

A46 Newark Bypass Options Summary Report

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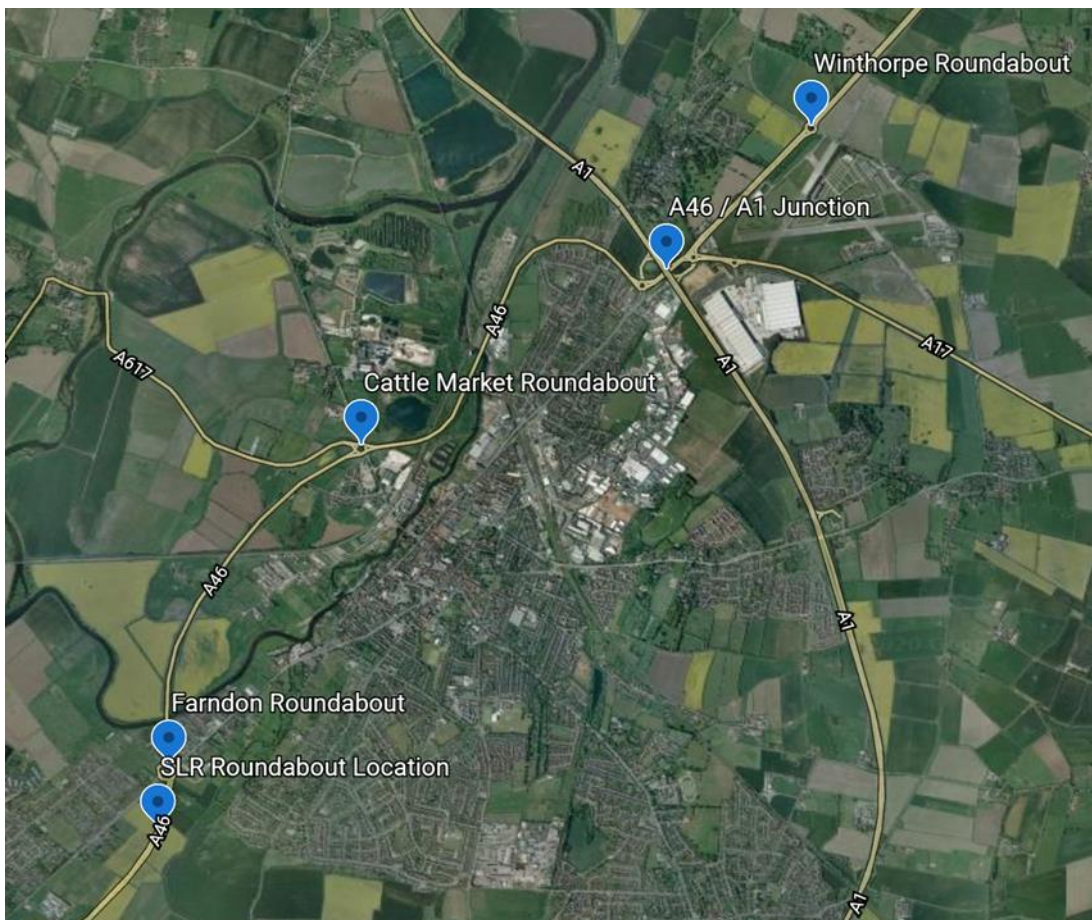
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1. Introduction

- 1.1.1 The A46 Newark Bypass scheme was included in the Government’s Autumn Statement 2014 and in the Department for Transport’s (DfT) Roads Investment Strategy (RIS) published in March 2015, as a scheme to be developed in RIS1 (2015-2020) and delivered in RIS2 (2020-2025).
- 1.1.2 The A46 corridor stretches for 250 km from Gloucestershire to Lincolnshire. With the Port of Bristol and Humber Ports at each end and Birmingham and East Midlands Airports close by, the corridor is a nationally significant trade and export route. The single greatest gap in this route is at the A46 at Newark; an upgraded dual carriageway opened in 2012, but stopped at Farndon Junction, three miles short of the A1.
- 1.1.3 In March 2020, the A46 Newark Bypass scheme was announced as part of RIS2 in order to complete the A46 ‘Trans-Midland Trade Corridor’ and support the delivery of one of Midlands Connects’ key priorities to create a ‘coast-to coast highway without the need for major new road-building across open countryside’.
- 1.1.4 The scheme focuses on a section of the A46, approximately 6 km in length, which passes the western and northern extents of Newark-on-Trent, Nottinghamshire (see Figure 1.1) between Farndon Roundabout and Winthorpe Roundabout, Nottinghamshire (see Figure 1.1) between Farndon Roundabout and Winthorpe Roundabout and links the A46 with other routes on the strategic road network, as well as the local road network.

Figure 1.1: Scheme Location Plan



1.1.5 The purpose of this Options Summary Report is to:

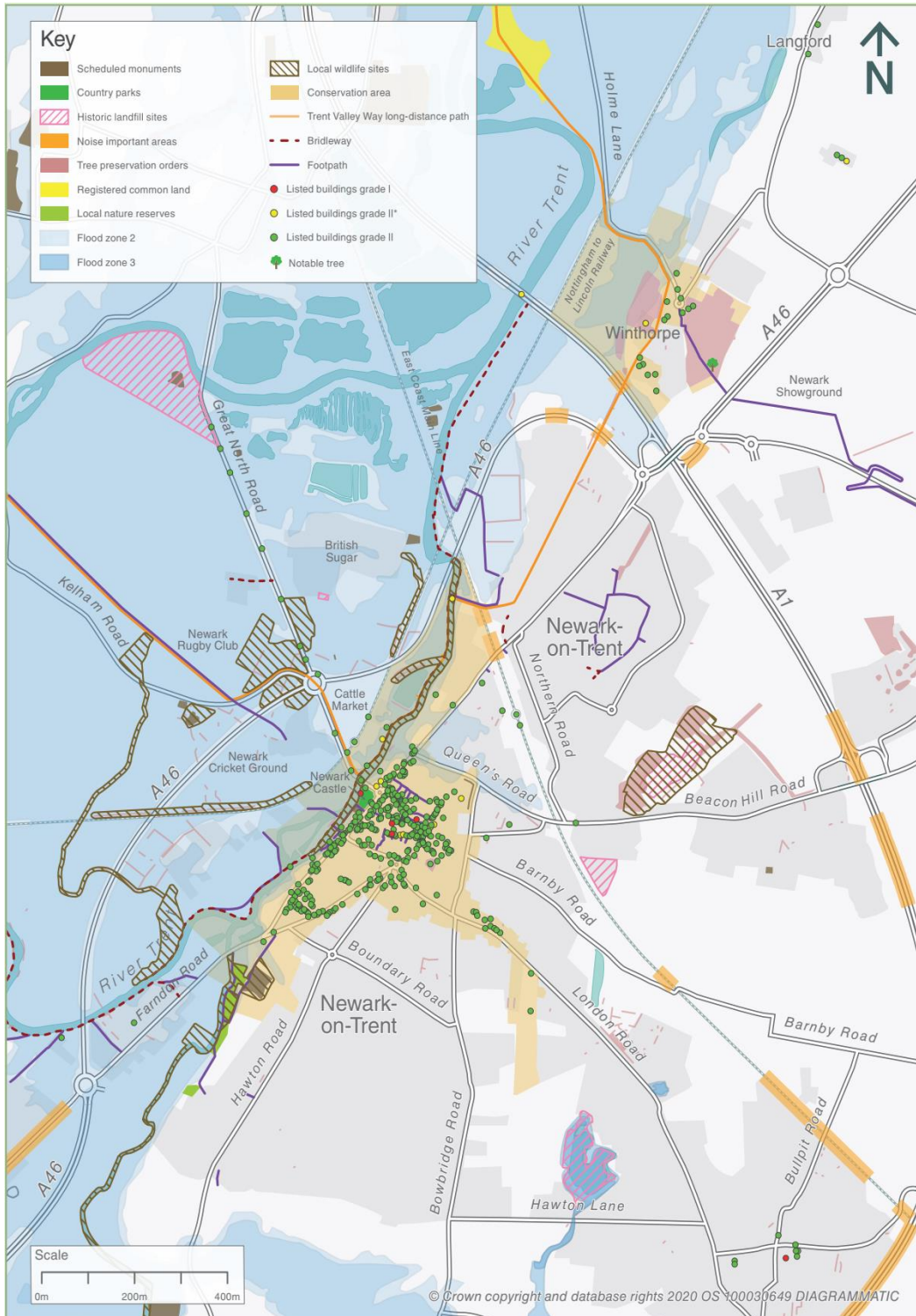
- Identify existing conditions, problems and constraints.
- Set out the scheme objectives.
- Describe the options presented at the Options Consultation and summarise the assessment undertaken of these options.
- Describe other options identified and investigated and reasons for rejection of these.

2. Existing Conditions

2.1 The Local Area

2.1.1 The location and setting of the A46 to the north of Newark-on-Trent presents a significant number of constraints and challenges, which are shown on the plan in Figure 2.1. These include flood plain, residential areas, scheduled monuments and listed buildings, archaeology and two river and three rail crossings. A more detailed Environmental Constraints Plan is included in Appendix A.

Figure 2.1: The Local Area

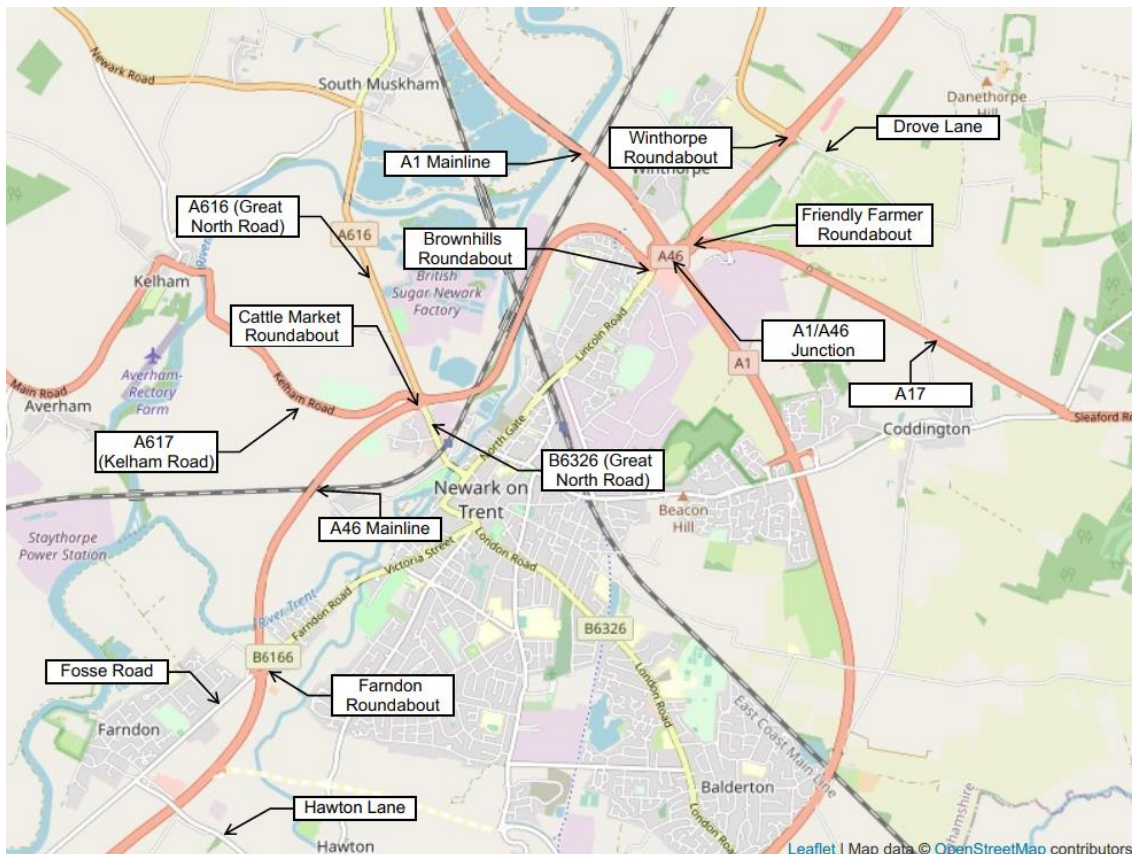


- 2.1.2 The A46 is located around the northern and western extents of the market town of Newark-on-Trent in Nottinghamshire. Between Farndon Roundabout and Winthorpe Roundabout, the road is in close proximity to residential, agricultural and industrial land.
- 2.1.3 To the north and south west of the A46 the land transitions from urban fringe to intensively rural farmed landscape.

2.2 Existing Highway Network

2.2.1 Figure 2.2 shows an overview of the existing highway network.

Figure 2.2: Existing Highway Network



Map data available under the Open Database Licence found at openstreetmaps.org/copyright. Date accessed 17/11/2020.

The Strategic Road Network

- 2.2.2 The section of the A46 between Farndon Roundabout and Brownhills Roundabout (A1/A46 Junction) is a wide single carriageway (speed limit 60 mph) with hatched central road markings to discourage overtaking. This section is designated as a High Load Route.
- 2.2.3 The section of existing A46 between Friendly Farmer Roundabout (A1/A46 Junction) and Winthorpe Roundabout, is a two-lane dual carriageway (speed limit 70 mph) and is designated as both a Heavy and a High Load Route.
- 2.2.4 The A1 intersects the A46 at the A1/A46 Junction, east of Newark-on-Trent. Near the junction, the A1 is a two-lane dual carriageway with slip roads to and from the grade separated junction.

Farndon Roundabout

- 2.2.5 The existing Farndon Roundabout is a five-arm, at grade, two-lane circulatory roundabout that links the A46 with Newark-on-Trent to the east and Farndon to the west via Fosse Road. It also provides private access to properties and a business to the south-east of the roundabout. The A46 southern approach to the roundabout is dual carriageway. Travelling north from the roundabout, the A46 is a single carriageway, locally widened to two lanes in the vicinity of the junction.

Cattle Market Roundabout

- 2.2.6 Cattle Market Roundabout, to the north-west of Newark-on-Trent, is a five-arm, at grade roundabout that connects the A46 to the A616 (Great North Road) and A617 (Kelham Road) to the north, and the B6326 (Great North Road) to the south, towards Newark-on-Trent town centre.
- 2.2.7 The A616 and A617 are single carriageway roads, both with speed limits of 50 mph in this area. The A617 provides access towards Kelham village, to the north-west of Newark-on-Trent, and continues to Mansfield. The A616 provides access to and from the area north-east of Newark-on-Trent and joins the A1 at Junction 30.
- 2.2.8 The B6326 is a single carriageway road that provides access between Cattle Market Roundabout and Newark-on-Trent Town Centre. There is a level crossing along the B6326 south of Cattle Market Roundabout, where the road crosses the Nottingham to Lincoln railway line; this railway line services the nearby Newark Castle Railway Station. The speed limit along the B6326 immediately south of the roundabout is 60 mph, but this is lowered to 30 mph before the level crossing, on the approach to the town centre.

