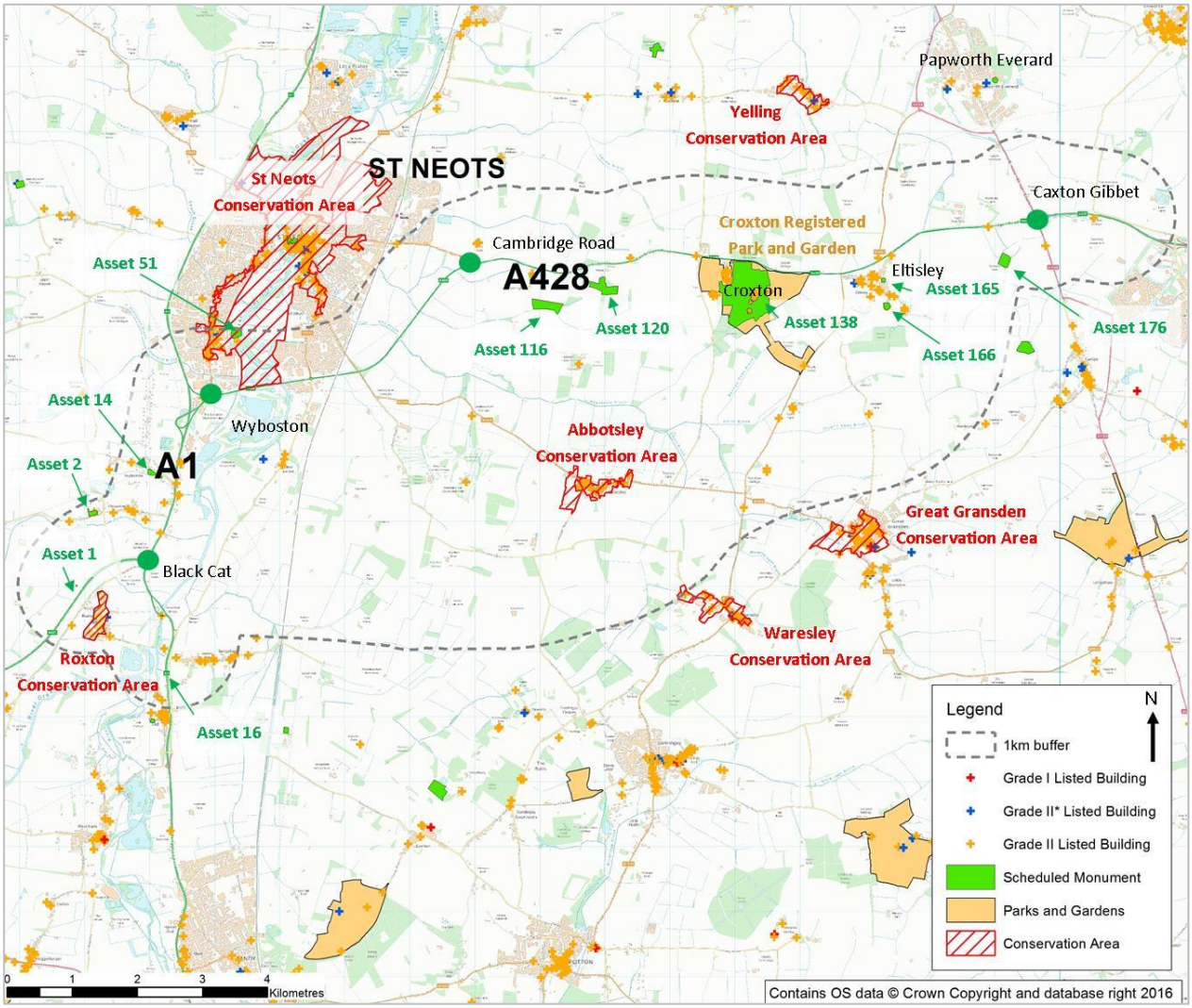


Table 5.2: High value assets within the study area

Asset no.	High value asset	Grid reference
Scheduled Monuments		
1	Bowl Barrow, known as 'Round Hill', 440m WNW of College Farm	TL 148550
2	Chawston Manor moated site and associated fishpond (asset 2)	TL 151561
14	Moated enclosure and associated building platforms, The Lane, Wyboston	TL 161567
16	Tempsford Bridge	TL 161545
51	The Hillings, Castle Hills. A Norman ringwork castle overlying a late Saxon vill and deserted medieval village	TL 173589
116	Deserted village at Wintringham	TL 221593
120	Deserted village (site of) at Weald	TL 229596
138	Croxton deserted medieval village and 16th-17th century garden visible as earthworks	TL 252597
165	Moated site at Pond Farm	TL272597
166	Moated site at Manor Farm	TL 273593
176	Moated site at Pastures Farm	TL 291600
Grade II* Listed Buildings		
3	Congregational Chapel, Roxton	TL 227565
4	Church of St Mary Magdalen, Roxton	TL 252592
45	Church of St Mary, Eaton Scotton	TL 252593
119	Church of St Margaret, Abbotsley	TL 268596
139	St James Church, Croxton, with 13th century origins	TL 153545
140	Croxton Park House	TL 151544
149	Church of St John the Baptist and St Pandionia which dates from the late 12th and early 13th centuries and was restored in 1875	TL 170588
Registered Park and Garden		
137	Croxton Park	TL 151544

Medium value assets within the study area

The following provides a summary of the medium value heritage assets identified within the study area:

- 46 Grade II Listed Buildings (details in Appendix D);
- Two non-designated buildings, Wintringham Hall (Asset 113) and the Old House in Eltisley (Asset 151). These are non-designated buildings of medieval origin which have been altered but still have a contribution to make to the objectives of the East of England Regional Research Framework, particularly understanding the origins and characterisation of Medieval rural settlement (East Anglian Archaeology, 2011).
- The partially excavated Roman site at Priors Gate (Asset 34) is a rural site occupied between the 2nd and 4th centuries. The excavated area comprised a range of industrial features such as quarry pits and agricultural features such as stock enclosures. The settlement is thought to be to the south of the excavated area. Priors Gate, and in particular the unexcavated settlement as the potential to contribute to the objectives of the East of England Regional Research Framework, particularly understanding the development of rural settlement in the Roman period.
- Eltisley Abbey (Asset 148) is the traditional site of a 9th century Benedictine nunnery comprising a moat, earthwork and St Pandionia's Well (Asset 150), which may have been the site of the original nunnery's water garden. Religion and settlement in the Anglo Saxon period and the transition to the medieval period are important areas of research in East of England Regional Research Framework.

- Conservation Areas at Roxton (Asset 185), St Neots (Asset 186), Croxton (Asset 187), Abbotsley (Asset 189), Waresley (Asset 190) and Eltisley (Asset 188).

Low and negligible value assets within the study area

A further 13 historic buildings and 67 archaeological remains have been assessed to be of low value, and 96 archaeological remains have been assessed to be of negligible value in the 300m study area (Appendix D).

Archaeological potential

There is the potential for unknown archaeology throughout the study area, particularly within areas where limited or no development has taken place. Based on the baseline information assessed, there is evidence for human activity within the study area from the prehistoric period through to the present day; with particular evidence relating to prehistoric settlement and funerary remains, early medieval and medieval settlement activity and post-medieval settlement and agricultural activity.

Known archaeological remains include a range of settlement sites, funerary sites, and archaeological findspots and scatters of prehistoric to post-medieval date, as well as areas of cropmarks which are indicative of human occupation activity from the prehistoric period through to the present day. There is therefore the potential for the proposed scheme to disturb unknown buried archaeology.

5.2.4 Value of receptors

An assessment of the value of identified cultural heritage assets was undertaken based on criteria provided in HA208/07 Vol 11, Section 3, Part 2 (Highways Agency, 2007b) and as summarised in Appendix C. Table 5.3 summarises the value of the receptors assessed as being of high, medium and low value identified within the study area.

Table 5.3: Value of cultural heritage receptors

Value / sensitivity	Examples within the study area
High	**Archaeological remains**: One Registered Park and Garden (Croxton Park), 11 Scheduled Monuments (five of which are within 300m of the existing A428, including: the moated enclosure at Wyboston; Tempsford Bridge; the deserted medieval villages at Weald and Croxton; and the moated site at Pond Farm). **Historic buildings**: Seven Grade II* Listed Buildings (three of which are within 300m of the existing A428, including: Croxton Park House, St James Church, Croxton; and the Church of St John the Baptist and St Pandionia).
Medium	**Archaeological remains**: Three archaeological remains including the partially excavated Roman site at Priors Gate, Eltisley Abbey, and St Pandionia's Well, , **Historic buildings**: 48 Grade II listed buildings, two non-designated historic buildings (Wintringham Hall and the Old House in Eltisley), and six Conservation Areas (Roxton, St Neots, Croxton, Abbotsley, Waresley and Eltisley).
Low	**Archaeological remains**: 6731 remains including partially excavated sites such as the prehistoric ring ditch at Eynesbury (Asset 74) or the possible enclosure at Abbotsley (Asset 103) visible as cropmarks. **Historic buildings**: 13 undesignated historic buildings ranging from small cottages such as the Thatch Cottage in Wyboston (Asset 24) to distinctive local features such as a cast iron mile post in Caxton (Asset 173)

5.2.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.2.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3 once a preferred option has been selected.

There is the potential for significant effects to the setting of existing assets including a listed building close to Black Cat and the potential for buried archaeology along all route options.

5.2.7 Assumptions and limitations

This assessment is based on readily available web based data sources. No geophysical or intrusive surveys have been completed to date. HER data was not available for the southern routes and would need to be obtained during Stage 3, if these are taken forward.

5.3 Landscape

5.3.1 Baseline sources

The following baseline sources have been used during the data gathering:

- Ordnance Survey (2015) Explorer Map 208 (1:25,000 scale)
- Designated sites and features identified on Multi-Agency Geographic Information for the Countryside (MAGIC) (Defra, 2016b)
- The Cambridgeshire Landscape Guidelines (Cambridgeshire County Council, 1991).
- Huntingdonshire Landscape and Townscape Assessment (Huntingdon District Council, 2007)
- Central Bedfordshire Landscape Character Assessment (Central Bedfordshire Council, 2016)
- Bedford Borough Landscape Character Assessment (Bedfordshire County Council and Bedford Borough Council, 2007)
- Core Strategy and Rural Issues Plan (Bedford Borough Council, 2008)
- Core Strategy and Development Management Policies (Central Bedfordshire Council, 2009)
- Policy Proposals Map (side B) and related insets (Central Bedfordshire Council, 2011)
- Adopted Proposals Map and inset maps 24 Croxton and 29 Eltisley (South Cambridgeshire District Council, 2012)

5.3.2 Geographical scope

The Stage 2 assessment has considered a study area covering a buffer of approximately 2km around the existing A428. Landscape and visual effects beyond this distance are likely to be negligible. The envelope for the final visual assessment is likely to vary dependent on topography and the potential visual prominence of proposed structures.

5.3.3 Baseline conditions

The following text is based on a desk based assessment and a drive through of the study area by a Landscape Architect. The drive through was undertaken during Stage 1 prior to the identification of Options 5 and 6 and does not fully cover these parts of the study area, particularly Option 6, which is the furthest south of the three options.

There are no areas of outstanding natural beauty (AONB) or national parks within 5km of the study area, and the area does not fall within a greenbelt. Croxton Park, located south of the A428 at Croxton, is registered as an historic park and garden (figure 5.2). There are numerous listed buildings in the study area (see section 5.2, cultural heritage). There are no other landscape designations within the study area.

The study area lies within the southern part of National Character Area (NCA) 88: Bedfordshire and Cambridgeshire Claylands (figure 5.2). The A428, along with the A1, M1, and A421, is recognised as having an impact on the local landscape character (Natural England, 2014a). Some of the key characteristics of the Claylands landscape are:

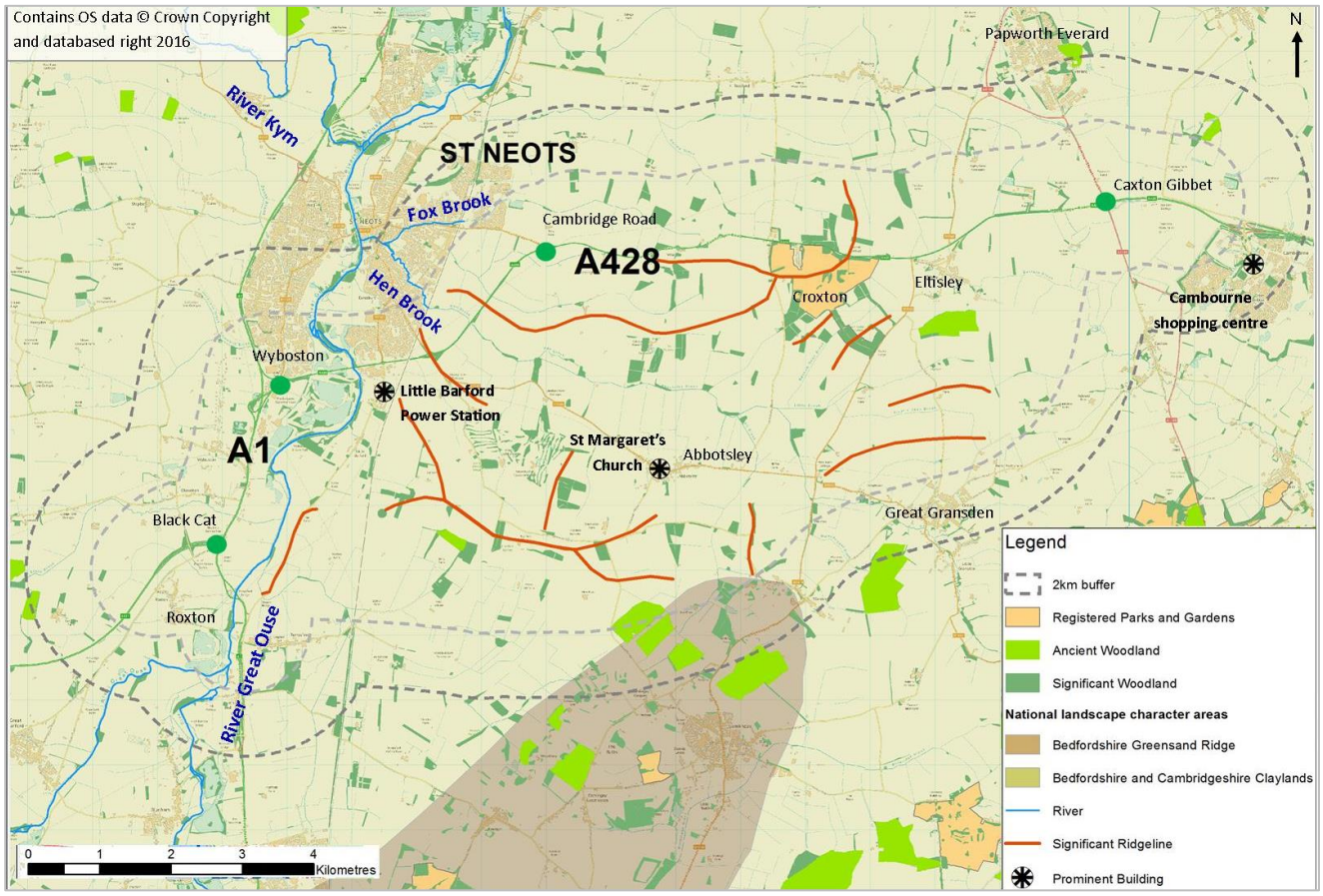
- Gently undulating topography and plateau areas, divided by broad shallow valleys.

- Predominantly an open and intensive arable landscape. Fields bounded by either open ditches or sparse closely trimmed hedges (with some locally well-developed hedges), both containing variable number and quality of hedgerow trees.
- River corridors of Great Ouse and Ivel compose cohesive sub-areas characterised by flood plain grassland, riverine willows and larger hedges.
- Woodland cover variable. Clusters of ancient deciduous woods on higher plateau area. Smaller plantations and secondary woodland within river valleys.
- Settlement pattern clusters around major road (A1) and rail corridors many with raw built edges. Smaller, dispersed settlements elsewhere. Village edge grasslands and small pastures an important feature.
- Restored gravel working lakes adjacent to River Great Ouse.

At a county level, Cambridgeshire County Council's publication, 'The Cambridgeshire Landscape Guidelines' (1991), indicates that the study area mainly lies within two landscape character areas: the 'Western Claylands' and 'Ouse Valley'. The underlying clay geology influences the whole study area with subtle variations locally at a district level.

The local landscape character areas (LCA) are as set out in table 5.4 and figure 5.3. For consistency the LCA references have been retained as per the original publications references, which are also given in the third column. The landscape character areas are described from west to east across the study area:

Figure 5.2: Key landscape features and views



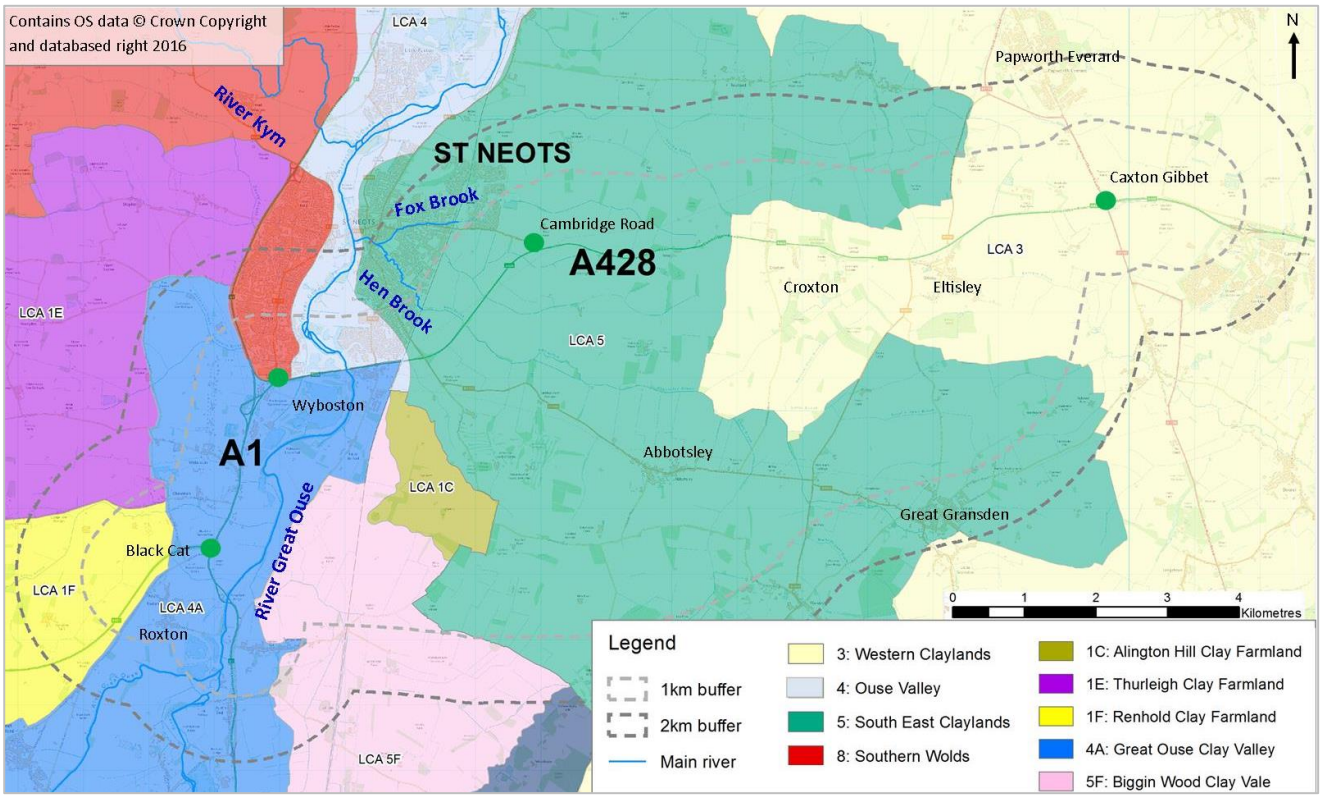
To the west of the study area, within Bedford Borough, two broadly similar areas of clay farmland provide the contextual setting of the Black Cat junction; these are LCA 1E Thurleigh Clay Farmland and 1F Renhold Clay Farmland. These clay farmland areas are characterised by the gently undulating landform and flatter, elevated plateaux with an underlying geology of Oxford Clay, overlain with Boulder Clay. This supports a large-scale, open landscape of intensive arable farmland with a pattern of fragmented hedges and remnant, mature

hedgerow trees and some scattered woodlands. Shallow valleys formed by small tributaries of the River Great Ouse are tree-lined, with clustered rural settlements which are generally of low density.

Table 5.4 :Landscape character areas

Reference	LCA name	Local authority and landscape assessment publication reference
LCA 1C	Alington Hill Clay Farmland	Bedfordshire County Council and Bedford Borough Council: Bedford Borough Landscape Character Assessment (2007).
LCA 1E	Thurleigh Clay Farmland	
LCA 1F	Renhold Clay Farmland	
LCA 3	Western Claylands	South Cambridgeshire District: Cambridgeshire Landscape Guidelines, Cambridgeshire County Council (1991).
LCA 4	Ouse Valley	Huntingdon District Council: Huntingdonshire Landscape and Townscape Assessment (2007).
LCA 4A	Great Ouse Clay Valley	Central Bedfordshire Council: Central Bedfordshire Landscape Character Assessment (2016).
LCA 5F	Biggins Wood Clay Vale	
LCA 5	South East Claylands	Huntingdon District Council: Huntingdonshire Landscape and Townscape Assessment (2007).
LCA 8	Southern Wolds	

Figure 5.3: Local landscape character areas



The Great Ouse Clay Valley (LCA 4A) is characterised by the broad, meandering course of the River Great Ouse within the low-lying floodplain with a mixed pattern of land use. Within the floodplain, worked out gravel pits form a series of lakes interspersed with a few pastures, wet meadows and large-scale arable fields, dissected by drainage ditches and hedgerows. Reclaimed former mineral workings provide public recreational areas. At the southern edge of St Neots and Eaton Socon, retail business, leisure and recreational developments strongly influence the character along the A428 on either side of the floodplain. At Wyboston there are extensive areas of horticultural nurseries with glass houses on the west side of the A1 and some to the east, north of the Black Cat junction.

Visually this is a fairly open landscape, with views across the Ouse valley from properties along the A1 and from Tempsford to the south, and from the A428 where it crosses the valley. However, there are stands of mature trees within the flood plain which restrict views locally, particularly in relation to flooded gravel pits.

Biggin Wood Clay Vale (LCA 5F) has a gently undulating landform and gradually rising ground towards the more elevated clayland plateau to the north. This area has large open arable fields with some hedgerows, a few scattered, isolated farms, and long views to distant wooded ridges. Overhead power lines form visually dominant features and the area is severed by the north-south route of the ECML railway.

Alington Hill Clay Farmland (LCA 1C) is characterised by its gently undulating clay plateau landform, large geometric arable fields with dense hedges and a few hedgerow trees. The scattered woods on the low escarpment slopes surrounding the plateau are prominent in views from the west and there are mixed and coniferous woodland blocks within the farmland. Settlement is sparse. The woodland at Alington Hill is a prominent feature on the ridgeline, and Sir John's Wood (replanted ancient woodland and county wildlife site) lies on the edge of LCA 5F and LCA 1C, situated on the south-facing escarpment.

The South East Claylands (LCA 5) shares many characteristics of the previously described Clay Farmland character areas, including the gently undulating landform, heavy clay soils supporting intensive arable farming and a pattern of large fields. LCA 5 is strongly influenced by extensive woodland cover and tall hedgerows with frequent mature hedgerow trees. The southern part of LCA 5 includes the broad valley of Hen Brook and its tributaries Abbotsley Brook, Small Brook, Barham Dean Brook, Little Brook College Dean Brook and Vicar's Dean Brook. This area has a quiet unspoiled character and comprises a coherent, unspoiled, homogenous landscape of good quality. Significant features include numerous woodlands, mature hedgerows and the gently undulating valleys with attractive open views framed by woodland blocks.

There are scattered, nucleated villages centred on village greens or of a linear pattern, with widespread evidence of the area's medieval history in the form of deserted villages, frequent moated sites and green lanes. The villages and farms within this part of the study area have associated smaller-scale fields and small pastures which are notable in an otherwise extensively arable farmland setting.

The Western Claylands (LCA 3) of South Cambridgeshire District shares the general clay farmland character of the adjoining LCA5, with scattered historic landscape features set within the pattern of large scale arable fields. The historic parkland landscape of Croxton Park with extensive woodland blocks occupies a significant area south of the existing A428. The villages of Croxton and Eltisley are located to the south of the A428, with occasional scattered properties and farmsteads along the A428 and in the wider countryside. There are remnant patterns of smaller fields and pastures around Eltisley.

Landscape features

Woodland and trees

Woodland blocks are small and infrequent within the Ouse valley and west of the ECML railway, but occur as frequent scattered features in the central and eastern areas. Ancient woodland (replanted) includes Sir John's Wood situated approximately 3.5 km due east of the Black Cat junction and Eltisley Wood, just south of Eltisley village.

Significant strips of riparian woodland occur along the east bank of the River Great Ouse and along a small tributary immediately east of the Black Cat junction. Riparian woodland also forms locally important features and occurs intermittently along lesser watercourses such as Hen Brook and its tributaries Little Brook and College Dean Brook. There are several larger areas of broad-leaved and mixed woodland close within the A428 corridor including Boys Wood, near Alington Hill, North Lodge Plantation, north of Croxton and recent planting at Northeast Farm and Pembroke Farm, near Caxton Gibbet.

There are two trees with veteran status located immediately adjacent to Cambridge Road between Wintringham and Croxton (The Woodland Trust, 2016). A 'veteran tree' is usually old, or displays signs of premature ageing, and has important wildlife and habitat features.

Tree protection orders

Partial information is available on publicly accessible sites for trees covered by tree protection orders (TPO) (i.e. for South Cambridgeshire district only). This includes numerous TPOs related to Croxton Park with a significant number of tree groups covered by TPOs on land along the existing A428 through Croxton, a linear tree belt north of Eltisley and several small groups and scattered individual trees along Little Brook on the district's southern boundary, near Abbotsley Road.

Information regarding TPOs in other administrative districts will be updated in subsequent consultation with local authorities as the scheme develops.

Hedgerows

The study area includes extensive tracts of rural countryside with numerous fields and a network of rural lanes, tracks and footpaths, most of which are bounded by hedgerows in various conditions. Hedges tend to be denser and with more frequent hedgerow trees east of the ECML railway. Good quality hedgerows with significant numbers of mature hedgerow trees, and of significance in terms of species diversity, are a notable feature within the southern part of the study area.

Agricultural land

Intensively farmed arable land makes up the majority of the study area. Permanent pastures are scarce and infrequent within the study area but occur as smaller-scale, irregular fields clustered around villages and some farmsteads and also occur as a small pocket of pastures at Leycourt, south of Eltisley. There is an extensive area of pasture land at Croxton Park.

Grassland

Other areas of grassland within the study area include recreational land and flood meadows within the River Great Ouse Valley, golf courses, and parkland and meadows at Croxton Park. Grassland within existing road verges and hedgerow bottoms and vegetation associated with minor watercourses and ditches, also occurs throughout the study area.

Waterbodies and watercourses

The most significant water course within the study area is the River Great Ouse which flows south to north in a meandering course more or less paralleling the A1. Lesser water courses include Hen Brook and its tributaries Little Brook and College Dean Brook, which flow from east to west through the centre of the study area, and Fox Brook and Gallow Brook which also flow east to west, just north of the existing A428. A further unnamed tributary brook flows in to the River Great Ouse just north of Tempsford. There are numerous field drainage ditches which lead into these streams and brooks throughout the study area.

Large waterbodies occur within the Ouse Valley in the form of flooded former gravel pits; several of these have been adopted for recreational activities including fishing. There is also a lake within Croxton Park. Other water bodies occur as modern agricultural irrigation reservoirs.

There are a number of historic moats within the study area east of the Ouse Valley; these occur at Abbotsley Golf and Country Club, Caldecote, Wintringham, Westbury Farm at Croxton, Manor Farm and Jesus College Farm at Eltisley and Pastures Farm near Croxton. There are also several old farm ponds scattered through the study area and other ponds associated with the medieval sites and villages of Wintringham and Weald.

Public rights of way

The Ouse Valley Way regional trail follows a meandering course roughly south-north along the Ouse Valley; along the river and valley floor west of Tempsford in the south, crossing the A1 at Wyboston to follow the east side of the main road into Eaton Socon, north of the A428. Further details on rights of way can be found in section 5.7.

Visual receptors

Potential visual receptors include residential and business properties within the study area including at Roxton, Wyboston, Eaton Socon, Croxton, Eltisley and Caxton Gibbet. Further visual receptors include travellers using the A428 and surrounding road network, the ECML or people using existing rights of way or open spaces and outdoor workers and visitors to Begwary Brook Local Nature Reserve and Croxton Park.

5.3.4 Value of receptors

The determination of value of landscape and visual receptors has been broadly based on the methodology set out within IAN 135/10 (Highways Agency, 2010a), as summarised in Appendix C.

The attribution of sensitivity to separate landscape character areas in table 5.4 includes the consideration of potential changes to landform as a large-scale and underlying component of local landscape character. The level of sensitivity attributed to LCAs reflects the relative proportion of any character area potentially affected by the scheme, local variations in the landscape character, and whether or not the LCA is already affected by the existing road network; e.g. the southern part of LCA 5 is currently unaffected by any major road and has a more secluded, unspoiled character and has a higher sensitivity than the northern and eastern parts which are already influenced by the existing A428.

Table 5.5 summarises the value of landscape and visual receptors according to their sensitivity (i.e. sensitivity to changes to perceived landscape character and views from residential properties, views from footpaths, etc.).

Table 5.5 :Value of landscape and visual receptors

Sensitivity	Landscape and visual receptor description	Examples within the study area
Landscape receptors		
High	Landscapes which would be unable to accommodate change of the type proposed. Typically these would be of high quality with distinctive elements and features making a positive contribution to character and sense of place and / or likely to contain features and elements that are rare and could not be replaced.	LCA 4 Ouse Valley / LCA 4A Great Ouse Clay Valley and LCA 3 Western Claylands & LCA 5 South East Claylands. Croxton Park Registered Park and Garden. Landscape features including woodland, trees and grassland.
Moderate	Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Generally unremarkable character but with some sense of place, locally designated and / or likely to contain some features and elements that could not be replaced.	LCA 1C Alington Hill Clay Farmland, LCA 1E Thurleigh Clay Farmland & LCA 1F Renhold Clay Farmland, LCA 5F Biggins Wood Clay Vale and LCA 8 Southern Wolds. Landscape features including hedges, agricultural land, water bodies and rights of way.
Visual receptors		
High	Views from residential properties, public rights of way (PRoW), public open space and recreational areas.	Domestic premises on the northern edge of Abbotsley, within Croxton, at Eltisley and scattered farm houses, etc. Walkers on the Roman road at Potton Road/Drewels Lane, Ouse Valley Way and other footpaths. People using Wyboston Leisure Park, Abbotsley Golf and Country Club, visitors to Croxton Park.
Medium	Views experienced by people working outdoors, views from scenic roads and from schools.	Workers / volunteers at Begwary Brook Nature Reserve and Sir John's Wood Local Nature Reserve. Travellers on Barford Road, Potton Road, minor roads around Abbotsley, Croxton, Great Gransden and Eltisley.

Sensitivity	Landscape and visual receptor description	Examples within the study area
Low	Views experienced by people at their place of work, from non-scenic roads and sports facilities.	Workers at facilities at Caxton Gibbet, businesses at Eltisley Business Park, businesses along the existing A428, businesses, hotels at Wyboston, and travellers on East Coast Mainline railway and A1.

5.3.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.3.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3.

There is the potential for significant effects to landscape due to the new route corridors proposed through the study area. Mitigation is likely to include landscape design to soften the engineering designs and additional landscape and planting to mitigate the effects on the landscape.

5.3.7 Assumptions and limitations

This assessment is based on readily available web based data sources and a drive through by a landscape architect.

5.4 Biodiversity

5.4.1 Baseline sources

The following baseline sources have been used during the data gathering:

- Biological data, including records and the locations of non-statutory wildlife sites, were sourced from Cambridgeshire and Peterborough Environmental Records Centre (CPERC) and Bedfordshire and Luton Biodiversity Recording and Monitoring Centre (BRMC). Bat records were sourced from Cambridgeshire Bat Group and mammal records from Cambridgeshire Mammal Group. Bat records surrounding Black Cat Roundabout were sourced from Bedfordshire Bat Group.
- Ordnance Survey (OS) and Geographical Information System (GIS) maps were examined to locate ponds and wet ditches which might provide suitable habitat for amphibians, notably great crested newts (GCN) *Triturus cristatus*. In addition, OS maps were used to identify the locations of public rights of way (PRoW) that could be used to survey land where access permission was not granted by landowners.
- MAGIC was used to identify the locations of statutory designated wildlife sites, ancient woodland, and any European Protected Species Mitigation (EPSM) licences issued by Natural England (Defra, 2016b).
- The results of an extended Phase 1 habitat survey, GCN habitat suitability index assessment (HSI), and GCN environmental DNA (eDNA) surveys of all accessible areas within the Option 1 study area were reviewed as part of the baseline assessment.
- A review of standard data forms and conservation objectives (JNCC, 2015; Natural England, 2014b) was undertaken for all European sites within the study area. This information supported a Habitats Regulations Assessment, the results of which were reviewed as part of the baseline assessment.
- A ‘top-up’ extended Phase 1 habitat survey of previously inaccessible parts of the Option 1 will be undertaken in spring 2017, where access can be gained. Surveys to establish a population estimate of GCN in seven ponds (eDNA surveys confirmed GCN presence in 2016) along Option 1 will also be undertaken in spring 2017. An extended Phase 1 habitat survey and GCN eDNA surveys for Option 5 and 6 are planned for summer 2017. The results of these surveys will inform the Stage 3 EAR.

5.4.2 Geographical scope

The study area covers each of the proposed route options and comprises a buffer of 5km for statutory designated wildlife sites, 1km for non-statutory designated sites (including ancient woodlands), and 1km for protected/notable species (including a search for all EPSM licences granted by Natural England, as shown on MAGIC). A search for statutory designated sites beyond the 5km buffer, but with hydrological connectivity to the proposed route options, was also undertaken. In addition, a 30km search radius from each route option for SAC designated for bats was also considered (Highways Agency, 2009a).

The biological data records were gathered for the Stage 0 study area, which included a broad corridor extending from the existing A428, between its junction with the A1 and the Caxton Gibbet junction and covered Option 1. A further data request was requested during Stage 1 to gather data for Options 5 and 6. The data search was undertaken to identify records of protected/notable habitats and species, and designated sites.

At Stage 1, an extended Phase 1 habitat survey was undertaken over summer 2016. This included a 1.2km wide corridor centred on the alignment of Option 1. Towards the end of the survey season, Options 5 and 6 were identified but it was too late to survey these within the 2016 survey window. These options are planned to be surveyed over summer 2017.

Accessible ponds within 500m of Option 1 were subject to GCN HSI and eDNA surveys in 2016. GCN eDNA and HSI surveys of the remaining Option 1 ponds plus all ponds along Options 5 and 6 are programmed to be undertaken in spring/summer 2017.

5.4.3 Baseline conditions

There are no SPA, SAC, Ramsar sites, National Nature Reserves (NNR), or Local Nature Reserves (LNR) located within the 5km study area for all route options.

There is one SAC designated for bats within the 30km study area: Eversden and Wimpole Woods SAC lies approximately 8.2km to the south east of Option1 and 7.2km south east of Options 5 and 6. Eversden and Wimpole Woods SAC is primarily designated for barbastelle bats *Barbastella barbastellus*, a species that can forage at great distance from its roost sites. South Cambridgeshire District Council has identified an area outside of the SAC that is of importance for bats originating from the site; at its closest point, this area is 4.6km from the Options 5 and 6 and 7.2km from Option 1 (SCDC, 2009).

Each route option also has theoretical hydrological connectivity to Portholme SAC and Ouse Washes SPA/Ramsar via the River Great Ouse, although these sites are approximately 16km and 30km away respectively (straight line distance from the proposed crossing point over the River Great Ouse).

There are eight SSSIs within the 5km study area of Option 1 and nine SSSIs within the 5km study areas of Options 5 and 6. Elsworth Wood SSSI is located approximately 1.1km north-east of the existing A428 at Caxton Gibbet (figure 5.4); this SSSI is designated for its nationally uncommon woodland, which is of importance to its invertebrate community, and nationally uncommon beetle species. Waresley Wood SSSI lies 1.8km to the south of Option 5. The closest SSSI to Option 6 is Weaveley and Sand Woods, which is located 670m to the south. These SSSIs are primarily designated for ancient woodland.

There are ten non-statutory designated wildlife sites within all of the 1km study areas; nine are county wildlife sites (CWS) and one is a protected road verge (PRV).