A1/A46 Junction

- 2.2.9 The A1/A46 junction consists of a dumbbell style arrangement of Brownhills and Friendly Farmer Roundabouts, linked by a bridge over the A1. Brownhills Roundabout provides access to and from Lincoln Road, towards Newark-on-Trent town centre, and the A46 southbound. Friendly Farmer Roundabout provides access to and from the A17 and the A46 northbound.
- 2.2.10 The A17 starts at King's Lynn, Norfolk, and extends to Newark-on-Trent, where it terminates at Friendly Farmer Roundabout on the A1/A46 Junction. The road consists of a single carriageway but is widened to a two-lane dual carriageway between Friendly Farmer Roundabout and the roundabout immediately to the east. National speed limits of 60 mph and 70 mph apply on the single and dual carriageway sections respectively.

Winthorpe Roundabout

- 2.2.11 Winthorpe Roundabout, located east of Winthorpe and next to Newark Showground, is a four-arm, at grade roundabout that connects the A46 to the A1133 to the north and Drove Lane to the south.
- 2.2.12 The A1133 is a single carriageway road with national speed limit (60 mph) that connects to the north-east of the roundabout. It provides access to Winthorpe and for routes to and from the north.
- 2.2.13 Drove Lane is a single carriageway road that passes to the north and east of Newark Showground and Newark Air Museum and connects into the south-east

of the roundabout. The road provides access between Winthorpe Roundabout and the A17. There is a national speed limit of 60 mph along the full length.

Technology

- 2.2.14 There is limited technology at present on this section of the A46, predominantly at some, but not all, of the junctions in the form of: single Closed-Circuit Television (CCTV) cameras; rotating plank signs; and traffic loops.

Existing Structures

- 2.2.15 There are 21 existing structures within the scheme extents; these take the form of highway bridges, underpasses and culverts.

2.3 Accidents

- 2.3.1 The accident impact analysis is based on 5-year (2014-2018) STATS19 data provided by the DfT to identify the number and characteristics of collisions and casualties in the study area for the A46 Newark Bypass scheme.
- 2.3.2 STATS19 is a dataset that gives details of personal injury collisions on public roads that are reported to the police. The dataset does not include damage-only collisions with no human casualties, or collisions on private roads or within car parks. It is recognised that not all non-fatal injury collisions are reported to the police and would therefore not be included in the analysis below.
- 2.3.3 Traffic collisions have been analysed along the A46 (10 km study area) including the Farndon Roundabout and the A1/A46 Junction based on the available STATS19 data and is reported in Tables 2.1, 2.2 and 2.3 and Figure 2.3.

Table 2.1: Number of casualties on A46 by casualty type

Casualty Type	Number of Casualties (2014-2018)
Pedestrian	0
Cyclist	8
Horse rider	0
Mobility scooter rider	0
Motorcyclist	26
Car/Van Passenger	155
Goods and Agricultural Passengers	8
Other vehicle occupant	0
Minibus	0
Bus/Coach	0
Total	197

Table 2.2: Number of collisions and casualties for junctions on the A46

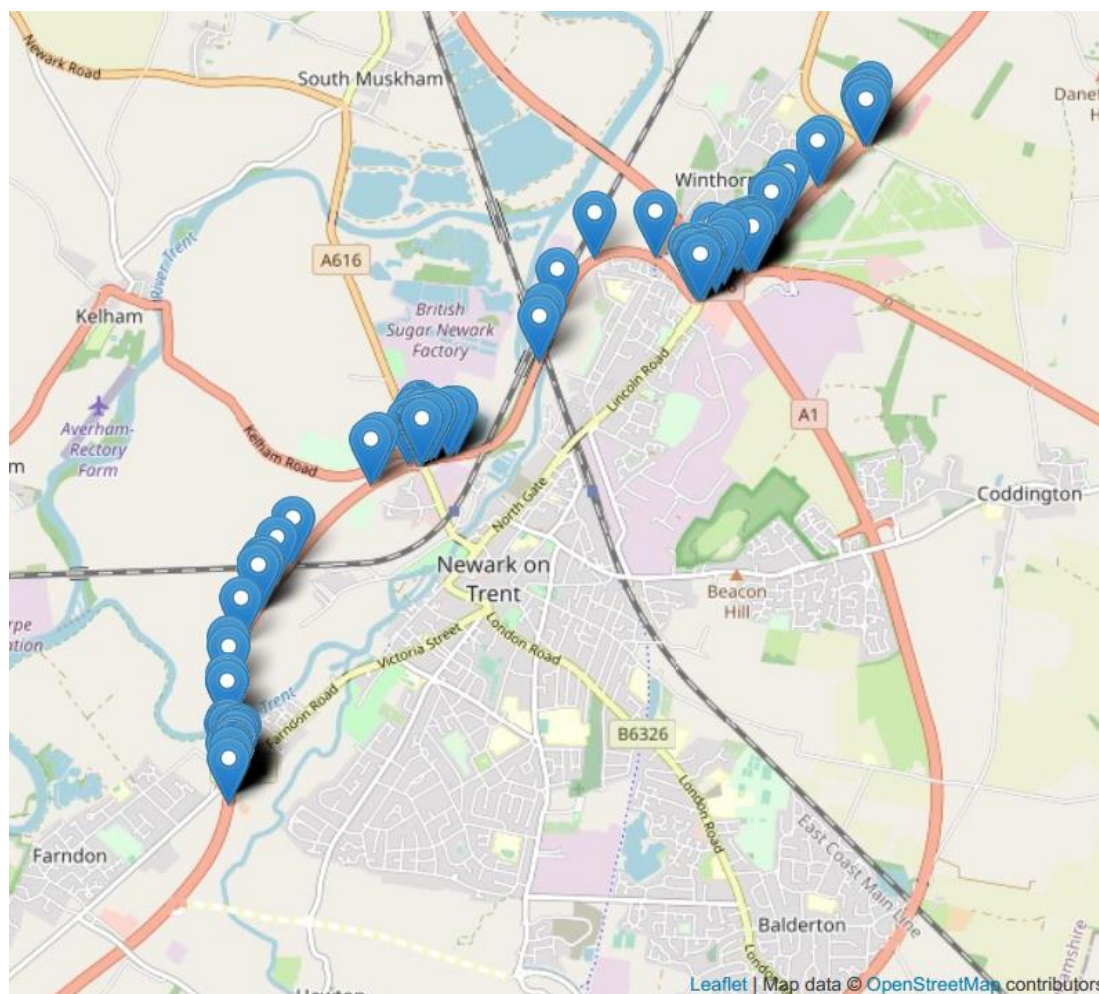
Junction	Number of Collisions (2014-2018)	Number of Casualties (2014-2018)	Average Casualties per Collision (2014-2018)
Farndon Roundabout	23	25	1.09

Junction	Number of Collisions (2014-2018)	Number of Casualties (2014-2018)	Average Casualties per Collision (2014-2018)
Cattle Market Roundabout	39	52	1.33
A1 / A46 Junction	56	77	1.38
Total	118	154	1.32

Table 2.3: Collision Severity for collisions on the A46

		Total Number of A46 Collisions (2014-2018)	Number of A46 Junction Collisions (2014-2018)*
Fatal	No.	3	1
	%	2.2%	0.8%
Serious	No.	13	11
	%	9.4%	9.3%
Slight	No.	122	106
	%	88.4%	89.8%
Killed or seriously injured	No.	16	12
	%	11.6%	10.2%
Total		138	118
*Note: Total number of collisions are inclusive of the number of collisions at junctions			

Figure 2.3: A46 Collision Locations



Map data available under the Open Database Licence found at openstreetmaps.org/copyright. Date accessed 17/11/2020.

- 2.3.4 Farndon Roundabout, Cattle Market Roundabout and the A1/A46 Junction were found to have 118 collisions in total, amounting to over 85% of the 138 collisions that occurred on this section of the A46 from Farndon to the A1 junction.
- 2.3.5 From the 138 collisions on the A46, there were 197 casualties, giving an average of 1.43 casualties per collision. The proportion of accidents where people were killed or seriously injured is 11.6% for the A46 in this study area, which is less than the national average of 24.4% for single carriageway A-roads for the same data period¹.
- 2.3.6 There were no pedestrian casualties on the A46, due to the limited pedestrian activity; however, there were 8 cyclist casualties, 6 of which happened at the Cattle Market Junction and 2 of which happened at the A1 / A46 Junction.

2.4 Journey Time Reliability

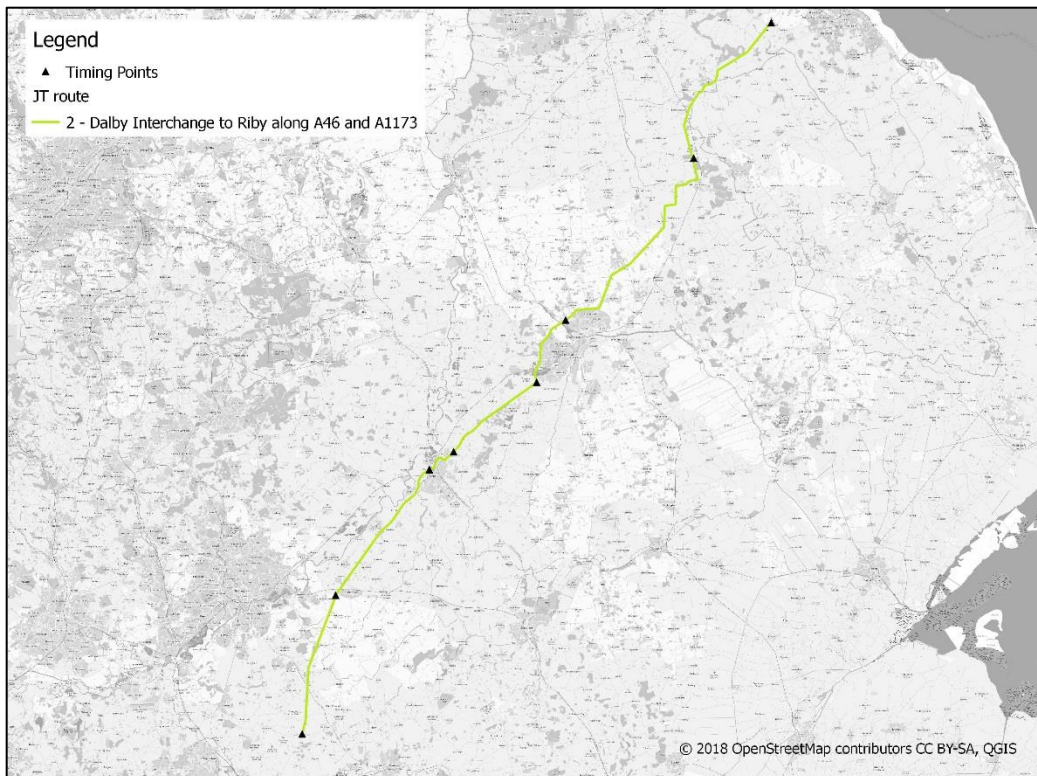
- 2.4.1 Trafficmaster data provided by the DfT, covering the period from January 2017 to September 2017, for the counties of Derbyshire, Nottinghamshire, Lincolnshire and South Yorkshire was analysed to understand the size and variation in

¹ Data source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895729/SRN_Casualty_Report_2018.pdf

journey times along the A46 corridor. The Trafficmaster dataset collects GPS data from tracked vehicles to derive information on travel times across individual links. The dataset provides observations in fifteen-minute intervals and includes all vehicle classes (cars, Light Goods Vehicles (LGVs), Heavy Goods Vehicles (HGVs), buses, taxis, motorised caravans, other).

- 2.4.2 The A46 journey time route shown in Figure 2.4 runs south-west to north-east along the A46 and A1173 corridor between Dalby Interchange (with A6006) and Riby (at junction with A18) and passes directly through the Newark Bypass scheme location.

Figure 2.4: A46 Journey Time Route



- 2.4.3 The journey times of the links comprising the route have been averaged across the March 2017 weekdays (Monday-Friday) for every modelled time-period:

- AM Peak: 07:00-10:00.
- Inter-Peak: 10:00-16:00.
- PM Peak: 16:00-19:00.

- 2.4.4 Several timing points have been selected along the route (Figure 2.4), to enable journey time calculations between major junctions.

- 2.4.5 Table 2.4 presents the mean observed journey times for the A46 corridor route, derived from the Trafficmaster data.

Table 2.4: Mean Observed Journey Time

Direction	AM (hh:mm:ss)	IP (hh:mm:ss)	PM (hh:mm:ss)
Northbound	01:24:31	01:24:26	01:29:26
Southbound	01:29:28	01:24:25	01:25:41

Trafficmaster - March 2017 (weekdays)

2.4.6 The A46 route from the Dalby Interchange to Riby, which is approximately 110 km in length, experiences delays during the PM period in the northbound direction and during the AM in the southbound direction. The observed mean travel times for the respective journeys are approximately five minutes higher compared to the inter-peak period.

2.4.7 Analysis of historic traffic patterns on the A46 demonstrates that:

- Traffic growth on the A46 between 2011 and 2017 in the vicinity of the scheme is approximately 3% per annum, which is higher than National Road Traffic Forecast growth for the East Midlands;
- Traffic volumes on the A46 are high for a wide single carriageway and within the recommended range for a dual carriageway;
- The morning and evening peak periods occur between 07:00-09:00 and 16:00-18:00 respectively;
- Hourly traffic flow profiles are similar for all weekdays;
- Traffic flows at the weekend are lower than on weekdays; and
- Traffic volumes are consistent throughout the year, March traffic volumes are in line with the annual average flows.

2.5 Topography, Land Use, Property and Industry

2.5.1 The A46 is part of the strategic road network and connects the M1 and Leicester to the A1 and Central Lincolnshire. Between Farndon and Winthorpe Roundabouts, the landscape along the A46 comprises road and rail corridors, a mix of urban fringe and heavy industry, open agricultural land, and the flood plains and river corridors of the Trent and Devon, forming distinct landscape features and supporting riverside development and a variety of wetland habitats.

2.5.2 The A46 forms the northern boundary of Newark-on-Trent being home to many residential properties and local businesses. To the north and south west of the A46 the land transitions from urban fringe to intensively rural farmed landscape. Extant planning permission exists within 500 m of the A46 for unimplemented or partially implemented development.

2.6 Climate

2.6.1 Through the Climate Change Act and amendment in June 2019, the Government is legally required to reduce UK emissions to net zero by 2050. To meet this target, a set of carbon budgets for five-year periods up to 2032 have been set. The UK is currently in the third carbon budgetary period (2018-2022).

2.6.2 The total baseline carbon emissions for the area without a scheme being in place (referred to as Do-Minimum scenario) have been calculated as follows:

- 2028 Opening Year: 418,559 tCO₂e
- 2043 Design Year: 474,103 tCO₂e

2.6.3 Opening Year emissions will, therefore, contribute 0.02% of the 5th carbon budget (UK carbon reduction target 2028 to 2032). Assuming consistent emissions from the operation of the Do-Minimum between 2028 and 2032, this will contribute around 0.1% of the UK's total carbon budget for that period.

2.7 Highway Drainage and the Water Environment

2.7.1 The existing surface water collection system consists of kerbs and gullies on the mainline and a combination of Combined Drainage Kerb Units and gullies at the junctions.

2.7.2 Inspection of the Highways England's Drainage Data Management System database indicated that for a large part of the road, gullies are draining directly into ditches at the side of the road. It is, therefore, assumed that for these sections there are no existing longitudinal carrier drains.

2.7.3 Within the 1km study area:

- Five Water Framework Directive (WFD) reported reaches have been identified as well as four additional ordinary watercourses. All WFD are under the jurisdiction of the Environment Agency (EA) and fall within the Humber River Basin District (RBD).
- There are no WFD lake waterbodies however, there are numerous non-WFD lakes located in the study area and north of the A46 between the A616 and A1.
- There are both Flood Zones 2 and 3 associated with the River Trent, the River Trent (Newark Branch), and Slough Dyke.
- There are no Source Protection Zones.
- There are two Local Nature Reserves (LNR).

2.7.4 The study area for the scheme is underlain by:

- Secondary B bedrock aquifer;
- Secondary A bedrock aquifer;
- Secondary A superficial aquifer; and
- One WFD groundwater body (Lower Trent Erewash).

2.8 Geology, Soils and Mining

2.8.1 Made Ground is not mapped within the study area but is anticipated to be present in areas of previous and existing development and along the existing highways.

2.8.2 Localised superficial deposits are present within the scheme. Alluvium, associated with the River Trent, is present across the majority of the south-western half of the study area. The Alluvium is described as soft to firm consolidated clay and silt, and may contain sand, gravel and locally, peat.

- 2.8.3 The Balderton Sand and Gravel Member underlies the majority of the north-eastern section of the study area. Small pockets of Holme Pierrepont Sand and Gravel Member are also present mainly located just west of the A1, north of Cattle Market and at the south-western extent of the study area.
- 2.8.4 The British Geological Survey (BGS) Geology of Britain Viewer (accessed May 2018 and October 2020) includes historical borehole logs located along the study area, which are likely to number in the hundreds. However, the majority of these logs are confidential, or the logs are noted as no longer available. Therefore, five logs, available for review have been selected along the study area.
- 2.8.5 The available BGS geological mapping indicates the bedrock along the scheme to comprise Mudstone of the Mercia Mudstone Group (MMG) and of the Gunthorpe and Edwalton Members.
- 2.8.6 There are no statutory geological SSSIs or Local Geological Sites within the study area. The study area is not in an area that is affected by mining (The Coal Authority, 2018). The BGS Mineral Map² for the area indicates that sand and gravel extraction has occurred in the area of Crankley Point and Sand and Gravel deposits are present in the area.
- 2.8.7 The A46 in the study area is mainly on the floodplain of the River Trent where the soils are in silty clay alluvium. The Agricultural Land Classification (ALC) is Grade 3b, which is not Best and Most Versatile (BMV³). Land use here is a mixture of heavy land arable rotations and grass.
- 2.8.8 On the upland around Winthorpe and Langford there is the Newport association of free-draining sandy and light loamy soils. The light loamy soils around Winthorpe and Langford are potentially of BMV quality. There are well drained loamy soils on terrace deposits that are likely to be in Grades 2 and 3a.
- 2.8.9 The UK Soil Observatory website⁴ shows the soils to be predominantly Gleysols with an area of Arenosols at the north-eastern end of the route. The Gleysols are predominantly classified as loamy and clayey floodplain soils with naturally high groundwater. Near the A1 interchange soils are classified as naturally wet very acid sandy and loamy. The Arenosols in the north-east are classified as freely draining slightly acid sandy soils.
- 2.8.10 A review of the Envirocheck report has been completed to identify potentially contaminative historical and current land uses. These include the following:
- An historical landfill 215 m north of the Cattle Market Roundabout.
 - There are three petrol stations within the study area; a Shell Garage and an Esso Garage located to the east of Friendly Farmer Roundabout and a Jet Garage north-east of Farndon Roundabout.
 - The Crankley Point Sewage Works is located approximately 80 m north-west of the A46.
 - There are two railway lines located within the study area. The East Coast Mainline crosses the A46 near the centre of the scheme. The Nottingham to Lincoln railway line crosses the scheme in two locations - in the centre and southern sections.

² British Geological Survey. Nottinghamshire Mineral Resources Map 1:100k dated 2002.

³ Best and Most Versatile agricultural land (BMV) is defined as Grades 1, 2 and 3a in accordance with the Agricultural Land Classification system.

⁴ UK Soil Observatory website. Accessed October 2020. <http://ukso.org/>

- There are also some industrial sites located within the study area:
 - The British Sugar Factory located immediately east of the A616 Great North Road, north-east of Cattle Market Roundabout.
 - Briggs scrap metal merchants located immediately west of the A616 Great North Road, north of Cattle Market Roundabout.
 - DX Freight Service Centre just east of the Newark Rail Crossing, west of Brownhills Roundabout.
 - Newark Lorry Wash and associated freight services located approximately 100 m south-east of Cattle Market Roundabout.
- Numerous farms are located in close proximity to the study area and are assumed to be operational farmsteads.

2.8.11 Potential contamination associated with the above historical and current contaminative land uses include a range of organic, inorganic and microbial contaminants within the soils, leachate or the underlying groundwater. Hydrocarbon contamination may be present in the non-aqueous (free) phase, the dissolved phase and/or the vapour phase.

2.8.12 Landfill gases such as methane, carbon dioxide, carbon monoxide and hydrogen sulphide may be present, associated with the sewage works and any significant thickness of made ground present. Contaminative dust, fibres and vapours may also be present from spillages and leakages and movement of materials.

2.9 Environment – Baseline Conditions

2.9.1 The main environmental features and designations within the study area are shown on the Environmental Constraints Plan (see Appendix A).

Air Quality

2.9.2 The local air quality study area is defined as the area within 200 m of the roads meeting the traffic screening criteria within the current standards. For the purposes of identifying the existing conditions (2017 base year) and assessment of impacts a combined study area applicable to all options has been derived. The combined study area includes sections of the following key roads: A46, A617, A1 and A17.

2.9.3 There are no designated Air Quality Management Areas (AQMA) within the air quality study area. The closest AQMA to the air quality study area is Syston AQMA (Charnwood Borough Council), which is located 1.6 km south of the air quality study area and encompasses residential properties along the main road through Syston.

2.9.4 There are two statutory designated ecological sites sensitive to nitrogen deposition (Twenty Acre Piece Site of Special Scientific Interest (SSSI) and Devon Park Pastures LNR) and 40 locally designated ecological sites (39 Local Wildlife Sites (LWSs) and one veteran tree) within the air quality study area.

2.9.5 There are no compliance links within the Department for Environment Food & Rural Affairs (Defra) pollution climate mapping (PCM) in the vicinity of the air quality study area. The nearest PCM link is on the A1434 at Lincoln, which is 1.4 km to the northeast of the air quality study area. The most recent PCM mapping which uses a 2018 reference year shows that for the earliest year available

(2018), this link has a projected NO₂ concentration of 19.9 µg/m³ and does not exceed by some margin the EU limit value of 40 µg/m³.

Cultural Heritage

2.9.6 There are no World Heritage Sites, Protected Wrecks, or Registered Battlefields within the study area. The following known designated heritage assets are located within the study area (1 km buffer of the scheme):

- 12 Scheduled Monuments.
- Four Grade I listed buildings.
- 14 Grade II* listed buildings.
- 324 Grade II listed buildings.
- One Grade II Registered Park and Garden.
- Two Conservation Areas.

2.9.7 In addition to the designated heritage assets, there is a rich and complex landscape of non-designated heritage. Data from the Nottinghamshire Historic Environment Record (HER) has been obtained to identify known heritage assets within the 500 m study area and to evaluate the potential for as-yet unknown archaeological remains. Over 500 individual records are located within this study area, relating to all periods of human occupation.

2.9.8 The Nottinghamshire Historic Landscape Characterisation (HLC) project (Nottinghamshire County Council, 2016⁵) identified 21 distinct character areas in the county, five of which are represented within the large 1 km study area. The historic landscape of the study area reflects recent changes to the landscape in terms of urban development, large-scale agriculture and mineral extraction.

Landscape

2.9.9 At the national landscape scale, the study area (2 km from the scheme) falls within the Trent and Belvoir Vales National Character Area (NCA) 48. The key landscape characteristics of the NCA are summarised as follows:

- Undulating, strongly rural and predominantly arable farmland, centred on the River Trent.
- A low-lying rural landscape with relatively little woodland cover, offering long open views.
- The area's generally fertile soils and good quality agricultural land have supported a diversity of farming over a long period but, because of this, little semi-natural habitat remains.
- The River Trent and its flood plain is a distinctive feature running through the landscape.

2.9.10 At a regional landscape scale, the study area is located within three of the Regional Character Areas outlined in the Newark and Sherwood Landscape Character Assessment (LCA) Supplementary Planning Document (December 2013), which further subdivides each of these LCA into policy zones and includes a landscape analysis for each policy zone:

⁵ http://archaeologydataservice.ac.uk/archives/view/notts_hlc_2016/index.cfm, accessed 17 April 2018

- Trent Washlands.
- East Nottinghamshire Sandlands.
- South Nottinghamshire Farmlands.

2.9.11 In terms of visual amenity, receptors with potential views of the scheme include:

- Users of recreational facilities within the study area:
 - Visitors to Newark Air Museum.
 - Visitors to Newark Castle Scheduled Monument and Registered Park and Garden.
- Recreational users of the extensive network of Public Rights of Way (PRoW) within the study area:
 - Walkers, cyclists and equestrians using Trent Valley Way, a long-distance walking route and National Cycle Network Route Number 64.
 - Recreational users of other Public Footpaths and permissive routes.
 - Users of Holme Marsh Registered Common Land, Farndon Ponds and Devon Park Pastures LNRs.
- Residential properties within the study area:
 - Residents within isolated residential properties scattered throughout the open countryside.
 - Residents within the village of Winthorpe.
 - Residents along the northern and southern edge of Newark-on-Trent directly south and east of the A46.
 - Residents on the north-east and eastern edge of Farndon village.
- Other receptors include:
 - Outdoor workplaces.
 - Motorists on main roads, the minor local road network, scenic roads.
 - Scenic roads/tourist routes and visitors to pubs.
 - Hotels and schools.
 - Indoor workplaces.
 - Users of sports facilities.

Biodiversity

2.9.12 There are two LNRs (Farndon Ponds and Devon Park Pastures) within 2 km of the scheme and one SSSI (Twenty Acre Piece) within the air quality study area, designated for its lowland neutral grassland. There are no other statutory designated nature conservation sites within 2 km of the scheme and there are no European sites where bats are one of the qualifying features within 30 km of the

2.9.13 There are 23 non-statutory designated conservation sites (LWSs) within 1 km of the scheme, some of which are also located in the air quality study area that includes 40 non-statutory designated ecological sites (39 LWSs and one veteran tree).

- 2.9.14 The desk study identified the following four priority habitat types (as listed in Section 41 of the NERC Act 2006) within 1 km of the scheme:
- Lowland mixed deciduous woodland.
 - Wood-pasture and parkland.
 - Coastal and floodplain grazing marsh.
 - Traditional orchards.
- 2.9.15 There is no ancient woodland within 1 km of the scheme. However, the desk study identified a pedunculate oak that has been classified as a 'notable tree' in the Woodland Trust's Ancient Tree Inventory, present at Winthorpe House. Notable trees are usually worthy of recognition and can be potential, next generation veteran trees.
- 2.9.16 Environment Agency monitoring of the River Trent indicates that the river supports a diverse fish population, with 13 species recorded between 2014 and 2016. Records include small numbers of the priority species European eel and bullhead.
- 2.9.17 Land within and adjacent to the scheme to the south of the Cattle Market Roundabout and to the north of the A1/A46 Junction predominantly comprises arable farmland and hedgerow typical of the Trent and Belvoir Vales NCA. The pastoral farmland centred around the Cattle Market Roundabout comprises fields of unimproved and semi-improved neutral grassland, some of which comprise a network of LWSs. Woodland appears largely to be restricted to Highways England soft-estate.
- 2.9.18 A review of legally protected and priority species records within 1 km of the scheme (records of bats have been reviewed within 2 km of the scheme), in combination with a review of aerial photographic imagery and preliminary walkover surveys, has identified the potential presence of the following species, which may be affected by the scheme:
- Bats.
 - Otter.
 - Great crested newt and common toad.
 - Water vole.
 - Common species of reptile, in particular grass snake and slow-worm.
 - Priority bird species, in particular assemblages of farmland and woodland birds.
 - Priority mammal, invertebrate and plant species, in particular hedgehog, brown hare, polecat and invertebrate and plant assemblages associated with less intensively managed habitats such as watercourses, standing waterbodies and meadows.
- 2.9.19 The potential presence of badger and invasive non-native species (INNS) (e.g. Japanese knotweed), both of which can be a significant constraint during construction, has been identified.

Noise and Vibration

- 2.9.20 Road traffic noise from the A-roads in the study area, such as the A46, A1 and A17, is the dominant source of ambient noise in the study area. There is also the potential for additional noise contribution at the properties near the London Kings Cross to Doncaster, and London St Pancras to Lincoln railway lines, plus the existing industrial premises. The land use within 600 m of A46 is a mixture of residential (on the edge of Newark, and at Winthorpe, and Farndon), agricultural and industrial areas.
- 2.9.21 Noise Important Areas (NIAs) along the A1, A46, A617, Fosse Road (red) and East Coast Mainline (blue) are shown on Figure 2.5.