There is one block of ancient woodland within 1km of Option 1 (approximately 400m away). There are two blocks of woodland within 1km of Option 5 (approximately 140m and 420m away). There are two blocks of ancient woodland within 1km of Option 6 (approximately 130m and 60m away). The following are also designated for ancient woodland: Elsworth Wood SSSI (approximately 1.1km to the north-east of all route options), Sir John's Wood CWS (adjacent to Options 5 and 6 and approximately 450m south of Option 1), Eltisley Wood CWS (approximately 500m west of Options 5 and 6, and 1.5km south of Option 1).

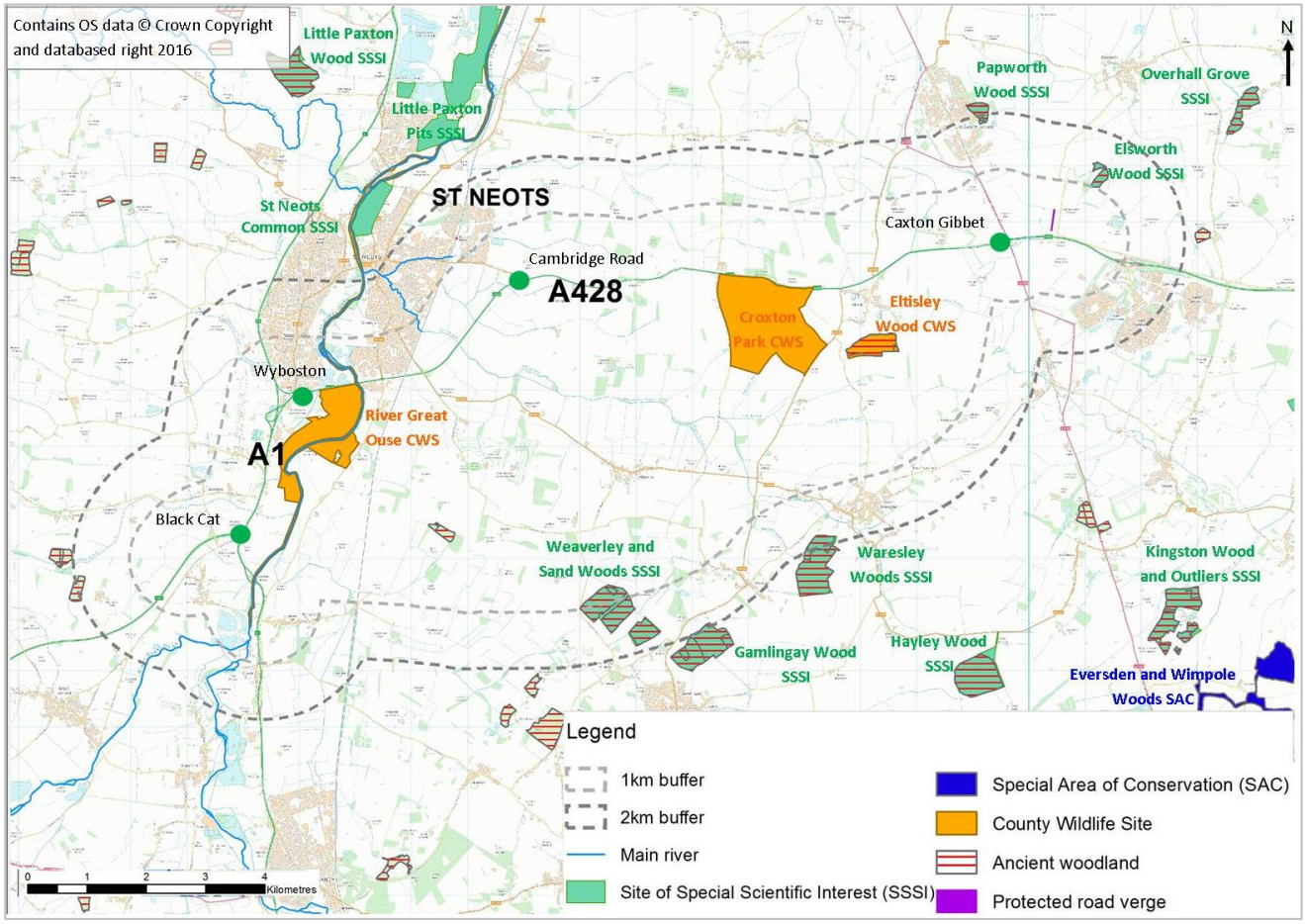
Details of the designated sites are provided in table 5.6.

Table 5.6 : Designated sites within the study area

Site Name	Grid reference	Relevant Route Option	Approximate distance from relevant route option	Reason for designation
Eversden and Wimpole Woods SAC	TL 340 526	All	8.5km southeast (Option 1) 7.2km southeast (Option 5 and 6)	Primarily designated for barbastelle bats.
Portholme SAC	TL 237 708	All	16km north of River Great Ouse crossing (all options)	Lowland hay meadows.
Ouse Washes SPA/Ramsar	TL 590 879	All	30km northeast of River Great Ouse crossing (all options)	Wintering and breeding wildfowl. Wetland habitats, plants and invertebrates.
Waverley and Sand Woods SSSI	TL 226 542, TL 232 538	All	670m south (Option 5) 2.5km southeast (Option 6) 3.6km southeast (Option 1)	The woodland is ancient in origin and of the ash-maple type which is restricted to lowland England and is a declining habitat.
Elsworth Wood SSSI	TL 313 617	All	1.1km northeast (all options)	Designated for its nationally uncommon woodland, which is of importance to its invertebrate community, and nationally uncommon beetle species.
Waresley Wood SSSI	TL 262 548	All	1.8km south (Option 5 and 6) 5km south (Option 1)	This woodland is of ancient origin and of the ash-maple community type which has a national distribution restricted to lowland England.
Papworth Wood SSSI	TL 291 630	All	1.9km south (all options)	Papworth Wood is known to be one of the oldest secondary woods in Cambridgeshire.
Gamlingay Wood SSSI	TL242534	Option 5 and 6	3.5km south (Option 5) 1.9km south (Option 6)	A woodland of ancient origin which consequently holds well developed plant and animal communities. It is additionally noted for its part location on a sandy loam soil type, unusual for this county, which is reflected in the vegetation.
Little Paxton Pits SSSI	TL 200 637	Option 1	2.4km northwest (Option 1)	Little Paxton Pits is an extensive area of flooded gravel workings of varied age, with a correspondingly diverse vegetation structure. The pits are of national importance for wintering wildfowl and an important stopping point for migrants. The invertebrate fauna is extremely rich and includes a number of national rarities.
St Neots Common SSSI	TL 183 613	All	2.5km west (Option 1) 4.8km northwest (Option 5 and 6)	This riverside common holds alluvial grassland and associated ponds, ditches and willow carr which together provide an area of diverse wildlife habitat supporting a variety of species.
Overhall Grove SSSI	TL 337 630	All	3.4km east (all options)	Overhall Grove is an ancient secondary woodland now dominated by small-leaved elm and represents a woodland type which is nationally restricted in its distribution.
Hayley Wood SSSI	TL291529	Option 5 and 6	4.6km south (Option 5 and 6)	One of the largest oxlip *Primula elatior* woods on the chalky Boulder Clay in Britain. Most of the wood is primary and has a recorded history of over 700 years. Many typical ancient woodland plants occur and the rides hold a rich vascular plant flora.

Site Name	Grid reference	Relevant Route Option	Approximate distance from relevant route option	Reason for designation
Little Paxton Wood SSSI	TL 170 635	Option 1	5km northwest (Option 1)	The site is situated on heavy calcareous boulder clay and represents a typical example of wet ash-maple woodland, which is found over such soils in lowland England. This type of woodland has undergone a significant decline over recent years.
Caldecote Meadows SSSI	TL348577	Option 5 and 6	5km southeast (all options)	An area of herb-rich grassland of a calcareous loam type, holding plant communities which are of nationally restricted distribution. Meadows of this type were once widespread throughout Cambridgeshire but are now scarce in the county.
River Great Ouse CWS	TL 37	All	Immediately adjacent (all options)	A major river not grossly modified by canalisation or poor water quality; supports >0.5 ha national vegetation community (NVC) S6 swamp; >0.5 ha S4 swamp; >0.05 ha MG13 grassland; a nationally scarce vascular plant and a breeding population of a nationally rare dragonfly.
Sir John's Wood CWS	TL195554	All	Immediately adjacent (Option 5 and 6) 450m southeast (Option 1)	Ancient semi-natural woodland and UK Biodiversity Action Plan (BAP) habitat: lowland mixed deciduous woodland.
Croxton Park CWS	TL 252 598	All	Immediately adjacent (Option 1) 1km north (Option 5 and 6)	Parkland with groups of 5 – 19 veteran trees associated with other semi-natural habitat. Also supports a population of nationally scarce vascular plant species Oxslip and qualifies for habitat mosaic.
Eltisley Wood CWS and ancient woodland	TL 272 588	All	490m west (Option 5 and 6) 1.5km south (Option 1)	An ancient woodland over 75% replanted which supports more than 40 woodland species, and also supports a population of a nationally scarce vascular plant species.
Begwary Brook Pits CWS	TL168563	All	570m north (Option 1) 680m north (Option 5) 610m north (Option 6)	CWS recognised for a mosaic of wetland habitats, including UK BAP priority habitats such as fen, marsh, swamp, rivers and canals.
Crimpledean Paddock CWS	TL259564	All	4km south (Option 1) 600m south (Option 5) 700m south (Option 6)	The field qualifies as CWS because it supports a population of a nationally scarce vascular plant species (*Trifolium ochroleucon*).
Latch Pool and Ditch CWS	TL174534	All	1.1km south (Option 1) 840m south (Option 5) 1km south (Option 6)	CWS recognised for water bodies.
Little Barford CWS	TL178570	All	1km north (Option 1) 1.35km north (Option 5) 1.1km north (Option 6)	CWS containing a variety of habitats including swamp and neutral grassland.
Elsworth (A428 to Common Farm) PRV	TL 305 610	All	Immediately adjacent (all options)	Neutral/ calcareous grassland and presence of a local red data book species.

Figure 5.4: Key habitats and features



The extended Phase 1 of Option 1 has shown that the majority of habitat coverage across the survey area comprises arable fields with small and localised blocks of semi-natural and plantation woodland. Most field boundaries support hedgerows, some of which support mature trees. The study areas support a number of Cambridgeshire Biodiversity Action Plan (BAP) priority habitats including farmland (arable); deciduous woodland; grazing marsh; wood pasture and parkland; traditional orchards; ponds; hedgerows; and rivers and streams. Other potentially notable habitats recorded include unimproved neutral grassland and arable margins. The Option 1 extended Phase 1 habitat survey report is provided in Appendix E. An extended Phase 1 habitat survey for Options 5 and 6 is programmed for spring / summer 2017.

There are several records of notable animal and plant groups within the 1km study areas for the options:

- Option 1: There are 57 species listed on Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006; 33 species listed under the Wildlife and Countryside Act 1981 (as amended) (including four species listed on the Conservation of Habitats and Species Regulations 2010 (as amended)); 57 species listed under the UK BAP; nine local BAP species; and seven birds listed under Annex 1 of the Birds Directive.
- Option 5: 59 species listed on section 41 of the NERC Act 2006; 25 species listed under the Wildlife and Countryside Act 1981 (as amended), including five species listed under the Conservation of Habitats and Species Regulations 2010 (as amended); 59 species listed on the UK BAP; eight local BAP species; and ten birds listed under Annex 1 of the Birds Directive.
- Option 6: 65 species listed on section 41 of the NERC Act 2006; 23 species listed under the Wildlife and Countryside Act 1981 (as amended), including five species listed under the Conservation of Habitats and Species Regulations 2010 (as amended); 65 species listed on the UK BAP; six local BAP species; and ten birds listed under Annex 1 of the Birds Directive.

The species that receive full legal protection that have been recorded within the study areas comprise badger *Meles meles*; GCN; water vole *Arvicola amphibius*; otter *Lutra lutra*; bats; grass snake *Natrix natrix* (Option 1 only); and common lizard *Zootoca vivipara* (Option 1 only). Habitats considered suitable to support all of these species were recorded during the extended Phase 1 habitat survey of Option 1, along with habitats suitable for various species listed on Section 41 of the NERC Act and the UK and Cambridgeshire BAPs.

Invasive species in the form of Himalayan balsam *Impatiens glandulifera* and Japanese knotweed *Fallopia japonica* were recorded within the Option 1 survey area during the extended Phase 1 habitat survey.

5.4.4 Value of receptors

The value of each receptor was determined based on a geographical scale, following the approach described in DMRB IAN 130/10 Ecology and Nature Conservation (Highways Agency, 2010b) and the Guidelines for Ecological Impact Assessment (CIEEM, 2016). An overview of the criteria used to determine the value of the receptors is provided in Appendix C.

The receptors included in table 5.7 are based on species recorded during the surveys or with the potential to be present on the scheme based on habitat suitability and known range (i.e. background data search and known habitats). For the purpose of this document, the list of receptors and the respective values should be treated as provisional and may change based on the outcome of more detailed surveys, assessments and consultation during future stages of the project. As a full baseline has yet to be established, a precautionary approach to assigning receptor valuations has been taken.

Table 5.7 : Value of receptors for nature conservation

Receptor	Description	Examples within the study area
Habitats and sites		
Very high	Very high importance and rarity, international scale and very limited potential for substitution. Includes Ramsar and European designated sites, or sites that meet the published selection criteria but not designated as such.	Eversden and Wimpole Woods SAC
High	High importance and rarity, national scale, and limited potential for substitution. Includes statutory designated sites such as SSSIs and NNRs, as well as ancient woodland and sites that meet published criteria for selection. Key / priority habitats.	Elsworth Wood SSSI, Papworth Wood SSSI, St Neots Common SSSI, Elsworth Wood Ancient Woodland, Hayley Wood SSSI, Caldecote Meadows SSSI and Gamlingay Wood SSSI
Medium	High or medium importance and rarity regional scale, moderate potential for substitution. Non-statutory designated wildlife sites, such as CWS designated in the county or unitary authority area context. LNRs. Includes key / priority habitats identified in local or Highways BAP. Habitats listed in accordance with the requirements of Section 41 of the NERC Act.	Eltisley Wood CWS, River Great Ouse CWS and Croxton Park CWS Veteran trees and habitats listed on Section 41 of the NERC Act or Cambridgeshire local BAP (LBAP) e.g. wood pasture and parkland
Low	Medium and low importance and rarity, local and site scale, higher potential for substitution. Receptor is relatively common and widespread but has elevated conservation status, e.g. is listed in accordance with the requirements of Section 41 of the NERC Act, LBAP.	Elsworth (A428 to Common Farm) PRV, hedgerows and semi-natural woodland
Species		
Very high	Sites with resident or regularly occurring population/s of species at an international or European level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.	Species listed on Annex I and Annex II of the Conservation of Habitats and Species Regulations 2010 (as amended) with functional linkages to SACs, SPAs or Ramsar sites

Receptor	Description	Examples within the study area
High	Sites with resident or regularly occurring population of species at UK or national level where loss would affect the conservation status or distribution at this geographic scale. Where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale. Species recorded as 'critically endangered' under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2016).	GCN, bats and otter
Medium	Resident or regularly occurring populations of species which may be considered at a regional, county or district level, or key / priority species where loss of these species would affect the conservation status or distribution at this geographic scale, or the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale. Species listed in accordance with the requirements of Section 41 of the NERC Act.	Water vole
Low	Areas of habitat or populations / communities of species valued at a local or site level. Receptor is relatively common and widespread but has elevated conservation status, e.g. is listed in accordance with the requirements of Section 41 of the NERC Act, LBAP, Birds of Conservation Concern Red or Amber listed (Eaton *et al*., 2015), Red Data Book listed and/or is legally protected.	Reptiles, badger and abundant Section 41 species such as brown hare *Lepus europaeus*

5.4.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.4.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3.

All options have the potential to significantly impact protected species and habitat, including local wildlife sites near Black Cat junction. Option 6 is within 1km of Weaveley and Sand Woods SSSI, with the potential for significant effects to the site through air quality change, fragmentation, disturbance or habitat degradation.

5.4.7 Assumptions and limitations

This assessment is based on readily available data sources, data requests from local record centres, an extended Phase 1 habitat survey, and GCN HIS / eDNA surveys. These surveys do not currently cover Options 5 and 6; surveys covering these options will be undertaken in summer 2017. With the exception of GCN HSI / eDNA surveys, no species specific surveys have been undertaken at the time of this assessment. These surveys will be undertaken in summer 2017.

5.5 Geology and soils

5.5.1 Baseline sources

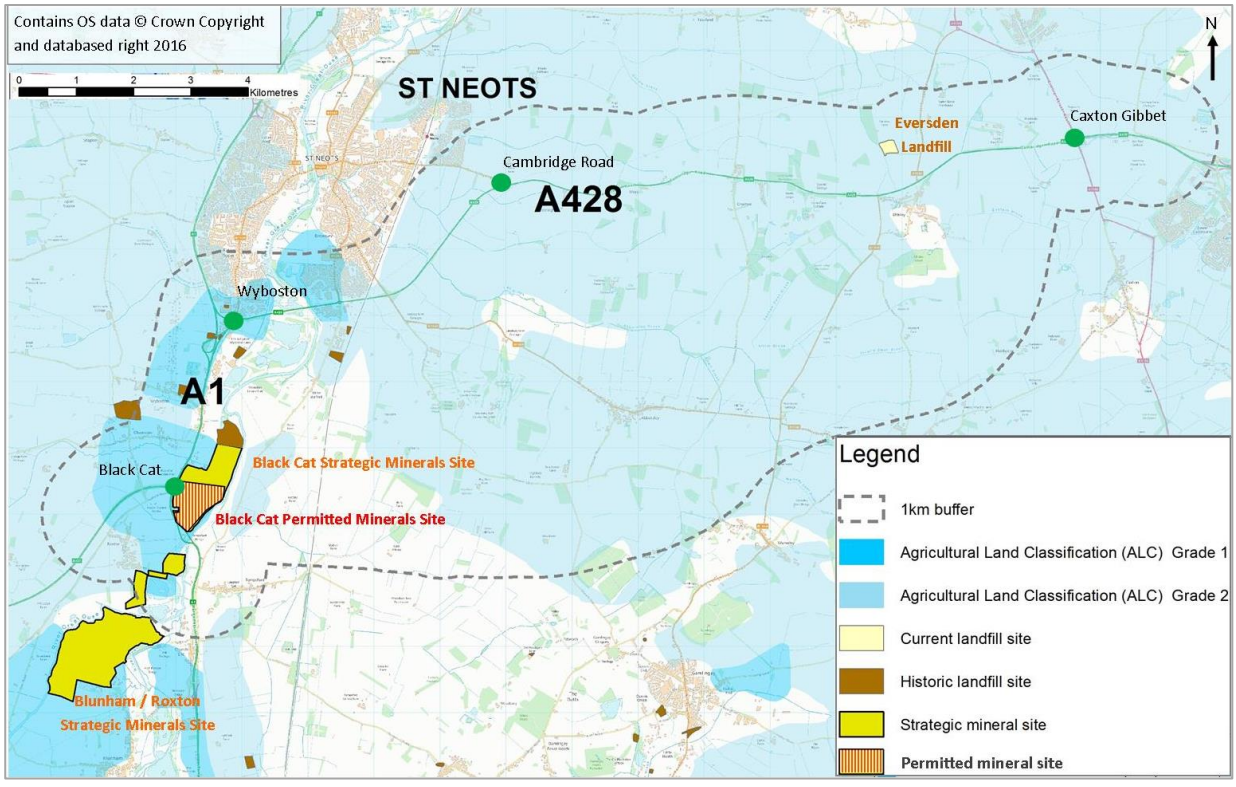
The following baseline sources have been used during the data gathering:

- Land use has been assessed by review of open map data and aerial photography including Google Earth[1] and Old-Maps[2]
- British Geological Survey (BGS) website (BGS, 2016) and BGS printed drift map, Sheet 187 (Huntingdon), and 207 (Biggleswade), 1:50,000 scale (1975)
- Bedfordshire (BGS, 1995) and Cambridgeshire (BGS, 2003) BGS Mineral Resources maps (1: 100 000)
- Council mineral policy maps (Cambridge County Council and Peterborough City Council, 2010; Bedfordshire County Council, 2005; Central Bedfordshire Council, 2013 and 2014)
- The Environment Agency (2016) website, using the "What's in Your Backyard" series of interactive maps and the Environment Agency Catchment Data Explorer
- Designated sites and features identified on the MAGIC website (Defra, 2016b)
- Cambridgeshire Geological Society website (2016) and the Bedfordshire Geology Group website (2016)
- Zetica Free Risk Map for unexploded ordnance, Map for Cambridgeshire and Bedfordshire (Zetica, 2016)
- Envirocheck Professional GIS data and historical Ordnance Survey mapping in GIS format obtained for this scheme (500m buffer around Option 1, Option 5 and Option 6).

5.5.2 Geographical scope

A 1km wide corridor study area was used around the existing options for the baseline review.

Figure 5.5: Key geology and soils features



[1] https://www.google.co.uk/earth/
[2] https://www.old-maps.co.uk/#/

5.5.3 Baseline conditions

Geology

The bedrock in the west of the study area and underlying the majority of the existing A428 is the Oxford Clay Formation, formed of silicate mudstone with sporadic limestone beds. The unit is estimated to be over 13.6m thick, as recorded in BGS borehole TL15NE2, with thicknesses of 58-69m typical for the unit (BGS, Sheet 187). The Oxford Clay dips towards the east, exposing the overlying West Walton and Ampthill Clay Formation in the east of the study area. The West Walton Formation comprises calcareous mudstones, silty mudstones and siltstone with fine grained sandstone and limestone. The Ampthill Clay Formation comprises predominantly smooth, slightly silty, grey mudstone with some limestone nodules. Typical thickness for the units combined is 20-52m (BGS, Sheet 187).

The superficial geology is predominantly the Oadby Member (grey, weathering brown, diamicton till). In the western part of the study area, along the A1 and western-most part of the existing A428, the superficial deposits are river terrace deposits, comprised of sand and gravel; and alluvium, comprised of clay, silt, sand and gravel, deposited within the valley of the River Great Ouse. In some isolated parts of the study area there are no superficial deposits recorded.

There are no geological faults anticipated within the study area. Made ground is expected beneath and surrounding the main roads in the area, including the A1 and A428. The soil in the majority of the study area is considered 'lime-rich loamy and clayey soils with impeded drainage'. In the west of the study area, either side of the River Great Ouse, the soil is described as 'freely draining, slightly acid loamy soils', with soils comprising 'Loamy and clayey floodplain soils with naturally high groundwater' directly adjacent to the watercourse.

No local geological sites, geological SSSIs, world heritage sites or national parks have been identified within the study area.

Soils

The study area includes agricultural land classification (ALC) grade 2 (very good) quality agricultural land (figure 5.5). In some localised parts of the study area (predominantly towards the western end of the study area) the soil is classified as grade 1 (excellent) and grade 3 (good). This high grade land should be considered a high sensitivity receptor. In the east of the study area, just south of Eltisley, the land is considered 'non-agricultural' with a grade 3 classification. Part of this area of land corresponds with designated ancient woodland areas.

Mining, quarrying and mineral resources

The wider corridor of the River Great Ouse is a mineral consultation area. This extends on both sides of the existing A428 and includes the area around Wyboston junction. Within the consultation area there are four mineral safeguard areas (MSA) for river valley/glacial sand and gravel, including two small areas to the west of the A1 Wyboston junction, an MSA extending southeast of St Neots along the Hen Brook and the River Great Ouse corridor. Within the River Great Ouse MSA, there are two strategic mineral sites involving the extraction of sand and gravel in the area around and to the south of Black Cat junction:

- The Black Cat site is approximately 36.5ha in area and is located immediately east of the A1-A421 Black Cat junction. There is one active quarry (permitted minerals site) located within this site operated by Breedon Aggregates (formerly Hope Construction Minerals).
- The Blunham/Roxton site is approximately 145ha in area and is located south of the A1-A421 Black Cat junction. There is a haul road running from the latter site to the Bedford Road.

A number of inactive, filled or flooded sand and gravel pits can be identified from the BGS Mineral Resources Maps (Cambridgeshire and Bedfordshire). All of these are in the Wyboston and Eaton Socon areas in the west of the study area.

The proposed scheme does not lie in an area where coal mining has been carried out.

Landfills and waste management facilities

There are nine historic landfills identified within the study area (figure 5.5). These were used for a range of wastes including commercial, industrial, inert, household and special wastes. There is one authorised landfill (Eversden Landfill) in the study area located approximately 1km north of Eltisley. The landfill is operated by Eversden Landfill, with an A6 'Landfill taking other wastes' licence. Waste management facilities can represent potential sources of ground gases as well as soil and groundwater contamination.

The Envirocheck records one waste management facility within the study area, the license status for which is listed as revoked. The facility was named Off Great North Road and was active between May 2012 and October 2015 and was for use for waste in construction (<50,000 tonnes).

Groundwater and hydrogeology

Surface water receptors are detailed in section 5.9, road drainage and the water environment. To avoid duplication this section only covers groundwater receptors.

The majority of the superficial deposits in the area are classified as a secondary (undifferentiated) aquifer, corresponding with the diamicton till (Oadby Member). In the west of the study area, along the A1, where the superficial deposits on the surface are formed from Alluvial and River Terrace Deposits, the deposits are classified as secondary A aquifers. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. The bedrock across the majority of the study area is designated as unproductive strata. This is due to its low permeability and lack of importance to water supplies and base river flow. A designated bedrock aquifer (principal aquifer) lies to the south east of the study area, within the Woburn Sands formation. Some of the western parts of the study area are in minor aquifer intermediate and high vulnerability zones (corresponding with the River Terrace Deposits and Alluvium); however, the majority of the study area is not in groundwater vulnerability zones.

The Environment Agency website "What's in your backyard" indicates that there are multiple groundwater abstraction licences identified within the study area. These are indicated for irrigation, general farming and domestic use. The level of detail on the website makes it difficult to determine the precise location, number and types of abstractions within the study area. More detailed studies at the next stage of assessment will be undertaken to determine this information. A groundwater source protection zone (total catchment Zone SPZ3) is present in the south eastern boundary of the study area (Environment Agency, 2016).

Potential sources of contamination

The study area is predominantly in a rural setting consisting of mostly agricultural land use. The historical land use of the study area can be summarised as follows:

- The area was comprised predominantly of agricultural, undeveloped land and woodland and the existing Great North Road (western half) and Cambridge Road (eastern half) in 1884. Residential buildings were concentrated within villages at either side of roads, whereas farms were set back from the roads via access routes. The ECML was present in the west of the study area.
- Between 1945 and 1950 there where road developments towards the eastern end of the area with a new roundabout built to replace the intersection between Cambridge Road and Ermine Street (A1198). Residential areas and roads were developed at various locations in the study area.
- There are no significant changes until 1958 to 1970, when new roads were constructed in the western end of the study area. Development increased either side of the roads and within the villages.
- Between 1974 and 1979 there were significant road developments in the study area, particularly west of St. Neots, east of Little End and north of Eltisley. There were also noticeable building developments across the study area especially south of St. Neots.
- In 1979 a new road was built north of Eltisley, connecting Cambridge Road to bypass the village centre.
- In 1983 a sewage works was present within 50m of the A1 north of Black Cat junction.
- There were significant changes until 2003 to 2008, when new roads were built in the east of the study area.

Four significant pollution events were recorded towards the north of the study area in 2002, 2003 and two in 2007, impacting water (with minor impacts to air and land), land (with no impact to air or water), water and water (with minor impact to land) respectively. One major water pollution incident was recorded just over 1km north of the existing A428 near Eaton Socon. There are also two expired discharge consents recorded by the Environment Agency located immediately east of the River Great Ouse, 1km north of Little Barford, These are associated with air and water releases from the Little Barford Generating Station.

The Envirocheck shows a number of tanks present within the study area associated with the historical filling stations. The current status of the tanks is unknown.

Unexploded ordnance (UXO)

Risk maps from Zetica (Cambridgeshire and Bedfordshire) suggest that the study area is in a low risk zone. Low risk equates to up to 10 bombs per 1000 acres. The Zetica regional unexploded bomb risk map states that readily available records indicate that a density of approximately 156 high explosive bombs were encountered within the St. Neots borough. There may be additional risk of UXO from bombers that have crashed from nearby airfields and remained undiscovered. Further information can be found in the Preliminary Sources Study Report (Jacobs, 2017b).

5.5.4 Value of receptors

An overview of the criteria used to determine the value of the receptors is provided in Appendix C. Table 5.8 summarises the value of the receptors identified within the study area.

Table 5.8 : Value of receptors for geology and soils

Receptor	Description	Examples within the study area
Geology, soils and hydrogeology		
High	Nationally designated sites of geological value. Agricultural land of grade 1 (excellent), grade 2 (very good) or grade 3a (good) quality. Principal Aquifer with or without local abstractions, or secondary A aquifer with abstractions. Proven mineral reserves and sites with extraction permits.	Grade 1 and 2 agricultural land classification (ALC) soils, e.g. around Black Cat (grade 1) and along the majority of the study area (grade 2). Minerals safeguarding areas around Black Cat and Wyboston. Groundwater within the superficial deposits such as the river terrace deposits secondary A aquifer where abstractions are present.
Medium	Grade 3b (moderate) agricultural land. Secondary A aquifer, no abstraction. Minerals sites identified for future extraction e.g. mineral consultation areas.	Surface water of the River Great Ouse, Abbotsley Brook, Vicar Dean Brook and any ponds located in the study area. Groundwater within the superficial deposits such as the diamicton till secondary (undifferentiated) aquifer.
Contaminated land receptors in addition to those above		
Very high	High impacts due to potential for exposure to contaminated land or landfill materials in the ground.	Construction workers / below ground workers during the works.
Medium	Medium impacts where industrial use is prevalent.	Risks to current and future highways and associated infrastructure, including nearby residential and commercial buildings from ground gas and contaminated land. Undeveloped land dominates the majority of the study area.
	Medium impact due to potential for limited temporary exposure where mitigation is undertaken.	Current and future highways users and nearby site users (commercial / industrial land use).

5.5.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.5.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3.

There is potential to significantly affect soils, as all options would result in the loss of a large amount of grade 1 (excellent) and 2 (very good) agricultural land. Junction improvements at Black Cat could also encroach into mineral sites, including the Black Cat strategic mineral site. Mineral extraction prior to construction could mitigate this effect.

The work would also need to include an assessment of risks from major accidents and disasters. This could include man made events such as creating pathways to a pollution source which creates a major pollution or health event. It also includes potential natural events such as subsidence (due to ground conditions) or erosion (including wind or water erosion) of structures that could lead to a categorical failure of the road.

5.5.7 Assumptions and limitations

This assessment is based on readily available web based data sources. No site surveys have been completed to date. Records of regional or local geological sites and more detailed records about site conditions would need to be obtained at Stage 3.

5.6 Climate change

5.6.1 Geographical scope

No geographical scope applies to this topic at this stage.

5.6.2 Baseline conditions

The A428, experiences a climate typical of much of terrestrial Southern England. Climatic variables (based on the 30 year average weather conditions) indicate a temperate climate with an average temperature of 10.5 degrees centigrade (°C). Average daily temperatures in summer (July) range from a maximum of 22.8°C to a minimum of 12.4°C. In winter (January) average temperatures range from a maximum of 7.3°C to a minimum of 1.6°C. The highest recorded temperature in the area was 37.3°C in Cavendish, (roughly 50km east of Cambridge) on the 10th August 2003.[3]

On average, December is the month with the least sunshine in contrast with July which has the most sunshine. Rainfall data shows that on average roughly 570mm falls on the area each year on average, with October classed as the wettest month with 59 mm of rainfall on average. The number of annual thunderstorms makes a significant contribution to the total annual rainfall. They can occur at any time of the year but are more frequent during the summer months. Over East Anglia, Lincolnshire and Humberside the average number of days of thunder per year is about 15 however there is considerable variability each year.[4]

5.6.3 Value of receptors and assessment methodology

Climate would not be assessed in the standard way of assessing value of receptors and magnitude. Instead, the process will involve a calculation of the carbon associated with the construction of the preferred option. It would also look at ways of how the designs have adapted to climate change and to compare the outcomes to planning policy recommendations. Climate change mitigation in terms of flood risk would be covered within the Road Drainage and Water chapter.

5.6.4 Design, mitigation and enhancement measures

Once the baseline carbon value has been calculated, mitigation would be identified to reduce the carbon footprint from this baseline. This may include using fewer materials through changes to the design or using

[3] (General information) - http://www.metoffice.gov.uk/public/weather/climate/u1214qgj0
[4] (Thunder and Hail) http://www.metoffice.gov.uk/climate/uk/regional-climates/ee

products with a lower embedded carbon footprint. An assessment would also be made to the vulnerability of the project to climate change and how the designs have been adapted to minimise this vulnerability.

5.6.5 Assumptions and limitations

There is not enough information available on the design and construction processes to date to quantify the carbon footprint.

5.7 Noise and vibration

5.7.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- England noise map viewer (Extrium, no date)
- Google Maps[5]

5.7.2 Geographical scope

The Study Area and the Calculation Area for the noise assessment would be defined in accordance with HD 213/11 – Revision 1. The Study Area is defined as a 1 km boundary around the start and end points of the physical works associated with the road project for each option, and any improved or bypassed routes as part of the scheme. The Calculation Area is then defined as all residential dwellings and other noise sensitive receptors within 600 m of the proposed scheme and for those roads (within 1 km of the proposed scheme) on the existing road network that are predicted to result in noise changes of 1 dB in the opening year or 3 dB in the design year.

HD 213/11 – Revision 1 requires consideration beyond the Calculation Area, to take into account the likely noise impacts on the wider road network (considered in terms of change in basic noise level (BNL)). This is required for such roads where there is a 1 dB increase or decrease in noise in the base year and/or a 3 dB increase or decrease in the future assessment year in comparison with the base year. These roads would be included in the noise Study Area.

5.7.3 Baseline conditions

The existing noise climate in the vicinity of the scheme is dominated by road traffic noise, predominantly from the A1, A428, A1198 and associated junctions. Other significant sources of road traffic noise include the B1428, B1043, B1046, B1428, and B1040. There are also a number of minor roads, in particular in St Neots, which contribute to the local soundscape.

In addition, rail noise from the ECML could dominate in some locations and contribute in general to the local soundscape. Recreational aircraft flying out of Bourn, Gransden Lodge and Little Gransden airfields may also contribute to the noise environment on occasion. Other noise sources will include road traffic noise from local roads and noise associated with general urban and rural activities.

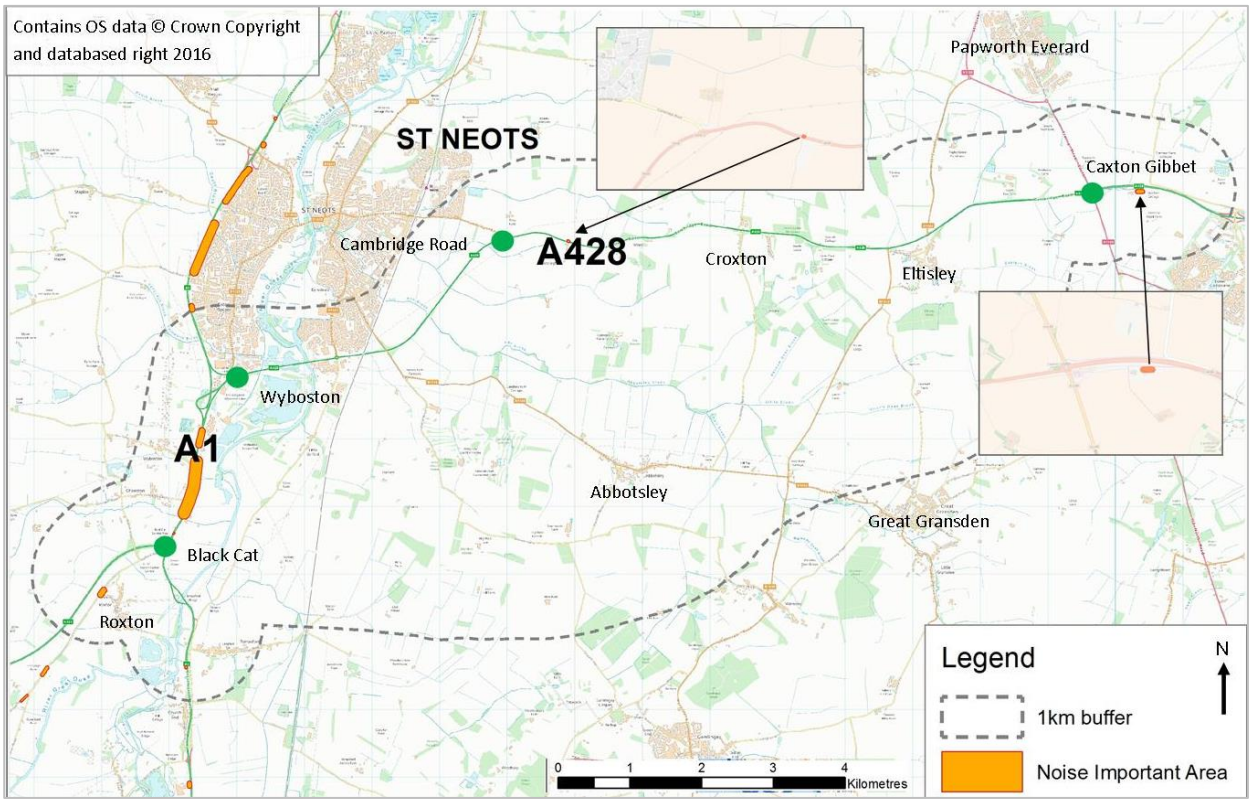
There are five noise important areas (NIA) in the study area (figure 5.6). Three are located on the A1, north of the Black Cat junction; one is located on Bedford Road (minor road); and two on the A428, one lies 1km east of the A428/B1428 Cambridge Road junction and the other lies 0.7km east of the A428/A1198 Caxton Gibbet junction. NIA are considered to be where the top 1% of the population experience the highest noise levels (Defra, 2014). There are no railway NIAs in the study area.