Figure 2.5: Noise Important Areas near to the scheme

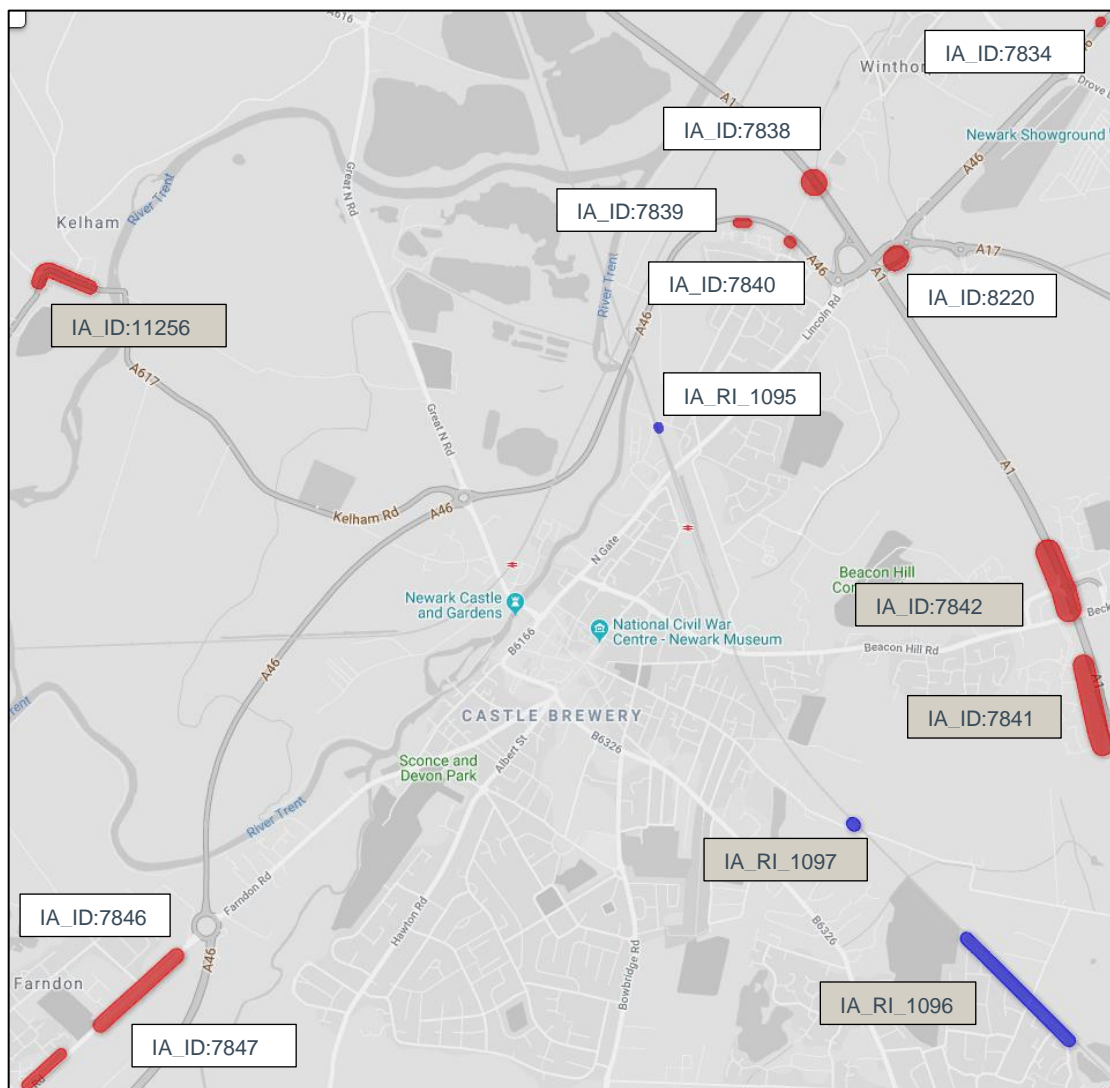


Table source: Accessed 24/04/2019 <http://extrium.co.uk/noiseviewer.html>

Population and Human Health

2.9.22 Receptor groups for Population include private property and housing, community land and assets, development land and businesses, agricultural land holdings and walkers, cyclists and horse riders but exclude vehicle travellers:

- The relevant section of the A46 passes several settlements including Newark-on-Trent, Winthorpe and Farndon. There are various groups of private dwellings and several isolated properties in proximity of the scheme.
- There are several community assets within 500 m of the options including, but not limited to, a primary school, a cricket club, a church and a community centre. There are also likely to be additional community asset receptors that have catchment areas that extend to within 500 m of the scheme.
- There are several businesses within the study area and some community assets that also operate as businesses, such as Newark Rugby Club. Businesses within 500 m of the scheme include, but are not limited to, a petrol station, multiple retail outlets, a hotel and several restaurants.
- For agricultural landholdings, information on farm ownership/occupancy is not available at this stage, but farm sizes are likely to be moderate to large, in excess of 100 ha. East of the A1, around Winthorpe, the soils are sandy and the land use is more variable, with rotations that include spring cereals and sugar beet. It is not known, at this stage whether this light land is irrigated.
- The National Cycle Network Route Number 64 runs from Market Harborough to Lincoln via Melton Mowbray and Newark-on-Trent. The cycle route passes underneath both the A1 and A46 north of Newark-on-Trent.
- In total, five Public Right of Ways pass under the A46 at various points, such as a bridleway south of the Newark Railway Crossing and a footpath north of the Newark Railway Crossing.

2.10 Accessibility

2.10.1 Newark-on-Trent is served by two rail stations that are approximately 1 km apart on separate train lines close to the centre of the town: Newark Northgate Station on the East Coast Mainline; and Newark Castle Station on the Nottingham to Lincoln railway line. Both lines cross under the A46 close to the north-eastern river crossing, while the Nottingham to Lincoln railway line also crosses the A46 between the Farndon and Cattle Market Roundabouts.

2.10.2 The main hub for buses is the bus station, which is located off Lombard Street to the south of the town centre. There are no services using the A46 south of the town, but there is a long-distance service to villages to the north (terminating at Saxilby), and a school route between Grantham and Collingham. Local services cross the A46 at Cattle Market Roundabout and Farndon Roundabout.

3. Scheme Objectives

- 3.1.1 The main objectives for the scheme can be found in the Client Scheme Requirements. These objectives are focussed around:
- Economic Growth and Development;
 - Movement of Goods and Access to Transport Hubs;
 - Accessibility;
 - Journey Times;
 - Safety;
 - Resilience;
 - Environment; and
 - Customer.
- 3.1.2 The A46 is a nationally significant trade and export route, with ports at either end of the corridor and East Midlands and Birmingham Airports close by. The single greatest gap in this route is the A46 at Newark; an upgraded dual carriageway opened in 2012, but which stopped three miles short of the A1. This scheme will fill this gap, creating a consistently good connection from the M1 at Leicester to Lincoln, and supporting UK, regional and local government transport and economic growth plans.
- 3.1.3 Locally, the Newark & Sherwood District Council's Infrastructure Delivery Plan (IDP), May 2010, recognises the importance of the A46 and the capacity issues faced by the bypass between Farndon Roundabout and the A1. Both the IDP and the Local Development Framework set out the scheme for explicit implementation. In addition to this, Significant residential growth is expected within the vicinity of the A46, as set out in the amended Newark and Sherwood Core Strategy Development Plan¹. Up to 9,080 new houses and 83.1 ha of employment land are proposed. The improvements to the A46 junctions around Newark-on-Trent have been identified as required infrastructure to deliver the Core Strategy.

4. The Proposed Options

- 4.1.1 Two options have been shortlisted following a thorough option identification and assessment process, and these are described as Option 1 and Option 2. The engineering, traffic, economic and environmental assessments are summarised for both options.
- 4.1.2 Options which have been discounted, and the reasons for this, are discussed in Chapter 5.

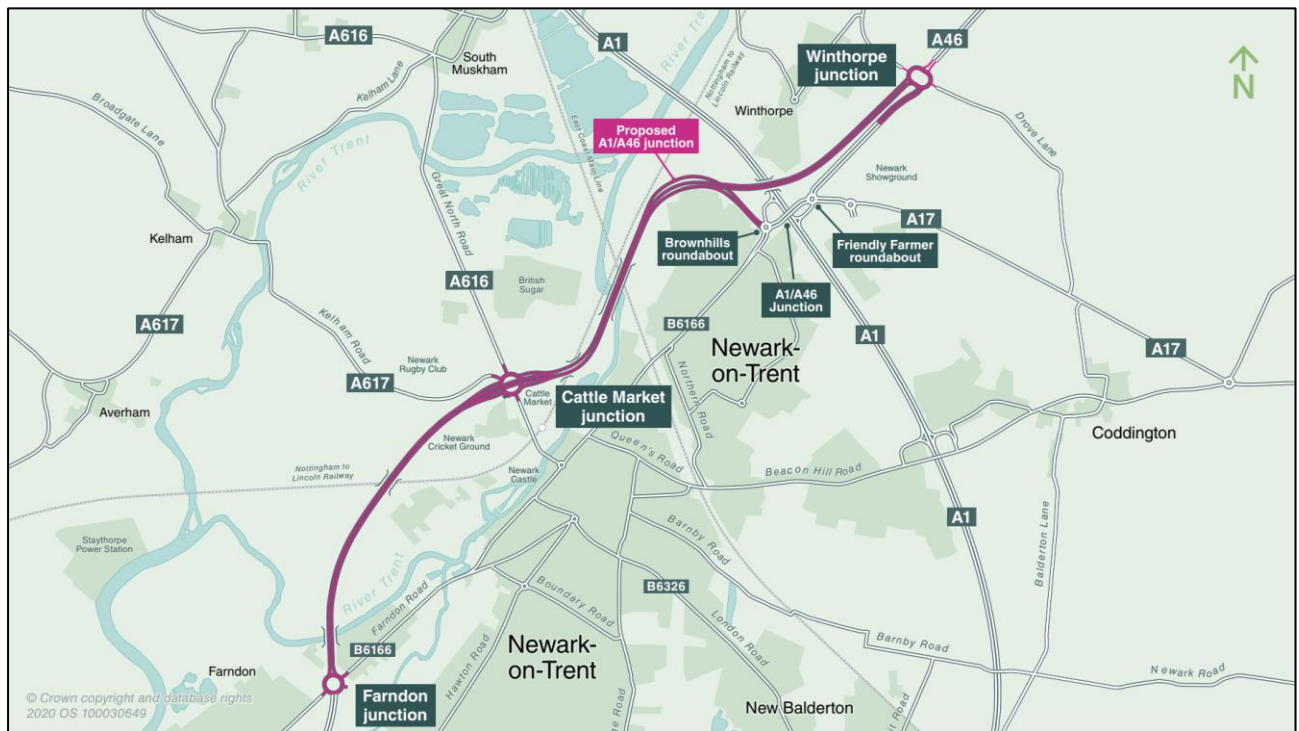
4.2 Description of Options

- 4.2.1 The layouts of Option 1 and Option 2 are show in Figures 4.1 and 4.2 respectively. Engineering layouts of the two options are included in Appendix B.

Figure 4.1: Option 1



Figure 4.2: Option 2



4.2.2 As Option 1 and Option 2 are similar in many respects they will be described together. Table 4.1 summarises the key differences in layout between the two options, and these are discussed in more detail below.

Table 4.1: Key layout differences between the two options

	Option 1	Option 2
Farndon Roundabout	As existing.	Signalised
Cattle Market Roundabout	Layout changed and signalised to allow A46 traffic to pass through the centre of the roundabout.	Grade separated with the A46 over the roundabout.
Winthorpe	New section of A46 ties-in to existing A46 to the west of Winthorpe Junction. New link over the A46 to provide access from Friendly Farmer Roundabout to the A46 eastbound.	New section of A46 would cross over the A1 and run slightly to the north of the existing road, joining back into Winthorpe Junction.

4.2.3 For the two options, the A46 would be widened to a dual carriageway to provide two lanes in each direction between the Farndon and Winthorpe Junctions. Both options would include a new link and a new bridge over the A1 to the north of the existing bridge, which allows traffic on the A46 to bypass the existing A1/A46 Junction and travel on to Winthorpe Junction.

4.2.4 In Option 1, Cattle Market Junction would be signalised, and the layout changed to a ‘hamburger’ allowing the A46 to pass through the centre of the roundabout. This would prioritise A46 through-traffic and reduce delays at this junction. The A617 would be diverted to a new roundabout with the A616 to the north of the junction, in order to reduce delays at Cattle Market Junction. Between the new

roundabout and Cattle Market Junction, the Great North Road would be widened to provide two lanes in each direction.

- 4.2.5 In Option 2, Cattle Market Junction would be grade separated, with the A46 elevated to pass over the roundabout. In this option, the A617 and A616 would be retained as they are currently.
- 4.2.6 In Option 1, the new section of A46 would cross over the A1 to the south of Winthorpe and tie-in to the existing A46 to the west of Winthorpe Junction. This junction would be enlarged, retaining the four-arms it currently has, and signalised to improve traffic flow. A new link over the A46 would provide access from Friendly Farmer Roundabout and the A1 to the A46 eastbound.
- 4.2.7 In Option 2, the new section of A46 would cross over the A1 and run slightly to the north of the existing road, and tie-in to Winthorpe Junction. The junction would be enlarged to a five-arm roundabout and signalised to improve traffic flow. This option would move the A46 slightly closer to Winthorpe but would remove the need for the flyover crossing over the A46 (as required in Option 1).
- 4.2.8 Farndon Junction would be signalised in Option 2 to improve flows on the roundabout during peak hours. The geometry of the junction would not be significantly changed for either option.

4.3 Engineering Assessment

Highway Alignment

- 4.3.1 The alignment of Option 1 and Option 2 is constrained by existing features. It may be necessary to utilise relaxations or departures from design standards to navigate these constraints. Where the latter is the case, formal technical approval from the Overseeing Organisation (Highways England) is required prior to incorporating the element of design into the scheme.
- 4.3.2 As design development progresses, there is the potential for the number and/or nature of these departures from standards to change; this is typical during design development.
- 4.3.3 An initial assessment of the geometry has identified that both options would feature two substandard curves along the A46 mainline between Cattle Market Junction and Brownhills Roundabout. These curves are inherited from the existing layout which is already below the desirable minimum standards. To provide a full standard alignment would have significant impact on residential areas in north east Newark-on-Trent and in Winthorpe. The hazards associated with the departures from standard and appropriate mitigation measures will need to be considered as the design is developed further in order for them to be formally assessed.

Structures

- 4.3.4 The proposed options will incorporate several existing and new structures. Table 4.2 lists each of the structures associated with the two options in turn, progressing from the southern end of the scheme to the north. The structural proposals apply to both scheme options except where specifically noted otherwise.

Table 4.2: Structures Assessment

Structure	Assessment
Farndon underpass (existing)	7m extension at the western end only; extension would be in the form of precast concrete boxes similar to the original construction.
Windmill Viaduct (existing and new)	Existing structure to be retained for A46 southbound carriageway; new approximately 90m span structure constructed parallel to the existing to carry the A46 northbound carriageway, and likely to be of the same form as the existing structure with two intermediate piers.
Pipe culvert No. 5 (existing)	Pipe culvert to be extended by approximately 24m for widened A46; new pipes could be attached to the existing structure and new headwall constructed.
Farm access underpass (existing)	Concrete box underpass extended by approximately 25m for widened A46; existing 'trough' section approach wing walls demolished, and new box sections and wing walls constructed.
Pipe culvert No. 6 (existing)	Pipe culvert to be extended by approximately 12m for widened A46; new pipes could be attached to the existing structure and new headwall constructed.
Nottingham to Lincoln railway line west crossing (existing and new)	Existing structure retained for A46 southbound carriageway with minor modifications to suit revised cross-section; new approximately 14 x 68.5m deck area bridge of similar form to and constructed at 4m offset from the existing structure (to avoid conflict between abutments) to carry A46 northbound carriageway; demolition or modification of existing wing walls / retaining walls may be required, extent to be determined in later design stages.
Pipe culvert No. 7 (existing)	Pipe culvert to be extended by approx. 17m for widened A46; new pipes could be attached to the existing structure and new headwall constructed.
Cattle Market flood relief culvert (existing)	Flood relief culvert to be extended by approximately 80m (north-east side) and 40 m (south-east side); extensions would use twin precast concrete boxes with in-situ sections to stitch to the existing structure.
Cattle Market Junction bridges (new)	Option 2 only: Two new underbridges required to carry the A46 mainline, in the form of approximately 27 x 28m deck area single span precast beam deck for each bridge with integral reinforced concrete abutments.
Cattle Market Junction approach retaining walls (new)	Option 2 only: form and length dependent on highways layout; likely to use reinforced earth, approximately 750m in length with average height of 4m.
Cattle Market Causeway Arches (A616)	Option 1 only: existing structures carry the northbound carriageway and retained without modification. New flood relief arch structures constructed parallel to and separated from the existing masonry arches to carry the southbound carriageway. Precast concrete arch units proposed to give a similar appearance to the existing arched structure. Other features such as the number of arches, spans, rises and coping details constructed to match the existing structure as far as possible.
Pipe culvert No. 12 (existing)	Pipe culvert to be extended by approximately 50 m for widened A46 and slip roads at Cattle Market Junction; new pipes could be attached to the existing structure and new headwall constructed.
Nottingham to Lincoln railway line east crossing (existing and new)	Existing structure retained for A46 southbound carriageway with minor modifications to suit revised cross-section; new approximately 35 x 20m deck area bridge of similar form to and constructed at 4m offset from the existing structure (to avoid conflict between abutments) to carry A46 northbound carriageway; demolition or modification of

Structure	Assessment
	existing wing walls and retaining walls may be required, extent to be determined in later design stages.
Nottingham to Lincoln railway line east crossing retaining walls (new)	Form and length dependent on highways layout so that earthworks do not encroach on the adjacent railway line; likely to use reinforced earth, approximately 500m in length with average height of 2m.
Nether Lock Viaduct (existing and new)	Existing structure retained for A46 southbound carriageway with minor modifications to suit revised cross-section; new approximately 14 x 230m deck area viaduct of similar form to the existing structure to carry A46 northbound carriageway; north abutment should be constructed to support northbound decks of Nether Lock Viaduct and the adjacent Nether Lock railway bridge.
Nether Lock railway bridge (existing and new)	Existing structure retained for A46 southbound carriageway with minor modifications to suit revised cross-section; new approximately 13.5 x 32m deck area railway bridge of similar form to the existing structure to carry A46 northbound carriageway.
Nether Lock railway crossing retaining walls (new)	Form and length dependent on highways layout so that earthworks do not encroach on the adjacent railway line; likely to use reinforced earth, approximately 160m in length with average height of 3m.
Sewage works access underpass (existing)	Concrete box underpass extended by approximately 25m for widened A46; existing wing walls on the west side demolished and new box sections and wing walls constructed.
Pipe culvert No. 16 (existing)	Pipe culvert to be extended by approximately 50m (north side) and 10m (south side) for widened A46 and slip roads to Brownhills Roundabout; new pipes could be attached to the existing structure and new headwalls constructed.
Winthorpe Road subways (existing and new)	Existing underpass to be demolished; new set of underpass structures to be constructed in the form of precast concrete boxes and retaining walls between the boxes, internal width of structure 7.5m and total length 80m, and headwalls with parapet / guardrail required at both ends of each box section.
A1 / A46 slip road flyover (new)	New single span structure of steel composite construction, approximately 34 x 37m deck area.
A1 / A46 slip road flyover retaining walls (new)	Could be reinforced concrete wall or reinforced earth in form, approximately 200m in length with average height of 4m.
A1 / A46 crossing (new)	New bridge to carry the A46 mainline over the A1; steel composite deck with integral abutments; span 54m with skew 20°; short wing walls, integral with the abutments.
Bleach House culvert extension (new)	New pipe culvert to carry watercourse that passes to the east of Friendly Farmer Roundabout beneath the A46; single corrugated steel pipe 1.6 m diameter (approximately same size as the existing pipe under Friendly Farmer Roundabout) and approximately 45 m long.
Friendly Farmer Roundabout / A46 on slip flyover (new)	Option 1 only: A two-span (35m/35m) steel composite deck would be used to offer a minimal deck construction depth and to accommodate the tightly curved slip road. The bridge deck would be supported by bearings on columns in the central reserve and abutments at the ends.

4.3.5 An extensive area of alluvium has been identified covering the region between Farndon Roundabout and the A1/A46 Junction. This suggests that most

structures will use piled foundations, which matches the foundations of most of the existing structures.

- 4.3.6 Environment Agency flood maps indicate the zone 2 and zone 3 flood areas covering the route section between Farndon Roundabout and Winthorpe Roundabout. Therefore, the structure designs will need to take account of the flood levels accordingly.
- 4.3.7 The dimensions including the span length and deck width for the new and widened structures are based on the current layouts in the scheme options. These may be revised as the project develops.
- 4.3.8 The interface with Network Rail's infrastructure is potentially problematic and the negotiations required to secure agreement to the construction of the new crossings, particularly over the East Coast Mainline at Nether Lock, should be started as soon as possible.

Geotechnical Assessment

- 4.3.9 The two options use largely the same route corridors, so the ground conditions will be similar, and the extents of earthworks and new structures are comparable in terms of geotechnical complexity. Although Option 2 introduces grade separation at Cattle Market Junction, and the associated need for reinforced soil or retaining walls to form the elevated section of the A46, it removes works along the A616 and the link between Friendly Farmer Roundabout and Winthorpe Junction with the associated earthworks and new structures.
- 4.3.10 The scheme area is part of the River Trent flood plain and is low lying and flat. The ground conditions reflect the flood plain environment, comprising alluvial soils such as soft compressible cohesive soils, which may be organic and may contain layers or lenses of Peat. Elsewhere the soils comprise non-cohesive material, termed Balderton and Holme Pierrepont Sand and Gravel members. The sand and gravel deposits may have been exploited commercially, which could account for some of the water bodies present.
- 4.3.11 Based on the historical borehole logs held by the British Geological Society (BGS) and which have been viewed, it is reasonable to expect alluvium thicknesses in excess of 5m to be present across parts of the site.
- 4.3.12 Ground stability in terms of bearing capacity and settlement must be accommodated in the design of new earthworks, especially when the new works are immediately adjacent to existing, settlement sensitive, infrastructure.
- 4.3.13 The geological map indicates two areas of 'sand and gravel' that impinge on the proposed route, these deposits are indicated in the area of Farndon Junction and north-east of the proposed A1/A46 Junction. The boundaries of these deposits should not be assumed to be definitive and that some lateral variation should be expected.
- 4.3.14 Given the number of water bodies to the north of the A46 and to the east of the A616 and the fact that the BGS identify a 'non-coal mining hazard' close to the British Sugar Factory, it suggests that the sand and gravel has probably been worked commercially as surface mines or quarries. Sugar factories require significant volumes of water and frequently construct reservoirs to serve their needs. In this case it is probable that they have taken over a worked-out and flooded sand and gravel pit, as their water supply.

- 4.3.15 It is possible that some worked-out sand and gravel pits may have been back-filled either with inert waste or may have been re-engineered as a landfill facility; however, the risk is low as no landfills appear on the Environment Agency register of landfills.
- 4.3.16 The available geological mapping indicates the bedrock to comprise Mudstone of the MMG between Winthorpe Roundabout and up to approximately 0.5km south-west of the Cattle Market Roundabout. The section between the proposed Hawton Lane Junction and up to 0.5km south-west of the Cattle Market Roundabout is recorded to be underlain by Mudstone of the Gunthorpe and Edwalton Members. No significant geotechnical issues are anticipated in relation to the bedrock formations identified.
- 4.3.17 A desk study will be required to review the geological / geotechnical data held by the BGS and others to allow a conceptual ground model to be developed. This can then be used to identify gaps in the knowledge and to form the basis for a scope for a targeted ground investigation.
- 4.3.18 The MMG is well known to be susceptible to weathering and exhibits a wide range of strength and other geotechnical properties that will not be apparent on published geological maps. Therefore, ground investigations will be required to identify the appropriate geotechnical design properties, especially where deep foundations are possible such as piles to support bridge abutments.
- 4.3.19 The bearing capacity for the cohesive alluvial soils is likely to be poor due to low undrained shear strength.
- 4.3.20 Construction of new embankments that abut the existing earthworks has potential to initiate settlement of both the new and existing earthworks with a risk of differential settlement.
- 4.3.21 Timescale and magnitude of the settlements can be predicted, and allowance made to accommodate these in the construction programme. Mitigation measures include excavation/replacement, surcharging, staged construction, lightweight fill and in-situ ground treatment.
- 4.3.22 The construction of new earthworks adjacent to new and existing piled foundations could induce settlement in the soils around the piles. This results in a down-drag on the pile shaft, known as negative skin friction, which induces additional load on the pile.
- 4.3.23 The settlement caused by the new earthworks will also impact the existing carriageway embankments. This could result in differential settlement and cracking in the existing carriageway.
- 4.3.24 It is likely that the bulk of earthworks fill will be imported; suitable sources of fill should be identified at an early stage so that transportation can be addressed.

Highway Drainage

- 4.3.25 To provide continuity with the existing surface water collection system, it is likely that the proposed options will incorporate a kerb and gully drainage system on the main line and a combination of a combined kerb-drainage system and gullies at the junctions to remove surface runoff.
- 4.3.26 At this stage, there is little information available on the existing sub-surface drainage network. This will have to be verified by drainage surveys during the

preliminary design stage. The proposed scheme would seek to follow the same rationale as the existing for the sub-surface drainage network.

- 4.3.27 It will generally be necessary to provide pre-earthworks cut-off drains, located at the top of cuttings or at the toe of embankments, to intercept runoff flowing towards the road from adjoining land. This is anticipated to be by means of a ditch, where space permits; where insufficient space is available, filter drains will be used.
- 4.3.28 Drainage attenuation ponds or ditches will support a Sustainable Urban Drainage System (SUDS) and form an integral part of the drainage design.

Street Lighting

- 4.3.29 An assessment of the specific requirements of street lighting will be undertaken at a later stage of the design development. The illumination of side roads and the A46 carriageway will be assessed individually; where there is existing street lighting provision, it is likely that this will continue in the final scheme proposals.

4.4 Safety Assessment

- 4.4.1 This safety assessment reviews the proposed options with reference to the road safety targets contained within the Highways England Delivery Plan. It then considers the effective construction traffic management that will be required to deliver the project. The remainder of the section reviews the potential implications for operational safety of the proposed options.
- 4.4.2 The safety review has assessed the proposals under the following broad headings:
- Overall layout.
 - General highway design features.
 - Junction strategy.
 - Tie-in points.
 - Severance and implications for the local highway network.
 - Relaxations and Departures from Standard.
- 4.4.3 This appraisal reviews the designs from a road safety perspective. Observations and recommendations are made about road safety aspects for consideration in future design development. Generally, if any safety issues are identified, steps would need to be taken to either design these out in ongoing design development of the scheme, or to provide appropriate mitigation measures to reduce the risk of occurrence to an acceptable level.
- 4.4.4 As the scheme is currently at the Options stage, the Road Safety Audit process has not yet been commenced (this would normally start at preliminary design stage).
- 4.4.5 Personal injury collision data for the A46 for the five-year period 2014 to 2018 has been obtained from the DfT. Over this length of the scheme there were 3 recorded fatal personal injury collisions and 12 serious personal injury collisions. The focus upon fatal and serious injury collisions is driven by the reduction target. Over this length of the existing A46 there were 3 recorded fatal and 13 serious personal injury collisions, which occurred in the following locations:

- Two fatal and one serious collision on the A46, between Farndon Roundabout and Cattle Market Roundabout.
- One fatal and seven serious collisions at the existing A1 / A46 Junction.
- Two serious collisions at the Farndon Roundabout.
- Two serious collisions at the Cattle Market Roundabout.
- One serious collision on the A46, between Cattle Market Roundabout and the existing A1 / A46 Junction.

4.4.6 The fatal and serious injury collisions at the existing A1 / A46 Junction might be expected to be addressed through the proposed bypass in both options. The serious injury collisions highlighted in the fourth bullet point might be expected to be addressed through the introduction of a grade separated layout at the Cattle Market Junction for Option 2. Further analysis of the collisions will be carried out as part of preparation of the Safety Plan.

Safety Review

4.4.7 Table 4.3 to Table 4.8 list the safety considerations relating to the two options. The assessment applies to both scheme options except where specifically noted otherwise.

Table 4.3: Safety Assessment – Overall Layout

Safety Consideration	Assessment
Proposed A1 / A46 grade separated junction	Removes A46 through traffic from existing at grade areas of the junction; expected to maintain or improve forward visibility; traffic volumes using the retained elements of the existing layout expected to drop; separation of local traffic would reduce number of conflicts and lead to a decrease in number of collisions on local and trunk roads; fatal and serious injury collision rate expected to decrease.
Junction options	Expected to deliver an improvement on existing layout; provide higher capacity and reduce delays and frustration; cumulative benefit of junction improvements expected to improve A46 traffic flow and driver safety.
Horizontal layout	Main carriageway includes curves below desirable minimum for 120 kph design speed between Farndon and A1 / A46 Junction, resulting in departures from standard; these elements are a legacy of the existing layout; the proposed design should improve safety by incorporating enhanced crossfalls and superelevation, as well as other mitigation measures as the design develops.
A1 crossing	Below desirable minimum horizontal layout of the existing A46 to the west; benefits of separating A46 through traffic from the existing A1 / A46 junction are expected to outweigh potential safety concerns related to these below desirable minimum elements, which would be subject to a package of mitigation design measures.
Gradients	In accordance with design standards; does not raise concerns for road safety in isolation or in combination with other design elements.
General road safety	No other concerns on the assumption appropriate parapets and road restraint systems (RRS) are incorporated into the design.