Sensitive receptors for humans include residential properties in: St Neots; Eaton Socon; Tempsford; Eynesbury; Roxton; Chawston; Wyboston and properties along Rookery Road; Little Barford; Croxton; Eltisley; Caxton; and Cambourne. There are also individual dwellings in the countryside, including some located immediately adjacent to the A428. A Travelodge hotel is located immediately adjacent to the Black Cat junction.

[5] https://www.google.co.uk/maps/

There are a number of schools in the study area including: Roxton VA (Church of England) Lower School; Middlefield Community Primary School; Ernulf Academy; Newton Primary School; Monkfield Park Primary School; Cambourne Village College; and Hardwick and Cambourne Community Primary School.

Figure 5.6: Key noise and vibration features



Other sensitive noise sensitive receptors include Croxton Park Registered Park and Garden, which is located adjacent to the existing A428. The park is also a CWS. Wyboston Lakes Golf course is located in Little Barford and the Abbotsley Golf Club approximately 2km west of Abbotsley are both recreation areas. There are numerous footpaths and other PRoW in the area.

5.7.4 Value of receptors

DMRB states that a methodology has not yet been developed to assign significance of effects according to both the value of a resources and the magnitude of an impact. However, the considered value for some examples of potential receptors within the study area are provided in table 5.9 based on the criteria set out in Appendix C.

Table 5.9 : Value of receptors for noise and vibration

Value	Receptor
High	Residential areas, individual residential property, educational receptors (schools, pre-schools)
Medium	Public footpaths, golf courses / clubs, parks, recreational ground / playing fields

5.7.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.7.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3.

There is potential for significant beneficial effects to property adjacent to the existing A428, as traffic is diverted onto a new offline route. However, this could also result in significant adverse effects to property in the vicinity of the mainline options. There is also potential for noise impacts to receptors around Black Cat junction as traffic volume increases. The scale of the traffic effects would be determined when the traffic modelling results are available.

5.7.7 Assumptions and limitations

No traffic modelling data has been made available at the time of this study.

5.8 People and communities

5.8.1 Baseline sources

The following baseline sources have been used during the Stage 1 data gathering:

- Ordnance survey mapping data
- Site visit and aerial photographs

5.8.2 Geographical scope

The desktop study area has considered a 1km buffer around all three options.

5.8.3 Baseline conditions

Private and community assets are considered within DMRB, Land Use (Volume 11, Section 3, Part 6 and part 8) and with consideration of IAN 125/15 (Highways Agency, 2001; 2015). DMRB outlines four subsidiary topics:

- Private property including the demolition of property or any associated loss of land which may result in the loss of facilities, quality of life, services or employment.
- Community land including land used by the public that is town or village green, a public park or land used for public and private recreation amenity, or land that is a disused burial ground.
- Development land including future land-use changes that are likely to occur independently of the Proposed Scheme, including land covered by land use planning designations and any planning proposals lodged with the planning authorities (this is covered in section 6).
- Agricultural land including agricultural land take, type of husbandry, severance of agricultural holdings, major accommodation works, access, water supply and drainage. This has links with section 5.5 (geology and soil).

In addition, there is guidance set out in the DMRB covering Pedestrians, Cyclists, Equestrians and Community Effects and Vehicle Travellers (Volume 11, Section 3, Parts 8 and 9) (Highways Agency, 1993e; 1993f).

Private property

St Neots is located along the existing A428 to the north west of the study area, and is the largest built up area in the area. Other residential areas include Wyboston, Roxton, Little Barford, Abbotsley, Croxton and Eltisley. There are also a number of farms and isolated property in the open countryside.

There are a number of commercial assets within the study area that also provide benefit to the community, the majority of which are located along the A428 corridor. Assets within 100m of the A428 include:

- Service areas at Black Cat junction (including Travelodge hotel), and at Caxton Gibbet junction (including McDonalds, Shell garage, and Costa cafe)
- Whitehall Industrial Estate in Croxton; Little End Road and Howard Road industrial estates in St Neots; and an industrial estate along Alington Road, south of St Neots
- Papworth Hotel on Ermine Street, where the A1198 meets the A428

- Kelpie Marine boat yard by Tempsford Bridge
- Little Barford electricity generating power station, south-east of St Neots
- Businesses, including Cemex cement plant located within Wyboston Leisure Park
- Roxton Garden Centre, approximately 300m south-west of the Black Cat junction
- Business (including McDonalds, BP garage, and independent retailers) adjoining the Great North Road in Wyboston
- St Neots Autograss Club motor sports circuit, located adjacent to the A428 immediately south of Black Cat
- Premier Inn and other businesses at Wyboston interchange
- Tesco superstore south of St Neots
- Abbotsley Golf Club, located approximately 2km west of Abbotsley
- Various farms, plantations, and associated businesses located in the countryside

Community land

There are a number of community receptors in the study area, including:

- The Robinson College, located on Great North Road south of Little End
- St Neots Community College, located approximately 600m north of the A428 in St Neots
- Middle Field Community primary school, located approximately 400m north of the A428 in St Neots
- Barford Road Pocket Park, located approximately 300m from the A428 in St Neots
- Wyboston Leisure Park, located south of St Neots
- Places of worship in St Neots, Abbotsley, Croxton, Eltisley, and Little Barford
- Newton Primary School in Eltisley

Development land

Bedford Borough: Land to the east of Black Cat and the A1 is designated as a Green Infrastructure Network Opportunity Zone (Lower Great Ouse Valley). These zones represent areas where development should deliver or contribute to the protection, enhancement and/or creation of green infrastructure in accordance with the priorities set out for each opportunity zone (Bedford Borough Council, 2013).

Central Bedfordshire: No development land has been identified with the study area that falls within Central Bedfordshire.

Huntingdonshire District: There are two allocated housing sites located adjacent to the A428 in St Neots: a 21ha site at Barford Road; and a 58ha site on and east of the ECML (north of Cambridge Road). The area at Barford Road is also allocated as an employment zone, where development of industry, warehousing and distribution, office and high technology uses will be prioritised.

The river Great Ouse valley north of the A428 is designated as an area of strategic greenspace enhancement. Action will be taken in this area to safeguard and enhance features of biodiversity / landscape / historic / recreational value (Huntingdonshire District Council, 2009).

South Cambridgeshire District: No development land has been identified in the study area that falls within South Cambridgeshire.

Agricultural land

The majority of the study area is classed as ALC grade 2 (very good) agricultural land (see section 5.5 - geology and soils). Remaining areas are classed as grade 1 (excellent) around Black Cat and grade 3 (good and moderate) to the south of Cambridge Road. There are a number of large commercial plots (over 100ha in size)

around the middle sections of the existing A428. There are smaller plots located around Black Cat and around the fringes of St Neots.

Transport and non-motorised users

The ECML runs north-south through the study area, parallel to the A1 and east of St Neots. The line links London to Edinburgh, via Peterborough, Doncaster, Wakefield, Leeds, York, Darlington and Newcastle.

The A1 and A421 meet at the Black Cat junction with the A1 continuing north from Black Cat as the Great North Road, joining the A428 south of St Neots at the Wyboston interchange. The A428 runs east towards Cambridge, joining the A1198 at the Caxton Gibbet interchange. There are a number of B roads and minor roads which cross or adjoin the existing road network in the study area:

- Bedford Road feeding into the Black Cat junction
- Colesden Road and The Lane, both joining the Great North Road in Wyboston
- B1428 at the Wyboston interchange and east of St Neots at the Tithe Farm junction
- B1043 connecting St Neots to the A428, continuing south towards Black Cat as Barford Road
- B1046 from St Neots over the A428 travelling south east towards Abbotsley Golf Club
- Drewels Lane which joins with the B1046 to the north west of Abbotsley Golf Club
- St Neots Road connecting Abbotsley with the B1046
- Abbotsley Road which joins the A428 west of Croxton, and continues south sown the study area towards Abbotsley, and north towards Toseland
- B1040 joins the A428 at Eltisley, continuing north to Papworth Everard and south towards Great Gransden

There are limited bus services operating along the A428. A Stagecoach service runs between Cambridge and Oxford via St Neots, Bedford and Milton Keynes; and two National Express services operate on the A428 once per day.

There are numerous PRoW within the study area, which are clustered around Black Cat junction and Wyboston; south-east of St Neots, between Hen Brook and Wintringham; and the settlements of Weald, Croxton, and Eltisley. The Ouse Valley Way regional trail runs adjacent to and crosses the Great North Road in Wyboston, and crosses the A428 going into St Neots at the Wyboston Interchange. National cycle route 12 (the Bedford Green-Wheel Cycle Network) runs north-south through the study area to the west of the Great North Road, crossing the A1 to the west of Black Cat junction.

The Felixstowe to Midlands Route Based Strategy report identified that the Black Cat, Wyboston and Caxton Gibbet roundabouts, and the A428 link between Wyboston and Caxton Gibbet have issues regarding cycling and pedestrian provision (Highways Agency, 2014).

Population and health

The Proposed Scheme is unlikely to affect population and therefore this is not assessed further within the EAR.

A preliminary health assessment has been completed to identify where there could be health effects from the Proposed Scheme. This involved undertaking a high level desk based assessment based on the ‘Rapid Health Impact Assessment Tool’ developed by the London Healthy Urban Development Unit (2013). This has used information from publically available sources only. As part of this exercise a causal pathway diagram has been produced and an assessment matrix completed (Appendix G).

The health assessment shows how some of the health impacts are being reported and mitigated within existing topic chapters e.g. noise, air quality and communities. In addition, other documents will cover aspects of the health assessments including the Human Health Risk Assessment undertaken as part of the contaminated land assessments within the ground investigation studies. Other measures to protect humans during construction and operation from contaminated land risks will be documented within the contaminated land assessment.

The health assessment has identified the following elements which could result in significant health impacts which would be scoped into the future assessment:

- All bypass options would sever open space and rights of way. This would decrease the viability and amenity of the open land between the existing A428 and the new offline route. A reduction in open space can result in increased severance, reduced amenity, and reduced property prices. These in turn can negatively impact health by increasing stress, physical accidents, and reducing physical activity.
- The scheme will involve construction works such as excavation and piling which could change pathways between pollution / contaminated land sources and receptors such as people either directly or indirectly through pollution of watercourses and soil. This could in turn affect health by leading to perceived impacts on physical health.

Health would not be assessed in the standard way of assessing value of receptors and magnitude. Instead, a more qualitative assessment would be undertaken looking at whether heath of the population overall would be negatively affected by the Proposed Scheme based on professional judgement and then this would be compared to planning policy objectives. Therefore, health is not covered within the following sections.

5.8.4 Value of receptors

Receptors have been assigned a value for sensitivity based on professional judgement, taking into consideration the importance of receptors to the community and scale of use (local, regional, national, etc.). For descriptions of sensitivity values, refer to Appendix C. Table 5.10 summarises the value of the receptors identified within the study area.

Table 5.10 :Value of receptors for people and communities

Value / sensitivity	Examples within the study area
High	**Private and community assets:** Schools, places of worship, Croxton Park Registered Park and Garden, Little Barford Power Station. **Traffic and transport:** A428, A1, A421, and the ECML. **Public rights of way**: National cycle route 12.
Medium	**Private and community assets**: Residential property, country parks, individual businesses, services, hotels including Wyboston Leisure Park, Abbotsley Golf Club, Black Cat services. **Traffic and transport**: A1198, B roads including B1428, B1043, B1046 and B1040. **Public rights of way**: Ouse Valley Way regional trail.
Low	**Private and community assets**: Playing fields / recreational ground, commercial grounds. **Traffic and transport**: Local roads including Bedford Rd, Barford Road, Colesden Road, The Lane, St Neots Road, Abbotsley Road, Drewels Lane. **Public rights of way**: Local PRoW, footpaths, and cycleways.

5.8.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.8.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3.

There is potential for significant effects to people and communities. Significant adverse effects could arise due to land severance and loss of access. This could be mitigated through good design and consultation with landowners. There could be a significant beneficial effect to traffic using the A428 as congestion and journey times improve.

5.8.7 Assumptions and limitations

This assessment is based on readily available web based data sources. No site surveys have been completed to date. No traffic modelling data has been made available at the time of this study.

5.9 Road drainage and the water environment

5.9.1 Baseline sources

The following baseline sources have been used during the data gathering:

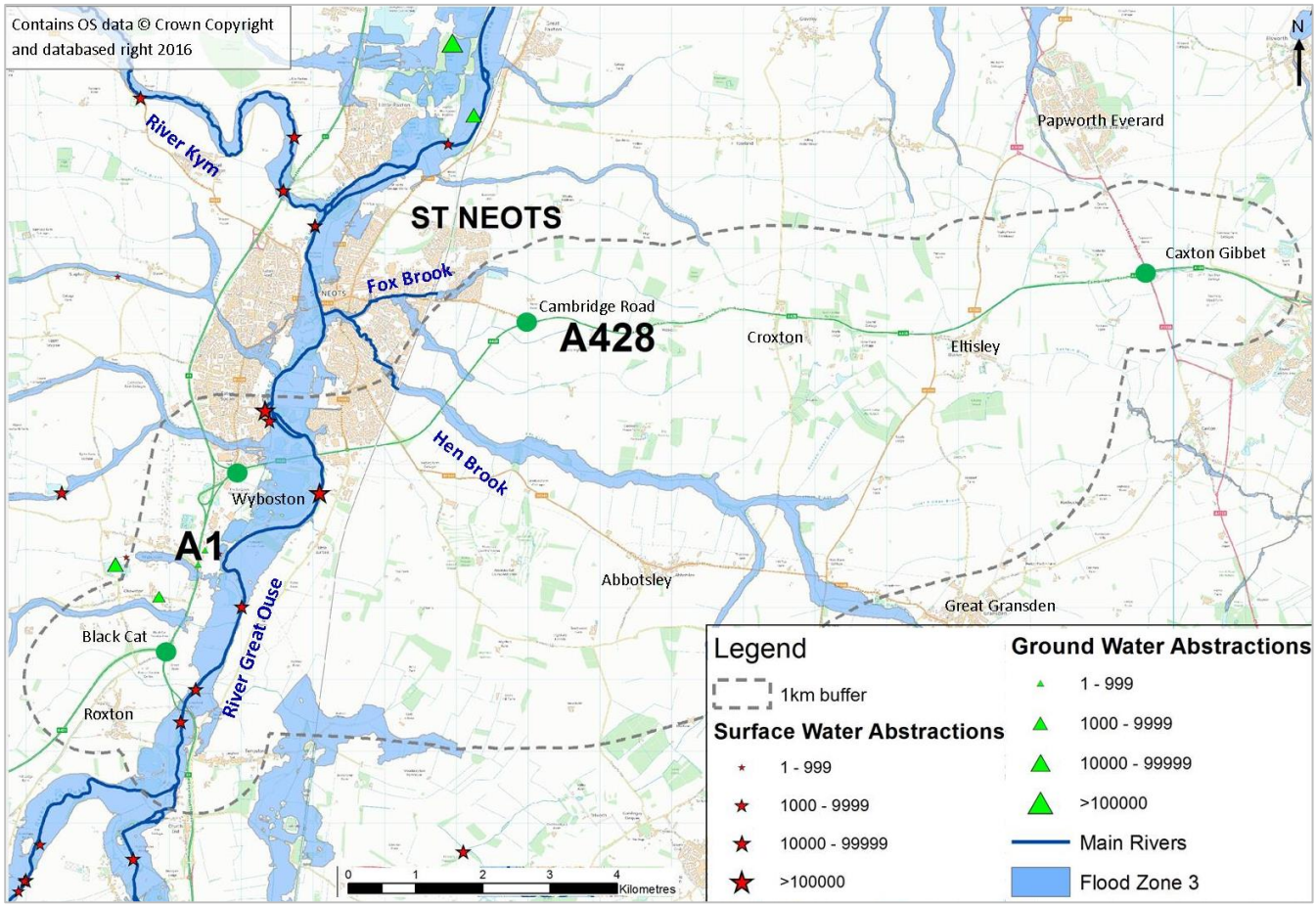
- Environment Agency interactive map - 'What's in Your Backyard' (Environment Agency, 2016)
- Anglian River Basin Management Plan (Environment Agency, 2009)
- Detailed river network and national receptor dataset (geospatial data available from the government's open data website[6])
- Environment Agency 'Flood Map for Planning' (Environment Agency, 2016)
- Updated flood map for surface water (available from Government open data website)
- Environment Agency 'Risk of Flooding from Reservoirs' (Environment Agency, 2016)
- Groundwater flood risk (available from Government open data website)
- British Geological Survey geology map (BGS, 2016)
- South Cambridgeshire and Cambridge City Level 1 Strategic Flood Risk Assessment (South Cambridgeshire District Council and Cambridge City Council, 2010)
- The Upper Ouse and Bedford Ouse Abstraction Licensing Strategy (Environment Agency, 2013)
- Cambridgeshire Preliminary Flood Risk Assessment (Cambridgeshire County Council, 2011)
- Catchment data explorer (Environment Agency, 2016)
- Highways England Drainage Data Management System (HADDMS) (accessed June 2017)

5.9.2 Geographical scope

The desktop study area has considered a 1km buffer around all three options (figure 5.7).

[6] https://data.gov.uk/publisher/environment-agency

Figure 5.7: Key road drainage and the water environment features



5.9.3 Baseline conditions

Two main rivers (the River Great Ouse and Hen Brook) are located within the study area. The River Great Ouse is designated as a main river throughout the entirety of the study area. Hen Brook is classified briefly as a main river within the study area, although the majority is classified as 'ordinary watercourse'. The River Great Ouse runs in a northerly then southerly direction and is fed by numerous tributaries along its length. The Hen Brook is one of the tributaries that feeds into the River Great Ouse and runs in a north-westerly direction.

There are a number of ordinary watercourses within the study area including Rockham Ditch (west of Black Cat junction), Hen Brook (downstream of the main river designation), Fox Brook, Gallow Brook, Abbotsley Brook, Vicar's Dean Brook, which is located east of the B1040. There are also a number of smaller unnamed tributaries.

There also a number of surface water ponds and lakes in the west of the study area such as the 'Wyboston Lake', 'Gingerbread Lake' and 'Links Pool' which are all within 250m of the existing A1 and A428 roads. There are two other unnamed surface water ponds in the west of the study area located east of the existing A1.

There are 11 surface water abstraction licenses listed in the study area. These are abstractions for spray irrigation, evaporative cooling, process water use and hydroelectric power generation. These all lie around Black Cat and Wyboston and there are no abstractions in the central and eastern part of the study area.

Flood risk

The Environment Agency flood map for planning indicates that The River Great Ouse is associated with an extensive floodplain (predominantly flood zone 3). The Hen Brook also has a small associated functional floodplain. Similar to the Great Ouse, the Hen Brook floodplain is predominantly classed as flood zone 3.

Surface water flood risk is classified as 'high' immediately adjacent to all of the watercourses with varying extents of 'medium' and 'low' risk, depending on the size of the watercourse. No major surface water flows could be identified away from the watercourse channels within the study area.

Environment Agency mapping shows there is a risk of flooding within the study area along the River Great Ouse should a failure in reservoir defences occur upstream on the River Great Ouse or the River Ivel. The flood risk mapping shows the maximum extent of flooding to cover the floodplain adjacent to the River Great Ouse with few properties at risk within the study area.

The majority of the study area is covered by superficial deposits of River Terrace Deposits and Oadby Member type, which are underlain by Mudstone (Oxford Clay Formation and Peterborough Member) based on BGS mapping. The Cambridgeshire Preliminary Flood Risk Assessment (PFRA) (2011) and South Cambridgeshire and Cambridge City Strategic Flood Risk Assessment (SFRA - 2010) identify locations with reports of groundwater flooding. None of these areas are located within the 1km study area.

According to the Cambridgeshire PFRA, no historical flood incidents from other sources have been recorded within the study area. There are flood defences in place to the east of the Riverside Park, located south of the B1428 near Eaton Ford, with the area to the east benefiting from these defences.

A review of HADDMS information has identified a number of historic flooding incidents including five separate dates in 2012 and one event each in 2013, 2014 and 2016.

Geomorphology, WFD and water quality

There are five Water Framework Directive (WFD) water bodies within the study area, including the Ouse (Roxton to Earith), Stone Brook, West Brook, Begwary Brook and Abbotsley and Hen. Each of these is classified as achieving moderate potential, except for the Begwary Brook which is currently achieving good potential (Environment Agency, 2016). The water bodies are within the Upper and Bedford Ouse catchment, forming part of the Anglian River Basin Management Plan. The study area falls within the Upper Ouse and Bedford Ouse Catchment Abstraction Management Strategy (CAMS) area, covered within Area A lying between AP3-AP5 (assessment points within Environment Agency, 2013).

Within the study area there are also a number of smaller watercourses (including the Fox Brook, Eastern Brook and Stone Brook) and smaller drainage channels. These form part of the main river catchments, with the smaller drainage channels typically draining the surrounding agricultural land.

There are a number of surface water ponds/lakes to the south of the Black Cat junction and in the vicinity of the Wyboston Leisure Park. There are three surface water abstractions within 1km of the scheme, located adjacent to the River Great Ouse. The study area also falls within a surface water safeguard zone (ID: SWSGZ1012) for pesticides, and is within a nitrate vulnerable zone (NVZ) for both surface waters and groundwater.

5.9.4 Value of receptors

An initial assessment of the water environment including flood risk, geomorphology and WFD, water quality and groundwater has been made using desk based information. The assessment of the water environment has been carried out in accordance with guidance contained in DMRB, Volume 11 Section 3: HD45/09: Road Drainage and the Water Environment (Highways Agency, 2009b). Where appropriate, informed professional judgement is also used to inform the assessment methodology, primarily in geomorphology, where there is a lack of guidance to date. Flood risk has been assessed in accordance with the requirements of the NPPF of 2012 and the accompanying online flood risk guidance.

An overview of the criteria used to determine the value of the receptors is provided in Appendix C. Table 5.11 summarises the value of the receptors identified within the study area.

Table 5.11: Value of receptors for road drainage and the water environment

Value / sensitivity	Examples within the study area
High	**Flood risk**: None identified. **Geomorphology and water quality**: River Great Ouse (main river with moderate potential under WFD and recreational value). **Groundwater**: Secondary A aquifer (superficial deposits).
Medium	**Flood risk**: None identified. **Geomorphology and water quality**: Hen Brook (main river with moderate potential under WFD). **Groundwater**: Secondary A aquifers (both bedrock and superficial) and secondary undifferentiated aquifer (superficial deposits).
Low	**Flood risk**: Ordinary watercourse fluvial flood risk receptors; surface water flood risk receptors; groundwater flood risk receptors; reservoir flood risk receptors e.g. residential properties in the floodplain by the River Great Ouse. **Geomorphology and water quality**: Other watercourses (small watercourses with sinuous planforms, but some are likely to be artificial); drainage channels (small modified channels, likely to be man-made); ponds and lakes. **Groundwater**: None identified.

5.9.5 Assessment methodology

At this stage, the assessment has been based on technical judgement and knowledge of other schemes.

5.9.6 Design, mitigation and enhancement measures

The OAM in Appendix F summarises the potential effects and mitigation for this topic for each option. At this stage, magnitude has not been assigned as this would come from the assessment work in Stage 3.

There is potential for significant effects to the water environment. All options would require work near / crossings over WFD waterbodies, which could lead to a deterioration of water quality. Junction improvements at Black Cat would also result in the loss of functional floodplain, which may require compensation.

The work would also need to include an assessment of risks from major accidents and disasters in relation to this chapter. This is could include the risk of a major flood event to the route and what measures have been taken to mitigate this.

5.9.7 Assumptions and limitations

This assessment is based on readily available web based data sources. No site surveys have been completed to date.

6. Assessment of cumulative effects

Once a preferred option is selected an assessment will need to be undertaken to consider adjacent developments and whether these are likely to have cumulative effects with the Proposed Scheme. The assessment will cover proposed developments with a 'committed consent' including developments with full or outline planning permission, developments yet to be implemented, or developments already under construction but yet to be completed or occupied. It will also include developments where land is allocated in an adopted local plan or in a finalised draft local plan.

The adjacent developments would be identified through a review of planning documents, submitted and approved planning applications and discussions with the local planning authorities. The following developments have been identified in close proximity to the scheme and are likely to require further assessment in Stage 3:

- **Huntingdonshire District Council**
  - Planning Application ref 1300388OUT: Loves Farm Eastern Expansion Development Area Cambridge Road St Neots. Outline application for the development of up to 1020 dwellings, up to 7.6ha of mixed use development, pedestrian/cycle routes, open space and other related infrastructure.
  - Planning Application ref 1300178OUT: Wintringham Park Cambridge Road St Neots. Development of mixed use urban extension to include: residential development of up to 2,800 dwellings; up to 63,500m^2 of employment development; district centre including shops, services; community and health uses; two primary schools; and open space and recreation facilities.
  - Emerging Policy - St Neots Eastern Expansion: 226ha of land allocated for mixed use development in accordance with the St Neots Eastern Expansion Urban Design Framework 2010 to comprise: approximately 3,820 homes; approximately 22ha of employment land; 4,000m^2 of retail floorspace including a supermarket and other retail uses; a care home, educational and community facilities; and strategic green space and open space.
- **South Cambridgeshire District Council**
  - Planning Application ref S/2903/14/OL West Cambourne: development of up to 2,350 residential units; retail up to 1.04ha; offices/light industry up to 5.66ha; community and leisure facilities up to 0.92ha; two primary schools and one secondary school (up to 11.28ha).
  - Emerging Policy SS/8 Cambourne West: allocated for the development of a sustainable, fourth linked village to Cambourne of approximately 1,200 dwellings by 2031.

The above developments will be included in the baseline traffic model and therefore cumulative effects relating to traffic and transport, noise and air quality from these developments will be considered within the assessment.

In addition, consultation will be undertaken with the East West Rail Consortium to discuss the proposed reopening of the Varsity Line between Oxford and Cambridge. This is currently at the options appraisal stage and is considering options along the central section of the route between Bedford and Cambridge. DfT confirmed its commitment to the creation of a new railway between Bedford and Cambridge in 2013.

The cumulative effects assessment will need to be undertaken based on a professional reviewing the relevant planning material and drawing links to potential effects with the Proposed Scheme. DMRB states that the significance should be determined by the extent to which the impacts can be accommodated by the resource. The assessment should take into account the following factors when determining significance:

- Which receptors/resources are affected?
- How will the activity or activities affect the condition of the receptor/resource?
- What are the probabilities of such effects occurring?
- What ability does the receptor/resource have to absorb further effects before change becomes irreversible?

Effects would be identified as short-term or long-term, permanent or temporary. Their magnitude would be identified, mitigation measures will be taken into account, and the residual significance of the effects would be

assessed, using the guidance in DMRB Volume 11, Section 2, Part 5 (Highways Agency *et al*., 2008) summarised in table 6.1. The cumulative effects assessment tables would need to be completed in accordance with The Planning Inspectorate's Advice Note Seventeen (Planning Inspectorate, 2015).

Table 6.1: Determining significance of cumulative effects (based on table 2.6 from DMRB Volume 11, Section 2, Part 5)

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor / resource is irretrievably compromised.
Major	Effects that may become key decision-making issue.
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance.
Minor	Effects that are locally significant.
Not significant	Effects that are beyond the current forecasting ability or are within the ability of the resource to absorb such change.

7. Conclusions

7.1 Summary of significant effects and mitigation measures

The Stage 2 EAR has assessed the potential effects associated with each of the options. Table 7.1 summarises the potential effects that may result from the Proposed Scheme and potential mitigation that could be employed. Once a preferred route is selected at Stage 3, bespoke mitigation plans can be developed to inform the designs.

At this stage, all options are likely to have significant effect on the environment, with the key aspects being to nature conservation, landscape and cultural heritage. The River Great Ouse is the most sensitive environmental part of the scheme identified to date, and it is likely that mitigation measures will include floodplain compensation and ecological mitigation in this area. There is likely to be significant effects associated with Black Cat in terms of the noise and visual aspects. Noise fencing and landscape planting could be undertaken to help mitigate the effects.

Table 7.1: Potential impacts and mitigation

Potential impact	Mitigation opportunities
During construction	
Air quality – potential decrease in air quality during construction due to additional construction vehicles and site machinery.	Employ good site practices to minimise dust and fumes. Avoid site traffic using routes through residential areas.
Cultural heritage – risk of disturbing archaeology during construction.	Avoid areas of known archaeology as identified in the desk based assessment.
Landscape – construction could result in the loss of vegetation or other landscape features.	Avoid sensitive areas and replace any vegetation removed as a result of the scheme. Employ root protection zones to protect adjacent trees during construction.
Nature conservation – construction works could result in the loss and/or fragmentation of habitat, mortality and injury to protected/notable species from vegetation removal and/or hydrological changes and disturbance to protected/notable species due to noise, vibration and lighting. Construction works could also spread invasive species.	Avoid known sensitive sites. Reinstate habitats following construction or offer compensatory habitat. Employ specific mitigation depending on species present.
Geology and soils – there is the potential for contaminated land along the footprint of the scheme. Land take associated with scheme may result in loss of proven mineral resources. There may be the need for temporary land take which could affect the use of adjacent land parcels or quality of land e.g. ALC grade.	Avoid known sensitive areas and develop a methodology for dealing with contamination during construction. Undertake a materials management strategy. Early consultation with landowners to identify concerns and to put in place specific mitigation e.g. providing temporary sites and accesses during construction.
Climate change–the construction works would also generate carbon which would contribute to climate change.	Use materials with a lower embedded carbon footprint. Undertake a materials management strategy.
Noise and vibration generated during construction works.	Employ low noise and vibration piling methods.
People and communities –there may be disturbance to community services during construction e.g. through traffic management. Construction works may require closures or diversions to existing routes for both vehicles and NMU. Health – there may be effects on health of workers if contaminated land pathways are exposed during construction.	Early consultation with third parties to identify concerns and to put in place specific mitigation e.g. providing alternative sites or access during construction. Apply footpath diversions where possible and offer alternative crossing points. Undertake a risk assessment to identify risk of exposure and any required mitigation.
Road drainage and water environment – there is the potential for pollution from site activities into adjacent watercourses.	Comply with pollution prevention guidance.

Potential impact	Mitigation opportunities
During operation	
Air quality - changes to the configuration of the road network could affect traffic patterns and local air quality. Easing congestion is likely to have a beneficial impact overall.	None identified at this stage.
Cultural heritage – new road layout could result in loss of a cultural heritage asset or affect the setting.	Avoid sensitive features where possible. Archaeological investigations in the form or geophysical surveys and trial trenches and potentially a watching brief.
Landscape – new road layout could affect the landscape character of the area and impact on important viewpoints.	Avoid sensitive features and consider additional screening to reduce the impact.
Nature conservation – potential permanent loss of habitat or severance due to footprint of the scheme. Potential impacts of changes to road lighting on sensitive species, such as bats. Road mortalities for protected species as a result of increased vehicle movements at new junctions or offline sections. Changes to water quality and air quality affecting sensitive receptors.	Avoid known sensitive sites. Reinstate habitats following construction or offer compensatory habitat.
Geology and soils – there may be permanent land take which could affect the use of adjacent land parcels or quality of land e.g. ALC grade.	Early consultation with landowners and other third parties to identify concerns and to put in place specific mitigation.
Climate change – there is the potential for climate to affect the proposed scheme.	Include design considerations to deal with a future changing climate e.g. design structures to a higher wind loading or use higher climate change assumptions in the drainage design.
Noise and vibration – changes to the road layout could increase traffic noise to sensitive receptors.	Avoid known sensitive sites. Consider the need for noise fencing.
People and communities – the scheme may increase severance of rights of ways. Health – there may be effects to health from a combination of severance of rights of way and loss of access to open space.	Provide new crossings to replace those lost. Identify cumulative health effects and provide additional rights of way or open space as required.
Road drainage and water environment – new crossings over watercourses could affect flood flows and result in the loss of functional floodplain. River crossings could also involve engineering to water bodies and result in changes to the geomorphological status.	Structures to be designed outside of the floodplain where possible, where this is not possible, open span structures should be considered to minimise effects. Floodplain compensation may be required to offset floodplain losses. Culverts and crossings should be designed following geomorphology principles to ensure no deterioration in status of the water body, bespoke mitigation or compensatory actions may be required for some crossings.

7.2 Recommendations

The three alignment options and the three Black Cat options were presented at the non-statutory engagement events in March and April 2017. The responses from these events will need to be reviewed to inform the selection of the preferred route alongside the traffic modelling results and the economic appraisal.

Table 7.2 outlines a number of environmental surveys and further assessments for future stages in the project.

Table 7.2: Proposed further environmental surveys and assessments

Topic	Potential further study / survey	Timing / stage
Air quality	Quantitative analysis of the traffic modelling results	Stage 3
	Air quality modelling	Stage 3
	Air quality monitoring	Stage 3
Cultural heritage	Desk based assessment	Stage 3
	Non-intrusive surveys	Stage 3

Topic	Potential further study / survey	Timing / stage
Landscape	Detailed landscape and visual assessment	Stage 3
	Tree survey (alongside topographical survey)	Stage 3
Nature conservation	Further habitat surveys including hedgerow surveys, ponds and a Phase 2 habitat survey of high quality habitats	See Extended Phase 1 habitat survey report for details about each survey (Appendix E)
	Aquatic surveys including river habitat survey, fish survey (including European eel) and white clawed crayfish	
	Terrestrial species surveys including for badgers, bats, breeding birds, GCN, reptiles, water vole and otter	
Geology and soils	Detailed risk assessment of contaminated land risks to relevant receptors	Stage 3
	Soil testing as part of ground investigations	Stage 3
Climate change	Carbon assessment	Stage 3
Noise and vibration	Quantitative analysis of the traffic modelling results	Stage 3
	Noise modelling	Stage 3
	Noise monitoring	Stage 3
People and communities	Review of right of way surveys	Stage 3
	Health assessment	Stage 3
	Analysis of the traffic modelling results	Stage 3
Road drainage and the water environment	Flood risk assessment	Stage 3
	Water Framework Directive screening	Stage 3

7.3 Potential approvals and consents

Statutory EIA

The Proposed Scheme lies outside of the existing highways corridor and therefore would not fall within permitted powers. The Proposed Scheme would involve construction and alteration of a highway where the speed limit for any class of vehicle is expected to be 50 miles per hour or greater and the scheme is greater than 12.5ha. The scheme also has the potential for significant environmental effects and therefore is likely to be classed as a Nationally Significant Infrastructure Project under the Planning Act (2008), and will require a Development Consent Order (DCO).

A screening determination form has been completed and this has indicated that the scheme will require a statutory EIA. This should be discussed with the Planning Inspectorate in the meetings prior to the submission of the Scoping Report, once a preferred route has been chosen.

Habitats Regulation Assessment (HRA) Screening

At Stage 1, an Assessment of Implications on European Sites (AIES) (which is now called the Habitats Regulation Assessment – HRA screening) was completed for Option 1. The Stage 1 AIES identified possible source-receptor pathways to three European sites: Eversden and Wimpole Woods SAC; Portholme SAC; and Ouse Washes SAC/SPA/Ramsar. It concluded that none of the anticipated elements of Option 1 alignment, or combination of elements, are expected to lead to a likely significant effect on any of the identified European sites. However, a more detailed assessment would be required once the design details are known. Consultation will be required with Natural England at the next stage to confirm this decision.

It is recommended that the HRA and the screening matrices are submitted to Natural England alongside a Discretionary Advice Service (DAS) request to seek specific feedback on the preferred option prior to submitting the Scoping Report to the Planning Inspectorate. This should also cover the proposed scope of the ecological surveys to agree the methods and techniques to be employed.

Potential consents and approvals

The Proposed Scheme may require other consents including listed building consent, scheduled monument consent, flood defence consent, ordinary watercourse consent, and rights of way closures and diversions, depending on the work to be undertaken. It is also likely that protected species licences will be required.

7.4 Future stages

The environmental assessment will continue to feed into the design process as part of identifying opportunities for further embedded (primary) mitigation and to minimise the scope of the future EIA. Further consultation will also be undertaken with environmental stakeholders to scope out the potential significant effects and mitigation. An environmental Scoping Report will be produced during Stage 3 of the PCF process for the option selected under the PRA. The scoping report will summarise the baseline assessments and identify whether the scheme is likely to have a significant effect on each receptor. The scoping report will include a summary of the assessment methodology that will be employed to assess potential significant effects. The scoping report can be used to provide background information to the Secretary of State as part of obtaining a screening and scoping opinion.

Abbreviations

Abbreviation	Term
AIES	Assessment of the Implications on European Sites
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
AQMA	Air Quality Management Area
AQO	Air Quality Objective
BAP	Biodiversity Action Plan
BGS	British Geological Society
BRMC	Biodiversity Recording and Monitoring Centre
CAMS	Catchment Abstraction Management Strategy
CIEEM	Chartered Institute of Ecology and Environmental Management
CO_2	Carbon Dioxide
CPERC	Cambridgeshire and Peterborough Environmental Records Centre
CIRIA	Construction Industry Research and Information Association
CWS	County Wildlife Site
DAS	Discretionary Advice Service
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
Defra	Department for the Environment, Food, and Rural Affairs
DBA	Desk Based Assessment
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
EAST	Early Assessment and Sifting Tool
EAR	Environmental Assessment Report
ECML	East Cast Main Line
eDNA	Environmental DNA
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPSM	European Protected Species Mitigation
GCN	Great Crested Newt
GIS	Geographic Information System
GLVIA	Guidelines for Landscape and Visual Impact Assessment
HER	Historic Environment Record
HIA	Health Impact Assessment
HRA	Habitats Regulations Assessment
HSI	Habitat Suitability Index
IAN	Interim Advice Note
IAQM	Institute of Air Quality Management
IEMA	Institute of Environmental Management and Assessment
IUCN	International Union for Conservation of Nature

Abbreviation	Term
JNCC	Joint Nature Conservation Committee
KPI	Key Performance Indicator
LBAP	Local biodiversity Action Plan
LCA	Landscape Character Area
LNR	Local Nature Reserve
LTP	Local Transport Plan
MAGIC	Multi Agency Geographic Information for the Countryside
MSA	Mineral Safeguarding Area
NCA	National Character Area
NERC	Natural Environment Research Council
NIA	Noise Important Area
NMU	Non-Motorised User
NNNPS	National Networks National Policy Statement
NNR	National Nature Reserve
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
NPPF	National Planning Policy Framework
NVC	National Vegetation Community
NVZ	Nitrate Vulnerable Zone
OAM	Options Appraisal Matrix
OAR	Options Appraisal Report
OS	Ordnance Survey
PCF	Project Control Framework
PFRA	Preliminary Flood Risk Assessment
PI	Performance Indicator
PM_{10}	Particulate matter less than or equal to 10 micrometres in diameter
PRA	Public Route Announcement
PRoW	Public Rights of Way
PRV	Protected Road Verge
RIGS	Regionally Important Geologic Site
RIS	Road Investment Strategy
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SPZ	Source Protection Zone
SRN	Strategic Road Network
SSSI	Site of Special Scientific Interest
TAR	Technical Appraisal Report
TPO	Tree Preservation Order
UXO	Unexploded Ordinance
WFD	Water Framework Directive

Glossary

Glossary	Definition
Abstraction point	An area or point where water is extracted from either surface water or pumped up from groundwater.
Air quality management area	Area defined by the local authority as an area requiring management because air quality levels do not meet national air quality objectives.
Air quality objective	National and European Directive limit and target values for substances released to the atmosphere for the protection of human health and ecosystems.
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Biodiversity action plan	An agreed plan for a habitat or species, which forms part of the UK's commitment to biodiversity in response to the Convention on Biological Diversity, Rio de Janeiro 1992.
Character area	An area of land with distinctive landscape features resulting from an interaction of wildlife, landforms, geology, land use and human activity as defined by the Countryside Agency.
Conservation area	An area designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being an area of 'special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance'.
Construction environmental management plan	Document setting out the roles and responsibilities, control measures, training and briefing procedures, risk assessments and monitoring systems to be employed during planning and construction of the works for all relevant environmental topic areas.
County / local wildlife site	Non-statutory designated sites of county importance for wildlife that are protected through planning policy.
Cumulative effects	Effects upon the environment that result from the incremental impact of an action when added to other past, present or reasonably foreseeable actions. Each impact by itself may not be significant but can become a significant effect when combined with other impacts.
Design Manual for Roads and Bridges	Provides standards, advice notes and other documents relating to the design, assessment and operation of trunk roads, including motorways in the United Kingdom.
Development Consent Order	Introduced by the Planning Act in 2008, a Development Consent Order is the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects.
Drainage network	The streams, rivers, lakes and other water bodies that form a particular drainage basin.
Ecological potential	The status of a heavily modified or an artificial body of water, so classified in accordance with the relevant provisions of Annex V of the River Basin Management Plan.
Ecological status	WFD term denoting a slight deviation from 'Reference Conditions' in a water body, or the biological, chemical and physico-chemical and hydromorphological conditions associated with little or no human pressure.
eDNA survey	A survey technique using analysis of water samples collected in the field to determine the presence of great crested newts from a waterbody.
Environmental Impact Assessment (EIA)	A process by which information about environmental effects of a proposed development is collected, assessed and used to inform decision making. For certain projects, EIA is a statutory requirement.
Environmental Statement	A document produced in accordance with the EIA Directive as transported into UK law by the EIA Regulations to report the results of an EIA.
Existing extraction site	An area currently being exploited for its mineral resources.
Extended Phase 1 habitat survey	A classification system used to record semi-natural vegetation, notable/protected habitats, and habitats with the potential to support notable/protected species. Each habitat type/feature is defined by way of a brief description and is allocated a specific name, an alpha-numeric code, and unique mapping colour.
Flood risk	The exposure, vulnerability and hazard associated with flooding.

Glossary	Definition
Flood zone	Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. Flood zone 3 shows the area that could be affected by a 1 in 100 year (1% chance) flood event. Flood zone 2 shows the area that could be affected by a major flood (1 in 1000, or 0.1% chance). Flood zone 1 shows areas that are very unlikely to experience flood (<0.1%).
Floodplain	A floodplain is flat or nearly flat land adjacent to a stream or river, stretching from the banks of its channel to the base of the enclosing valley walls and (under natural conditions) experiences periods of flooding.
Geomorphology	The study of landforms and the processes that create them.
Habitat Suitability Index	A habitat assessment technique used to evaluate the suitability of a waterbody for great crested newts.
Heritage assets	The historic environment assets such as archaeological remains, historic buildings and historic landscapes which have archaeological, architectural, artistic or historic value.
Local nature reserve	Nature reserves designated under the National Parks and Countryside Act (1949) for locally important wildlife or geological features. They are controlled by local authorities in liaison with English Nature.
Listed building	A building or structure designated under section 69 of the Planning (Listed Building and Conservation Areas) Act 1990 as being of 'special architectural or historic interest'.
Main river	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers. N.B. Main River designation is not an indication of size, although it is often the case that they are larger than Ordinary Watercourses.
Mineral consultation area	An area identified in order to ensure consultation between the relevant local authorities and the minerals industry before certain non-mineral planning applications made within the area are determined.
Mineral safeguarding area	An area which covers known deposits of minerals which are desired to be kept safeguarded from unnecessary changes by non-mineral development.
Mitigation	The action of reducing the severity and magnitude of change (impact) to the environment. Measures to avoid, reduce, remedy or compensate for significant adverse effects.
Nationally Significant Infrastructure Project	Major infrastructure developments in England and Wales, such as proposals for power plants, large renewable energy projects, new airports and airport extensions, and major road projects, as set out in the Planning Act (2008). See entry for Development Consent Order.
Nitrate vulnerable zone	A designation required under the Nitrates Directive (91/676/EEC) for all land draining to and contributing to the nitrate pollution in "polluted" waters. Polluted waters are those where nitrate levels exceed, or are likely to exceed, the levels set in the Directive.
Noise important area	The top 1% of noisiest locations adjacent to major roads.
Non-motorised user	A term to describe users of the highway who do not travel by motorised vehicles e.g. pedestrians, cyclists or horse riders.
Ordinary watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards. Note that Ordinary Watercourse does not imply a "small" river, although it is often the case that Ordinary Watercourses are smaller than Main Rivers.
Potential effect	The predicted consequential change may occur upon the environment as a result of a development, in the absence of mitigation.
Preferred extraction site	Areas of known resources where planning permission might reasonably be anticipated.
Principal aquifer	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
Public right of way	A widely known right to cross private land is known as a 'right of way'. If this is a right granted to everyone it is a 'public right of way'.
Ramsar	Ramsar sites are wetlands of international importance designated under the Ramsar Convention.
Receptor	A defined individual environmental feature usually associated with population, fauna and flora that have potential to be impacted by a development.
Registered park and garden	Gardens, grounds and other planned open spaces with historical significance. Registration is a 'material consideration' in the planning process.

Glossary	Definition
Residual effect	The predicted consequential change on the environment from the impacts of a development after mitigation.
Secondary A aquifer	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
Secondary B aquifer	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
Secondary (undifferentiated) aquifer	Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type.
Scheduled monument	Scheduled Monuments are protected by law designated under the Ancient Monuments and Archaeological Areas Act 1979 and are, by definition, of national importance.
Scoping	The process of identifying the issues to be addressed by an environmental impact assessment process. It is a method of ensuring that an assessment focuses on the important issues and avoids those that are considered unlikely to be significant.
Setting	The setting of an asset is the surroundings in which a place is experienced, while embracing an understanding of perceptible evidence of the past in the present landscape.
Significance	A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic.
Site of special scientific interest	A site of national importance due to its wildlife or geological value that is protected by the Wildlife and Countryside Act 1981 (as amended).
Site Waste Management Plan	A tool for detailing the amount and type of waste that will be produced on a construction site and how it will be eliminated, reduced, re-used, recycled and disposed of and to help meet regulatory controls and reduce the costs of waste.
Source protection zone	These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. Divided into three main zones (inner, outer and total catchment).
Special area of conservation	A site designated under the Habitats Directive due to its international value for certain habitats and species of conservation importance (those listed on Annex I and II of the Directive).
Special protection area	A site designated under Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive') due to its international importance for birds.
Tree preservation order	A Tree preservation order is an order made by a local planning authority in England to protect specific trees, groups of trees or woodlands in the interests of amenity. An Order prohibits the: cutting down; topping lopping; uprooting; wilful damage or destruction of trees without the local planning authority's written consent. If consent is given, it can be subject to conditions which have to be followed. In the Secretary of State's view, cutting roots is also a prohibited activity and requires the authority's consent.
Water body	Discrete section of a river, groundwater area, lake or coast that is a defined management unit under the WFD.
Water Framework Directive	A substantial piece of EU water legislation that came into force in 2000, with the overarching objective to get all water bodies in Europe to attain Good or High Ecological Status. River Basin Management Plans (RBMP) have been created which set out measures and potential mitigation to ensure that water bodies in England and Wales achieve 'Good Ecological Status'.

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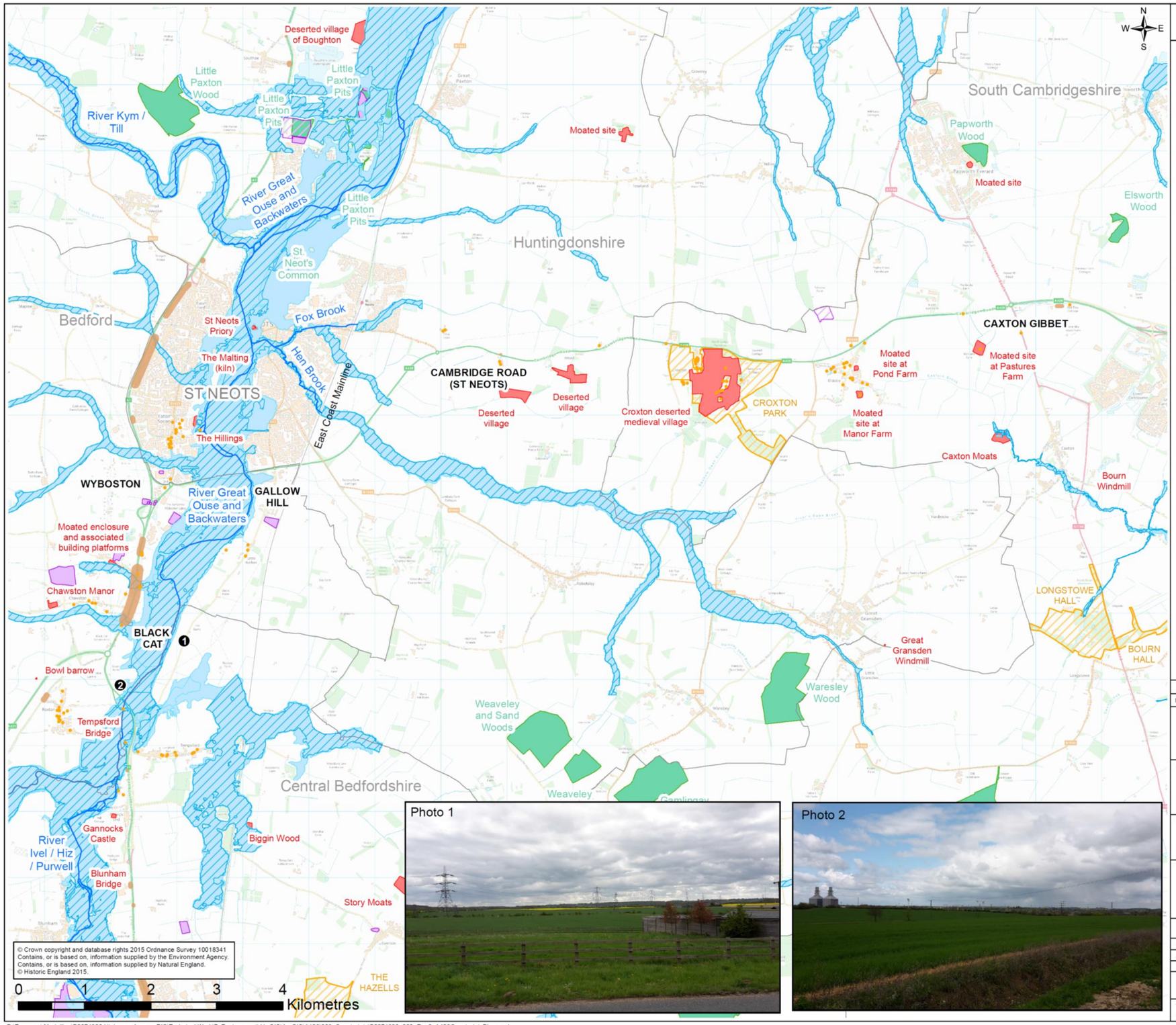
Appendix A. Development plan and policy review

Appendix B. Environmental constraints plan

highways england



Legend

- Listed Buildings
- Rivers
- Local Planning Authority Boundary
- Scheduled Monuments
- Flood Zone 3
- Flood Zone 2
- Current Landfill Sites
- Historic Landfill Sites
- Registered Parks
- Sites of Special Scientific Interest
- Noise Important Areas
- Photo Location

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
0	10/11/2016	Initial Issue	LM	CB	IC	SB

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Appendix C. Criteria for assessing sensitivity

This tabulates how the baseline has been assessed in terms of its value and sensitivity. The assessment was based on table 2.1 from the DMRB Appendix 11 Section 2 (recreated in table C.1). It has then been interpreted by technical specialists for each receptor in table C.2. The majority of topics have four levels of value in accordance with DMRB. Where there are only three, this has been explained in the relevant box. Additional notes are also added under the topic heading where applicable. The table is used as guidance for the assessment and is not designed to be prescriptive. Technical judgement will be used to provide the final value.

Table C.1: Guidance for assessing value (sensitivity) taken from DMRB Appendix 11 Section 2

Value (sensitivity)	Typical descriptors
Very high	Very high importance and rarity, international scale and very limited potential for substitution.
High	High importance and rarity, national scale and limited potential for substitution.
Medium	High or medium importance and rarity, regional scale, limited potential for substitution.
Low (or lower)	Low or medium importance and rarity, local scale.
Negligible	Very low importance and rarity, local scale.

Table C.2: Topic specific interpretation of the DMRB guidance for the Proposed Scheme

Value (sensitivity)	Typical Descriptors
Air quality	
Notes	All receptors are treated as equally sensitive, with sensitivity being identified as locations representative of exposure to the averaging periods of relevant air quality objectives, e.g., annual, daily and hourly exposure.
Cultural heritage (using the criteria set out in DMRB Volume 11 Environmental Assessment Section 3, Part 2, HA 208/07,Cultural Heritage)	
Very high	**Archaeological remains:** World Heritage Sites (including nominated sites). Assets of acknowledged international importance. Assets that can contribute significantly to acknowledged international research objectives. **Historic buildings:** Structures recognised as of universal importance as World Heritage Sites. Other buildings of recognised international importance. **Historic landscapes** World Heritage Sites recognised for their historic landscape qualities. Historic landscapes of international value, whether designated or not. Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factor(s).

Value (sensitivity)	Typical Descriptors
High	**Archaeological remains:** Scheduled monuments (including proposed sites). Undesignated assets of schedulable quality and importance. Assets that can contribute significantly to acknowledged national research objectives. **Historic buildings:** Scheduled monuments with standing remains. Grade I and Grade II* listed buildings. Other listed buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the listing grade. Conservation areas containing very important buildings. Undesignated structures of clear national importance. **Historic landscapes:** Designated historic landscapes of outstanding interest. Undesignated landscapes of outstanding interest. Undesignated landscapes of high quality and importance, and of demonstrable national value. Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factor(s).
Medium	**Archaeological remains:** Designated or undesignated assets that contribute to regional research objectives. **Historic buildings:** Grade II listed buildings. Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations. Conservation areas containing buildings which contribute significantly to their historic character. Historic townscape or built-up areas with important historic integrity in their buildings, or built settings (e.g. including street furniture and other structures). **Historic landscapes**: Designated special historic landscapes. Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value. Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor(s).
Low	**Archaeological remains:** Designated and undesignated assets of local importance. Assets compromised by poor preservation and/or poor survival of contextual associations. Assets of limited value, but with potential to contribute to local research objectives. **Historic buildings:** 'Locally listed' buildings. Historic (unlisted) buildings of modest quality in their fabric or historical association. Historic townscape or built-up areas of limited historic integrity in their buildings, or built settings (e.g. including street furniture and other structures). **Historic landscapes**: Robust undesignated historic landscapes. Historic landscapes with importance to local interest groups. Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations.
Landscape using the criteria set out in Interim Advice Note 135/10 Landscape and visual effects assessment, Highways England, 2010)	
Notes	IAN135/10 does not include for a very high category in landscape and visual assessment.
High	**Landscape:** Landscapes which by nature of their character would be unable to accommodate change of the type proposed. Typically these would be of high quality with distinctive elements and features making a positive contribution to character and sense of place, likely to be designated, but the aspects which underpin such value may also be present outside designated areas, especially at the local scale, areas of special recognised value through use, perception or historic and cultural associations and / or likely to contain features and elements that are rare and could not be replaced. **Visual:** Residential properties, users of Public Rights of Way or other recreational trails (e.g. National Trails, footpaths, bridleways etc.) and users of recreational facilities where the purpose of that recreation is enjoyment of the countryside (e.g. Country Parks, National Trust or other access land etc.).

Value (sensitivity)	Typical Descriptors
Medium	**Landscape:** Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Typically these would be comprised of commonplace elements and features creating generally unremarkable character but with some sense of place, locally designated, or their value may be expressed through non-statutory local publications, containing some features of value through use, perception or historic and cultural associations and / or likely to contain some features and elements that could not be replaced. **Visual:** Outdoor workers, users of scenic roads, railways or waterways or users of designated tourist routes and schools and other institutional buildings, and their outdoor areas.
Low	**Landscape:** Landscapes which by nature of their character would be able to accommodate change of the type proposed. Typically these would be comprised of some features and elements that are discordant, derelict or in decline, resulting in indistinct character with little or no sense of place, not designated, containing few, if any, features of value through use, perception or historic and cultural associations and / or likely to contain few, if any, features and elements that could not be replaced. **Visual:** Indoor workers, users of main roads (e.g. trunk roads) or passengers in public transport on main arterial routes and users of recreational facilities where the purpose of that recreation is not related to the view (e.g. sports facilities).
Biodiversity (Bespoke criteria using DMRB and IEEM guidance)	
Very high	**Habitats**: Very high importance and rarity, international scale and very limited potential for substitution. Includes Ramsar and European designated sites, or sites that meet the published selection criteria but not designated as such. **Species**: Sites with resident or regularly occurring population/s of species at International or European level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.
High	**Habitats**: High importance and rarity, national scale, and limited potential for substitution. Includes Sites of Special Scientific Interest, National Nature Reserves and sites that meet published criteria for selection. Key/priority habitats important at a national scale. **Species**: Sites with resident or regularly occurring population of species at International, European, UK or National level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.
Medium	**Habitats**: High or medium importance and rarity, regional scale, moderate potential for substitution. Includes key/priority habitats identified in Section 41 of the NERC Act 2006 and/or County or Highways BAP that are important at a regional, county or district scale. Sites of Nature Conservation Importance, Local Wildlife Sites and Local Nature Reserves designated in the county or unitary authority area context. **Species**: Resident or regularly occurring populations of species which may be considered at a regional, county or district scale, where loss of these species would affect the conservation status or distribution at this geographic scale, or the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale. Includes key/priority species listed in accordance with the requirements of Section 41 of the NERC Act and/or the County or Highways BAP that are important at this scale.
Low	**Habitats**: High importance and rarity, national scale, and limited potential for substitution. Includes Sites of Special Scientific Interest, National Nature Reserves and sites that meet published criteria for selection. Key/priority habitats important at a national scale. **Species**: Sites with resident or regularly occurring population of species at International, European, UK or National level where loss would affect the conservation status or distribution at this geographic scale, or where the population forms a critical part of a wider population at this scale, or is at a critical phase of its life cycle at this scale.

Value (sensitivity)	Typical Descriptors
Geology and soils (Bespoke criteria using DMRB guidance)	
Very high	**Geology and soils:** World Heritage Sites, sites protected under EU legislation (SAC, SPA, Ramsar Site) for geological reasons. Earth Heritage Sites (designated for their geological importance/geodiversity), Designated European GeoParks. Agricultural land with an ALC grade 1 (excellent). Nationally important mineral sites for energy such as coal, oil and gas. **Groundwater**: Principal aquifer with local (<1km) abstraction wells **Land contamination:** Construction workers and very sensitive land uses such as residential housing with gardens, allotments, schools and nursing homes, essential public buildings such as hospitals and fire stations and sites of international Importance e.g. World Heritage Sites, SAC, SPA.
High	**Geology and soils**: Sites protected under UK wildlife legislation for their geological value (SSSI, NNR, WCA, LNR). Sites protected by a Limestone Pavements Order. Agricultural land of Grade 2 (very good) or Grade 3a (good) quality. Existing mineral extraction sites. Minerals sites with poor quality energy minerals or silica (industrial) sand for use in glass making. **Groundwater**: Principal Aquifer with no local abstractions or secondary A aquifer with abstractions. **Land contamination:** Future site users and sensitive land uses proposed such as residential housing without gardens, open spaces, nationally important designated sites, significant transport links e.g. railway, airport, significant utilities (e.g. high pressure gas main, sewage works).
Medium	**Geology and soils:** Regionally Important Geological Sites (RIGS). Agricultural land of Grade 3b (moderate) quality. Mineral sites for construction aggregates – minerals used in building and engineering or to manufacture building and engineering products such as concrete. Minerals sites identified for future extraction e.g. Minerals consultation areas. **Groundwater**: Secondary A aquifer, no abstraction **Land contamination:** Moderately sensitive land uses such as commercial developments.
Low	**Geology and soils:** Agricultural land with an ALC grade of 4 (poor) or 5 (very poor). Inferred mineral resource or reconnaissance mineral resource e.g. Minerals Safeguarding Areas. **Groundwater**: Secondary B aquifer. **Land contamination:** Low sensitivity land use such as Industrial Sites and local transport links and services.
Noise and vibration (using the criteria set out in the Scottish Governments Technical Advice Note Assessment of Noise)	
Additional notes	This table sets out a guide for determining the sensitivity of a receptor. However, for assessment purposes, the variation in the sensitivity of receptors in terms of noise impact is taken into account by applying different scales to classify magnitude of impact (e.g. by using different scales for daytime and night-time) rather than by varying the assignment of sensitivity to specific types of receptors.
Very high	**Noise and vibration:** None identified.
High	**Noise and vibration:** Receptors where people or operations are particularly susceptible to noise for example residential, including private gardens where appropriate, quiet outdoor areas used for recreation, conference facilities, theatres/auditoria/studios, schools during the daytime, hospitals/residential care homes and places of worship.
Medium	**Noise and vibration:** Receptors moderately sensitive to noise, where it may cause some distraction or disturbance for example offices, bars/cafes/restaurants where external noise may be intrusive, sports grounds when spectator noise is not a normal part of the event and where quiet conditions are necessary (e.g. tennis, golf, bowls)
Low	**Noise and vibration:** Receptors where distraction or disturbance from noise is minimal for example buildings not occupied during working hours, factories and working environments with existing high noise levels, sports grounds when spectator noise is a normal part of the event, night clubs

Value (sensitivity)	Typical Descriptors
People and communities (Bespoke criteria using DMRB guidance)	
Additional notes	No very high receptors have been identified, as the people and community features are all of national importance or less and are likely to have some way to substitute.
Very high	**Land use and businesses:** None identified **Traffic and transport:** None identified **Public rights of way:** None identified
High	**Land use and businesses:** A highly or frequently accessed resource. No alternative facilities, access arrangements or opportunities are available within an easily accessible distance. **Traffic and transport:** Roads comprising of part of the Strategic Road Network (SRN). **Public rights of way:** National trails and Sustrans routes.
Medium	**Land use and businesses:** A limited range of alternative facilities, access arrangements or opportunities are available within an easily accessible distance. A moderately, or-semi-frequently accessed resource. **Traffic and transport:** Roads of regional importance including A roads not part of the SRN. **Public rights of way:** Regionally important rights of way.
Low	**Land use and businesses:** A wide range of alternative facilities, access arrangements or opportunities are available within an easily accessible distance. An infrequently accessed resource. **Traffic and transport:** Local roads. **Public rights of way:** Local importance rights of way.
Road drainage and the water environment (using the criteria set out in DMRB Volume 11 Section 3 Part 10 HD 45/09 - Table A4.3 Estimating the Importance of Water Environment Attributes)	
Very high	**Flood risk and drainage:** Floodplain or defence protecting more than 100 residential properties from flooding. **Geomorphology and water quality:** WFD overall status of 'High'. A watercourse that appears to be in complete natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, free from any modification or anthropogenic influence. An EC Designated Salmonid / Cyprinid fishery. Site protected/designated under EC or UK habitat legislation (SAC, SPA, SSSI, Water Protection Zone, Ramsar site, salmonid water) and or species protected by EC legislation. Watercourse widely used for recreation, directly related to watercourse quality (e.g. swimming). **Groundwater:** Principal aquifer providing a valuable resource because of its high quality and yield, or extensive exploitation for public and/or agricultural and/or industrial supply. Source Protection Zone (SPZ) 1 (Inner Protection Zone). Designated sites of nature conservation dependant on groundwater.

Value (sensitivity)	Typical Descriptors
High	**Flood risk and drainage:** Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding. **Geomorphology and water quality:** WFD overall status of 'Good'. A watercourse that appears to be in natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, with very limited signs of modification or other anthropogenic influences. Major Cyprinid fishery. Species protected under EC or UK legislation. Watercourse used regionally for recreation. **Groundwater:** Secondary A aquifer capable of supporting water supplies at a local scale and forming an important source of base flow to significant surface waters. SPZ2 (Outer Protection Zone). Local areas of nature conservation known to be sensitive to groundwater impacts.
Medium	**Flood risk and drainage:** Floodplain or defence protecting 10 or fewer industrial properties from flooding. **Geomorphology and water quality:** WFD overall status of 'Moderate'. A watercourse showing signs of modification, recovering to a natural equilibrium, and exhibiting a limited range of morphological features (such as pools and riffles). The watercourse is one with a limited range of fluvial processes and is affected by modification or other anthropogenic influences. Watercourse not widely used for recreation or limited local use, or recreation use not directly related to watercourse quality. **Groundwater:** Secondary B aquifer and/or poor groundwater quality and/or low permeability make exploitation of groundwater unlikely. SPZ3 (Source Catchment Protection Zone). Changes to groundwater not expected to have an impact on local ecology.
Low	**Flood risk and drainage:** Floodplain with limited constraints and a low probability of flooding of residential and industrial properties. **Geomorphology and water quality:** WFD overall status of 'Poor' or 'Bad'. A highly modified watercourse that has been changed by channel modification or other anthropogenic pressures. The watercourse exhibits no morphological diversity and has a uniform channel, showing no evidence of active fluvial processes and not likely to be affected by modification. Highly likely to be affected by anthropogenic factors. Heavily engineered or artificially modified and could dry up during summer months. Fish sporadically present or restricted; no species of conservation concern. Not used for recreation purposes. **Groundwater:** Very poor groundwater quality and/or very low permeability make exploitation of groundwater unfeasible. No known past or existing exploitation of this water body. Changes to groundwater are irrelevant to local ecology.

Appendix D. Cultural heritage assets

Asset	HER Ref or Historic England Ref. No	Description	Value
1	1013521	Bowl Barrow, north west of College Farm, a Scheduled Monument	High
2	11531	Chawston Manor moated site, a Scheduled Monument	High
3	36545	Congregational Chapel, Roxton, a Grade II* Listed Building	High
4	36551	Church of St Mary Magdalen, Roxton, a Grade II* Listed Building	High
5	8810	Site of a milepost, Roxton	Low
6	MBB19824	Roxton (known as)	Negligible
7	17182	Wall foundations, South East of Chawston	Low
8	MBB19827	Stray finds from the Roxton Area (3)	Negligible
9	MBB19828	Stray finds from the Roxton Area (2)	Negligible
10	MBB19829	Stray finds from the Roxton Area (1)	Negligible
11	8808	Milestone at Roxton	Low
12	MBB20032	North Bedfordshire (known as)	Negligible
13	2025	Finds bought up by dredging from the Great Ouse	Low
14	1012076	Moated Enclosure, Wyboston, a Scheduled Monument	High
15	1311862	Brook Cottages, a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
16	1005393	Tempsford Bridge, Roxton, a Scheduled Monument	High
17	1321633	Tempsford Bridge, a Grade II Listed Building, Roxton	Medium
18	12460	Cottage south of Scuttle Cottage Nags Head Lane, Wyboston	Low
19	1114092	The Old Anchor, a Grade II Listed Building, Tempsford	Medium
20	1321208	Scuttle Cottage, a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
21	18001	A WW2 tank trap, Wyboston	Low
22	12456	Little Thatch, Nags Head Lane, Wyboston	Low
23	8809	Site of a milestone, Wyboston	Low
24	12457	Thatch Cottage, Nags Head Lane, Wyboston	Low
25	880	Timber framed cottage, Wyboston	Low
26	12473	20 High Street, Wyboston, Chawston and Colesden	Low
27	1146418	Forty Farmhouse, a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
28	1321213	Dovecote at Forty Farmhouse (Asset 27), a Grade II Listed Building, Wyboston, Chawston and Colesden	Medium
29	MCB18207	Partially excavated Saxon settlement features, Alpha Park, Eaton Socon	Low
30	MCB18768	Ridge and furrow, St Neots	Negligible
31	MCB18208	Partially excavated medieval and post medieval remains, Alpha Park, Eaton Socon	Low
32	MCB18206	Neolithic features partially excavated at Alpha Park, Eaton Socon	Low
33	MCB16788	Roman Bronze Bracelet, Eaton Socon	Negligible
34	MCB16504	Partially excavated Roman rural site, Priors Gate	Medium
35	1146453	The Crown Inn, a Grade II Listed Building, Wyboston	Medium
36	00369	Neolithic hearth, Little End, Eaton Socon	Low

Asset	HER Ref or Historic England Ref. No	Description	Value
37	MCB16505	Roman features partially excavated at Alpha Park, Eaton Socon	Low
38	MCB18769	Possible enclosure, St Neots	Low
39	11778	Cropmarks North of 'The Bell' Public House, St. Neots	Negligible
40	1321214	Bell Farmhouse, a Grade II Listed Building, St Neots	Medium
41	MCB20473	Roman and Post-medieval activity: Land at 21 to 35 Great North Road, Eaton Socon, Cambridgeshire: an archaeological trial	Low
42	MCB15261	Post-medieval and undated features, Priors Gate, St. Neots	Negligible
43	00511	Palaeolithic finds, Eaton Socon	Negligible
44	11779	Roman pottery scatter and Saxon brooch, St. Neots	Negligible
45	1127971	Church of St Mary, Eaton Scotton, Grade II* Listed Building	High
46	MCB18770	Ditches, St Neots	Negligible
47	11777	Roman pottery scatter, St. Neots	Negligible
48	MCB16709	Neolithic pits, Colmworth Business Park, Eaton Socon	Low
49	MCB16710	Romano-British and undated remains, Colmworth Business Park, Eaton Socon	Low
50	479	ROMAN POTTERY found 1960	Negligible
51	1009629	The Hillings, Castle Hill, Scheduled Monument	High
52	10064	Conjoined square enclosures, St. Neots	Low
53	MCB18771	Track, St Neots	Negligible
54	00376	Fully excavated ring ditch, Eynesbury	Negligible
55	MCB17706	Fully excavated Early Saxon sunken-featured buildings, Eynesbury	Negligible
56	00377	Mesolithic flints, Eynesbury	Negligible
57	00447	Neolithic-Bronze Age flint scatter, Eynesbury	Negligible
58	10198C	Iron Age pottery, Eynesbury Hardwicke	Negligible
59	10198D	Romano-British pottery, Eynesbury Hardwicke	Negligible
60	10198G	Post-medieval finds, Eynesbury Hardwicke	Negligible
61	10198A	Fully excavated Mesolithic flint working site, Eynesbury	Negligible
62	10198E	Fully excavated Saxon settlement and cemetery, Eynesbury Hardwicke	Negligible
63	10198B	Fully excavated Neolithic site, Eynesbury Hardwicke	Negligible
64	10198F	Fully excavated ridge and furrow, Eynesbury Hardwicke	Negligible
65	10198	Fully excavated Bronze Age ring ditch, Eynesbury Hardwicke	Negligible
66	MCB17676	Fully excavated south cursus, Eynesbury	Negligible
67	MCB17705	Romano-British agricultural ditches and droveway, Eynesbury	Low
68	00378	Cropmark complex, Eynesbury Fields	Low
69	MCB15825	Iron Age features, Tesco Extension, Barford Road	Low
70	01308	Undated lithic implement, Eynesbury Hardwicke	Negligible
71	06150	Eastern cursus, Eynesbury	Low
72	MCB15950	Trackway and ditches, Barford Road, Eynesbury	Negligible
73	MCB15951	Prehistoric ditch and recent features, Barford Road, Eynesbury	Low
74	MCB15828	Ring ditch and associated features, Barford Road, Eynesbury	Low

Asset	HER Ref or Historic England Ref. No	Description	Value
75	03542	Lithic implements, Eynesbury	Negligible
76	11496	Saxon finds, Barford Road	Negligible
77	05689	Multi-phase enclosure system and possible hengiform monument, Eynesbury Fields	Low
78	05690	Sub Rectangular Enclosure at Gallow Hill	Low
79	10065	Cropmark enclosure and linear feature, St. Neots	Low
80	03543	Flint scraper, Eynesbury Hardwicke	Negligible
81	MCB17211	Undated and medieval features, Potton Lane, Eynesbury Hardwicke	Negligible
82	01307	Flint core, Eynesbury Hardwicke	Negligible
83	01562	Flint implements, Eynesbury Hardwicke	Negligible
84	MCB18836	Ditches, Eynesbury Hardwicke	Negligible
85	01319	Flint blade, Eynesbury Hardwicke	Negligible
86	MCB18832	Pits, Eynesbury Hardwicke	Negligible
87	MCB18831	Possible ditches, Eynesbury Hardwicke	Negligible
88	02388	Roman road, Eynesbury Hardwicke	Low
89	MCB18833	Ditches, Eynesbury Hardwicke	Negligible
90	MCB18835	Ridge and furrow, Eynesbury Hardwicke	Negligible
91	03532	Flint scraper, St. Neots	Negligible
92	MCB15791	Iron Age coin, E of St. Neots	Negligible
93	MCB18834	Ditches, Eynesbury Hardwicke	Negligible
94	MCB18821	Ridge and furrow, St Neots	Negligible
95	MCB18823	Cropmark ditches inSt Neots Parish	Negligible
96	04064	Pit, St. Neots Bypass	Negligible
97	MCB 18824	Cropmark ditches in Abbotsley Parish	Negligible
98	MCB18822	Pit, St Neots Rural	Negligible
99	MCB18830	Circular enclosure and adjacent ditches	Low
100	04062	Undated ditches, St. Neots bypass	Negligible
101	03535	Flint flake, St. Neots Rural	Negligible
102	03539	Prehistoric flint flake, St. Neots	Negligible
103	MCB19042	Possible enclosure, Abbotsley	Low
104	04063	Pit, St. Neots Bypass	Negligible
105	1211327	Farm buildings at Tithe Farm	Medium
106	MCB19041	Cropmark ditches in Abbotsley Parish	Negligible
107	1211328	Tithe farmhouse about 1 mile east of railway bridge	Medium
108	01270b	Moat and Medieval chapel site, Wintringham	Low
109	02385	Tanning vat, Wintringham	Negligible
110	MCB19038	Cropmark ditches in Abbotsley Parish	Negligible
111	1290056	Granary south west of Wintringham Hall	Medium
112	1211324	Barn about 100 yards south of Wintringham Hall	Medium
113	01270a	Wintringham Hall	Medium