Safety Consideration	Assessment
Orientation	Route generally does not lie on a direct east-west alignment, so there would be limited impact from the rising or setting sun.

Table 4.4: Safety Assessment – General Highway Design Features

Safety Consideration	Assessment
Forward visibility and associated widening on bends	Where forward visibility is not provided in accordance with current standards, the safety impacts will be managed through the departure approval process. Highway features would be expected to lie outside the visibility splay and not affect road safety.
Cross-section	Standard rural all-purpose dual carriageway (D2AP); nearside hard strip would be expected to accommodate gullies where a kerb is present and areas of standing / running water during heavy rainfall to avoid impact upon live traffic lanes.
Road Restraint System (RRS)	Current proposal of vertical concrete barrier in the central reserve has the benefit of significantly reducing potential of 'cross-over' collisions as well as directing errant vehicles onward in their original direction of travel; Road Restraint Risk Assessment Process will be used to identify locations where RRS will be required.
Lighting systems	Lighting systems in accordance with standards provide road safety benefits but unlikely to be as great as might be expected, and no indication of expected benefits at junctions; street lighting provided / retained at junctions to provide users with opportunity to identify junction layout and features, as well as presence of other users, at night.
Environmental mitigation proposals	Consideration of their impact upon road users and any potential mitigation incorporated throughout design development.
Traffic signs and other roadside features	Features will be located away from high risk areas or designed to be passively safe; key focus will be to avoid hazards in the first instance; mitigation will be provided where a hazard cannot be designed out.

Table 4.5: Safety Assessment – Junction Strategy

Safety Consideration	Assessment
Traffic signs	Clear signing for unfamiliar users critical to successful operation of all layouts.
New merge and diverge points from/to A1 / A46 Junction	Diverges would be expected to have enhanced advanced direction signs and road markings to safely forewarn users of earlier exits than the exiting layout.
Roundabouts	<p>The design of roundabouts in both options needs to consider on-carriageway and off-carriageway cyclists;</p> <p>Option 2: there would be a benefit at Cattle Market Junction to on-carriageway cyclists compared to Option 1, due to the removal of A46 through traffic from the junctions.</p> <p>At Farndon and Winthorpe Junctions, cyclists on the roundabout circulatory would be negotiating A46 through traffic as well as local traffic; the inclusion of on-carriageway facilities for cyclists at the at grade junctions will be considered during preliminary design.</p> <p>The layout of the A616 and A617 to the north of the Cattle Market junction in Option 2 would not include a separate roundabout and this would increase the number of arms at the Cattle Market junction. This would be expected to increase the likelihood of</p>

Safety Consideration	Assessment
	conflicts at the junction but is likely to be largely offset by the avoidance of conflicts at a second roundabout to the north. The Winthorpe Junction in Option 2 would include two dual carriageway arms joining the circulatory carriageway in the south-western quadrant. Due to this layout the design of the A46 entry is likely to require careful attention to entry path curvature to provide control on entry speeds which are a critical factor in roundabout safety.
Cycle routes	Where off-carriageway cycle facilities exist, it is key that they are clear to understand and provide safe crossing points to encourage their use.
Number of junctions	Reduced number of junctions would be expected to reduce number of collisions for through traffic.
Junction layout	Simpler junctions should be safer due to their comprehensible layout and fewer points of conflict; choice of junction layout should consider traffic flows and turning movement proportions to minimum risk of collision; needs of vulnerable users would be considered in the next design stage.

Table 4.6: Safety Assessment – Tie-in Points

Safety Consideration	Assessment
General design	To current design standards, as intuitive as possible for road users to limit non-compliance.
Local road network	Connections all occur on existing roads of a good standard, largely away from property accesses.
Horizontal and vertical layout	Relatively straight horizontal layout at the tie-ins at each end of the scheme; vertical profile relatively constant; forward visibility does not appear to be compromised; no obvious road safety concerns.
Location of tie-ins	Tie-ins located away from junctions or significant highways features, so the layout should be easy for road users to comprehend.
Vulnerable users	Users such as pedestrians, cyclists and equestrians have lower capacity for diversion than motorised vehicle users; where existing provisions are severed by the scheme, diversion routes may have an impact upon the safety of these users; equestrians and cyclists require special consideration for proposed crossings.

Table 4.7: Safety Assessment – Other Highway Features

Safety Consideration	Assessment
Field / private accesses	Accesses on the existing A46 that require safe alternatives as the scheme is developed; unlikely that continued access from the dual carriageway will be provided; safety benefits in removing traffic movements to / from a high-speed road.
Laybys	Four existing laybys along the A46; similar replacements would form parts of the scheme proposal.

Table 4.8: Safety Assessment – Severance and Implications for the Local Highway Network

Safety Consideration	Assessment
Grade separated junction	Option 2: The introduction of a grade separation at Cattle Market Junction would be expected to reduce the level of severance experienced by all local road users, due to the separation from A46 through traffic.
Cattle Market Roundabout	Footpath to the west that currently crosses the A46, which would most likely require a diversion (probably via Cattle Market Junction) due to the widening of the main carriageway; existing shared use path at the roundabout will need to be considered in the junction modifications, which should be possible with the proposal for the roundabout to be signalised and crossing points being only on the east-facing slip roads.
Friendly Farmer Roundabout	Existing footpath to the north already severed by the A46; alternative arrangements would be investigated, should this be justified.
Routes that cross the A46	Routes for pedestrians and cyclists would be maintained, or improved, where possible.

4.4.8 The two options would be expected to have a positive impact upon road safety and contribute to the Highways England target of reducing the number of people that are killed or seriously injured on the trunk road network. The safety benefits are expected to extend to all user groups including vulnerable users.

4.4.9 Whilst both options would offer benefits for all user groups, Option 2 would have a greater benefit than Option 1, due to the additional grade separated junction that would separate A46 through traffic from local traffic.

Impact During Construction, Maintenance, Operation and Demolition

4.4.10 Throughout the design process, construction, maintenance, operational and future demolition risks for all relevant populations will be considered and recorded. The project Construction Design and Management (CDM) risk register is currently the record of hazards identified by designers throughout this early phase of design work. This is a single multi-disciplinary register to capture early identification of hazards and possible mitigation for consideration in future design stages.

4.4.11 Historic construction information will be sought where necessary. Further surveys, investigations and searches will be undertaken to identify and gather more information about the existing conditions and hazards beyond any information that might be available.

4.4.12 Key design hazards identified for the operation phase of the two options are:

- Pedestrian routes are prevalent in and around the locality. It will be necessary to consider pedestrian (and cyclist) facilities in the proposed design to ensure safe routes and points of access are implemented and that maintenance operations can be undertaken without a safety impact upon users.
- Appropriate width of merge and diverge slip roads at the proposed grade separated Cattle Market Junction for maintenance activities to take place safely whilst remaining open to traffic (Option 2 only).

- Collisions in the vicinity of junctions; grade separated and at grade junctions throughout the scheme will consider the safety needs of all user types.
- Operational safety regarding horizontal layout, vertical profile and stopping sight distance.
- The proposed grade separated Cattle Market Junction in Option 2 is expected to result in a lower level of risk of all users, from the separation of A46 through traffic, relative to the at grade proposal in Option 1.

4.4.13 Key construction hazards identified for the two options are:

- Working near live traffic for 'on-line' activities.
- Construction of the grade separation proposed at Cattle Market Junction in Option 2 would present more safety hazards than the at grade solution proposed in Option 1.
- Construction work occurring close to or diverting the routes of pedestrians, cyclists and equestrians.
- Substantial movement of material and subsequent impact of construction-related traffic on other road users.
- Working in proximity to water bodies and water courses.

4.4.14 Further assessment and consideration of construction, maintenance, operation and demolition implications will be undertaken during preliminary design.

4.5 Walking, Cycling and Horse-riding

4.5.1 For the two options there are implications for existing walking, cycling and horse-riding routes, including footpaths, shared use paths, long distance walking routes and associated crossings of the A46. The options could lead to an impact upon pedestrian, cyclist and equestrian journeys for commuting and accessing community facilities. However, walking, cycling and horse-riding facilities would be retained as appropriate and the provision of replacement and additional facilities such as crossings would, at the very least, ensure that severance does not increase for pedestrians, cyclists and equestrians.

4.5.2 Wherever possible, the intention would be to reduce overall severance in comparison with the effect of the existing A46. In addition, the safety of pedestrians, cyclists and equestrians would be expected to improve with higher quality facilities. Design decisions related to the needs of pedestrians, cyclists and equestrians will be recorded as the design progresses and will be presented in Walking, Cycling and Horse-Riding Review Reports at the Preliminary and Detailed Design stages of the scheme.

Table 4.9: Observations relevant to walking cycling and horse-riding

Structure	Assessment
Farndon Junction Shared Use Path	The existing Shared Use Path (SUP) following the B6166 Farndon Road passes under the A46 via an underpass. A grade separated crossing will be retained at this location and the scheme will have little impact on the quality of the crossing facility. The design will seek to minimise personal security issues (real and perceived) where the SUP passes through structures. Consideration of options to retain this important link during construction will be required.

Structure	Assessment
River Trent Bridleway	There would be expected to be minimal impact upon the bridleway that runs alongside the River Trent under the A46 as the viaduct would be widened on-line at this location.
B6166 Farndon Road	There is an opportunity, subject to funding, to improve the SUP on the B6166 Farndon Road between the A46 and town centre, which would be expected to improve the safety and convenience of this route for users. It is currently of a sub-standard width and provides a low-quality route primarily due to the numerous crossings. Such improvements would lie outside the immediate scope of this scheme.
Footpath Crossing of A46 south west of Cattle Market Junction (FP14) & Cattle Market Junction	<p>Provision of an at grade crossing on a dual carriageway would be considered inappropriate at this location.</p> <p>Option 1: The existing footpath between the A617 and the A46 will be stopped up, and a new route created utilising the stopped-up section of the A617 connecting into Cattle Market roundabout; crossing facilities will be installed or upgraded to allow pedestrians and cyclists to travel around the north and east sides of the junction. There is an opportunity to improve the existing signal-controlled Toucan crossing of the A46 at this location. This is a key link between Newark-on-Trent and the key employment site at British Sugar. The route alongside the A616 also continues to the north as far as South Muskham. Consideration of options to retain this important link across the A46 during construction will be required.</p> <p>Option 2: The existing footpath between the A617 and the A46 will be stopped up, with the footpath being diverted along the A617 to Cattle Market roundabout; crossing facilities will be installed or upgraded to allow pedestrians and cyclists to travel around the north and east sides of the junction. Pedestrians and cyclists would be separated from A46 traffic but would be required to cross slip roads and roundabout arms, depending upon their overall route at the junction. Traffic signal-controlled crossings could be included to help improve the safe use of these crossings.</p>
River Trent Bridleways and Footpath	There would be expected to be minimal impact upon the bridleways and footpath that pass under the A46 alongside the River Trent between Cattle Market Junction and Brownhills Roundabout as the existing A46 viaduct would be widened on-line at this location. The footpath that utilises an underpass further to the north close to a water treatment works would be expected to be retained and would pass through an extended underpass below the proposed dual carriageway.
Footpath between Winthorpe & Newark-on-Trent	The existing grade separated route under the A46 and A1 is of an adequate quality and provides an important link between Newark-on-Trent and the village of Winthorpe. A grade separated crossing is expected to be retained at this location and the scheme will have little impact on the quality of crossing at this point. The design will seek to minimise personal security issues (real and perceived) where the SUP passes through structures. Consideration of options to retain this important link during construction will be required.
Pedestrian route east of the A1	The existing footbridge parallel to the A1 which provides access from the A46 to the industrial park to the north of the A1 would be retained. There is opportunity, subject to funding, to improve the sharp right-angled turn that is required to access the bridge from the A46, to reduce the likelihood of collisions between users travelling in opposite directions around the corner.
Uncontrolled crossings of the A46 to the east of the A1	The use of existing uncontrolled pedestrian crossings of the A46 on the northern side of the A1 are considered to involve high risks with high vehicle speeds and poor visibility at the crossing points. Site

Structure	Assessment
	<p>assessments have indicated there is little or no demand for use of these crossing points. There is an opportunity to remove or divert these at grade crossings at this location and, if such facilities are warranted, designs with lower associated risks would be sought for inclusion.</p> <p>Option 1: The new structure for the link between Friendly Farmer Roundabout and the A46 eastbound provides an opportunity for a grade separated crossing of the A46.</p>
Brownhills Roundabout	<p>The two options are expected to have a notable impact on the existing shared pedestrian and cyclist facilities close to Brownhills Roundabout. However, there is an opportunity to provide improved pedestrian and cyclist facilities on Lincoln Road (B6166) and Winthorpe Road (providing onward links to Winthorpe and the industrial park to the north of the A1). Collision analysis showed that several cyclist collisions occurred on these links and therefore upgraded facilities are likely to be of significant benefit to users.</p>

4.6 Traffic Analysis and Economic Assessment

Base year model

- 4.6.1 The base transport model is the Enhanced A46 MRTM which has its foundation in the Highways England MRTM.
- 4.6.2 It is considered that the 2017 base year highway assignment model developed for the A46 Newark Bypass Options Identification analysis calibrates and validates to within acceptable margins of the Transport Analysis Guidance (TAG) criteria. It demonstrates a good representation of traffic behaviour in the study area and forms a robust basis from which future year forecasts and option testing can be developed.

Traffic Forecasting

- 4.6.3 Traffic forecasts have been prepared for the current estimated opening year for the scheme (2028), the scheme design year (2043), and the horizon year (2051) to support the economic appraisal of the two scheme options.
- 4.6.4 The forecasts have used the DfT's National Trip End Model (TEMPO v7.2) as well as planning data and highway scheme data collated from various local planning and highway authorities, covering the whole study area to form the forecast model's Uncertainty Logs. Uncertainty Logs for both the highway schemes and planning developments contain details regarding the likelihood of completion and assumed dates of implementation for each of the model forecast years, with local authorities asked to confirm final assumptions.
- 4.6.5 Traffic growth for LGVs and HGVs has been based on the 2018 Road Traffic Forecasts for the forecasting outputs. The traffic forecasts have been undertaken using a variable demand modelling approach.
- 4.6.6 Forecast models have been developed for the following:
- Three time periods – AM Peak Period, Inter-Peak Period and PM Peak Period.
 - Three forecast years – 2028, 2043 and 2051.
 - Three scenarios – Do Minimum, Do Something: Option 1 and Option 2

Forecast Results

- 4.6.7 The two options demonstrate a reduction in transient and overcapacity queued delays compared to the Do Minimum scenario in 2043, resulting in an increase in average speed across the Fully-Modelled Area (FMA).
- 4.6.8 Option 1 consistently has the highest transient and overcapacity queued delays of the two options in the 2043 forecast year. Option 1 provides less reduction in delays as all the scheme junctions are at grade whilst Cattle Market is grade separated in Option 2.
- 4.6.9 There is a slight increase in trips in the FMA in both options in the AM and PM peaks compared to the Do Minimum and there is also an increase in the total travel distance demonstrating that the average distance of trips is increasing due to the reduction in delays.