Asset	HER Ref or Historic England Ref. No	Description	Value
114	MCB1640	Moated Site at Wintringham Hall excavated	Low
115	02406	Searchlight cropmark, Wintringham	Low
116	1006815	Deserted Medieval Village, Wintringham, a Scheduled Monument	High
117	MCB19040	Cropmark ditches in Abbotsley Parish	Negligible
118	MCB19044	Metalled track and ditches cropmark in Abbotsley Parish	Negligible
119	395444	Church of St Margaret, Abbotsley, a Grade II* Listed Building	High
120	1006849	Deserted Medieval Village, Weald, a Scheduled Monument	High
121	1210919	North Farmhouse, a Grade II Listed Building, Abbotsley	Medium
122	1331371	Grade II Listed mile post to the north west of the Spread Eagle Public House, Croxton	Medium
123	02451	White Hall, Croxton	Low
124	02517	Ridge and furrow, Croxton	Negligible
125	02329	The Downs, Croxton	Low
126	1163272	The House on the Hill, a Grade II Listed Building, Croxton	Medium
127	1127172	Rose Cottage, a Grade II Listed Building, Croxton	Medium
128	1331392	Orchard Cottage and two further cottages, a Grade II Listed Building, Croxton	Medium
129	1163289	Forge Cottage and Ivy Cottage, a Grade II Listed Building on High Street, Croxton	Medium
130	1127171	The Downs, a Grade II Listed Building, Croxton	Medium
131	1127174	A Grade II Listed village pump outside Chef's Cottage (Asset 135), Croxton	Medium
132	1163314	Lindsey Cottage, a Grade II Listed Building, Croxton	Medium
133	1331393	Myrune Cottage, a Grade II Listed Building, Croxton	Medium
134	1127173	The Manor House, a Grade II Listed Building, Croxton	Medium
135	1163308	Chef's Cottage, a Grade II Listed Building, Croxton	Medium
136	1127175	Gatehouse Lodge, a Grade II Listed Building, Croxton	Medium
137	1127163	Croxton, Registered Park and Garden II*	High
138	1006849	Deserted Medieval Village, Croxton, a Scheduled Monument	High
139	1127168	Church of St James, Croxton, a Grade II* Listed Building	High
140	100491	Croxton Park, a Grade II* Listed Building, Croxton	High
141	02387	Bronze Age rapier, Croxton Park	Negligible
142	1309225	Well head, north of Croxton Park, a Grade II Listed Building, Croxton	Medium
143	1210921	Grade II Listed milestone, Great Gransden	Medium
144	MCB18911	Ridge and furrow, Croxton	Negligible
145	MCB18912	Ditches, Croxton	Negligible
146	02403	Pit alignments, Eltisley	Negligible
147	MCB17254	Ridge and furrow, Church End, Eltisley	Negligible
148	MCB19662	Ditches and mounds as part of garden at Old House, Eltisley	Medium
149	1127179	The Parish Church of St John the Baptist and St Pandionia, a Grade II* Listed Building, Eltisley	High
150	02380	Eltisley Abbey, St. Pandionia's Well (site of)	Medium
151	02380a	Post Medieval house and moat, The Old House, Eltisley	Medium

Asset	HER Ref or Historic England Ref. No	Description	Value
152	1127180	Grade II Listed Lych gate to the north east of the Parish Church (Asset 149), Eltisley	Medium
153	1163524	52, The Green, Grade II Listed Building, Eltisley	Medium
154	1163469	The Old House, Grade II Listed Building, Eltisley	Medium
155	MCB17175	Primitive Methodist chapel, Eltisley	Low
156	1290148	Grade II Listed Barn to the East of Leycourt Farmhouse, Great Gransden	Medium
157	1127181	Kent Cottage, Grade II Listed Building, Eltisley	Medium
158	1331396	Green Farmhouse, Grade II Listed Building, Eltisley	Medium
159	1163501	Pond Farmhouse, Grade II Listed Building, Eltisley	Medium
160	1163520	South View, Grade II Listed Building, Eltisley	Medium
161	1331397	The Old Post Office, Grade II Listed Building, Eltisley	Medium
162	1223662	A Grade II Listed K6 telephone box at Eltisley	Medium
163	1163534	A Grade II Listed mile stone at Eltisley	Medium
164	02317	The Leeds Arms, Eltisley	Low
165	1019176	Moated site at Pond Farm, a Scheduled Monument	High
166	1019177	Moated site at Manor Farm, a Scheduled Monument	High
167	1331394	A Grade II Listed mile post at Eltisley	Medium
168	05753	Ridge and furrow, Eltisley	Negligible
169	02463	Windmill (site of), Eltisley	Negligible
170	02541	Probable windmill mound, Papworth Everard	Negligible
171	02350	Ridge and furrow, Eltisley	Negligible
172	MCB17322	Hare Park, Eltisley	Negligible
173	MCB18044	Cast Iron Milepost, Cambridge Road, Caxton	Low
174	1162760	A Grade II Listed mile post south of Pembroke Farm, Caxton	Medium
175	MCB19627	Group of rectilinear enclosure cropmarks	Low
176	n/a	Moated site at Pastures Farm, a Scheduled Monument	High
177	02494	Neolithic findspot, north west of Caxton Gibbet	Negligible
178	11873	Bronze Age flints, Swansley Wood	Negligible
179	02470	Site of Caxton Gibbet	Low
180	MCB16333	Ridge and furrow, Elsworth	Negligible
181	MCB15131	World War Two Airfield at RAF Caxton Gibbet	Low
182	03515	Linear cropmarks, Elsworth	Negligible
183	1331369	A Grade II Listed mile post near the junction with Elsworth Road, Caxton	Medium
184	CB15017	Ridge and furrow, Cambourne Elsworth Turn	Negligible
185	n/a	Roxton Conservation Area	Medium
186	n/a	St Neots Conservation Area	Medium
187	n/a	Croxton Conservation Area	Medium
188	n/a	Eltisley Conservation Area	Medium
189	n/a	Abbotsley Conservation Are	Medium
190	n/a	Waresley Conservation Area	Medium

Asset	HER Ref or Historic England Ref. No	Description	Value
191	1210913	Hardwicke Farmhouse, a Grade II Listed Building	Medium
192	1289878	Home Farmhouse, a Grade II Listed Building,Waresley-cum-Tetworth	Medium
193	1211037	A Grade II Listed milestone, Great Gransden	Medium
194	1210922	Moor Farmhouse, a Grade II Listed Building, Great Gransden	Medium
195	1211043	A Grade II Listed barn at Moor Farmhouse, Great Gransden	Medium
196	1308237	Jesus College Farm, a Grade II Listed Building	Medium
197	1309206	Manor Farmhouse, Eltisley, a Grade II Listed Building	Medium
198	01116	Moated Site at Hardwicke Manor	Low
199	01119	Moated Site at Caldecote Farm	Low
200	MCB19113	Saxon features at Eynesbury	Low
201	01115	Homestead Moat at Eynesbury and Hardwicke	Low
202	MCB17704	Late Bronze Age to Early Iron Age pit alignment	Low
203	MCB17698	Neolithic pits	Negligible
204	MCB16490	Early Medieval occupation at Lions Farm, Abbotsley	Negligible
205	02320	Medieval settlement at Hardwicke	Low
206	01136	Homestead Moat at Waterloo Farm	Low
207	MCB17697	Possible Neolithic double enclosure	Low
208	MCB19086	Medieval occupation at Lansbury Farm	Low
209	MCB17703	Early Bronze Age features excavated at Barford Road,	Low
210	MCB15831	Barford Road evaluation, Late Bronze Age to Roman	Low
211	MCB19055	Rectilinear enclosure visible as cropmarks	Low
212	01135a	Site of seventeenth century dovecote, Manor Farm	Negligible
213	00512	Mesolithic finds from Eaton Socon	Negligible
214	MCB19056	Possible enclosure visible as cropmark	Negligible
215	00616	Roman coin found at Parkes Farm	Negligible
216	MCB19066	Enclosure and pits visible as cropmarks	Negligible
217	07873	Possible Iron Age settlement at Eynesbury visible as cropmarks	Low
218	09972	Rectilinear enclosure visible as cropmark	Low
219	02358	Roman coins and medieval pottery found over a period of years	Low
220	MCB19067	Enclosures at Polesden Road visible as cropmarks	Low
221	MCB19061	Group of enclosures and ditches	Low
222	MCB18954	Curvilinear enclosure at Polesden Road visible as cropmarks	Low
223	MCB19061	Possible enclosures visible as cropmarks	Negligible
224	00447	Flint scatter, Neolithic to Bronze Age, including a tanged arrowhead	Negligible
225	MCB18828	Rectangular enclosure at Poles Farm Cottage, visible as cropmarks	Low
226	MCB19080	Rectangular enclosure visible as cropmarks	Low
227	MCB19031	Ditches and enclosures at Abbotsley	Low
228	MCB18829	Rectangular enclosure	Low
229	MCB18829	Ditches and enclosures north of St Neotts Road visible as cropmarks	Low

Asset	HER Ref or Historic England Ref. No	Description	Value
230	MCB18958	Curvilinear enclosure	Low
231	01135	Ponds at Manor Farm, Abbotsley	Negligible
232	MCB18966	Rectangular enclosure visible as cropmarks	Low
233	MCB19063	Hengiform enclosure, Abbotsley, visible as cropmarks	Low
234	04253	Possible Roman villa visible as cropmarks	Low
235	00800	Roman coin	Negligible
236	02355	Roman pottery at Caldecote Manor	Negligible
237	02397	Mesolithic tranchet axe, Eynesbury	Negligible
238	MCB18926	Possible enclosure or quarry visible as cropmarks	Negligible
239	MCB19062	Possible ditch visible as cropmarks	Negligible
240	12076	Possible park at Eynesbury	Low
241	MCB18959	Levelled ridge and furrow	Negligible
242	MCB19032	Field system visible as cropmarks	Negligible
243	09799	Roman coin	Negligible
244	MCB19046	Trapezoidal enclosure visible as cropmarks	Low
245	MCB18962	Possible enclosures	Negligible
246	02357	Possible Roman Cemetery	Low
247	CB15602	Roman to Medieval remains, Newton County Primary School	Negligible
248	01179	Moated site north east of Jesus Farm	Low
249	02349	Deer Park in Eltisley Wood	Low
250	01144	Moated site in Eltisley Wood	Low
251	MCB17255	Roman settlement at Caxton End	Low
252	02417	Possible Saxon building at Great Gransden	Low
253	10020	Medieval earthworks at Eltisley	Low
254	MCB16718	Neolithic Axe from Caxton End	Negligible

Appendix E. Extended Phase 1 habitat survey report

Appendix F. Options Appraisal Matrix

Options considered	Existing baseline	Do nothing		Option 1 (Orange) – full offline northern route	
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.		Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.	
Topic	Qualitative description	Qualitative assessment		Qualitative assessment	
Receptors					
Air quality	There are no air quality management areas (AQMA) within 200m boundary of the study area. The nearest AQMA is within St Neots High Street. Existing sensitive receptors are the residential areas including towns and villages such as Chawston, Wyboston, Eynesbury, Croxton and Eltisley.	Sensitive receptors are likely to experience a worsening of air quality in the future due to increased congestion under the do nothing scenario.		Sensitive receptors along the existing A428 at Eynesbury Manor, Croxton and Eltisley are likely to experience slight beneficial effects of air quality due to reduced traffic on the existing A428 that would reduce the pollutant emissions.	
Cultural heritage	Within the study area are 11 scheduled monuments, ranging in date from a Prehistoric bowl barrow to an early 19th century bridge at Tempsford. There are earthworks relating to three deserted medieval villages at Croxton, Weald and Wintringham, four medieval moated sites and at Castle Hills the remains of a Norman ringwork castle. Croxton Park, immediately south of the existing A428, is a mid-18th century house and garden set within a 16th century deer park. Croxton Park is a grade II* registered park and garden. There are seven grade II* listed buildings in the study area, comprising five parish churches, a non-conformist chapel and the house at Croxton Park; a further 41 grade II listed buildings and four conservation areas are within 300m of the A428.	The do nothing baseline is unlikely to result in significant effects to cultural heritage.		**Designated sites**: There is the potential to adversely impact the setting of two deserted medieval villages at Weald and Wintringham, both of which are scheduled monuments. There is the potential for adverse effects on the setting of a scheduled monument near the junction with the A1198 and a grade II listed farmhouse and barn to the east of Cambridge Road. There is the potential to take traffic (and noise and air quality impacts) away from Croxton Park, which may bring benefits to the setting of this site. **Archaeological remains:** There is a potential for adverse impacts on prehistoric archaeological remains near to the B1046 during construction. There is the potential for unknown archaeology along a predominantly offline route.	
Landscape	Croxton Park, located south of the A428 at Croxton, is registered as a historic park and garden. Mature woodland and parkland trees, many protected by tree preservation orders (TPO) are associated with the park including its boundaries along the existing A428. There are numerous listed buildings in the study area. There is significant woodland cover within the study area, including ancient woodland (e.g. Eltisley Wood and Sir John's Wood) and numerous non-designated small and medium-sized deciduous woodlands throughout the farmland to the east of the river Great Ouse, including woodlands on the National Forestry Inventory. The area to the south of the existing A428 and east of Potton Road is a quiet rural landscape of good quality, with a coherent, unspoiled, homogenous character. Significant features include numerous woodlands, mature hedgerows and small-scale stream valleys with attractive open views. This area includes frequent historic landscape features (Roman road, moated farmhouses, small-scale pastures, etc.) and is of high sensitivity to intrusive development and changes to the landform. Key visual receptors include scattered rural properties and farms with residential clusters at Croxton cross roads, Abbotsley, Eltisley and Caxton Gibbet. Users of the Ouse Valley Way national trail have views of the A1 between Tempsford and the southern edge of St Neots at Wyboston.	The do nothing baseline is unlikely to result in significant effects to landscape and visual.		**Designations:** The route would directly impact on one known TPO north of the existing A428 at Weald. **Character:** There would be direct long-term adverse effects for the Ouse Valley (high sensitivity) and Clayland landscape character areas (LCA) (medium to high sensitivity). There could be permanent, adverse physical effects on the River Great Ouse floodplain from a new road across the valley and improvements south of Black Cat, and to the component landscape features of farmland east of the River Great Ouse including severance and loss of some woodland blocks. The changes to landform in the section east of the Ouse Valley to Potton Road (through Biggins Wood Clay Vale and Alington Clay Farmland LCAs) would cause significant adverse impact on local landscape character due to open views cross undulating farmland. The footprint of the improved Black Cat junction would mean removal of the existing motel to the northwest, and another property to the northeast. The new section on embankment across the valley of Hen Brook east of St Neots, would be very prominent in the wider landscape setting, parallel to the existing A428.The proposed grade-separated junction at Cambridge Road would require substantial earthworks which would be out of character with the surrounding topography and could affect the landscape setting of Wintringham medieval village. The alignment to the north of the existing A428 avoids Croxton Park and medieval villages of Wintringham and Weald and the associated landscape features, and could benefit the setting of these features. **Visual impact:** Significant adverse visual effects would be likely at Black Cat, Cambridge Road and Caxton Gibbet. However, there are few visual receptors at these locations. Scattered rural properties would be adversely affected by visual impacts, some significantly. Users of all public rights of way (PRoW) east of St Neots would likely experience significant adverse effects, although vegetation planting or other screening could mitigate these impacts. Users of local footpaths at Black Cat would experience changes due to the proposed new layout.	
Biodiversity	There is one special area of conservation (SAC) designated for bats within 30km of the study area. Eversden and Wimpole Woods SAC lies 8.5km to the south east of the A428. The nearest site of special scientific interest (SSSI) is Elsworth Wood located approximately 1.1km north-east of Caxton Gibbet junction. There is a cluster of SSSI located less than 5km away from the existing A428. Croxton Park county wildlife site (CWS) is located adjacent to the A428. Eltisley Wood, River Great Ouse and Begwary Brook are all CWSs within the study area. The study area includes a number of biodiversity action plan (BAP) priority habitat including deciduous woodland, wood pasture and parkland, coastal and floodplain grazing marsh, lowland fens, and young trees. There is also the potential for protected species including badgers; great crested newt (GCN); water vole; otter; bats; grass snake; and common lizard.	The do nothing baseline is unlikely to result in significant effects to nature conservation.		**Designated sites:** There are unlikely to be significant effects to SSSIs given the distances involved although the presence of a bat SAC within 10km would need further consideration. The proposed route is located immediately adjacent to the River Great Ouse CWS with the potential for impacts arising due to direct habitat loss, habitat degradation, changes in air/water quality, noise/light disturbance, and severance. **Habitats**: Broadleaved woodland is located at various locations along the proposed route and would be directly affected at Croxton Park. Lowland fen and floodplain grazing marsh is located close to the proposed route at its western end and may be affected by hydrological changes. Compensation habitat creation is likely to be required if impacts are unavoidable resulting in additional land procurement. **Protected and priority species:** The presence of protected species including bats, badgers, GCN and reptiles is probable, although impacts could likely be addressed using standard mitigation.	

Options considered	Existing baseline	Do nothing		Option 1 (Orange) – full offline northern route	
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.		Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.	
Topic	Qualitative description	Qualitative assessment		Qualitative assessment	
Geology and soils	The soils are generally grade 2 (very good), with pockets of grade 1 (excellent) around Wyboston. The wider corridor of the River Great Ouse is a mineral consultation area. There are mineral safeguarding areas (MSA) located at the Wyboston interchange, Little Barford, the River Great Ouse, and east of St Neots. There are strategic mineral sites located at Black Cat junction and Blunham / Roxton. Potential contamination sources include authorised and historic landfills, fuel stations and highway services, a railway line and associated made ground, Little Barford Power Station and other land uses including industrial, commercial and agricultural. The majority of the superficial deposits in the area are classified as a secondary (undifferentiated) aquifer. In the west of the study area, along the A1, deposits are classified as secondary A aquifer.	The do nothing baseline is unlikely to result in significant effects to geology and soils.		**Soils:** This option would result in temporary and permanent loss of grades 1, 2 and 3 agricultural land through the footprint of the new alignment. There could be further loss of viable land through the severance of land between the existing A428 and offline sections. This could be minimised through consultation and good design. **Geology**: The western section of construction would cover a mineral consultation area, two MSA, a permitted mineral extraction site, and Black Cat strategic mineral site. The option may result in a loss of access to the minerals in the immediate area of any construction works, therefore reducing the volume of minerals available for extraction. Mineral extraction prior to construction could mitigate the effect; however, the area is covered by the current Black Cat junction, A1 and A421. **Contamination:** Construction of the option could result in disturbing contaminated ground along the route. This could require bespoke mitigation to manage the risk to receptors. **Groundwater**: Construction of the option at Black Cat junction and the western-most part of the option could mobilise contaminants, potentially impacting secondary A and secondary (undifferentiated) aquifers. This could require bespoke mitigation to manage the risk. Any cuttings or discharges to the ground could potentially impact groundwater receptors.	
Noise and vibration	There is an existing noise important area (NIA) located along the A1 between Black Cat and Wyboston and one located to the east of Caxton Gibbet on the existing A428. Noise and vibration receptors include residential properties along the A1 and in the south of St Neots on the A428.	Under the do nothing scenario, increased congestion could lead to either marginally increased noise levels for these receptors (due to increased flows) or marginally decreased noise levels (due to decreased line speeds).		**Noise important areas:** Traffic noise would be reduced at NIA located between Black Cat and Wyboston. **Noise sensitive receptors:** Noise would be reduced at residential properties along the A1 and in the south of St Neots on the A428. Properties in Croxton and Eltisley would also experience a decrease in traffic noise. There are various outlying properties in and to the east and southeast of Little Barford that currently experience low levels of traffic noise that would be adversely impacted by this option. Additionally, there are properties along the northern side of the A428 at Cambridge Road that would experience major noise increases at their northern facades (which currently experience low levels of traffic noise). Overall, more properties are considered likely to experience noise decreases than increases.	
People and community	Settlements include St Neots, Croxton, Eltisley, Wyboston, and Abbotsley. These contain residential property and community receptors such as schools and places of worship. Receptors adjacent to the A428 include the Wyboston Leisure Park and service stations located at the Black Cat junction and Caxton Gibbet junction. There are further commercial receptors located along Alington Road, Great North Road, and the Abbotsley Golf Hotel. Major roads in the study area include the A428, A1, A421, and A1198. The East Coast Main Line runs north-south parallel to the A1 and east of St Neots. There are 27 PRoW within the study area, which are clustered around Black Cat junction and Wyboston; southeast of St Neots, between Hen Brook and Wintringham; and the settlements of Weald, Croxton, and Eltisley.	The do nothing scenario would result in no traffic improvements on the A428, causing increased congestion and delays. This could also lead to greater access issues for residents in settlements in the vicinity of the A428.		**Land use:** The offline sections of this option would cause land severance, creating small pockets of land between the new alignment and existing A428. This could also affect access routes to isolated properties and farms. This could be mitigated through good design and consultation with landowners. **Property (residential / commercial):** This option could reduce disturbance (cumulative noise, air quality, and visual effects) to residential property along the existing A428/A1. Access to settlements could improve as the existing A428 would be used for local traffic only. This option could physically impact upon commercial assets around Black Cat and Caxton Gibbet junction, requiring their relocation. **Transport:** There would likely be a beneficial effect from traffic using the A428 from reduced congestion and journey times. This option would require one crossing over the railway line, which could result in disruption to rail services during construction. **Rights of way:** Offline sections of this option would dissect PRoW, which would require closure, diversion, or safe crossings. There is an opportunity to improve non-motorised user (NMU) access along the 'old' A428.	
Water environment	There are two main rivers within the study area (the River Great Ouse and Hen Brook). The River Great Ouse is associated with an extensive floodplain, while the Hen brook has a considerably less extensive flood plain. There are five Water Framework Directive (WFD) water bodies within the study area, including the Ouse (Roxton to Earith), Stone Brook, West Brook, Begwary Brook and Abbotsley and Hen. All are classified as having moderate potential, except for the Begwary Brook which is currently achieving good potential.	The do nothing baseline is unlikely to result in significant effects to the water environment.		This option would require a new crossing and works within the flood zone of the River Great Ouse. The option would also require the extension of existing structures on three smaller watercourses, with new crossings and potential realignments. The option could alter existing flood risk patterns as a result of new and extended structures and working within the floodplain. Floodplain losses around the River Great Ouse are likely to require compensation. Physical modifications to rivers/watercourse could alter the channel characteristics and water quality and could lead to a change or deterioration in the WFD status of the rivers/watercourses.	
Design considerations					
Waste and materials	There is no existing waste and material baseline applicable to the scheme.	A small amount of materials and a small amount of waste would be generated during the routine maintenance.		This option would require large amounts of raw materials and would generate waste. The impacts can be mitigated by undertaking a materials management strategy from the start of the design process.	
Climate change	Climate change is likely to result in more extreme weather patterns including flash flooding and drought.	There would be no opportunities to make the A428 more resilient to climate change.		This option would allow the A428 to be designed to be more resilient to climate change, including increasing capacity of culverts and drainage systems and providing surfacing more resistant to extreme weather conditions.	
Resilience to environmental risks, accidents and disaster	There is no evidence of environmental risks that have occurred along the A428.	There would be no opportunities to make the A428 more resilient to environmental risks.		No opportunities have been identified to date to make the option more resilient to environmental risks, accidents and disaster.	

Options considered	Existing baseline	Do nothing	Option 1 (Orange) – full offline northern route
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Full offline dualling between Black Cat and Caxton Gibbet with a grade separated junction at Cambridge Road. Grade separation of both Black Cat and Caxton Gibbet.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment
Crosscutting topics			
Health	Existing health receptors include residents in St Neots and the surrounding area, NMU and recreational ground users adjacent to the existing road network, and visitors to the businesses adjoining the road network.	Increases to noise levels and reduction in air quality could affect the health of sensitive receptors near the junction e.g. the community receptors and residential properties.	The new road could reduce driver stress, and have beneficial effects on the health of local residents who use the route. The offline route would also take noise and air quality effects away from a large number of receptors. There is also an opportunity to improve NMU access along the 'old' A428. These could have a positive effect on health.
Ecosystems services	The habitats and landscape around the existing road network provide a value to people who live in St Neots and the surrounding area.	Increases to noise levels and reduction in air quality could affect existing habitats and biodiversity near the junction.	Offline sections have the potential to affect woodland and other habitats, which provide value to the landscape and local amenity. The option would also result in loss of functional floodplain, which acts as a natural flood defence.
Socioeconomics	St Neots is an important regional centre for businesses and commercial enterprises. The A428 forms an important part of the strategic route between Milton Keynes and Cambridge, via Bedford.	Increased congestion is likely to deter development within the area and could affect long term economics.	An option that reduces congestion along the A428 is likely to help the local economy in terms of supporting development. There may be minor effects on socio-economics due to disruption during construction and minor adverse effects to businesses along the existing A428 which benefit from passing trade.
Other considerations			
Potential planning route	Not applicable.	No capital works required, therefore no planning permission would be required. Assumes that routine maintenance would fall under permitted development powers.	This option would require a Development Consent Order.
Is this likely to require a statutory EIA?	Not applicable.	No planning required and therefore no statutory EIA required.	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.
Is this likely to require an Appropriate Assessment?	Not applicable.	No capital works required and therefore no Appropriate Assessment required.	Initial screening has indicated that this option is unlikely to require an Appropriate Assessment.
What other environmental consents and approvals may be required?	Not applicable.	Routine maintenance may require consents and approvals under relevant legislation e.g. protected species licences.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work.
Overall summary			
Does this meet the environmental KPIs	Not applicable.	There would be no opportunity to contribute to KPI targets.	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.
Does this provide opportunities under the RIS designated funds?	Not applicable.	There would be no opportunity to use RIS designated funds to further improve the environment.	This option has the potential to access designated funds to improve NIAs, reduce historic severance and increase biodiversity along the route.
Summary of the environmental appraisal	Not applicable.	This is assessed as the baseline to compare other options to. Air quality and noise is likely to get worse at the junction without intervention.	This option has an offline footprint that has been designed to avoid sensitive features. This option would provide an opportunity to move adverse effects associated with the existing road away from Croxton Park, potentially enhancing this feature. There are potential significant effects to the landscape that would need further design inputs at Stage 2. However, overall this is considered to be the environmentally preferred offline option as it would provide opportunities for improvement to the NIA, NMU access and to Croxton Park.

Options considered	Option 5 (Purple) – Offline alignment to the north of Abbotsley		Option 6 (Pink) – Offline alignment to the south of Abbotsley	
Option description	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge road Junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.		Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.	
Topic	Qualitative assessment		Qualitative assessment	
Receptors				
Air quality	Similar to Option 1.		Similar to Option 1.	
Cultural heritage	**Designated sites:** There is the potential to adversely impact on the settings of a scheduled monument near the junction with the A1198, and nine grade II listed buildings; these are mostly isolated farmsteads and barns set within open countryside. The option passes within 500m of Abbotsley Conservation Area which contains 17 grade II and one grade II* listed buildings. **Archaeological remains:** There is a higher risk of adverse effects on known and unknown archaeology along the entirely offline footprint.		**Designated sites:** Similar to Option 5. This option would be slightly further away from the Abbotsley Conservation Area. **Archaeological remains:** Similar to Option 5.	
Landscape	**Designations:** No direct adverse physical effect on Croxton Park Registered Park and Garden, but potential effects on the landscape setting to the south. No impact on known TPOs. Alignment passes within approximately 50m of Sir John's Wood and 200m of Eltisley Wood (ancient woodlands). **Character:** Physical impacts for Ouse Valley (LCA 4/4A), Biggin Wood Clay Vale (LCA 5F) and Caxton Gibbet would be the same as Option 1. Adverse physical impacts on the South East and Western Claylands (LCA 3 & LCA 5) would be greater than Option 1due to the route being unrelated to the existing A428 corridor with the route forming a new intrusive feature in open farmland. There would be significant severance of agricultural land and related hedges and boundary features including small streams. This route would be particularly damaging to the valley landscape north of Abbotsley which has a coherent, unspoiled rural character with attractive views. Changes to landform in this section would create a significant adverse effect. The alignment bisects Long Plantation (priority habitat deciduous woodland) and directly affects the edges of a number of smaller woodlands. There would be significant impact on small-scale pasture and residential properties at Leycourt, south of Eltisley. **Visual impact:** These would be the same as for Option 1 through the Ouse Valley, at Black Cat junction and Caxton Gibbet. To the east of the River Great Ouse adverse visual effects would potentially be experienced by scattered rural houses and farms and residents on the northern edge of Abbotsley and southeast edge of Eltisley and people using Abbotsley Golf Course.		**Designations:** Similar to Option 5. **Character:** Similar to Option 5. East of the Ouse Valley there would be a greater adverse effect on the open character of Biggin Wood Clay Vale (LCA 5F). There would be no impact on Alington Hill (LCA 1C), but there would be a significant increase in physical and visual impacts within the South East Claylands (LCA 3) due to a long diagonal cut across the southern escarpment and adverse effects on mature woodlands, including Crane Hill, Bushy Common Plantation and Thistle Hill Plantation. There would be a reduced adverse effect on the Hen Brook Valley compared to Option 5, but a significant adverse effect on the secluded, quiet Small Brook valley, southeast of Abbotsley. **Visual impact:** There would be an increased visual impact compared to Option 5, particularly for scattered rural residential receptors with the route running close to a number of farmsteads.	
Biodiversity	**Designated sites:** This option lies closer to the group of SSSIs to the south of the study areas and also lies less than 10km away from a bat SAC. Therefore, further screening is required to understand the effects to these designated sites, notably with respect to habitat severance. The non-statutory data does not cover the full alignment of this option, therefore there may be other non-statutory designated sites affected by the option that are not known at this stage in the assessment. There are unlikely to be impacts to SSSIs given the distances involved although the presence of a bat SAC within 10km may need further consideration. **Habitats:** Priority habitats likely to be affected include woodland and floodplain grazing pasture. The Extended Phase 1 habitat survey does not currently cover the full extent of this alignment. Compensation habitat creation is likely to be required if impacts are unavoidable resulting in additional land procurement. **Protected and priority species**: Similar to Option 1.		**Designated sites:** The proposed route is located within 1km of Weaveley and Sand Woods SSSI. At this distance, impacts associated with air quality change, fragmentation, disturbance or habitat degradation could arise. A more detailed assessment with respect to impacts to this site would therefore be required. The proposed route is located within 10km of a bat SAC (Eversden and Wimpole Woods SAC) so an Assessment of Impacts to European Sites would be required to identify any likely significance effects, notably with respect to habitat severance. **Habitats:** Several blocks of deciduous woodland, which is a priority habitat, would be directly affected. The severance and loss of these habitats would require mitigation, and is likely to impact protected species (notably bats). A block of ancient semi-natural woodland and ancient replanted woodland is also located within 200m of the proposed alignment and may be adversely affected. The Extended Phase 1 habitat survey does not currently cover the full extent of this alignment. **Protected and priority species:** Similar to Option 1..	
Geology and soils	**Soils:** Similar to Option 1, except the option would potentially require more permanent land take. **Geology:** Similar to Option 1; construction would cover thin strip of MSA north east of Abbotsley village rather than east of St. Neots. **Contamination:** Similar to Option 1. **Groundwater:** Similar to Option 1.		**Soils:** Similar to Option 5. **Geology:** Similar to Option 5. **Contamination:** Similar to Option 5. **Groundwater:** Similar to Option 5.	
Noise and vibration	**Noise Important areas:** Similar to Option 1. **Noise sensitive receptors:** Similar beneficial effects as Option 1. There are various outlying properties along the whole alignment that currently experience low levels of traffic noise that would be adversely impacted by this option. Properties on the northern side of Abbotsley would also experience increases in traffic noise.		**Noise Important areas:** Similar to Option 1. **Noise sensitive receptors**: Similar to Option 5. Property located at the southern side of Abbotsley would experience increases in traffic noise.	

Options considered	Option 5 (Purple) – Offline alignment to the north of Abbotsley	Option 6 (Pink) – Offline alignment to the south of Abbotsley
Option description	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge road Junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.
Topic	Qualitative assessment	Qualitative assessment
People and community	**Land use:** Similar to Option 1. The negative effects from land severance caused by Option 1would be reduced as the southern offline alignment would avoid creating small land parcels. **Property (residential / commercial):** Similar to Option 1. There could also be greater beneficial effects to settlements along the existing A428 and Croxton Park. This option would impact the grounds of the Abbotsley Golf Club through direct land take, as well as disturbance by noise and visual intrusion if not mitigated. **Transport:** Similar to Option 1. This would result in a continued use of the existing A428 for traffic accessing St Neots, which would not have as much benefit as Option 1as an NMU route. **Rights of way:** Similar to Option 1.	**Land use:** Similar to Option 5. **Property (residential / commercial):** Similar to Option 5. Impacts to the Abbotsley Golf Club and grounds would be avoided by the more southern alignment. **Transport:** Similar to Option 1. **Rights of way:** Similar to Option 1.
Water environment	Similar to Option 1 except the option would require the extension of existing structures on two smaller watercourses, with new crossings and potential realignments.	Similar to Option 1except that the option would require the extension of existing structures on three smaller watercourses, the crossing of four new watercourses and the potential requirement for realignments. Would also require construction in an additional area of flood zone 2.
Design considerations		
Waste and materials	Similar to Option 1.	Similar to Option 1.
Climate change	Similar to Option 1.	Similar to Option 1.
Resilience to environmental risks, accidents and disaster	Similar to Option 1.	Similar to Option 1.
Crosscutting topics		
Health	Similar to Option 1.	Similar to Option 1
Ecosystems services	Similar to Option 1. The option would also create an additional manmade feature within the landscape, with potential impacts on views from the Greensand Ridge, affecting the enjoyment of this asset. It would also create another barrier within the landscape scale habitat areas.	Similar to Option 5.
Socioeconomics	An option that reduces congestion along the A428 is likely to help the local economy in terms of supporting development. However, the bypass away from St Neots could affect the local economy in the town centre, as it benefits less from passing trade. There may be minor effects on socio-economics due to disruption during construction.	Similar to Option 5.
Other considerations		
Potential planning route	This option would require a Development Consent Order.	This option would require a Development Consent Order.
Is this likely to require a statutory EIA?	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.	This option has the potential for significant environmental effects and therefore an Environmental Statement is likely to be required.
Is this likely to require an Appropriate Assessment?	Initial screening has indicated that this option could require an Appropriate Assessment due to it lying less than 10km from the SAC and the potential for habitat severance.	Initial screening has indicated that this option could require an Appropriate Assessment, as it is within10km from the SAC and has the potential for habitat severance.
What other environmental consents and approvals may be required?	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work.	This option may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work.
Overall summary		
Does this meet the environmental KPIs	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.	There are opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of this option.
Does this provide opportunities under the RIS designated funds?	This option has the potential to access designated funds to improve NIAs and reduce historic severance.	This option has the potential to access designated funds to improve NIAs and reduce historic severance.

Options considered	Option 5 (Purple) – Offline alignment to the north of Abbotsley	Option 6 (Pink) – Offline alignment to the south of Abbotsley
Option description	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge road Junction. The alignment lies to the north of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.	Full offline dualling between Black Cat and Caxton Gibbet with no connection to Cambridge Road junction. The alignment lies to the south of Abbotsley. Grade separation of Black Cat and Caxton Gibbet.
Topic	Qualitative assessment	Qualitative assessment
Summary of the environmental assessment	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 5km to the south of the route. This option could require an Appropriate Assessment due to the proximity to the Eversden and Wimpole Woods SAC, which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than Option 1, as it would require more mitigation to offset potentially significant effects. Compared to Option 1, it would also create another major road within the landscape and create additional barriers to protected species migration within the study area.	This option is located closer to the Greensand Ridgeline and also to four SSSIs located within 3km to the south of the route. This option could require an Appropriate Assessment due to the proximity to the Eversden and Wimpole Woods SAC, which is designated for bats. The high sensitivity of this area makes this less environmentally favourable than Option 1and Option 5, as it would require more mitigation to offset potentially significant effects. Compared to Option 1, it would also create another major road within the landscape and create additional barriers to protected species migration within the study area.

Options considered	Existing baseline	Do nothing	Option A	Option B	Option C
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Dumbbell roundabouts near the existing Black Cat junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.	Eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.	One roundabout at existing Black Cat junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment	Qualitative assessment	Qualitative assessment
Receptors					
Air quality	There are no AQMAs within 200m of the study area. The nearest AQMA is within St Neots High Street, approximately 4.5km from the junction. Existing sensitive receptors include residential areas in Roxton and Wyboston.	Sensitive receptors are likely to experience a worsening of air quality in the future due to increased congestion under the do nothing scenario.	There may be a slight improvement in air quality as congestion reduces at Black Cat. However, the local junction widening would likely increase the traffic capacity as well as reduce the distance between the emission source and receptors, which would give rise to pollutant emissions.	Similar to Option A.	Similar to Option A.
Cultural heritage	Four scheduled monuments are located within 1km of the junction, ranging in date from a Prehistoric bowl barrow to an early 19th century bridge at Tempsford. There are six grade II listed buildings and one conservation area, Roxton Conservation Area, within 300m of the junction and adjoining road network.	The do nothing baseline is unlikely to result in significant effects to cultural heritage.	**Designated sites:** This option would likely result in the removal of the grade II listed building to the north of Black Cat (Brook Cottages). **Archaeological remains:** Option has the potential to affect unknown buried archaeology. The footprint will also affect areas of known archaeology (cropmarks) and will require further archaeological investigation.	**Designated sites**: This option involves undertaking works near Tempsford Bridge, which could have significant effects on the setting of the scheduled monument. This option may have an effect on the setting of the Brook Cottages listed building. **Archaeological remains:** Similar to Option A.	**Designated sites:** Similar to Option A. **Archaeological remains:** Similar to Option A.
Landscape	Visual receptors include residential property in Roxton and Wyboston, cultural heritage assets, and users of the Ouse Valley Way regional trail. These receptors will have views of the A1 between Tempsford and the southern edge of St Neots at Wyboston.	The do nothing baseline is unlikely to result in significant effects to landscape and visual.	**Designations:** Option has the potential to impact the setting of cultural heritage designations (see cultural heritage). **Character:** Introduction of a new grade separated junction will likely permanently alter the landscape setting in the vicinity of Black Cat junction. **Visual impact:** Three tier junction could result in significant visual effects to receptors in the area, including property in Roxton, Tempsford, and along the Great North Road, and users of PRoW.	**Designations:** Similar to Option A. **Character:** Similar to Option A. **Visual impact:** Similar to Option A, however there may be less visual effect from the junction as it would be a two tier junction, as opposed to three tier like Options A and C. However, the effect is still likely to be significant.	**Designations:** Similar to Option A. **Character:** Similar to Option A. **Visual impact:** Similar to Option A.
Biodiversity	There are three CWS located within 500m of Black Cat junction: Begwary Brook CWS, River Great Ouse CWS; and Wyboston Pits CWS. The study area includes a number of BAP priority habitat including deciduous woodland, and lowland fens. There is also the potential for protected species including badgers; great crested newt; water vole; otter; bats; grass snake; and common lizard.	The do nothing baseline is unlikely to result in significant effects to nature conservation.	**Designations:** Option would require one crossing over the River Great Ouse CWS, with the potential for impacts arising due to direct habitat loss, habitat degradation, changes in air/water quality, noise/light disturbance, and severance. **Habitats:** Option would encroach into the River Great Ouse corridor and have the potential to impact habitats and species. The area is a habitat enhancement area and additional habitat creation could be undertaken as part of the option to meet Highways England targets for improving biodiversity. **Species:** Option has the potential to impact protected and notable species; however, this could likely be managed through standard mitigation.	**Designations:** Option would require crossings over River Great Ouse CWS in two locations, with potential for greater effects to the site. **Habitats:** Similar to Option A. **Species:** Similar to Option A.	**Designations:** Similar to Option A. **Habitats:** Similar to Option A. **Species:** Similar to Option A.
Geology and soils	Soils in the study areas are ALC grade 1 (excellent). Black Cat junction is located within a mineral consultation area and mineral safeguarding area, located along the River Great Ouse corridor. There are strategic mineral sites located at Black Cat junction and Blunham / Roxton. Superficial deposits in the study areas are classified as secondary A aquifer.	The do nothing baseline is unlikely to result in significant effects to geology and soils.	**Geology:** This option affects a small area within the minerals area, therefore is least likely to be affected by the programme of the minerals extraction. **Soils**: Option would result in permanent loss of grade 1 agricultural land. **Contamination:** Option could result in disturbing contaminated ground, mobilising contaminants. This could require bespoke mitigation to manage the risk to receptors. **Groundwater:** Secondary A aquifer could be affected by mobilised contaminants.	**Geology:** This option affects a large footprint within the permitted minerals site and the programme could be subject to the timing of the phasing of extraction. **Soils**: Similar to Option A. **Contamination:** Similar to Option A. **Groundwater:** Similar to Option A.	**Geology:** This option affects a footprint both within the permitted minerals site and a strategic minerals site. The programme will need to take into account the phasing of the extraction of the mineral workings. **Soils:** Similar to Option A. **Contamination:** Similar to Option A. **Groundwater:** Similar to Option A.

Options considered	Existing baseline	Do nothing	Option A	Option B	Option C
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Dumbbell roundabouts near the existing Black Cat junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.	Eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.	One roundabout at existing Black Cat junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment	Qualitative assessment	Qualitative assessment
Noise and vibration	There is an existing NIA located along the A1 between Black Cat and the Wyboston interchange. Noise and vibration receptors include residential properties in Roxton and Wyboston.	Under the do nothing scenario, increased congestion could lead to either marginally increased noise levels for these receptors (due to increased flows) or marginally decreased noise levels (due to decreased line speeds).	**Noise sensitive areas:** Option may result in a slight improvement in the short term to properties around Black Cat as congestion reduces. However, there is likely to be increased traffic volume which could increase noise levels in this area. **Noise important areas:** Option may lead to an improvement in the NIA to the north of Black Cat in the short term due to reduced congestion but could lead to an increase in noise levels in the long term due to additional traffic flows in this area.	**Noise sensitive areas:** Similar to Option A. This option may have less of an effect than options A and C as the junction would be two tiered. **Noise important areas:** Similar to Option A.	**Noise sensitive areas:** Similar to Option A. **Noise important areas:** Similar to Option A.
People and community	Residential property is located in the vicinity of the junction at Roxton and Wyboston. Other receptors in the area include the Wyboston Leisure Park, Black Cat Services, and Roxton Garden Centre. There are further commercial receptors located along Great North Road. Major roads in the study area include the A428, A1 and A421. There are 6 PRoW within the study area clustered around Black Cat junction.	The do nothing scenario would result in no traffic improvements at Black Cat, causing increased congestion and delays. This could also lead to greater access issues for residents in settlements in the vicinity of the junction.	**Land use:** New junction would not cause significant land severance. **Property (residential / commercial):** Option could result in cumulative noise / air / visual effects to residential property near the junction. Black Cat services would need to be relocated. **Transport:** There would likely be beneficial effects for traffic using Black Cat junction, as congestion and journey times reduce. **Rights of way:** Construction of the option would require the closure / diversion of PRoW adjoining the existing junction.	**Land use:** Similar to Option A. **Property (residential / commercial):** Similar to Option A. There may be slightly reduced cumulative noise / air / visual effects to residential property as the junction is two tiered. **Transport:** Similar to Option A. Beneficial effect may not be as great as other options as new junction would not accommodate all movements. **Rights of way:** Similar to Option A.	**Land use:** Similar to Option A. **Property (residential / commercial):** Similar to Option A. **Transport:** Similar to Option A. **Rights of way:** Similar to Option A.
Water environment	The River Great Ouse main river is located to the east of Black Cat junction. South Brook is located to the north of the junction. Both waterbodies have floodplain classed as Flood Zone 2 and 3. The Ouse (Roxton to Earith) is a WFD water body and is classified as having moderate potential.	The do nothing baseline is unlikely to result in significant effects to the water environment.	This option affects a small footprint in the floodplain and is likely to require some floodplain mitigation.	This option affects a larger footprint than both options A and C in the floodplain and is likely to have the greatest impact on flood risk and will require floodplain mitigation.	This option affects a greater footprint in the floodplain than Option A, but smaller than Option B, and will require floodplain mitigation.
Design considerations					
Waste and materials	There is no existing waste and material baseline applicable to the scheme.	A small amount of materials and a small amount of waste would be generated during the routine maintenance.	All options will require materials to construct, and will generate waste. This is unlikely to be significant in the context of the overall scheme, and could be mitigated by undertaking a materials management strategy from the start of the design process.		
Climate change	Climate change is likely to result in more extreme weather patterns including flash flooding and drought.	There would be no opportunities to make the junction more resilient to climate change.	All options would allow the junction to be designed to be more resilient to climate change, including increasing capacity of culverts and drainage systems and providing surfacing that is more resistant to extreme weather conditions.		
Resilience to environmental risks, accidents and disaster	There is no evidence of environmental risks that have occurred at Black Cat junction.	There would be no opportunities to make the junction more resilient to environmental risks.	No opportunities have been identified to date to make the options more resilient to environmental risks, accidents and disaster.		

Options considered	Existing baseline	Do nothing	Option A	Option B	Option C
Option description	Description of the existing baseline environment including sensitive features. Further details can be found in the EAR.	This assumes that no works are undertaken.	Dumbbell roundabouts near the existing Black Cat junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.	Eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.	One roundabout at existing Black Cat junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.
Topic	Qualitative description	Qualitative assessment	Qualitative assessment	Qualitative assessment	Qualitative assessment
Crosscutting topics					
Health	Existing health receptors include residents in Roxton and Wyboston, NMU and recreational ground users adjacent to the existing junction, and visitors to the businesses adjoining the road network.	Increases to noise levels and reduction in air quality could affect the health of sensitive receptors near the junction e.g. the community receptors and residential properties.	The introduction of a new offline, grade separated junction has the potential to result in adverse effects from noise, and air quality, which in turn could lead to cardiovascular or respiratory issues. A multi-tiered junction also presents a potentially significant visual intrusion to the local communities, which could lead to a perceived reduction in local amenity, causing stress and anxiety to local residents. There could be minor benefits to driver health if junction improvements improve driving conditions (e.g. through reducing congestion), resulting in less driver stress.		
Ecosystems services	The habitats and landscape around the existing junction provide a value to people who live in the surrounding area.	Increases to noise levels and reduction in air quality could affect existing habitats and biodiversity near the junction.	All options have the potential to affect habitat, which provide value to the landscape and local amenity. All options would also result in loss of functional floodplain, which acts as a natural flood defence.		
Socioeconomics	St Neots is an important regional centre for businesses and commercial enterprises.	Increased congestion is likely to deter development within the area and could affect long term economics.	All options have the potential to positively impact socioeconomics by reducing congestion on the junction, supporting development in the region. There could be minor adverse impacts during construction due to disruption to local businesses.		
Other considerations					
What other environmental consents and approvals may be required?	Not applicable.	Routine maintenance may require consents and approvals under relevant legislation e.g. protected species licences.	All options may require protected species licences, flood defence consent, ordinary watercourse consent, and consent to temporarily / permanently close PRoW, depending on the impacts of the work. Options may require listed building consent for the building to the north of Black Cat.		
Overall summary					
Does this meet the environmental KPIs	Not applicable.	There would be no opportunity to contribute to KPI targets.	All options have opportunities to reduce noise levels at the NIA and to upgrade footpath crossings as part of the designs.		
Does this provide opportunities under the RIS designated funds?	Not applicable.	There would be no opportunity to use RIS designated funds to further improve the environment.	All options have limited potential to access designated funds to improve NIAs, reduce historic severance and increase biodiversity.		
Summary of the environmental appraisal	Not applicable.	This is assessed as the baseline to compare options to. Air quality and noise is likely to get worse at the junction without intervention.	Option would likely improve noise and air quality around Wyboston, as a proportion of the through traffic gets diverted onto the bypass. There is potential for significant impacts to a grade II listed building to the north of Black Cat and potential impacts to unknown buried archaeology. The option would encroach into the River Great Ouse corridor and have the potential to impact habitats and species. The option will have a footprint within floodplain, requiring compensation. There would also be a significant footprint within mineral sites, with potential programming risks and implications. A three tier junction will have greater landscape and visual impact. There will also be an increased perception of noise impacts, which may be more difficult to mitigate due to the additional junction height.	Option would likely improve noise and air quality around Wyboston, as a proportion of the through traffic gets diverted onto the bypass. There is potential for significant impacts to a grade II listed building to the north of Black Cat and potential impacts to unknown buried archaeology. The option would encroach into the River Great Ouse corridor and have the potential to impact habitats and species. The option will have a footprint within floodplain, requiring compensation. There would also be a significant footprint within mineral sites, with potential programming risks and implications. A two tier junction would have a lower landscape and visual impact than the other two options and be potentially easier to mitigate in terms of noise impacts. There could be effects to the setting of the scheduled monument at Tempsford Bridge, depending on the extent of the works to the south.	Option would likely improve noise and air quality around Wyboston, as a proportion of the through traffic gets diverted onto the bypass. There is potential for significant impacts to a grade II listed building to the north of Black Cat and potential impacts to unknown buried archaeology. The option would encroach into the River Great Ouse corridor and have the potential to impact habitats and species. The option will have a footprint within floodplain, requiring compensation. There would also be a significant footprint within mineral sites, with potential programming risks and implications. A three tier junction will have greater landscape and visual impact. There will also be an increased perception of noise impacts, which may be more difficult to mitigate due to the additional junction height.

Appendix G. Health assessment

G.1 Introduction

The objective of a health assessment is to make justifiable recommendations to safeguard and enhance human health. The method used focusses on the environmental, social, services, and intrinsic determinants of health. Health determinants combine to produce health outcomes. These are most apparent at the scale of populations, rather than individuals.

The health assessment is based on the outputs of the other EIA chapters including air quality, noise and people and communities. There may also be links to other documents including the Design and Access Statement or Equality Impact Assessment. There will be cross references to these documents in general to minimise duplicating the text. The health assessment will outline any gaps in human health that are not covered by the standard EIA chapters.

G.2 Methodology

At this stage in project development the health assessment has been undertaken in a qualitative way based on a series of question prompts (see table G.1). These have been completed using technical judgement to identify whether a specific issue should be scoped into the next level of the assessment. This has been based on the 'Rapid Health Impact Assessment Tool' developed by the London Healthy Urban Development Unit[7], and has used information from publically available sources only.

G.3 Logic diagram

Logic diagrams have been used to identify the potential health linkages on the project. One has been produced for the construction phase (figure G.1) and one for operation (figure G.2). The questions outlined in the rapid health impact assessment matrix (table G.1) were used as points of reference in creating these diagrams.

G.4 Rapid Health Impact Assessment

The rapid health impact assessment (table G.1) has been used to highlight potential health impacts. This shows how some of the health impacts can be reported and mitigated within existing topic chapters (e.g. noise, air quality and communities), or where there could be potential significant health impacts that are not covered in EIA chapters or other documents. Impacts will be scoped into the health assessment during the next stage of assessment.

[7] London Health Urban Development Unit. (2013). Rapid Health Impact Assessment Tool

Figure G.2: Construction phase health impact logic diagram

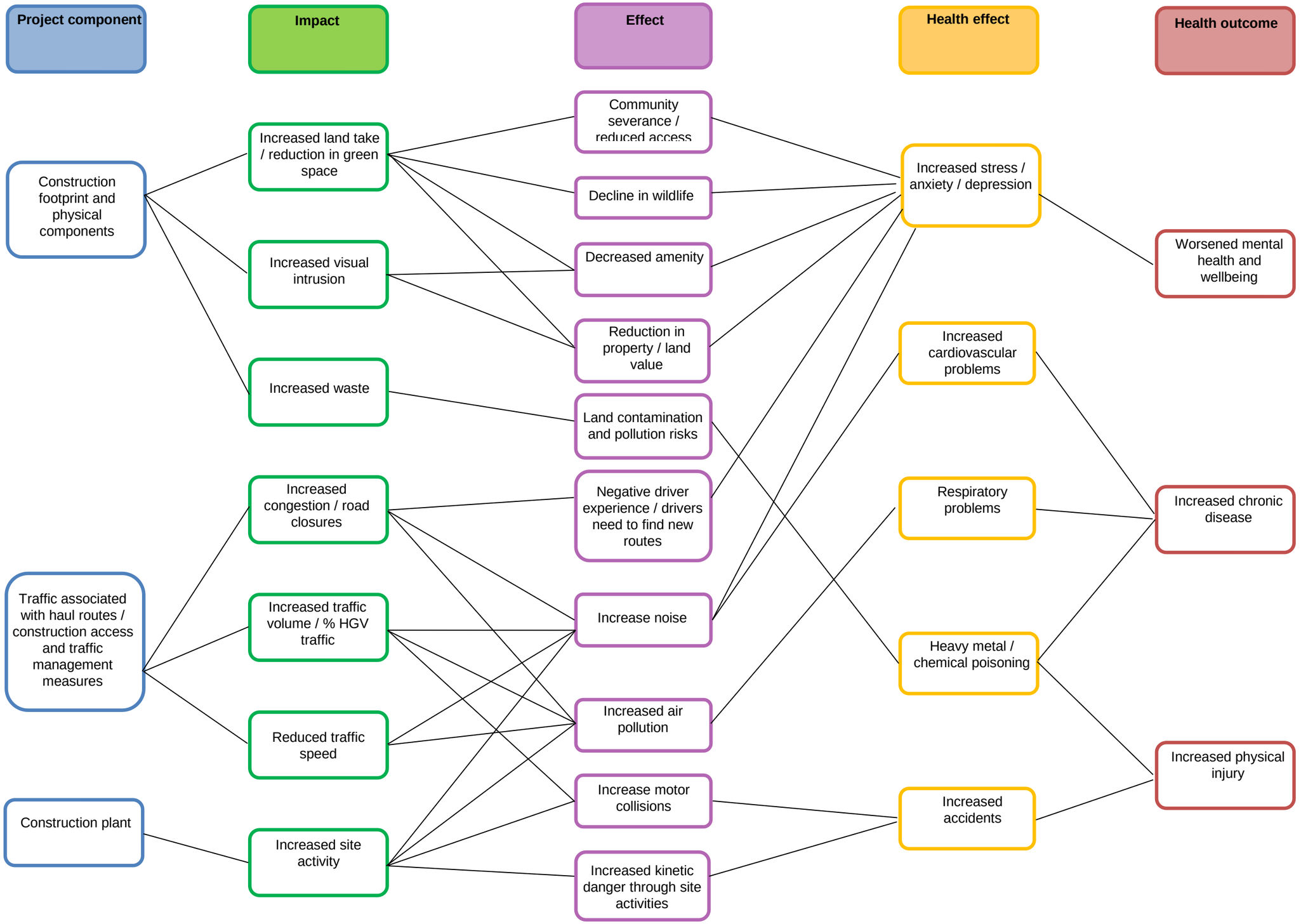


Figure G.3: Operational phase health impact logic diagram

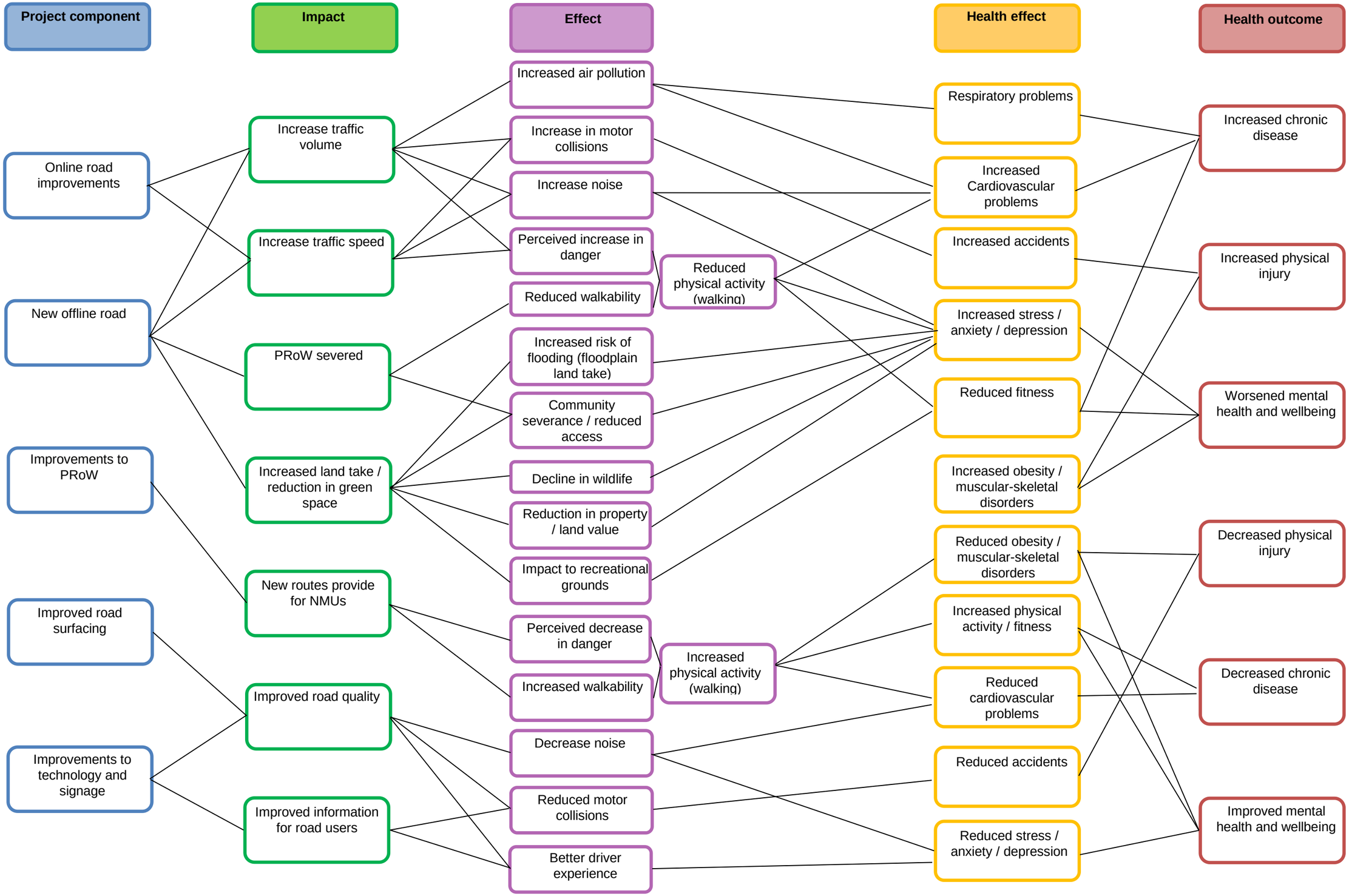


Table G.1: Rapid health impact assessment

Assessment criteria	Potential health impact	Likely to be significant	Details / evidence	Further considerations
Access to healthcare services and other social infrastructure				
Does the proposal assess the capacity, location and accessibility of other social infrastructure, e.g. schools, social care and community facilities?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	The scheme will be designed to avoid direct impacts to community facilities. This is not expected to have a significant impact on health.	Impacts on community facilities could be covered in the people and communities EIA chapter.
Access to space and nature				
Does the proposal retain and enhance existing open and natural spaces?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	Option 1 would sever open space and rights of way. It is assumed that the existing A428 will be retained. This would decrease the viability and amenity of the open land between the existing A428 and new offline route. A reduction in open space can result in increased severance, increased flood risk, reduced biodiversity, reduced amenity, and reduced property prices. These in turn can negatively impact health by increasing stress, physical accidents, and reducing physical activity. This would be of less relevance to Options 5 and 6 due to the distance from the existing A428.	The loss of open space could be considered within EIA chapters, including landscape and nature conservation. Cumulative effects would also be considered within the EIA. However, the health impacts from these cumulative effects would require further assessment and should be assessed in the HIA. The scheme will need to consider measures to mitigate any potential health impacts, and could for example consider the creation of new open spaces and designing these to benefit health.
In areas of deficiency, does the proposal provide new open or natural spaces, or improve access to existing spaces?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No		
Does the proposal provide links between open and natural spaces and the public realm?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☐ Yes ☒ No	The scheme will not specifically provide links between open space and the public realm. However, an objective of the scheme is to reinstate rights of way historically severed by the A428. This could improve access between community areas and open space.	Impacts on rights of way and NMUs could be covered within the people and communities EIA chapter.
Air quality, noise and neighbourhood amenity				
Does the proposal minimise construction impacts such as dust, noise, vibration and odours?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	Construction of the scheme would result in noise and dust pollution from plant and HGV movements. This could in turn result in increased stress, respiratory problems, and cardiovascular problems.	Measures to mitigate the construction effects of air quality and noise could be considered further within the respective EIA chapters.

Assessment criteria	Potential health impact	Likely to be significant	Details / evidence	Further considerations
Does the proposal minimise air pollution caused by traffic and energy facilities?	☐ Positive ☐ Negative ☐ Neutral ☒ Uncertain	☒ Yes ☐ No	All options will result in changes to traffic levels, which may reduce air pollution by reducing congestion, or increase pollution by increasing the amount of traffic using the Proposed Scheme. This could result in positive or beneficial effects to cardiovascular and respiratory problems.	The effects of air quality and measures to mitigate these could be considered further within the air quality EIA chapter.
Does the proposal minimise noise pollution caused by traffic and commercial uses?	☐ Positive ☐ Negative ☐ Neutral ☒ Uncertain	☒ Yes ☐ No	All options will result in changes to traffic levels, which may reduce noise pollution by reducing congestion, or increase pollution by increasing the amount of traffic using the Proposed Scheme. This could result in positive or beneficial effects to stress and cardiovascular problems.	The effects of noise pollution and measures to mitigate these could be considered further within the noise and vibration EIA chapter.
Does the proposal minimise visual intrusion of the scheme, for example increasing land take and light pollution?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	All options will involve junction improvements at Black Cat and Caxton Gibbet and the construction of a new offline road, which could have significant visual impacts. This could in turn affect health by leading to a perceived loss of amenity and reduced house prices, resulting in increased stress.	Visual and landscape effects and measures to mitigate these could be considered further within the landscape EIA chapter.
Does the proposal change pathways between pollution sources or potential contaminated land?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	The scheme will involve construction works such as excavation and piling which could change pathways between pollution / contaminated land sources and receptors such as people either directly or indirectly through pollution of watercourses and soil. This could in turn affect health by leading to perceived impacts on physical health.	A risk assessment could identify measures required to mitigate effects from contaminated land. These pathways could have linkages to health and should be considered within the HIA. Mitigation would be identified in the risk assessment and could include additional barriers or control measures.
Accessibility and active travel				
Does the proposal prioritise and encourage walking (such as through shared spaces)?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☐ Yes ☒ No	The scheme is being designed to retain rights of way in the study area. A scheme objective is also to reinstate rights of way historically severed by the A428. This could increase connectivity of NMU routes, increasing physical activity through walking.	Impacts on rights of way and NMUs could be covered within the people and communities EIA chapter.

Assessment criteria	Potential health impact	Likely to be significant	Details / evidence	Further considerations
Does the proposal prioritise and encourage cycling (for example by providing secure cycle parking, showers, and cycle lanes)?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☐ Yes ☒ No	The scheme is being designed to retain rights of way in the study area. A scheme objective is also to reinstate rights of way historically severed by the A428. This could increase connectivity of NMU routes, increasing physical activity through cycling.	Impacts on rights of way and NMUs could be covered within the people and communities EIA chapter.
Does the proposal connect public realm and internal routes to local and strategic cycle and walking networks?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☐ Yes ☒ No	National cycle route 12 is within the study area for all options. An objective of the scheme is to reinstate historic right of way severance. This could improve access to this strategic network, promoting their use, and increasing physical activity.	Impacts on rights of way and NMUs could be covered within the people and communities EIA chapter.
Does the proposal include traffic management and calming measures to help reduce and minimise road injuries?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	An objective of the scheme is to increase the safety of the road network. This includes designing the roads to remove or minimise design departures, for example by removing sharp bends and increasing visibility. This could result in less vehicle collisions, reducing physical accidents on the road network.	The impact the scheme has on road safety could be covered within the scheme's operational safety assessment.
Is the proposal well connected to public transport, local services and facilities?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	There are limited public transport services operating on the A428. This is not expected to have a significant impact on health.	Impacts on public transport could be covered in the people and communities EIA chapter.
Does the proposal seek to reduce car use by reducing car parking provision, supported by the controlled parking zones, car clubs and travel plans measure?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☐ Yes ☒ No	An aim of the scheme is to improve the performance and capacity of the A428. This would likely increase use of the road, rather than dissuade travel by car. This could increase noise and air pollution from an increase in traffic, leading to stress / respiratory / cardiovascular problems.	Although this could result in adverse impacts to health, given the wider benefits brought about by improvements to the NMU network, this is not expected to be significant.
Crime reduction and community safety				
Has engagement and consultation been carried out with the local community?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☐ Yes ☒ No	Consultation with local authorities and communities is an important element of the scheme, and will influence the final design.	Consultation is ongoing and will influence the design and EIA. Comments raised during the consultation highlighting community safety / health issues will be taken on board in future stages.

Assessment criteria	Potential health impact	Likely to be significant	Details / evidence	Further considerations
Access to work and training				
Does the proposal provide access to local employment and training opportunities, including temporary construction and permanent end-use jobs?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	The proposal will generate employment through construction of the scheme. This would likely include training opportunities for high skilled labour. Permanent end use jobs will likely be minimal beyond maintenance roles. This is not expected to have a significant impact on health.	Impacts on employment and training could be covered in a socioeconomic assessment.
Does the proposal include opportunities for work for local people via local procurement arrangements?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	It is currently unknown what the procurement arrangements will be for the workforce, it is assumed that some positions will be sources locally. This is not expected to have a significant impact on health.	Impacts on employment and training could be covered in a socioeconomic assessment.
Does the proposal improve access to regional employment?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	Improvements to A428 could improve driver experience thus improving commutes and making regional employment opportunities easier to access. This could increase driver wellbeing, reducing stress caused by difficult commutes.	Impacts on regional employment could be covered in the socioeconomic assessment. Impacts on driver experience could be covered in the people and communities EIA chapter.
Social cohesion and lifetime neighbourhoods				
Does the proposal connect with existing communities, i.e. layout and movement which avoids physical barriers and severance, and land uses and places which encourage social interaction?	☒ Positive ☐ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	All options would involve the construction of a new offline route, retaining the existing A428 as a local road. This could improve connection between local communities as strategic traffic is moved onto the new route. This could lead to an increased sense of community, decreasing stress and depression.	Impacts to community could be covered in the people and communities EIA chapter.
Minimising the use of resources				
Does the proposal make best use of existing land?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	All options would result in a significant amount of land being permanently lost to a new offline route. This will result in the loss of grade 1, 2 and 3 agricultural land. This could reduce the price of land and property, resulting in increased anxiety and stress.	The impact of land take could be covered in the people and communities chapter.

Assessment criteria	Potential health impact	Likely to be significant	Details / evidence	Further considerations
Does the proposal encourage recycling (including building materials)?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☒ Yes ☐ No	The scheme will require a substantial amount of material to construct, and will likely result in a significant amount of waste. The impact from this is not yet known. However, the scheme will be designed to the principles of the circular economy. This is not expected to have a significant impact on health.	Impacts from waste could be covered in the material EIA chapter.
Does the proposal incorporate sustainable design and construction techniques?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	The scheme will be designed with sustainability in mind. This will include measures to minimise material consumption and waste generation, and include provision for future climate change. This is not expected to have a significant impact on health.	The scheme design is ongoing. The EIA will document the design environmental considerations, and the embedded mitigation to reduce environmental impacts.
Climate change				
Does the proposal incorporate renewable energy?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	The operational energy use for the scheme will be minimal. Technology and lighting will be designed to be energy efficient. This is not expected to have a significant impact on health.	This is unlikely to require further consideration in the HIA.
Does the proposal ensure that buildings and public spaces are designed to respond to winter and summer temperatures, i.e. ventilation, shading, and landscaping?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	The scheme design will consider the impact on changing temperature on road surfacing. This is not expected to have a significant impact on health.	This is unlikely to require further consideration in the HIA.
Does the proposal maintain or enhance biodiversity?	☐ Positive ☒ Negative ☐ Neutral ☐ Uncertain	☒ Yes ☐ No	All options could adversely impact habitats, protected species, and designated sites. Impacts to these will be avoided through design where possible, mitigated where not possible, and compensated for where loss is inevitable. A decline in biodiversity can result in increased stress /depression through loss of amenity.	Impacts to biodiversity could be covered in the nature conservation EIA chapter.

Assessment criteria	Potential health impact	Likely to be significant	Details / evidence	Further considerations
Does the proposal incorporate sustainable drainage techniques?	☐ Positive ☐ Negative ☒ Neutral ☐ Uncertain	☐ Yes ☒ No	The scheme drainage design will incorporate sustainable drainage. This could include attenuation ponds to promote infiltration. This is not expected to have a significant impact on health.	Impacts relating to flooding could be covered in a Flood Risk Assessment.

Appendix K – Scheme Assessment Report (January 2018)

A428 Black Cat to Caxton Gibbet

Scheme Assessment Report

(HE551495-JAC-HGN-00-RP-CH-0002)- Revision P06

January 2018

Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ
Highways England Company Limited registered in England and Wales number 09346363

Contents

1. Existing Conditions

The existing A428 is an intermittent route between Coventry and Cambridge. At Bedford the A428 becomes the A421 to Black Cat junction, the A1 then continues north before the A428 restarts at Wyboston. At Cambridge the road ends and becomes the A14 which continues to Felixstowe.

On the route between Felixstowe and the M1 at Milton Keynes, the existing A428 stretch between Wyboston junction and Caxton Gibbet is the only single carriageway section. It consists of a number of priority junctions and private accesses along the single carriageway section. In addition, there is only one grade separated junction along the route and this is located at Wyboston between A1 and the A428.

The Black Cat junction is an interchange between the A1 and the A421 and has been recently improved as part of Highways England's Pinch Points Programme. For full details regarding the existing conditions refer to Section 3 of the Technical Appraisal Report (TAR) issued at PCF Stage 1.

2. Planning Factors

2.1 Existing Routes

The A428 between A1 and A1198 consists of approximately 2.3km long dual carriageway section between the Black Cat and Wyboston Junction. The remaining route beyond Wyboston Junction to Caxton Gibbet is a single carriageway section with four roundabouts and priority junctions which restrict free flow travel on the section, contributing to delays and accidents. The total length of the existing A428 between Black Cat junction and Caxton Gibbet is 16.8km.

The junctions described below are three of the key junctions along the route included in the scope of this scheme;

- Black Cat Junction – an at grade 5-arm partially signalised roundabout connecting the A1 and the A428 to the local road network via Bedford Road. There is also an arm to Breedon Quarry to the west.
- Cambridge Road Junction – an at grade 3-arm roundabout connecting the existing A428 to Cambridge Road.
- Caxton Gibbet Junction - an at grade 4-arm roundabout connecting the existing A428 to the A1198.

The A428 connects A14 and A1303 to Felixstowe and Cambridge respectively in the east while connecting to the A421 linking to Milton Keynes which connects to the M1 at Junction 13 in the west.

2.2 Solutions Investigated

The following mainline and junction options have been generated, analysed and assessed using a two stage sifting tool. Initially, 16 mainline options were identified in the PCF Stage 1 as highlighted in the Technical Appraisal Report (TAR) document number HE551495-JAC-GEN-00-REP-C-0001. Five additional offline options were also considered as part of the options identification phases. Many of the mainline options were similar variations of each other and so several were discarded to avoid repetition. Three further mainline options were discarded due to their high environmental impacts.

For Black Cat junction, 12 options were identified and these are referenced in the Annex to the TAR document number HE551495-JAC-GEN-BCJN-RP-CH-0001. A Red-Amber-Green table for the junction options was used to discount nine options for Black Cat junction. The remaining options were further developed and these are detailed in the sections below.

2.2.1 Mainline Option

- Option 1 - A428 full offline dualling with grade separation of Black Cat junction, grade separation of Cambridge Road roundabout and grade separation of Caxton Gibbet roundabout.
- Option 2 - Local junction widening with channelization at existing A428 junctions, grade separation at Black Cat junction, at-grade junction improvements at Cambridge Road roundabout, grade separation at Caxton Gibbet roundabout and upgrade to existing A1 junctions.
- Option 3 - A428 dual carriageway bypass from Black Cat to Cambridge Road roundabout with grade separation at Black Cat, Cambridge Road and Caxton Gibbet roundabouts. No changes to the mainline carriageway between Cambridge Road and Caxton Gibbet junctions.
- Option 4 - A428 dual carriageway bypass from Black Cat junction to Cambridge Road roundabout with online dualling between Cambridge Road roundabout and Caxton Gibbet roundabout. Grade separation at Black Cat and Caxton Gibbet roundabouts; and at-grade junction improvements at Cambridge Road roundabout.
- Option 5 - Option 5 is an offline dual two-lane Expressway between Black Cat and Caxton Gibbet with a design speed of 120kph. It follows a corridor approximately 500m north of Abbotsley and 1.5km north of Great Gransden. The total length of the proposed route is 18.35km. The option includes grade separation at Black Cat junction and Caxton Gibbet junction.
- Option 6 - Option 6 is an offline dual two-lane Expressway between Black Cat and Caxton Gibbet with a design speed of 120kph. Option O.E follows a corridor approximately 0.75km south of

Abbotsley and 1km south-east of Croxton and Croxton's 'Registered Parks and Grassland' area. The total length of the proposed route is 18.3km. The option includes grade separation at Black Cat junction and Caxton Gibbet junction.