Journey Times

- 4.6.10 Comparisons of journey times have been carried out to identify the impact of the scheme options on delays on key routes. Journey times have been considered for five routes in both directions as listed below:
- Route 1: A46 from Southern Link Road to Winthorpe;
 - Route 2: A1 from Grantham to Wadworth Interchange;
 - Route 3: A617 from A38 to A46;
 - Route 4: A17 from A46 to A15; and
 - Route 5: A46 from A606 to A158.
- 4.6.11 The two options have significantly decreased the journey times along the A46 within Newark as well as improving journey times along other key routes in the FMA.
- 4.6.12 Option 1 has the least travel time savings of the options as three of the scheme junctions are still at grade resulting in delays at signals and give-ways. Option 2 has similar journey time savings for vehicles travelling through the scheme on the A46 as for Option 1 Farndon and Winthorpe are also at grade. However, there are higher journey time savings for vehicles on the surrounding road network crossing the A46 in all time periods due to the grade-separation of Cattle Market and the signalisation of the Farndon junction.

Traffic Flows

- 4.6.13 There are significant increases in traffic flow along the A46 between Farndon roundabout and Winthorpe roundabout for both options. These increases are seen in both directions and are due to the scheme improvements which provide extra capacity along the A46, in particular at the Cattle Market roundabout.
- 4.6.14 The highest increase in traffic flow on the A46 is predicted to occur between the Cattle Market roundabout and the A1. This section of the A46 would be upgraded from single carriageway to dual carriageway for both options.
- 4.6.15 The new section of the A46, joining Cattle Market with Winthorpe junction, allows through traffic to bypass the congested Friendly Farmer roundabout leading to a decrease in traffic along the existing section of the A46 to the east of the A1.

- 4.6.16 The freed capacity along this existing A46 section results in traffic re-routing from Beckingham Road and the A1 to the A17. Beckingham Road as a result experiences a decrease in daily flow across all options and in both directions of approximately 50%. The A17 in contrast has an increase in traffic flow of over 200% eastbound and 100% westbound.
- 4.6.17 For both options there is a reduction in traffic flow through central Newark and along the Newark Southern Link Road compared to the Do Minimum. This is to be expected given the increased capacity along the A46, as through-traffic will favour the A46 mainline over smaller roads through Newark or a longer route along the Southern Link Road.
- 4.6.18 In the wider area, it can be observed that there is an increase in traffic flow along the A46 between Nottingham and Lincoln as traffic re-routes from smaller roads, as well as the redistribution of trips as a variable demand response. The impact of the scheme on other roads in the wider area, however, is minimal with only small changes in traffic flow.

Economic Appraisal

- 4.6.19 The economic appraisal of the two options has followed the DfT's TAG and detailed methodology for quantifying potential impacts and monetising them. Table 4.10 identifies the approach adopted to appraise the economic impacts of the options.

Table 4.10: Overview of Economic Assessment Methodology

Element of Economic Appraisal	Assessment Method
Transport economic appraisal	Transport User Benefit Appraisal (TUBA) software (version 1.9.10) using parameters from the DfT's TAG Databook version 1.9.1 (December 2017)
Accidents	Cost and Benefit to Accidents – Light Touch (COBA-LT) software (version 2013.2) using economic parameters file version 2018.1
Journey time reliability	TAG Urban Roads method set out in TAG Unit A1.3
Delays during construction	Qualitative approach
Air quality	Approach set out in TAG Unit A3 Chapter 3
Noise impacts	Approach set out in TAG Unit A3 Chapter 2
GHG emissions	Approach set out in TAG Unit A3 Chapter 4
Dependent Development	Qualitative approach

- 4.6.20 The monetised economic impacts of the two options are summarised in the Analysis of Monetised Costs and Benefits table (Table 4.11), which includes results from the TUBA and COBA-LT software programs, as well as the assessments undertaken for journey time reliability, noise, air quality and greenhouse gases (GHGs). As per TAG, all costs and benefits are reported in 2010 prices, discounted to 2010.
- 4.6.21 Scheme capital costs have been estimated by the Highways England Commercial team. These include the results of a quantified risk assessment

(rather than Optimism Bias) and the effects of construction price inflation. The costs have been provided on a year by year basis as factor costs in 2010 prices.

Table 4.11: Analysis of monetised costs and benefits (£'000)

Appraisal Element	Option 1	Option 2
Economic Efficiency: Consumer Users: (Commuting)	39,759	53,414
Economic Efficiency: Consumer Users (Other)	51,879	67,823
Economic Efficiency: Business Users and Providers	139,979	176,155
Wider Public Finances (Indirect Taxation Revenues)	13,596	9,898
Accident Reduction Impacts	-4,300	-1,230
Air Quality Impacts	-13,037	-13,013
Noise Impacts	1,385	1,963
Greenhouse Gases Impacts	-39,604	-37,951
Present Value Benefits (PVB)	189,656	257,059
Broad Transport Budget Present Value Costs (PVC)	216,188	221,717
Initial BCR	0.88	1.16
Reliability Benefits	11,754	15,456
Adjusted BCR	0.93	1.23

- 4.6.22 The best performing option is Option 2, with core transport user benefits of £257M and an initial BCR of 1.16.
- 4.6.23 The economic benefits of both options are similarly distributed between business, commuting and 'other' journey purposes.
- 4.6.24 Approximately 60% of benefits are derived by business users, who have the highest value of time. Approximately 17% and 23% of benefits are apportioned to commuter and 'other' trips, respectively. Although commuter trips have a higher value of time than 'other' trips, there is a significantly higher volume of 'other' trips, resulting in the higher level of benefits.
- 4.6.25 Across both options, the indirect tax impacts are positive and are realised as taxation revenues to the public sector ranging from £9.9M for Option 2 to £13.6M for Option 1.
- 4.6.26 The two options have accident benefits on the A46 between Farndon and the Cattle Market Roundabout, as well as at the two junctions themselves. All options also have accident benefits at the A1/A46 junction and along the A1 itself. This is due to dualling of the A46 between Farndon and the A1 and alterations at the scheme junctions as part of each option, making these links statistically safer to travel on. The biggest accident disbenefits are seen outside the extents of the scheme on the A46 east of Winthorpe, the A17 and on the A617 / A616 north of the Cattle Market roundabout. This is due to the increases in flows on these links as traffic re-routes due to the additional capacity provided by the scheme.
- 4.6.27 Option 1 has accident disbenefits overall as both the Cattle Market roundabout and the Winthorpe roundabouts are retained as at grade junctions. The Cattle Market roundabout has been upgraded to a signalised hamburger roundabout,

whilst the Winthorpe roundabout has had an increase in capacity by altering its alignment. At grade junctions here lead to less traffic being attracted onto the A46 and other strategic roads for Option 1. The A46 has a lower accident rate than the surrounding local roads, meaning that because less traffic is being attracted away from the local roads, the accident benefit in the local area is less for Option 1 than Option 2. This results in slight accident disbenefits overall as the disbenefits outside the scheme extents discussed above are not offset by the benefits within the scheme extents. The disbenefit for Option 1 is greater than Option 2 because it has a lower capacity, particularly at the Cattle Market and Farndon, meaning less traffic is being attracted from the local roads which have higher accident rates.

- 4.6.28 It should be noted that the scheme itself is safer in all options than the existing arrangement as discussed in the Safety Assessment in Section 4.4.
- 4.6.29 In terms of environmental impacts, the results reflect the differences in highway layouts proposed, proximity of the scheme options to air quality and noise receptors, and differences in congestion and vehicle-kilometres arising from traffic re-routing. Both options achieved slight noise impact benefits, but had significant disbenefits for impact to air quality. Both options also cause significant GHGs disbenefits, ranging from a disbenefit of £38M (Option 2) to £40M (Option 1).
- 4.6.30 The economic appraisal concludes that Option 1, with an overall PVB of £189.7M, delivers the lowest benefits, including the lowest journey time savings between the options. However, Option 1 is the lower cost option, which gives an adjusted BCR of 0.93.
- 4.6.31 Option 2 has higher journey time savings than Option 1 and also has lower GHG disbenefits, giving a similar overall PVB of £257.0M, with slight accident disbenefits. Option 2 is the higher cost option which gives an adjusted BCR of 1.23.
- 4.6.32 Sensitivity tests have been undertaken:
- to assess the impact of a low traffic growth scenario on the benefits of Option 2. This concluded that the low traffic growth scenario would result in a reduction in BCR from 1.23 to 0.84, a reduction of 32%.
 - to assess the impact of a low traffic growth scenario on the benefits of Option 2 with a high carbon cost for greenhouse gas emissions. This concluded that the high cost for carbon would result in a further reduction in BCR for the low growth scenario from 0.84 to 0.77, a reduction of 8%; and
 - to determine the impact on the benefits of using a high carbon cost for greenhouse gas emissions for both options. This concluded that due to the higher greenhouse gas disbenefits, the adjusted BCRs for both options reduce compared to the Core scenario by approximately 8 to 12%.

4.7 Environmental Assessment

- 4.7.1 The scheme options will potentially impact on a large study area and have the potential to result in significant effects on environmental topics. The potential effect of the scheme options has been assessed as part of the previous Option Identification Stage on the following topics: Air Quality; Cultural Heritage; Landscape and Visual Effects; Biodiversity; Geology and Soils; Materials Assets

and Waste; Noise and Vibration; Population and Human Health; Road Drainage and the Water Environment; Climate Effects and Vulnerability; and Cumulative Effects. This assessment of the scheme options and scope for mitigation is summarised below.

Air Quality

- 4.7.2 The scheme options have the potential to affect local air quality pollutant concentrations at sensitive receptors, both during construction and operation.
- 4.7.3 During construction, while there is the potential for increased emissions of dust, with the application of appropriate mitigation, significant effects at nearby receptors would be unlikely. Additional traffic during construction would be expected to be less than that of operation and would be temporary and is considered unlikely to affect air quality.
- 4.7.4 For local air quality, monitoring data indicates that there are currently no exceedances of AQ strategy objectives for NO₂ or PM₁₀ either adjacent to the scheme options or within the wider air quality study area. There are no AQMA or PCM non-compliance links within the air quality study area.
- 4.7.5 For the operational phase, a detailed local air quality assessment has been undertaken to estimate NO₂ for the opening year, at selected human health receptors, as well as estimating nitrogen deposition rates at ecological receptors.
- 4.7.6 PM₁₀ concentrations were estimated for the base year and shown to be below AQ strategy objectives. As such, no opening year assessment is therefore required under current guidance.
- 4.7.7 During operation, there are not expected to be any exceedances of the NO₂ UK AQ strategy objectives in the opening year, either with or without the scheme options. The scheme options are therefore not expected to have a significant effect on local air quality.
- 4.7.8 The maximum increase in local air quality is predicted to be 1.9 µg/m³ under Option 2, adjacent to the B6326 Great North Road, north of the junction with the B6166 Castle Gate/Bar Gate. The maximum decrease is predicted to be 3.9 µg/m³ also under Option 2, within the A1/A46 Junction. Neither location exceeds the AQ strategy objective, with or without Options 1 or 2.
- 4.7.9 The change in nitrogen deposition rates for both scheme options is expected to be less than the latest habitat assessment screening criteria (total nitrogen deposition greater than the relevant critical load and the change in nitrogen deposition greater than 1% of the relevant critical load and greater than 0.4 kg N/ha/yr) at all relevant statutory designated sites (one SSSI and one LNR) and the majority of the non-statutory designated sites.
- 4.7.10 Seven non-statutory LWS are expected to exceed the relevant nitrogen deposition critical load and have a change in nitrogen deposition greater than 1% of the relevant critical load or 0.4 kg N/ha/yr under Options 1 and 2 (three for Option 1 and six for Option 2):
- Option 1 and 2:
 - Newark (Beet Factory) Dismantled Railway LWS.
 - Dairy Farm Railway Strip, Newark LWS.
 - Option 1 only:

- Newark Grassland LWS.
- Valley Farm Grassland LWS.
- Kelham Road Grassland II LWS.
- Great North Road Grasslands LWS.
- Option 2 only:
 - Trent Banks/Wharves, Newark LWS.

- 4.7.11 Detailed site investigation will be required to determine whether there are species that could be adversely affected by increased nitrogen deposition within these sites. Following the precautionary principle at this stage, there is therefore the potential for significant adverse effects on 'designated habitats' within the seven LWSs.
- 4.7.12 Compliance with the EU Air Quality Directive has been considered. There are no Defra PCM links within the study area. The nearest PCM link is the A1434 at Lincoln, which is 1.4 km to the north-east and does not exceed the EU limit value of 40 µg/m³ for annual mean NO₂ concentrations. Consequently, all scheme options are not a risk to non-compliance with the EU Air Quality Directive.
- 4.7.13 Mitigation measures to control dust during construction would be specified within contract documentation and incorporated into a Construction Environmental Management Plan (CEMP). The precise measures would depend on the intended construction methods and the degree of dust generation at each site, but could include:
- Regular water-spraying and sweeping of unpaved and paved roads to minimise dust and remove mud and debris.
 - Ensuring any temporary site roads are no wider than necessary to minimise their surface area.
- 4.7.14 For the operational phase there would not be expected to be any likely significant adverse effects on human health receptors for either option, therefore, no mitigation is proposed.

Historic Environment

- 4.7.15 The types of impacts that can occur as a result of the scheme options include:
- Physical impacts, such as partial destruction or total loss of a heritage asset.
 - Settings impacts, such as non-physical changes to the character and significance of assets arising from works such as alteration of lines of sights, severance between associated buildings or landscapes, removal of screening, air and noise pollution.
- 4.7.16 The construction of either of the scheme options would result in adverse physical impacts on one Grade II Listed Building related to causeway structures along the Great North Road (1297727) and two Conservation Areas: Newark and Winthorpe. Both options are likely to adversely impact the Grade II listed Causeway Culvert 420 m north west of the level crossing (1297727), but Option 1 is likely also to impact the Grade II causeway arches 500 m and 650 m from the level crossing (1228733 and 1196289, respectively). A full understanding of the condition and significance of the Grade II listed arches and culverts associated with the Great North Road is necessary to understand the extent of

impacts all scheme options would have on these assets and to inform design and mitigation measures.