- Option 7 – improvements to Black Cat, Wyboston Junction, and Wyboston to Barford Rd, Barford Road and Cambridge Road in the form of two tier grade separated junction, larger roundabout etc.
- Option 8 - Two-tier grade separated junction with local access at Black Cat junction.

2.2.2 Black Cat Junction:

For Black Cat junction, the following options were produced at PCF Stage 1.

- Option 1A - Dumbbell roundabouts on Roxton Road with merge and diverge slips from A428 and A1 connecting to the two roundabouts.
- Option 1B - Dumbbell roundabouts near the existing Black Cat junction with merge and diverge slips from A428 and A1 connecting to the two roundabouts.
- Option 1C - Similar to the option 1b above with merge and diverge on the A428 located further away from the mainline.
- Option 1D - Dumbbell roundabouts on Roxton Road with merge and diverge slips from A428 connecting to the two roundabouts. New roundabouts on the A1 with merge and diverge slips from A1 connecting to the new roundabout with a side road connecting the roundabout on the A1 and southern roundabout at Roxton.
- Option 1E - Dumbbell roundabouts on Roxton Road and A1 with merge and diverge slips from A428 and A1 connecting to the two dumbbell roundabouts.
- Option 2A - Dumbbell roundabouts on Roxton Road with diverge and merge from A428 connecting to the roundabouts. Another dumbbell to the east of A1 with diverge and merge from A428 connecting to these roundabouts with southbound diverge and merge on A1 connecting to east roundabout and link roads connecting east and west roundabouts.
- Option 2B - One roundabout on Roxton Road with diverge and merge from A428 connecting to the roundabout. Another roundabout to the east of A1 with diverge and merge from A428 connecting to this roundabout with southbound diverge, merge on A1 and link roads connecting this roundabout.
- Option 3A - One roundabout at existing Black Cat junction with merge and diverge slip roads from A428 and A1 connecting the roundabout.
- Option 3B - Similar to the option 3A above, with merge and diverge on the A428 moved further away from the mainline.
- Option 4 - Junction with slip roads and interchange links for all direction. Loop slip roads between A1 northbound and A428 eastbound as well as A1 southbound and A428 westbound.
- Option 5 - Eastbound diverge slip and westbound link from A428 connecting to A1 northbound and southbound respectively. Southbound diverge loop from A1 connecting to A428 westbound.
- Option 6 - Eastbound diverge link road from A428 connecting to A1 northbound and diverge slip connecting to existing Black Cat junction. Southbound diverge link road from A1 connecting to A428 westbound, and westbound merge slip on A428 connecting from existing Black Cat junction.

2.3 Solutions Developed

The conclusion of the TAR, based on the multi-discipline assessment of the mainline options, suggested that Options 1, 5 and 6 should be taken forward to the non-statutory consultation in PCF Stage 2. These are detailed in Section 2.3.1. For Black Cat junction, the options were assessed based on their constructability, safety, traffic flow and cost and it was determined that three options will be taken forward to the non-statutory consultation in PCF Stage 2. These are detailed in Section 2.3.2. It is anticipated that a preferred route and junction option will be announced by early 2018.

2.3.1 Mainline Options:

- Option 1 Orange route: A428 full offline dualling with grade separated junctions at Black Cat, Cambridge Road and Caxton Gibbet roundabout.
- Option 5 Purple route: an offline dual two – lane Expressway between Black Cat and Caxton Gibbet. It follows a corridor approximately 500m north of Abbotsley and 1.5km north of Great Gransden. The route runs south of Option 1 and does not require grade separation at Cambridge Road.
- Option 6 Pink route: an offline dual two – lane Expressway between Black Cat and Caxton Gibbet The option follows a corridor to south of Abbotsley, Croxton and Croxton's registered parks and Grassland area. The route runs south of Option 1 and Option 5 and does not require grade separation at Cambridge Road.

2.3.2 Black Cat Junctions:

- Option A (Formerly Option 1A and 1C) – a combination of option 1A and 1C with a northern roundabout bypass between A428 eastbound and A1 northbound. There is also a free flow link between the A1 southbound and the A428 westbound. There are dumbbell roundabouts located between the A1 and Roxton Road with links from these connecting all traffic movements between the A1 and A428.
- Option B (formerly Option 6) – retaining the existing roundabout and providing three main connector roads to link the main traffic movements of the junction.
- Option C (formerly Option 3B) - A singular roundabout and three-tier junction including a free flow roundabout bypass between the A428 eastbound and the A1 northbound. Merge and diverge links from the roundabout connect all traffic movements between the A1 and A428.

All the developed options can be referred to in more detail in section 4 of this report.

3. Do-Nothing Consequences

3.1 Journey Times and Traffic Flows

To help understand future problems along the A428, traffic models were developed to provide evidence about the situation if no improvements were implemented. The traffic models were also used to assess the situation if the scheme was constructed. The performance of the route has been considered in two areas:

- Link Capacity
- Journey Times

Link Capacity

The A428 SATURN model has forecast years of 2023 (proposed scheme opening), 2038 (design year) and 2051 (final forecast year). Flows have been extracted from these forecast models for sections of the route and are presented by year in Table 3.1 to Table 3.3 alongside an assessment of link capacity against the theoretical capacity of the link (as estimated at PCF Stage 0).

Table 3.1 : 2023 Capacity Assessment

Section	Peak hour Volume		DMRB ref. Capacity (Veh/hr)	V/C Ratio	
	AM	PM		AM	PM
Eastbound					
A1 – Black Cat junction to Wyboston Interchange	2,616	2,677	3,700	0.71	0.72
A428 – Wyboston Interchange to Barford Road roundabout	1,210	1,443	1,200	1.01	1.20
A428 – Barford Road roundabout to Cambridge Road roundabout	628	874	1,200	0.52	0.73
A428 – Cambridge Road roundabout to B1040 / St Ives Rd junction	883	1,011	1,200	0.74	0.84
A428 – B1040 / St Ives Rd junction to Caxton Gibbet roundabout	944	1,053	1,200	0.79	0.88
Westbound					
A428 - Caxton Gibbet roundabout to B1040 / St Ives Rd junction	1,106	1,304	1,200	0.92	1.09
A428 - B1040 / St Ives Rd junction to Cambridge Road roundabout	1,149	1,301	1,200	0.96	1.08
A428 – Cambridge Road roundabout to Barford Road roundabout	915	984	1,200	0.76	0.82
A428 – Barford Road roundabout to Wyboston Interchange	1,408	1,511	1,200	1.17	1.26
A1 – Wyboston Interchange to Black Cat junction	2,920	2,623	3,700	0.79	0.71

Table 3.2 : 2038 Capacity Assessment

Section	Peak hour Volume		DMRB ref. Capacity (Veh/hr)	V/C Ratio	
	AM	PM		AM	PM
Eastbound					
A1 – Black Cat junction to Wyboston Interchange	2,731	2,804	3,700	0.74	0.76
A428 – Wyboston Interchange to Barford Road roundabout	1,315	1,533	1,200	1.10	1.28
A428 – Barford Road roundabout to Cambridge Road roundabout	704	995	1,200	0.59	0.83
A428 – Cambridge Road roundabout to B1040 / St Ives Rd junction	940	1,024	1,200	0.78	0.85
A428 – B1040 / St Ives Rd junction to Caxton Gibbet roundabout	872	1,044	1,200	0.73	0.87
Westbound					
A428 - Caxton Gibbet roundabout to B1040 / St Ives Rd junction	1,143	1,334	1,200	0.95	1.11
A428 - B1040 / St Ives Rd junction to Cambridge Road roundabout	1,203	1,350	1,200	1.00	1.12
A428 – Cambridge Road roundabout to Barford Road roundabout	932	1,042	1,200	0.78	0.87
A428 – Barford Road roundabout to Wyboston Interchange	1,473	1,590	1,200	1.23	1.32
A1 – Wyboston Interchange to Black Cat junction	2,750	2,767	3,700	0.74	0.75

Table 3.3 : 2051 Capacity Assessment

Section	Peak hour Volume		DMRB ref. Capacity (Veh/hr)	V/C Ratio	
	AM	PM		AM	PM
Eastbound					
A1 – Black Cat junction to Wyboston Interchange	2,742	2,788	3,700	0.74	0.75
A428 – Wyboston Interchange to Barford Road roundabout	1,445	1,571	1,200	1.20	1.31
A428 – Barford Road roundabout to Cambridge Road roundabout	777	1,041	1,200	0.65	0.87
A428 – Cambridge Road roundabout to B1040 / St Ives Rd junction	910	1,043	1,200	0.76	0.87
A428 – B1040 / St Ives Rd junction to Caxton Gibbet roundabout	910	1,096	1,200	0.76	0.91
Westbound					
A428 - Caxton Gibbet roundabout to B1040 / St Ives Rd junction	1,214	1,324	1,200	1.01	1.10
A428 - B1040 / St Ives Rd junction to Cambridge Road roundabout	1,202	1,373	1,200	1.00	1.14
A428 – Cambridge Road roundabout to Barford Road roundabout	953	1,115	1,200	0.79	0.93
A428 – Barford Road roundabout to Wyboston Interchange	1,491	1,589	1,200	1.24	1.32
A1 – Wyboston Interchange to Black Cat junction	2,617	2,808	3,700	0.71	0.76

It is clear that as demand on the road network increases the capacity constraints of the single carriageway A428 will become more and more of an issue with more frequent flow break down, congestion and queuing.

Journey Times

The A428 SATURN model allows us to see how speeds and journey times are expected to change in the future given the increased demand on the network.

Journey times for a route using the A421, A1 and A428 between Bedford and Cambridge passing through the key junctions on the route (as shown in Figure 1) have been extracted from the model for the AM and PM periods in each modelled year and are presented in Table 3.4.

Figure 1:A421/A1/A428 Route

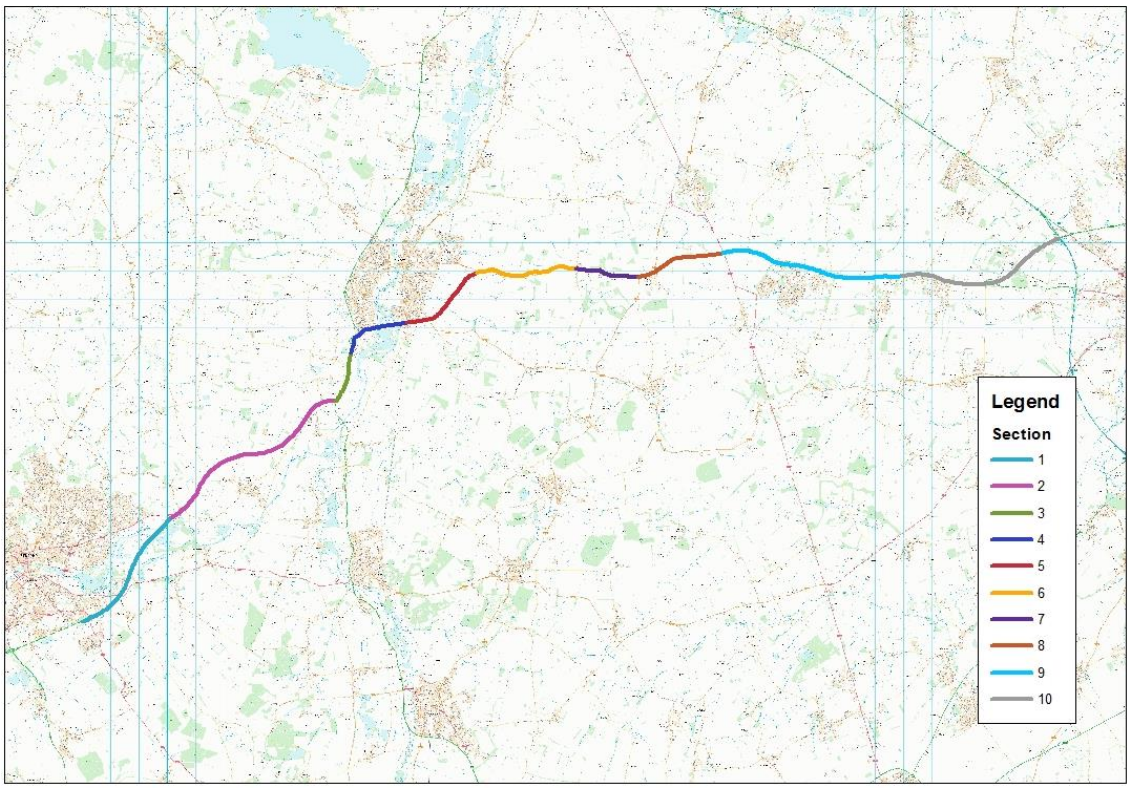


Table 3.4 : A428 Forecast Journey Times

Route	2023		2038		2051	
	AM (s)	PM (s)	AM (s)	PM (s)	AM (s)	PM (s)
A421/ A428 EB	2,205	2,124	2,583	2,353	2,764	2,446
A421/ A428 WB	2,307	2,185	2,406	2,385	2,535	2,492

From these results we can see that journey times will increase on this route as the level of traffic grows (by approximately an average of 6 minutes in the AM between 2023 and 2051, and approximately 5 minutes in the PM), however, SATURN does not provide a direct representation of the impact on journey time reliability and instead presents an average time.

With traffic volumes exceeding capacity at links and junctions the network will experience flow breakdown and increased variability given much worsened journey time reliability than experienced now.

3.2 Barrier to Economic Growth

This area of the UK has significant aspirations for economic growth. Transport connectivity is critical to these growth aspirations. Delays and unpredictable journey times affect business activity and disrupt people's ability to access their place of work or go about their daily business.

Information on expected growth in the vicinity of the scheme was collated as part of the development of the Uncertainty Log for the scheme to inform traffic forecasting. A summary of the information contained in the Uncertainty Log is provided in Table 3.5.

Table 3.5 : A428 Uncertainty Log Development

Local Authority	Near Certain / More than Likely		Reasonably Foreseeable / Hypothetical	
	Houses	Jobs	Houses	Jobs
Bedford Borough Council	0	481	0	0
Central Bedfordshire	0	2,510	0	1,151
Cambridge City Council	6,887	15,528	1,760	9,856
Huntingdonshire District Council	13,790	16,147	8,526	4,567
South Cambridgeshire District Council	30,170	17,164	0	1,212

This growth in housing and jobs across the local area will lead to significantly increase demand upon the transport network.

In addition, the DfT's Road Traffic Forecasts 2015 (RTF15) suggest that LGV growth in the East of England is expected to increase by 86% from 2016 levels by 2051 and by 51% for HGVs in their Core Scenario.

As shown in Section 3.1 journey times are expected to increase and the increase in traffic volumes is likely to lead to flow breakdown, congestion and queuing, this causes more unreliable journey times and could impact the economic performance of these expected developments and could influence companies and people to not relocate to the area.

3.3 Safety

The Technical Appraisal Report prepared at stage 1 identified that A428 Cambridge Road to Caxton Gibbet has a higher rate of killed and seriously injured (KSI) casualties than the norm for a single carriageway Strategic Road Network (SRN) route. Additionally, the fatal weighted index for A428 between Wyboston and Caxton Gibbet is higher than the SRN norm. 9 collision clusters were identified on A428 and 3 on A1. As traffic volumes increase the likelihood of casualties may increase, and the road is already performing less well than would be expected for a similar SRN. This suggests that no action may result in deterioration in safety performance of the route.

3.4 Walkers, Cyclists and Horse Riders (WCH)

The existing A428 single carriageway route between Wyboston and Caxton Gibbet has limited facilities for these users, and creates a barrier where at-grade public rights of way intersect. It has no safe facility for users to travel between Caxton Gibbet and St Neots. There are no operational bus stops in the length, although there are disused bus stops at Chawston. The WCH assessment, which has included workshops with user group representatives, has identified the following key areas of existing severance:-

a) Black Cat Roundabout – NMU routes from Roxton to the Black Cat Roundabout services area (restaurant; Travelodge; filling station) and Chawston (McDonalds) are required to cross the A421 at the signalised roundabout at grade.

b) A1 Chawston Lane – NMU bridge not available for cyclists

c) A428/Great North Road junction – NMU route between Wyboston Lakes and the west side of St Neots crosses the junction at an uncontrolled at-grade crossing.

d) A428/Barford Road Junction – NMU route from St Neots to business area crosses the junction at an uncontrolled at-grade crossing.

e) A428 between Cambridge Road junction, villages at Croxton, Eltisley and Caxton Gibbet junction – limited NMU facilities, and intersections with public rights of way, requiring at-grade crossing of the route.

f) Caxton Gibbet Roundabout – bus stops on A1198 and shared pedestrian/cycle facilities towards Cambourne on the north side of A428 are separated from hotel and McDonalds on the south side of the route by the roundabout, requiring users to cross at uncontrolled, at-grade facilities.

4. Summary of Alternative Schemes

4.1 General

In this section, summaries will be given to the three mainline and three Black Cat junction options that were selected for further development as outlined in Section 2.3 .

4.2 Mainline Options

The three mainline options share some common design improvement proposals which includes grade separated junctions at Black Cat, Cambridge Road and Caxton Gibbet depending on the option selected. The proposed route of Option 1 is located in close proximity to the existing route corridor. This option provides a direct connection to the Cambridge Road Junction. The proposed alignment of Options 5 and 6 are further south. Each of the proposed mainline options share similar improvements that are outlined below:

- Grade separated junctions at Black Cat and Caxton Gibbet.
- Dual two lane carriageway designed to expressway standard between Black Cat and Caxton Gibbet.
- Traffic sign gantries will be installed in the appropriate locations to facilitate driver comprehension of the junction and route layout.
- A number of bridge structures, NMU paths (and grade separated crossings), slip roads are incorporated in the scheme which can be referred to the Appendix drawings in the TAR document number HE551495-JAC-GEN-00-REP-C-0001.
- All three mainline options require bridge structures over the River Great Ouse and East Coast Mainline.
- All options would be Expressways, and would prohibit use by walkers, cyclists and horse riders. Provision of a safe facility near the existing route linking existing facilities on the east side of Caxton Gibbet junction with existing facilities which link to St Neots at Cambridge Road junction has been identified, and is supported by stakeholders. Stakeholders prefer the use of the existing NCR 12 between St Neots and Roxton as the remainder of the alternative route. Severance reduction measures at A428/Great North Road junction, Wyboston are also required.

These changes shall necessitate the requirement to review all other infrastructure including drainage, lighting, road restraint systems and the existing pavement. Buildability and construction duration has been assessed and presented in TAR. The construction durations are shown for each individual option. The most significant buildability issue for the three junctions is maintaining traffic flow and junction operation during the construction phase. This would be managed by the deployment of suitable traffic management involving lane closures.

Construction and project costs for each option have been developed by Highways England Commercial Services Division on behalf of Highways England.

4.2.1 Option 1 (Orange Route)

This option provides an offline route to Expressway standards between Black Cat and Caxton Gibbet which is approximately 18.9km long. In addition, significant improvements are also proposed for the three junctions (Black Cat, Cambridge and Caxton Gibbet) along the length of the route. These will be upgraded to grade separated junctions to improve flows. This is the only option which provides a direct connection to the Cambridge Road junction.

The proposed works begin east of the existing Black Cat junction and continue easterly for approximately 3km. The route would head north and from there it would travel north east passing through the improved Cambridge Road junction before heading east towards the Caxton Gibbet junction.

This option includes a total of seven departures, of which six relate to highways design and one relates to drainage design.

4.2.2 Option 5 (Purple Route)

This option is also an offline dual carriageway route designed to Expressway standards and the overall length is approximately 18.4km. The scheme is similar to Option 1 in terms of providing improvements to the Black Cat and Caxton Gibbet junctions to grade separated junctions.

The proposed works begin east of the existing Black Cat junction and continue in an easterly direction, passing over the River Great Ouse and East Coast Mainline. The route then heads in a north-east direction towards the Caxton Gibbet junction.

This option involves a total of six departures, of which five relate to highways design and one relates to drainage design.

4.2.3 Option 6 (Pink Route)

Option 6 is an offline dual carriageway route designed to Expressway standards and the overall length is approximately 18.3km. Option 6 heads east from Black Cat junction for approximately 7km before heading north-east between Abbotsley and Great Gransden. It then joins the existing A428 at Caxton Gibbet junction. Similar to Option 5, this option does not pass through Cambridge Road junction.

This option involves a total of six departures, of which five relate to highways design and one relates to drainage design.

4.3 Black Cat Junction Options

The three Black Cat junction options share some design similarities such as:

- Retaining a connection to from the junction to the local highway network via Bedford Road.
- Tie-in to the existing A421 at the existing Roxton Road Bridge.
- Provide a free-flow link between the A428 eastbound and the A1 northbound.
- Provide a safe walking/cycling facility along Roxton Road, linking to a new facility between Roxton Road and the A1 on the north-west corner of Black Cat Interchange. This would enable users to bypass the grade separated interchange, providing a safe connection between existing public rights of way, the National Cycle Route (NCR 12) on Roxton Road, and the west side of A1 north of the junction.

4.3.1 Option A (Drawing No. HE551495-JAC-HGN-BCJN-DR-CH-0001)

This option consists of a three tier grade separated junction with a dumbbell roundabout located between Roxton Road and the existing Black Cat junction. The A1 is proposed at the lowest tier replacing the current Black Cat junction to the east of the current alignment. The middle tier will be the free-flow link between the A1 southbound and the A428 westbound and the top tier will be for the proposed A428. This option impacts a listed building located to the north of the junction and accesses should be provided to the properties affected by the realignment of A1 to the north of the junction.

The major traffic flows for this junction are between the A421 eastbound and A1 northbound as well as the A1 southbound and the A428 westbound. Therefore, these routes have been designed as free flow links with 2-lane carriageways to reduce congestion. This route provides access to all routes between the A1 and A428 as well as providing connection to the local road network via Bedford Road.

This option consists of nine departures from standards, all nine relate to highway design.

The list of proposed structures is attached to the Annex to TAR document number HE551495-JAC-GEN-BCJN-RP-CH-0001. Appropriate changes will be made to the existing structures where required in order to reduce the total cost of construction.

4.3.2 Option B (Drawing No. HE551495-JAC-HGN-BCJN-DR-CH-0002)

This option involves the construction of three main connector roads in the vicinity of A428 and the A1 based on the most significant traffic flows.

- A link between the A428 eastbound and the A1 northbound via a one-directional connector road west of the intersection of the A1 and A428 (Connector road 1).
- A link between the A428 westbound and the A1 southbound (Connector road 2).
- A link between the A1 southbound and A428 westbound (Connector road 3).

A link has also been designed to bypass the retained roundabout to provide free flow for the A1 southbound. The existing roundabout is linked to the A428 via two slip roads allowing diverging and merging with Connector Road 1 and Connector Road 3 respectively. The existing A1 is to be retained; however A1 southbound link will act as a bypass of the roundabout. The local road network access to the A428 and A1 is retained via the roundabout connection to Bedford Road.

Where the traffic flow is very low or does not impact on the overall traffic capacity of the junction, it is anticipated not to provide links where connection can be achieved via Wyboston junction. A link has not been provided between the A1 southbound and A428 eastbound as the forecast traffic flow is very low. In addition, no link has been provided between the A1 northbound and the A428 eastbound as this connection is achieved via Wyboston junction.

This option would also impact on the listed building located to the north of the junction and alternative accesses should be provided to those properties that are impacted by the A1 southbound link to the north of the junction.

This option involves seven departures, all related to highway design. The existing Tempsford Bridge over the River Great Ouse will require widening to support the proposed A1 southbound merge. The list of proposed structures is attached to the Annex to TAR. Appropriate changes will be made to the existing structures where required in order to reduce the total cost of construction.

4.3.3 Option C (Drawing No. HE551495-JAC-HGN-BCJN-DR-CH-0003)

This option involves constructing a three-tier grade separated roundabout. The A1 is the lowest tier at approximately ground level or just below throughout the length of the junction. The roundabout is at the tier above that, the A428 is third tier and runs above the roundabout. The radius of the roundabout varies from a 90m to 120m radius. This was required in order to accommodate all eight connector roads as well as connection on the existing highway network via Bedford Road.

Merge and diverge slips roads from the A428 westbound and eastbound will connect to the roundabout along with the merge and diverge connector roads from the A1 northbound and southbound.

A free flow link to bypass the roundabout has been designed between the A428 eastbound and the A1 northbound as this section of the route has one of the major traffic flows at the junction. The connector road has also been proposed as a 2 lane carriageway in order to reduce congestion.

Similar to the two other options, this also impacts the listed building located to the north of the junction. Accesses should be provided to the properties impacted by the realignment of the A1 to the north of the junction.

There are seven departures from standard all related to highway design.

A list of new and existing structures will be found for all the options in Appendix A in the Annex to TAR. Existing structures may require realigning and widening in order to accommodate the proposed junction layout.

4.4 Conclusion

Mainline:

The three mainline options are all offline roads. All three options include grade separation at Black Cat and Caxton Road junctions. Option 1 is the only option to provide direct access to Cambridge Road. However, this would require additional capital relative to Options 5 and 6 as a grade separated junction would be required at Cambridge Road in order to ensure a free-flow expressway between Black Cat and Caxton Gibbet. All options pose significant design challenges, including spanning the River Great Ouse flood plain and the East Coast mainline.

Options 5 and 6 both have six departures each whereas Option 1 has seven departures. These can be found in the "Departures from Standards Checklist" document number HE551495-JAC-HGN-00-RP-Z-0003.

All the three options provide a free-flow link, dual carriageway link between Black Cat junction and Caxton Gibbet Junction. All options will help alleviate congestion and reduce journey times for vehicles travelling within this corridor.

Black Cat Junction:

The three junction options propose slightly different junction designs. Two of the options propose to improve the current Black Cat junction to a three tier grade separated junction; the other proposes to design connector roads which can link the proposed A428 and the other roads with high traffic flow to the proposed A428 whilst retaining the existing roundabout.

The A1, A421 and A428 are vital routes and contribute to large capacity of Black Cat junction traffic flow. The three tier junction will provide efficient traffic flow as it provides free flow access to the A428 and connecting other roads within the junction. It will provide more challenges in construction as compared to the connector roads, however it can be mitigated by taking appropriate design considerations into account.

Option B and C both have seven departures each whereas Option A has nine departures due to its more complex design. The departures for all three options are listed in a separate report; "Departures from Standards Checklist" document number HE551495-JAC-HGN-00-RP-Z-0003.

All of the above options are potentially effective solutions to the problems that exist at present. Either of the solutions will provide free flow to the A428 and it will improve travel conditions to the north and south of A1.

5. Tables of Traffic, Economics and Costs

5.1 Modelling

In order to predict the impact of the scheme in the future a series of transport models have been developed to produce forecasts of traffic flows in future years based on detailed modelling of the existing traffic conditions and our current understanding of future growth in the model area.

The model developed to test these improvements has been developed in SATURN with a base year of 2016. The model network used existing coding from the A14 Cambridge to Huntingdon SATURN model and was expanded using information from the DfT's Integrated Transport Network (ITN) dataset to cover the proposed model area. Traffic Demand in the model has been developed using Mobile Phone Data in a process agreed with Highways England that is similar to the development of their Strategic Model's matrices. The methodology behind the development of the Traffic Model can be found in the Appraisal Specification Report (Document reference: HE551495-JAC-XXX-XX-RP-TR-0001)

The model has been validated against observed data for journey times, screenlines and links. Full information on the validation of the model is provided in the Local Model Validation Report Document number HE551495-JAC-XXX-XX-RP-TR-0004.

5.2 Forecasting

Forecast models have been built to predict traffic conditions in the future and to allow the quantification of benefits for improvements to the A428 between Black Cat and Caxton Gibbet in the following years:

- 2023 – Scheme Opening Year
- 2038 – Scheme Design Year
- 2051 – Final Forecasting Year

Forecast models have been built based on the base year models described above. The base year network was updated to include scheduled improvements in each year including small scale improvements linked to developments in the area.

To estimate forecast traffic demand, housing and employment development data was obtained from surrounding Local Authorities and assigned a level of certainty based on the likelihood of each site being developed. Industry standard trip rate software was then used to estimate the number of trips entering and exiting each development. This development growth was then combined with background growth from TEMPRO v7.2 and the combination was constrained to TEMPRO v7.2 figures.

5.3 The Expected Effects of the Scheme Options

All of the options are expected to significantly reduce traffic flow on the single carriageway A428 and promote strategic or inter-town traffic to use the new A428 expressway. This is expected to improve conditions for local traffic (as the single carriageway A428 will become easier to use and less congested) and provide improved journey times for longer distance travel (as the traffic will be travelling on a higher standard of road and will be less interrupted by at grade junctions).

The Route Option 1 options are likely to provide the greatest relief in traffic volumes on the single carriageway section of the A428 through providing a connection to St Neots at Cambridge Road, and therefore allowing additional traffic to access the new expressway.

Junction Options A and C cater to all movements at the junction and provide the A1 with an entirely free flow route through the junction and this would be expected to provide better journey time savings than Option C, however, through removing significant traffic from the junction in Option B it is likely that this will also show considerable journey time savings.

5.3.1 Journey Times

The journey time performance of several key movements likely to be affected by the scheme have been extracted from the SATURN Model and compared to the Do Minimum (DM) for the three Orange Route options (Option 1), and Option 5 (Pink) and Option 6 (Purple) variants. The routes considered are:

- Bedford (Node 7281) to Cambridge (Node 1185)
- St Neots (Node 4101) to Cambridge (Node 1185)
- Bedford (Node 7281) to St Neots (4101)
- Sandy (Node 3681) to Buckden (Node 3335)

Comparisons in the AM and PM in 2051 are shown in Table 5.1 and Table 5.2 below

Table 5.1 : AM Journey Time Comparison

Route	DM Journey time (s)	Option 1_A Journey Time (s)	Option 1_B Journey Time (s)	Option 1_C Journey Time (s)	Option 5_C+ Journey Time (s)	Option 6_C+ Journey Time (s)
Bedford to Cambridge	3241	2462	2604	2531	2336	2336
Cambridge to Bedford	3146	2429	2433	2433	2388	2388
St Neots to Cambridge	1961	1680	1677	1674	1875	1875
Cambridge to St Neots	1874	1652	1674	1654	1789	1789
Bedford to St Neots	1591	1331	1484	1443	1362	1362
St Neots to Bedford	1553	1308	1338	1385	1502	1502
Sandy to Buckden	1746	1663	1739	1681	1690	1690
Buckden to Sandy	1099	959	996	945	962	962

Table 5.2 : PM journey Time comparison

Route	DM Journey time (s)	Option 1_A Journey Time (s)	Option 1_B Journey Time (s)	Option 1_C Journey Time (s)	Option 5_C+ Journey Time (s)	Option 6_C+ Journey Time (s)
Bedford to Cambridge	3201	2531	2482	2523	2438	2436
Cambridge to Bedford	3041	2428	2398	2400	2344	2344
St Neots to Cambridge	2120	1782	1748	1775	1866	1866
Cambridge to St Neots	1978	1737	1727	1739	1825	1823
Bedford to St Neots	1398	1374	1399	1389	1387	1381
St Neots to Bedford	1327	1308	1298	1311	1352	1349
Sandy to Buckden	1477	1384	1406	1393	1425	1424
Buckden to Sandy	1016	953	973	954	973	969

As can be seen all the options significantly reduce journey times for the majority of routes, particularly for east-west journeys.

5.3.2 Traffic Volumes and Capacity

Traffic volumes have been extracted from the forecast traffic models for sections of the existing A1/A428 route and the new expressway.

The new expressway link is forecast to remain within capacity and obviously does not provide a comparison to the Do Minimum to assess performance. As such the V/C ratio for links on the existing A1/A428 route between Black Cat and Caxton Gibbet has been compared for each currently modelled option and the Do Minimum for 2051 as shown in Table 5.3 and Table 5.4.

Table 5.3 : AM Link Capacity Comparison

Route	DM V/C Ratio	Option 1_A V/C Ratio	Option 1_B V/C Ratio	Option 1_C V/C Ratio	Option 5_C+ V/C Ratio	Option 6_C+ V/C Ratio
Eastbound						
A1 – Black Cat Junction to Wyboston Interchange	0.74	0.95	0.79	0.89	0.85	0.85
A428 – Wyboston Interchange to Barford Road Roundabout	1.20	0.95	0.93	0.93	0.96	0.95
A428 – Barford Road Roundabout to Cambridge Road Roundabout	0.65	0.31	0.50	0.34	0.26	0.26
A428 – Cambridge Road Roundabout to B1040 / St Ives Rd Junction	0.76	0.23	0.23	0.24	0.39	0.39
A428 – B1040 / St Ives Rd Junction to Caxton Gibbet Roundabout	0.76	0.27	0.29	0.27	0.67	0.67
Westbound						
A428 - Caxton Gibbet Roundabout to B1040 / St Ives Rd Junction	1.01	0.11	0.11	0.11	0.45	0.45
A428 - B1040 / St Ives Rd Junction to Cambridge Road Roundabout	1.00	0.29	0.29	0.31	0.59	0.59
A428 – Cambridge Road Roundabout to Barford Road Roundabout	0.79	0.36	0.38	0.39	0.41	0.41
A428 – Barford Road Roundabout to Wyboston Interchange	1.24	1.10	1.12	1.11	1.11	1.11
A1 – Wyboston Interchange to Black Cat Junction	0.71	0.79	0.75	0.77	0.69	0.69

Table 5.4: PM Link Capacity Comparison

Route	DM V/C Ratio	Option 1_A V/C Ratio	Option 1_B V/C Ratio	Option 1_C V/C Ratio	Option 5_C+ V/C Ratio	Option 6_C+ V/C Ratio
Eastbound						
A1 – Black Cat Junction to Wyboston Interchange	0.75	0.82	0.75	0.80	0.84	0.84
A428 – Wyboston Interchange to Barford Road Roundabout	1.31	1.25	1.12	1.22	1.06	1.06
A428 – Barford Road Roundabout to Cambridge Road Roundabout	0.87	0.50	0.69	0.51	0.42	0.42
A428 – Cambridge Road Roundabout to B1040 / St Ives Rd Junction	0.87	0.10	0.10	0.11	0.52	0.52
A428 – B1040 / St Ives Rd Junction to Caxton Gibbet Roundabout	0.91	0.20	0.25	0.21	0.72	0.72
Westbound						
A428 - Caxton Gibbet Roundabout to B1040 / St Ives Rd Junction	1.10	0.25	0.22	0.25	0.57	0.57
A428 - B1040 / St Ives Rd Junction to Cambridge Road Roundabout	1.14	0.43	0.40	0.42	0.75	0.76
A428 – Cambridge Road Roundabout to Barford Road Roundabout	0.93	0.64	0.65	0.63	0.43	0.43
A428 – Barford Road Roundabout to Wyboston Interchange	1.32	1.25	1.23	1.23	1.05	1.05
A1 – Wyboston Interchange to Black Cat Junction	0.76	0.65	0.64	0.64	0.69	0.69

This suggests that the all options are likely to improve conditions on all links except for on the A1 between Wyboston and Black Cat southbound in the AM. However, with the A1 southbound becoming free flow through Black Cat junction in all options it is likely that conditions overall are still being significantly improved.

5.4 The Economic Performance of the Selected Alternative Schemes

5.4.1 Introduction

As mentioned above the options have been modelled in SATURN with variable demand traffic forecasts. Outputs from these models have been used in industry standard TUBA software to calculate and monetise expected Journey Time and Vehicle Operating Costs (VOC) benefits.

Additional benefits from maintenance delay benefits, safety benefits, wider impacts and journey time reliability have been included.

5.4.2 Scheme Costs

Scheme costs have been received for the following options:

- Route Option 1 with Black Cat Option C
- Route Option 5 with Black Cat Option C
- Route Option 6 with Black Cat Option C
- Black Cat Option A only
- Black Cat Option B only
- Black Cat Option C only
- Black Cat Option C+ Only

However, the Option 1 with Black Cat Option C scheme cost is a year older than the other costs and has a different price base; it also contains more uncertainty than the Option 5 or Option 6 costs and so is likely to be lower when an updated Option 1 scheme cost is produced in the future.

To get scheme costs to assesses each option and generate a BCR it has been necessary to remove junction C costs from the route options and then add the alternative junction costs. This is not strictly correct as there will double counting of things like land and preparation costs and things like additional slip roads missed off entirely. However, these costs will be comparable across options and have been used as the best option for costing available. Scheme costs for each option are shown below table 5.5.

Table 5.5: Scheme Costs

Route Option	Black Cat Option	Undiscounted Scheme Cost (2010 Prices) (£000s)
Option 1 (Orange)	Option A	£701,302
	Option B	£684,237
	Option C	£697,432
Option 5 (Pink)	Option C+	£637,167
Option 6 (Purple)	Option C+	£620,380

5.4.3 Economic Assessment and BCR

Section 5.3 showed that all the Route Option 1 variants are shown to have very similar impacts as the only change is the style of junction at Black Cat junction, however, this does have an impact on the benefits estimated by TUBA as even minor traffic re-routing distances can lead to very different overall benefits. Table 5.6 below provides the results of the economic assessment.

Table 5.6: Route 1 Economic Assessment Results (Excluding Wider Impact Benefits)

	Route Option 1			Route Option 5	Route Option 6
	Black Cat A	Black Cat B	Black Cat C	Black Cat C+	Black Cat C+
Present Value of Benefits (PVB) (£000s)	£842,052	£795,154	£850,541	£507,164	£461,542
PVC(£000s)	£582,229	£568,057	£578,863	£576,321	£576,300
Net Present Value (NPV) (£000s)	£259,823	£227,097	£271,678	£-69,157	£-114,758
Benefit Cost Ratio (BCR)	1.45	1.40	1.47	0.88	0.80

Route 1 (Orange) produces the highest level of overall benefits and the highest BCR.

Table 5.7 shows the adjusted BCR for the 3 schemes with the expressway if wider impacts are included within the overall scheme benefits.

Table 5.7: Benefit to Cost Ratios Including Wider Impacts for All Options (£000s).

	Route Option 1			Route Option 5	Route Option 6
	Black Cat A	Black Cat B	Black Cat C	Black Cat C+	Black Cat C+
Present Value of Benefits (PVB) (£000s)	£1,133,952	£1,065,754	£1,123,841	£715,564	£667,642
PVC(£000s)	£582,229	£568,057	£578,863	£576,321	£576,300
Net Present Value (NPV) (£000s)	£551,723	£497,697	£544,978	£139,243	£91,342
Benefit Cost Ratio (BCR)	1.95	1.88	1.94	1.24	1.16

Considering Wider Impacts as part of the scheme benefits, Route Option 1 (Orange) is likely to represent a medium value for money where Route 5 and 6 (Pink and Purple) represent a low value for money.

5.5 Conclusion

Without intervention it is believed that the A1 and A428 between Black Cat and Caxton Gibbet will suffer from low journey times, congestion, queuing and poor journey time reliability in the future.

All of the schemes modelled at this point have been shown to greatly relieve capacity constraints and improve journey times along this route. Route Option 1 has been modelled with Junctions A, B and C to provide three comparable options and identify the best performing option both in terms of traffic conditions and economic assessment.

Overall the schemes modelled are seen to have similar impacts with Route 1 showing the highest PVB and highest BCR.

6. Technology and Maintenance Assessment

6.1 Technology

As all three mainline options are proposed as an Expressway and will therefore require a high level of technology, as detailed below. The provision of technology will be the same for each option, although the amounts and positions will differ dependant on the highway geometry and visibility requirements.

Technology to be provided:

- Variable message signs (VMS) for incident/traffic management and driver information at approximately 1.5km intervals;
- Variable mandatory speed limits (VMSL) for congestion management;
- Traffic detectors;
- Comprehensive CCTV coverage;
- Associated cabinets and cabling;
- Power supplies will be required to each technology location which will need to connect into the main grid.

6.2 Maintenance

To aid with maintenance of technology assets, maintenance hardstandings will be incorporated into the emergency refuge areas with technology clustered in the locality, where practicable.

Off network access to technology assets will also be considered during the design process. This will enable access from the local road network where the highways cross.

6.3 Lighting

The existing A428 is partially lit. The existing junctions Black Cat, Cambridge Road and Caxton Gibbet are fully lit junctions. The existing lighting mainly consists of a mixture of High Intensity Discharge (HID) lamps and Light Emitting Diodes (LEDs). As a minimum we are retaining existing lighting extents. Any new junctions will be lit with the approaches partially lit if connecting to an unlit section. Approaches connecting to lit sections to be fully lit.

As part of the Junction Improvement; in order to achieve compliance with TD34/07 ‘Design of Road Lighting for the Strategic Motorway and All Purpose Trunk Road Networks’, Expressways Technical Note, CIE 115/2010 ‘Lighting of roads for motor and pedestrian traffic’, TD 22/06 ‘Layout of Grade Separated Junctions’ and for safety and operational reasons, lighting shall be provided on the junctions with the following recommended lighting extents:

- The junctions’ on/off-line elements connecting to unlit sections shall extend for a distance long enough to include:

  (a) the 5 seconds of driving at the expected traffic speed of 70mph i.e. 156m from the top of the slip roads;

  (b) the peak traffic queuing distance on the approach to a give way or stop line;

  and

  (c) the distance required to illuminate any bend at the end of an exit slip road or the beginning of an entry slip road;
- The junctions’ on/off-line elements connecting to lit sections shall be fully lit and lighting extended to tie-in with the lit sections.
- Gaps of less than four times the stopping sight distance between lit sections are to be lit in accordance with the requirements of TD34/07 C.3.19;

Where lighting is being provided, it is recommended to install efficient full cut-off lighting technology such as Light emitting Diodes (LEDs) being dynamically controlled according to traffic flows by Highways England's Central management System (CMS) and Motorway Road Lighting Control System (MoRLiCS) to reduce the lighting levels where the traffic flow is low in off-peak hours to provide the right amount of light in the right place and at the right time to have a healthier, safer and greener network.

Embracing the above technology is betterment of the existing lighting network as the above proposed technology will achieve energy and carbon emission savings, maintenance savings, reduced environmental implications and a safer network.

The above recommendation is subject to undertaking a detailed economic assessment in accordance with the requirements of TA49.

7. Environmental Assessment and Environmental Design

7.1 Overview

The Stage 2 Environmental Assessment Report (EAR reference HE551495-JAC-EGN-00-RP-LE-0001) contains a detailed description of the baseline environment for each environmental topic area and includes the Options Appraisal Matrix (OAM) which summarises the different effects likely for each mainline and Black Cat option. The Stage 2 Scoping Report (HE551495-JAC-EGN-00-RP-LE-004) contains detail about the proposed scope of the environmental work going forward.

All three mainline options start at Black Cat and cross over the River Great Ouse floodplain. The River Great Ouse is a sensitive landscape both in terms of the contribution it makes to the landscape character of the area, the habitats it provides, the existing floodplain, the potential for well-preserved archaeological remains and the aesthetic and amenity value that it provides to people.

The design of the crossing is likely to be a material consideration to the acceptability of the whole scheme. It would need to be well designed and appropriate to the character of the landscape. It would also need to be as open span as possible to avoid loss of floodplain and to minimise severance of the longitudinal connectivity of the water body and associated habitats.

The Black Cat options are all likely to make the junction more visible in the landscape, and noise levels are likely to increase in the vicinity. The remaining offline sections are likely to have effects associated with new infrastructure corridors within a rural setting. However, there are likely to be benefits associated with the options as traffic (and noise and air quality issues associated with the traffic) are moved away from sensitive receptors including noise important areas at Wyboston and Croxton Park.

7.2 Air Quality & Greenhouse Gases

The nearest Air Quality Management Areas (AQMA) is located in St Neots' High Street, approximately 2km to the north of A428, which is declared for nitrogen dioxide (NO2) by Huntingdonshire District Council. The AQMA is adjacent to a bridge crossing over the River Great Ouse. This bridge is used as an alternative route for traffic when the A428 crossing at Wyboston is closed due to accidents. There is no local monitoring in the immediate area along the A428. The Paddocks, St Neots is the nearest monitoring location to the A428, and is located 2km to the north of the A428.

The initial traffic modelling indicates that the Orange option may result in increased rat running through St Neots, as traffic tries to join the new road at Cambridge Road Junction. Air quality modelling would be required to test whether this has an impact on the AQMA, and whether mitigation measures would be required, for example traffic calming within St Neots. Further analysis of the traffic data would inform the level of risk associated with this option.

Traffic from the A428 is the dominant source of emissions within the study area and air quality is likely to be poorer where there is existing congestion e.g. around Wyboston. Therefore, the three bypass options that reduce congestion and move traffic away from sensitive receptors are likely to result in general improvements to air quality.

There are likely to be temporary construction effects on air quality associated with dust and emissions during construction. However, these would to be managed to acceptable levels through general good construction site practices.

The Proposed Scheme is likely to impact on carbon dioxide in two ways; firstly, carbon is generated during the construction phase as a result of extracting raw materials, processing materials for use in construction and the movement of vehicles during the construction phase (construction carbon); and secondly, carbon is generated from vehicles during the operation phase as a result driving along the new route corridor (operation carbon).

Operation carbon will be quantified as part of the business case over summer 2017 using the Highways England carbon tool (August 2015 as amended February 2016) and based on the traffic modelling outputs. The direct energy associated with the operation of the road, such as energy from the use of lighting would not be considered in line with IAN 153/11 (Highways Agency, 2011b).

7.3 Noise

There are five noise important areas in the study area. Three are located on the A1, north of the Black Cat junction; one is located on Bedford Road (minor road); and two on the A428, one lies 1km east of the A428/B1428 Cambridge Road junction and the other lies 0.7km east of the A428/A1198 Caxton Gibbet junction. The mainline bypass options are likely to improve noise levels in all areas except Black Cat, as congestion would be reduced and the route would be further away in general from sensitive receptors. Further improvements could be made by providing noise barriers along sections of the route adjacent to sensitive receptors and by using low noise surfacing.

The noise levels at Black Cat are likely to increase and it is likely that there could be significant effects in this location. A detailed noise model would need to be developed to assess the effects of the scheme and whichever option is taken forward. Noise barriers are likely to be required around Black Cat and further work is required to assess the feasibility of these in terms of the wind loading of fences, particularly on the proposed third tier of the junction under options A and C, and the available space at ground level for bunding and planting for each design.

The existing noise climate in the vicinity of the scheme is dominated by road traffic noise, predominantly from the A1, A428, A1198 and associated junctions. The noise patterns will change following the implementation of the Proposed Scheme with some areas experiencing increased noise and some decreased noise, which would vary for the different options. Receptors along the Pink and Purple routes could be more sensitive the changes in noise levels than the Orange route, as they are further away from the existing A428.

7.4 Landscape Impacts

The Greensand Ridge lies to the south of the study area and forms an important feature in the local landscape character. The Greensand Ridge forms an area of high ground with rights of way with extensive views towards the study area. Options 5 and 6 are likely to have a greater effect on views from the Greensand Ridge due to their scale and proximity to this feature.

Croxton Park is registered as an historic park and garden. The Proposed Scheme could enhance the landscape and setting of this designated site, as the traffic and noise would be moved further away from the site boundary. The setting of the designated site could be further enhanced through additional planting and sensitive design.

The study area is described as having a gently undulating topography and plateau areas, divided by broad shallow valleys. The offline sections would have an impact in terms of landscape character and views. The effects could be mitigated through careful design and sensitive planting. The effects are likely to greater for Options 5 and 6, as these lie within the open countryside rather than the orange option, which to some degree follows the existing infrastructure corridor.

The three tier options at Black Cat (Option A and C) are likely to result in a greater visual impact due to the increased scale of the junction compared to Option B. The junction is likely to form a dominant feature within the landscape, particularly as it will be coupled with a large structure across both the River Great Ouse floodplain and the ECML railway. The design of the river crossing is likely to be a material consideration in the acceptability of the entire scheme.

Woodland blocks are small and infrequent within the Ouse valley and west of the ECML railway, but occur as frequent scattered features in the central and eastern areas. There are a number of woodland areas scattered within the study area. Many of these have been avoided through the stage 1 option alignment designs. Some woodland areas would still be affected by each of the options. The effects could be minimised by reducing the width of the construction corridor in these areas and providing suitable mitigation planting including new areas of woodland within the landscape.

7.5 Historic Environment

As noted in the landscape section, the options would all involve moving the traffic and noise away from Croxton Park, which is a scheduled monument. The setting of this historical asset could be enhanced and improved through sensitive design of the Proposed Scheme.

There are a number of known designated and non-designated sites to the south of the existing A428, which shows the high potential for buried archaeology within the study area. These include a number of deserted medieval villages to the south of the existing A428 including at Weald and Croxton. The absence of sites with the records to the north of the existing A428, is likely to be an absence of records rather than an absence of sites and the whole area should be treated as having a high risk of archaeology. This would need to be investigated through the production of a desk based assessment, followed by a programme of investigation likely involving geophysics and targeted intrusive investigations.

The Black Cat options lie close to the conservation area at Roxton. Option 1 passes close to the conservation areas of Croxton and Eltisley. Options 5 and 6 pass close to conservation areas at Abbotsley, Great Gransden and Waresley. The options could affect the setting of these designated features and further assessment would be required to understand the effects to and methods for mitigating the effects e.g. through sympathetic designs and additional screening.

There is a Listed Building that lies close to Black Cat junction, which is likely to be affected by all of the Black Cat options, and potentially to the point of removal depending on how the slip roads connect to the A1. A site visit is required at the next stage to assess the effects to this structure and to potentially influence the designs of the slip roads / access roads to avoid the loss of this feature.

7.6 Biodiversity

Eversden and Wimpole Woods Special Area of Conservation (SAC) lies approximately 8.5km to the south east of the existing A428 and is primarily designated for barbastelle bats Barbastella Barbastellus. This is unlikely to be directly affected by the Proposed Scheme given the distance to the site, however woodland and hedgerows within the study area could provide suitable foraging and roosting habitat to support the interest features of the SAC.

The River Great Ouse corridor is an important linear feature for connecting habitats through the study area. The river itself is likely to support aquatic habitats and species, as well as providing potential habitat for otter and watervole. The riparian habitat is also likely to provide a longitudinal habitat for a wider array of species and the floodplain supports wetland habitats and features.

The crossing of the Great Ouse floodplain is common for all options and would need careful design to avoid severing the connectivity between habitats up and down stream of the crossing. Mitigation is likely to include providing an open span structure to maintain connectivity between the habitats. The River Great Ouse corridor could provide a focal point for ecological enhancements as part of the Proposed Scheme such as improvements to existing habitat features.

The study area supports a number of Cambridgeshire BAP priority habitats including deciduous woodland, grazing marsh, wood pasture and parkland, traditional orchards, ponds, hedgerows, and rivers and streams. In addition, protected species that have been recorded within the study area include badger, great crested newts, water vole, otter, bats, grass snake and common lizard. Specific ecological mitigation would need to be identified through the more detailed phase 2 surveys to minimise the effects to these habitats and species once the preferred option has been selected. Protected species licences and compensatory habitats are likely to be required for all options.

7.7 Water

The main water feature within the study area is the River Great Ouse. This lies immediately to the east of Black Cat, and would need to be crossed by all options. The design of the crossing is likely to be a material consideration in the acceptability of the Proposed Scheme, as the river corridor includes a large area of floodplain. A viaduct crossing has currently been assumed, to minimise the loss of floodplain and to avoid impeding flood flows, based on lessons learnt from the A14.

In addition, a viaduct would reduce risks to both latitudinal and longitudinal connectivity of habitats. This would reduce the risk of the options creating a deterioration in ecological status under the water framework directive. Flood risk modelling and a river corridor survey would need to be completed to further assess the risks to the water environment.

7.8 Physical Activity

There are a number of rights of way within the study area. The effects of each of the options on rights of way and non-motorised users are documented in section 6 of the TAR document number HE551495-JAC-GEN-00-REP-C-0001. One of the RIS objectives is about improving rights of way. Mitigation and further enhancement associated with the design of the Proposed Scheme would help reduce severance caused by the new and existing A428.

NMU routes have been impacted in each route option alignment which involves footpaths, Bridleways, Byways and Footways or cycle routes along the length of the route. These crossings are listed below for the three mainline options.

- Option 1 has 22 crossings
- Option 5 has 12 crossings, and
- Option 6 has 9 crossings

NMU crossings for the three Black Cat junction options have been impacted. These crossings include footpaths and cycle path in the vicinity of the junction. In total there are four affected public rights of which are located and connected to the roundabout.

7.9 Journey Quality

Journey quality is expected to improve under all of the options, as congestion would reduce and the journey times would become more reliable. Safety improvements and new planting would also improve the experience of the route to drivers.

7.10 Other DMRB Environmental Topics Not Required by TAG

7.10.1 Geology and Soils

The bedrock in the west of the study area and underlying the majority of the existing A428 is the Oxford Clay Formation, formed of silicate mudstone, with sporadic limestone beds. The superficial geology is predominantly the Oadby Member (grey, weathering brown, diamicton till). In the western part of the study area, along the A1 and western-most part of the existing A428, the superficial deposits are river terrace deposits, comprised of sand and gravel; and alluvium, comprised of clay, silt, sand and gravel, deposited within the valley of the River Great Ouse. There are no geological faults anticipated within the study area. Made ground is expected beneath and surrounding the main roads in the area, including the A1 and A428.

The majority of the study area includes agricultural land classification (ALC) grade 2 (very good) quality agricultural land. In some localised parts of the study area (predominantly towards the western end of the study area) the soil is classified as grade 1 (excellent) and grade 3 (good). This high grade land should be considered a high sensitivity receptor. All options would result in the loss of the best and most versatile agricultural land. The designs would need to keep the loss to a minimum by retaining existing field boundaries where possible and retaining parcels of land that are large enough to retain viability for farming.

There is an existing minerals site adjacent to the Black Cat junction and the floodplain has been identified as a potential source of further minerals. The design and construction phasing at Black Cat would need to include minimising the risk to the minerals extraction programme, as part of minimising the sterilisation of mineral resources in this area. The minerals extraction programme may affect the phasing of Black Cat junction within the overall construction programme.

There is the potential for contaminated land within the study area and further investigation and assessment is required to understand this risk. This will include building on the existing baseline (documented in the PSSR) and following this up with a programme of ground investigations. At this stage, the risk is expected to be similar for all options. It is likely that bespoke mitigation would be required to minimise the risk of contaminated land pathways opening up to both environmental (rivers and soil) and human (local residents, construction workers, road maintenance crews) receptors.

7.10.2 Materials

The cut fill balance is documented within the Constructability Reports for Stage 1 and 2:

- Option 1: Approximately 1.3 million cu.m of fill material to be imported from offsite source which would have an impact due to increased vehicle numbers on the local road network.
- Option 5: Approximately 0.472 million cu.m of fill material to be imported from offsite source which would have an impact due to increased vehicle numbers on the local road network.
- Option 6: Approximately 0.226 million cu.m of fill material to be imported from offsite source which would have an impact due to increased vehicle numbers on the local road network.
- Option A: Median imported material (for stage 1)
- Option B: Least imported material (for stage 1)
- Option C: Most imported material (for stage 1)

The above shows that from a purely a fill aspect, Option 1 requires large amounts of material compared to Option 5 and 6, and Option B has the least materials out of the Black Cat options.

7.10.3 People and Communities

The overall scheme would have significant benefits to traffic and transport within the area. It would also align with longer term objectives to provide an Expressway between Oxford and Cambridge. There will be short term effects during construction, as traffic management would be required, particularly around Black Cat and the other junction tie ins. However, as the majority of all options is offline, it would mean that the existing A428 could remain open during construction.

The Proposed Scheme would support economic growth and development within the region and is likely to have beneficial effects in terms of socio-economics. Some businesses along the existing A428 could suffer from a loss of passing trade and the services at Black Cat are likely to require relocation as part of the proposed works. These issues would need investigating in more detail during stage 3 in discussion with the relevant businesses and other interested parties.

Options 5 and 6 are located on either side of Abbotsley and could bring noise and air quality effects closer to this community. These options are also likely to make the village have less rural characteristics affecting the character and the setting of the community.

The Proposed Scheme is likely to reduce noise and improve air quality to areas around Wyboston, which would have benefits to the health of adjacent residents. The Proposed Scheme is also looking at improving rights of way through the study area and providing a dedicated non-motorised route along the existing A428, which could have significant health benefits in terms of physical exercise.

7.10.4 Potential of Options Considered to Affect the Environment in Comparison to The Preferred Route

The OAM summarised the effects of each of the different options and this is summarised in the table 18.1 presented within the TAR document number HE551495-JAC-GEN-00-REP-C-0001 and table 10.1 of the annex to the TAR HE551495-JAC-GEN-BCJN-RP-CH-0001 which includes the Black Cat options.

The OAM shows that all Black Cat options have a similar environmental effect. Option B is considered to be the environmentally preferred option, as it is two tiers instead of three and would have less of a landscape and visual

effect. There is little to distinguish between Options A and C at this stage from an environmental point of view. All options are likely to benefit Wyboston, in terms of noise and air quality effects, assuming that the option is implemented as part of a full scheme rather than as a standalone junction option.

The OAM also shows that Option 1 is environmentally preferred option from the three alignment options. This is because the option roughly follows existing infrastructure corridors (the railway and the existing A428) rather than creating a new infrastructure feature within the landscape. This would have less ecological, landscape and setting effects than Options 5 and 6. It would also result in environmental benefits to Croxton Park, as traffic is moved away from this designated site.

Options 5 and 6 would affect large areas of the open landscape and would take the route closer to designated sites to the south, with a higher risk of requiring an appropriate assessment under the Habitats Regulations. These options are also more likely to be visible from the Greensand ridge to the south. The options would also need further detailed assessment at the Caxton Gibbet tie in, to assess the effects on the scheduled monuments to the south and on Croxton Park to the north, which would lie between two infrastructure corridors (the old and new A428).

7.10.5 Potential of Options Considered to Achieve the Scheme's Environmental Objectives in Comparison to The Preferred Route

All options would improve the environmental impact of transport on communities along the existing A428 corridor between Wyboston and Caxton in an equal way. This is because all options would reduce congestion and move the traffic away from existing noise important areas. Moving the bulk of the traffic away from Croxton Park would also provide a benefit on the setting of this site.

The second environmental objective is about reducing the impact of new infrastructure on the natural environment. The environmental appraisal has influenced all options through the Stage 1 and 2 design process. This has included moving the alignment of all three alignment options to avoid sensitive features such as woodland areas, the scheduled monuments and multiple river crossings.

Option 1 is likely to have lower environmental effects on the natural and built environment compared to Options 5 and 6, as it broadly follows existing infrastructure routes and avoids a new corridor within the landscape. This would also create severance effects for protected species and wildlife corridors.

7.11 Conclusion

In summary, Option 1 is the environmentally preferred alignment option, as this is likely to have fewer environmental effects and require less mitigation than Options 5 and 6. The key sensitive area is the designs associated with the crossing of the River Great Ouse and further survey and assessment is required as part of identifying bespoke mitigation in this location.

The Black Cat options are likely to have a similar environmental effect. Option B is likely to have lower landscape and visual effects, as it only two tiers instead of three. Further assessment is required for all Black Cat options to understand how the designs and construction may affect the Listed Building to the north of the junction and the impacts to the minerals sites to the east of the junction.

8. Public Consultation

8.1 Summary of Consultation

Between 6 March and 23 March 2017 Highways England consulted on plans to improve the A428 between Black Cat and Caxton Gibbet. The A428 connects communities between St Neots and Cambourne and links the East of England to important regional, national and international hubs such as the Felixstowe and Harwich ports. It also connects Bedford, Milton Keynes and the M1 to Cambridge and the M11. Three new route options were put forwards as well as three options to improve Black Cat junction.

8.2 Results of Public Consultation

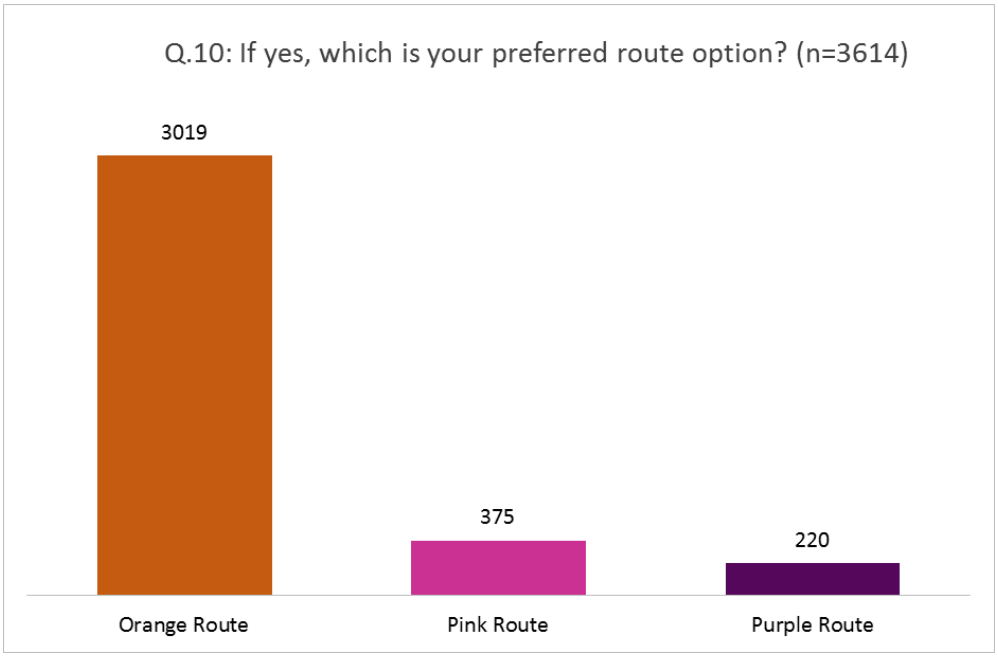
A total of 4,184 responses were received during the consultation period. A majority of respondents use the current A428 between Black Cat to Caxton Gibbet by car, with public transport as the second most common mode of transport. Many of the respondents stated they used the road for leisure and entertainment purposes, shopping, visiting friends or relations, commuting to / from work and other business / commercial reasons.

8.2.1 Preferences

A majority of respondents noted a preference for a specific route (3592 responses out of 3806). Overall, a large majority of respondents demonstrated a preference for the orange route.

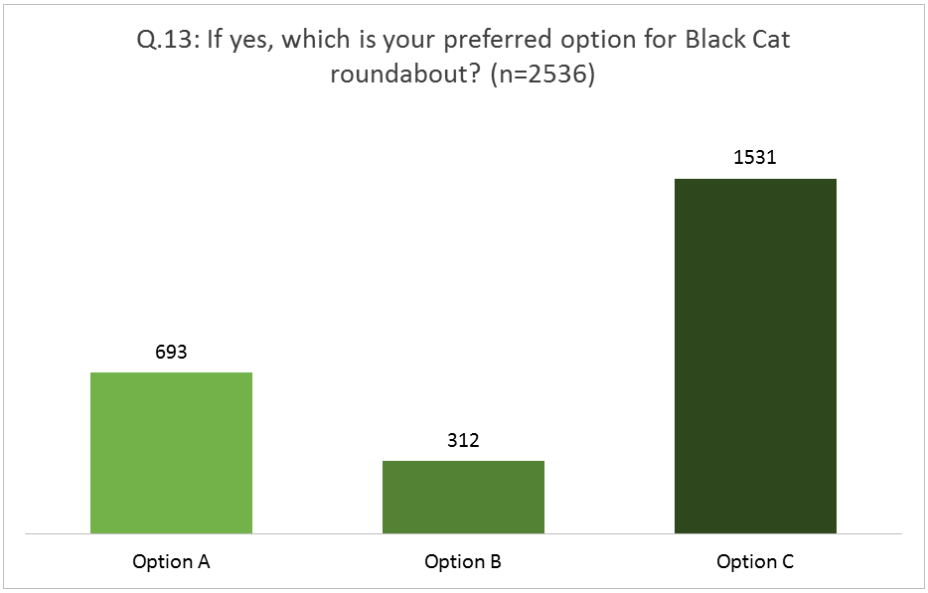
A majority of respondents noted that there is a need to improve the A428 between Black Cat and Caxton Gibbet in order to reduce congestion problems (2359 responses of 3822 responses to this question). Many respondents also felt improvements are needed to improve safety conditions (1917 responses of 3823 responses to this question). A majority of respondents also noted the need for improvements at Black Cat junction (2226 responses of 3822 responses to this question).

Mainline Options



Junction Options

Many respondents stated that they had a preferred option for Black Cat junction (2469 of 3716 responses to this question). Of those who had a preference, most stated their preference was Option C.



8.2.2 Comments

Some of the main comments around the route options are:

Mainline Options:

- Many respondents commented on various aspects of the route design, including:
  - the need for further information and detail at Caxton Gibbet junction,
  - the importance of a junction at St Neots for connectivity,
  - queries around public transportation in parallel with or instead of the proposed developments
  - the route should not include any roundabouts
- Suggestions for route proposals, including several respondents stating that the existing A428 should be retained for local traffic.
- Alternatives to proposals including upgrading the existing A428, a new road following more closely the existing road corridor and various other alternatives.
- Comments on the potential environmental impacts, with particular concerns over destroying the local countryside, noise pollution, air pollution and impact on wildlife as well as agriculture.
- Comments on traffic and safety, in particular highlight their current understanding of issues affecting local roads and the high levels of traffic and congestion.
- Comments around the provision of facilities for non-motorised users, including suggestions for a new segregated cycle path along the new road.

More detailed comments on the specific routes are outlined in the Summary Analysis Report produced by Dialogue by Design.

Junction Options:

Some of the main comments around the Black Cat junction options are:

- Asserting the necessity for improvements to the Black Cat junction, in particular referring to the recent redesign which is largely regarded as inadequate.
- Opposition to retaining a roundabout at Black Cat junction in any capacity.
- The need to incorporate improvements at Black Cat into wider developments in the area, in particular the proposed development for the A1.
- Concern at the cost of the proposed development, and waste of resources in previous upgrades.

- Alternative suggestions such as moving the junction altogether and focusing on development of flyovers.
- Concerns around environmental impacts, in particular around noise and air pollution, visual impacts, and the amount of land take required.
- Comments around the perceived current issues at Black Cat junction, most notably delays and congestions caused by the build-up of traffic at the junction.
- Concern about the potential impacts of the Black Cat development on non-motorised users, and the promotion of cycle ways to be installed.

More detailed comments on the specific junction options are outlined in the Summary Analysis Report produced by Dialogue by Design.

8.3 Stakeholder Consultation Views

8.4 Conclusion

Response to the consultation confirmed a significant need for improvements to the A428 between Black Cat and Caxton Gibbet. There is a strong preference for the orange route option, with various specific comments on the routes. Many respondents also highlighted a preference for Option C at the Black Cat junction.

9. Appraisal Summary Table

9.1 Appraisal Summary Table

An Appraisal Summary Table (AST) was previously developed at PCF Stage 0 for an option described as *"A428 full offline dualling with Grade Separation of Black Cat junction and Grade Separation of Caxton Gibbet roundabout"* which was chosen as the preferred scheme at that stage.

This description matches those any combination of route option with junction option. As stated in Chapter 5 only 3 options have been modelled to date, Route Option 1 with Junction Options A, B and C; this was to identify a best performing junction which will then be modelled with Route Options 5 and 6.

The AST covers a range of impacts, many of which have not yet been revisited at this stage and therefore an updated assessment is not yet available. These are:

- Economy
  - Reliability impact on business users
  - Regeneration
  - Wider Impacts
- Social
  - Reliability impact on commuting and other users
  - Physical Activity
  - Journey Quality
  - Accidents
  - Security
  - Access to services
  - Affordability
  - Severance
  - Option and non-use values

Three ASTs, one for each modelled option to date, are appended to this report in Appendix B.

For economy impacts, Journey Time reliability and Wider Impacts will be assessed in more detail as part of the development of the Economic Assessment Report but this assessment is not yet complete and as such in the ASTs attached each option has been scored with the assessment at PCF Stage 0.

Further social impact assessment will also be undertaken; however, at this point the qualitative assessments from PCF Stage 0 are considered to broadly hold true and as such are included. These will be revisited following further assessment in line with the methodology outlined in the Appraisal Specification Report.

10. Conclusion

10.1 Technical Assessment

Table 10.1 below, provides a technical assessment of the three mainline route options. It compares the major technical factors to be considered when selecting a Preferred Route.

Table 10.1 Technical Assessment

Criteria	Route Options		
	Option 1 (Orange route)	**Option 5 (Purple route)**	**Option 6 (Pink route)**
Planning / Stakeholder Engagement	Achieves policy objectives, should be capable to resolve issues about proximity to housing at St Neots. This option has good public support.	Achieves policy objectives but has less public support as a result of environmental concerns.	
Safety	Risk of possible collisions / incidents is more compared with pink and purple routes owing to additional junction at Cambridge Road, but the risk on the existing A428 route is reduced owing to greater transfer of local traffic. Otherwise all as Option 5 and 6.	New route would provide Expressway safety performance, suggesting casualty and KSI rates comparable to motorway without MIDAS. Casualty and KSI rates on existing route would reduce owing to significant traffic reduction and residual measures to improve NMU facilities (applies to option 1 as well).	
Walkers, Cyclists and Horse Rider (WCR) impact	This option removes up to 20,000 vehicles per day from the A428 between Cambridge Road and Caxton Gibbet junctions. On carriageway cycle facilities may not be desirable from a safety perspective. This will need a link as per the other options. These users would not be permitted on the new route thus may require a safe and convenient alternative. Otherwise as options 5 and 6.	These options remove up to 10,000 vehicles per day from the A428 between Cambridge Road and Caxton Gibbet. All options intersect with existing public rights of way and other facilities. Grade separated crossings would be provided at most PROW intersections. A link is needed alongside existing route from east of Caxton Gibbet to north of Cambridge Road; dealing with severance at Caxton Gibbet - east to west on south side and across new routes; south to north NMU facility across junction (A1198); and measures to deal with severance at Wyboston.	
Traffic	Route is likely to attract the greatest traffic flow by providing a link to St Neots at Cambridge Road. This will encourage	Route will attract traffic flow but not to the same magnitude as the Orange route.	

	St Neots-Cambridge traffic to use the new route.	
Economics	Orange route will provide greatest benefit as it caters to St Neots traffic better.	
Environment	All options will require sensitive consideration of the River Great Ouse corridor from a landscape, ecological and flood risk perspective.	
	This option would provide an opportunity to move adverse effects associated with the existing road away from Croxton Park and potentially enhance this feature.	These options would create a major new corridor within an otherwise rural and open landscape. This would create additional barriers to protected species migration within the landscape.

10.2 Option Comparison Table

Based on the content of this report and the table above, route Option 1 (Orange route) provides greatest benefit in terms of technical and specific scheme objectives. Route Option 1 has been modelled with Black Cat Junction Options A, B and C to provide three comparable options to identify the best performing option. Table 10.2 below, shows comparison of the major factors to be considered when selecting a Preferred Route based on the main elements of this report.

Table 10.2 Option Comparison Table

Criteria	Route Option 1			Route Option 5	Route Option 6
Junction Option	Option A	Option B	Option C	Option C+	Option C+
Addressing the Problems	Fully addresses the identified problems	Partially address the identified problems	Fully addresses the identified problems	Partially address the identified problems	Partially address the identified problems
Meeting the Scheme Objectives	Fully address the scheme objectives	Partially address the scheme objectives	Fully address the scheme objectives	Partially address the scheme objectives	Partially address the scheme objectives
Deliverability	Likely to be deliverable	Likely to be deliverable	Likely to be deliverable	Likely to be deliverable	Likely to be deliverable
Feasibility	Likely to be feasible	Likely to be feasible	Likely to be feasible	Likely to be feasible	Likely to be feasible
Planning / Programme	TBC	TBC	TBC	TBC	TBC
Engineering / Complexity	Least simplicity of design. Most amount of new pavement. Median opportunity to	Greatest simplicity of design. Least amount of new pavement. Greatest	Median simplicity of design. Median amount of new pavement. Least	NA	NA

	minimise traffic disruption and enhance local stakeholder experience during construction.	opportunity to minimise traffic disruption and enhance local stakeholder experience during construction.	opportunity to minimise traffic disruption and enhance local stakeholder experience during construction.		
Traffic Benefit	Provides significant capacity improvements to the Black Cat junction where the A1 currently meets the A421. Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather.	Provides significant capacity improvements to the Black Cat junction where the A1 currently meets the A421. Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather.	Provides significant capacity improvements to the Black Cat junction where the A1 currently meets the A421. Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather.	Provides significant capacity improvements to the Black Cat junction where the A1 currently meets the A421. Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather.	Provides significant capacity improvements to the Black Cat junction where the A1 currently meets the A421. Scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather.
Present Value of Benefit (000s)	£1,133,952	£1,065,754	£1,123,841	£715,564	£667,642
Scheme Cost (000s) (Need updated costs from Highways England)	£582,229	£568,057	£578,863	£576,321	£576,300
BCR	1.95	1.88	1.94	1.24	1.16
Maintenance Liability	TBC	TBC	TBC	TBC	TBC
Environmental Impact	Refer to AST Tables				
Walkers, Cyclists and Horse Riders Impact	The proposed grade -separated junction would sever the route from Roxton to the north-west side of A1 across the junction. This would be replaced with a safe link for walkers and cyclists along Roxton Road, and then at the north-west side of the junction linking Roxton Road, existing public rights of way and the north-west side of A1, north of the junction. No existing bus stops would be affected, and the route taken by existing bus routes (including X5, Milton Keynes to Cambridge) would remain available.				
Public Consultation Results	Medium Public support	Least Public support	Greater Public support	NA	NA
Road Safety	The existing junction is an at-grade signalised roundabout. The proposed options are complex grade-separated junctions. It is likely that the safety performance would not show an improvement on the existing junction owing to the greater extent and complexity of network, and any departures from standards proposed would need appropriate				

	mitigation/removal. The geometry of the interfaces with the main carriageway of A421/A428 would be improved so their current safety performance would be enhanced.

10.3 The Recommended Route/ Black Cat Junction Option

The recommended route will be announced in early 2018.

Appendix A. Option General Arrangement Drawings

Appendix B. Appraisal Summary Table