- 4.7.17 While Option 1 would not extend into the boundaries of the Scheduled Monument, remains of schedulable quality may be encountered in the vicinity of the moated site 750 m north west of Dairy Farm (1016051).
- 4.7.18 Significant effects resulting from adverse impacts on setting may also occur due to alterations in the landscape character around the heritage assets. This is due to the proximity of the scheme options to numerous designated heritage assets, including Scheduled Monuments and Grade I and II* Listed Buildings.
- 4.7.19 The construction of either scheme options may also result in permanent adverse effects on non-designated archaeological remains dating from the prehistoric to modern periods. There is potential for schedulable quality remains in the vicinity of Farndon Roundabout where Palaeolithic sites of international importance have been identified.
- 4.7.20 The construction and operation of the Flood Compensation Areas (FCAs) for either scheme option has the potential to result in temporary or permanent adverse impacts on both designated and non-designated heritage assets, and the historic landscape.
- 4.7.21 Measures to mitigate impacts on cultural heritage resulting from the scheme options will be considered through the design development of the highway layout, in combination with appropriate screening to assist in the reduction of visual and noise impacts. In particular, these should be considered in relation to the Scheduled Monuments and Grade II* listed buildings identified.
- 4.7.22 Where direct physical impacts cannot be avoided, consultation with statutory stakeholders and designers to enable appropriate mitigation or recording through archaeological investigation and excavation would be required.
- 4.7.23 Discovered areas of buried archaeological remains that would be affected by the construction of the preferred scheme option should be managed through an agreed research strategy of compensation.

Landscape and Visual

- 4.7.24 As a direct result of the overall land take, and noticeable views of construction activities and the loss of physical landscape resource elements, both scheme options would result on both temporary and permanent significant adverse effects during construction.
- 4.7.25 During operation, a number of residual adverse landscape and visual effects are likely to be significant for either scheme options. Both scheme options would result in residual adverse effects on landscape pattern, tranquillity, the cultural landscape and landcover, and visual receptors to the north of Newark and south-east of Winthorpe where new and elevated sections of road are proposed and the adverse impact on scale, appearance and visual amenity.
- 4.7.26 It is noted that there is considerable scope to mitigate localised impacts during future design development, with Option 1 providing the greatest opportunity to integrate the scheme options within the landscape and mitigate views.

Biodiversity

4.7.27 At this stage of the biodiversity assessment, only a desk-based data-gathering exercise and a preliminary walkover has been undertaken. Therefore, it is not possible to fully assess the potential likely significant effects of the scheme on ecological features as no detailed field surveys have yet been undertaken. It is noted that detailed site investigations will be required as part of future stages to determine whether there are LWSs that could be adversely affected by increased nitrogen deposition.

Statutory Designated Sites

4.7.28 The local air quality assessment concluded that there are no likely significant effects associated with nitrogen deposition during operation with both options at either Twenty Acre Piece SSSI or Devon Park Pastures LNR.

Non-Statutory Designated Sites

4.7.29 Habitat loss and fragmentation, and/or changes to hydrology and water quality, associated with construction of both scheme options could potentially affect the following LWSs:

- Old Trent Dyke LWS.
- Dairy Farm Railway Strip, Newark LWS.
- Great North Road Grasslands LWS.
- Trent Banks/Wharves, Newark LWS.
- Newark (Beet Factory) Dismantled Railway LWS.
- Newark Trent Grassland LWS.

4.7.30 Whereas Habitat loss and fragmentation, and/or changes to hydrology and water quality, associated with construction of Option 1 could potentially affect the following LWSs:

- Kelham Road Grassland II LWS.
- Newark Grassland LWS.
- Valley Farm Grassland LWS.
- Kelham Road Redoubt Grassland LWS.

4.7.31 Increases in nitrogen deposition associated with operation of both scheme options could lead to significant adverse effects at the following LWSs:

- Newark (Beet Factory) Dismantled Railway LWS.
- Dairy Farm Railway Strip, Newark LWS.

4.7.32 Increases in nitrogen deposition associated with operation of the scheme could lead to significant adverse effects for Option 1 at the following LWSs:

- Newark Grassland LWS.
- Valley Farm Grassland LWS.
- Kelham Road Grassland LWS.
- Great North Road Grasslands LWS.

4.7.33 Increases in nitrogen deposition associated with operation of the scheme could lead to significant adverse effects for Option 2 at the following LWSs:

- Trent Banks/Wharves, Newark LWS.
- Flintham Park LWS.

4.7.34 The air quality assessment concluded that there are no likely significant effects associated with nitrogen deposition during operation at the majority of the non-statutory designated sites (39 LWS and one veteran tree) assessed for both options. There are 7 LWS sites where the significance of effect of the change in nitrogen deposition cannot be fully evaluated at this stage. These sites will be further assessed following site evaluation by the project expert for biodiversity.

Priority Habitats and Ancient Woodland

4.7.35 Habitat loss and fragmentation, and/or changes to hydrology and water quality, associated with construction of all scheme options could potentially affect lowland mixed deciduous woodland, lowland fen, and coastal and floodplain grazing marsh.

4.7.36 Habitat loss and fragmentation associated with construction of Option 1 could potentially affect lowland meadow.

4.7.37 Habitat loss and fragmentation associated with construction of Option 2 could potentially affect wood-pasture and parkland associated with Winthorpe House.

Aquatic Habitats and Species

4.7.38 A review of OS maps and aerial photographic imagery identified two Main Rivers, four Ordinary Watercourses and 15 standing waterbodies within 150 m of the scheme options.

4.7.39 Two of the rivers located within the Study Area for aquatic features are Water Framework Directive (WFD) assessed river waterbodies. These are the River Trent and the Slough Dyke. Both are currently at Moderate Overall potential and both classified as Heavily Modified Waterbodies (HMWB). Environment Agency monitoring indicates that the River Trent supports a diverse fish population with 13 species recorded between 2014 and 2016, including small numbers of the priority species European eel and bullhead.

4.7.40 During construction, there is the potential for both of the scheme options to result in losses of in-channel and riparian habitat as well as disturbance to associated species. Both options include proposed works at Cattle Market Roundabout which will result in a minor loss of open watercourse along the Old Trent Dyke as a result of the earthworks footprint. Both options will also result in a new crossing of the Slough Dyke. No direct loss of the open channel is expected; however, the proposed structure may result in shading effects limiting growth of aquatic vegetation. No works to the existing A46 or A1 crossing of the Slough Dyke are anticipated to arise from the scheme.

4.7.41 Option 1 would result in the direct loss of the standing waterbody at OS GR SK7930454893. Both Option 1 and 2 will result in the direct loss of a waterbody at OS GR SK8041155996. Only minor impacts associated with increased shading (habitat degradation) due to the widening of an existing A46 crossing, associated with both options, are expected to occur at the standing waterbody at OS NGR: SK 78519 53936.

Other Habitats

- 4.7.42 Both scheme options will result in the loss and fragmentation of habitat, including the loss of arable farmland, hedgerow and woodland.

Legally Protected and Priority Species

- 4.7.43 Both scheme options may result in the following potential impacts subject to the option chosen and the presence of legally protected and priority species:

- Changes to noise levels affecting species that are vulnerable to noise disturbance, e.g. birds;
- Loss and damage of habitat supporting legally protected and priority species;
- Indirect impacts that may affect legally protected and priority species, for example changes to water quality that may affect prey abundance;
- Direct mortality or injury to legally protected and priority species through construction activities and through road traffic collision during operation; and
- Disturbance to legally protected and priority species from noise, light or other visual stimuli.

Invasive Non-Native species

- 4.7.44 Both scheme options may result in spread of invasive non-native species, e.g. Himalayan balsam, Japanese knotweed and signal crayfish (and crayfish plague).

Summary

- 4.7.45 In the absence of field surveys and detailed construction design at this stage, and the uncertainty of how the effects of habitat loss and fragmentation will be addressed, the precautionary principle has been applied when determining the magnitude of impacts. It is considered that Option 1 and 2 could therefore result in significant adverse effects.
- 4.7.46 Without confirmation of an environmentally sensitive bridge design and security of compensation for habitat loss, both scheme options could have significant adverse effects on biodiversity. This is due to a likely significant adverse effect on the River Trent, which is a key environmental resource of high value. The River Trent and its floodplain is the greatest biodiversity resource within the Trent and Belvoir Vales National Character Area. In addition, both scheme options could result in significant effects on key environmental resources of medium value, e.g. LWSs, priority habitats and species, watercourses and waterbodies and arable farmland and hedgerow. The number of significant effects could result in a cumulative significant adverse effect, particularly on the suite of LWSs supporting grassland habitat centred on the Cattle Market Roundabout.

Geology and Soils

- 4.7.47 The effects on geology have been scoped out due to the absence of any designated or non-designated geological sites.
- 4.7.48 During construction, the scheme options are expected to have a significant adverse effect on agricultural soils. This is due to loss of soil quality, the size and extent of the scheme, and the associated Flood Compensation Areas (FCAs),

which could have the potential to reduce the quality of the agricultural soils. Loss of BMV land on its own is 8 ha under Option 1 and 9 ha under Option 2. Therefore, Option 1 is expected to have least damaging effect on agriculture.

- 4.7.49 It is noted that the above land-take figures do not take into account the creation of FCAs at Averham and the Devon River catchment. These would result in the reduction of quality, but not loss, of agricultural land (BMV land) over an area of up to 50 ha in addition to the loss of between 8-10 ha for the road itself. Any further land take for the FCAs will likely increase the effects on agricultural soils.
- 4.7.50 There are not expected to be any additional impacts during the operational phase, as any land that is temporarily acquired during construction will be returned to the owner in a condition equivalent to its original state. The overall effect of the options on agricultural soils during operation would not be significant.
- 4.7.51 During construction and operation, the risk of the scheme options having an adverse impact on land contamination, controlled waters, human, property and ecological receptors is not expected to be significant.
- 4.7.52 Design, mitigation and enhancement measures will be identified for the adverse impacts identified for both the construction and operational phases. Where significant effects are identified in the assessment, mitigation that will potentially be considered within the design includes, but will not be limited to, changes to the vertical alignment, alternative foundation options, development of piling risk assessments, earthworks and materials management or use of lined drainage. Other post-design mitigation measures will include the development and use of appropriate Risk Assessment, Method Statements and a CEMP, and adherence to good site working practices, in accordance with relevant legalisation and guidance.

Materials Assets and Waste

- 4.7.53 The use of material assets and the generation of waste would likely be the two main impacts resulting from construction-related activities for both the scheme options.
- 4.7.54 It has been determined that the effects of the scheme options on material assets use and construction waste generation would be significant.
- 4.7.55 Option 1 and Option 2 would have similar impacts on waste infrastructure and material asset use. Minimal impact is envisaged during the operational stage of the scheme options, due to limited material asset use and waste generation which may arise from maintenance works.
- 4.7.56 The design of the preferred scheme option will ensure that material use and wastage is minimised throughout its lifecycle.

Noise

- 4.7.57 The noise assessment demonstrates that for both scheme options, significant noise impacts are predicted at a number of noise sensitive receptors identified within the study area.
- 4.7.58 The results from the assessment indicate that for both scheme options, the potential changes in noise at three of the seven NIAs within 1 km of the scheme options, are over 1 dB and are therefore considered significant. These are NIA 7839 in Newark-on-Trent plus NIA 7846 and NIA 7847 in Farndon.

- 4.7.59 The assessment of the likely effects of the construction phase will be established at the Preliminary Design Stage, once construction methodologies, plant and schedules, and proposed hours of operation, are available to inform the assessment.
- 4.7.60 The main construction activities that are likely to take place are site preparation, demolition, earthworks, retaining wall construction and road works. All activities have the potential to cause some disturbance at nearby sensitive receptors.
- 4.7.61 Construction is also likely to result in an increase in HGVs to the area travelling to and from site. Estimated traffic and vehicle movements are not yet known and therefore a construction traffic noise impact assessment has yet to be carried out.
- 4.7.62 It has been established that 10,863 residential receptors are within the study area and therefore identified as sensitive receptors. In addition, there are 162 non-residential properties within this study area that have been identified as sensitive noise receptors, including community areas, churches and schools.
- 4.7.63 Option 1 in the opening year, has a potential significant adverse change in noise, in the short term, on 12 properties. With 53 properties, in the future year, expected to experience significant adverse change in noise in the long term.
- 4.7.64 Option 2 in the opening year, has a potential significant adverse change in noise, in the short term, at 19 properties. With 56 properties, in the future year, expected to experience significant adverse change in noise in the long term.
- 4.7.65 However, within the town centre, the noise levels at properties that are very close to roads can exceed the significant observed adverse effect level. Small differences in traffic, between the different options, can lead to changes in noise levels that exceed 1dB in some scenarios, but are just below 1dB in others. In reality, these differences in noise are not significant between the scheme options.
- 4.7.66 To mitigate potential noise impacts during construction, Contractors would be required to ensure they are adhering to good working practices such as using 'sound reduced' equipment that is well maintained, switched off when not in use as well as careful loading/unloading of equipment and materials that are handled with care and not dropped from height creating unnecessary noise.
- 4.7.67 Even with appropriate mitigation in place, it may not be possible to eliminate all noise impacts. However, best practice, considerate working hours as well as frequent and open communications with stakeholders will help to reduce the residual impact of construction noise.
- 4.7.68 For all scenarios, low noise surfacing was taken into account in the noise predictions. Further noise mitigation, such as environmental noise barriers or bunds, will be investigated in more detail as part of the design development.

Population and Human Health

- 4.7.69 Refer to Section 4.5 for impact of the scheme on walking, cycling and horse-riding.
- 4.7.70 Option 2 would have greater adverse effects on private dwellings than Option 1 as there may be the requirement to acquire two residential properties to accommodate the new A46 towards Winthorpe Junction.

- 4.7.71 In Option 2 there would be no requirement to realign the A617 approach to Cattle Market Junction and consequently this option would avoid the significant adverse effect of land take at Newark Rugby Club that would be required for Option 1.
- 4.7.72 Both scheme options have the potential to result in adverse effects on local businesses. Option 1 involves the permanent severance of one entry and the only exit from the service area east of the Friendly Farmer Roundabout whilst for both options the proposed works at Winthorpe Roundabout would amend access to the Showground, the golf centre, indoor bowls centre, driver training centre and the karting centre. However, it is considered that Option 1 has greater adverse effects than Option 2 due to the permanent loss of the Mint Leaf restaurant and petrol filling station to the north of the Friendly Farmer Roundabout.
- 4.7.73 Effects on agricultural holdings are only assessed during construction and for the first year of operation. As a result, the effect of both options on agricultural holdings is not significant.
- 4.7.74 There is little to distinguish between the scheme options in terms of which has the greatest adverse impacts on population and human health. On balance, Option 2 would have a smaller adverse effect than Option 1.

Road Drainage and Water Environment

- 4.7.75 During construction, both scheme options have a similar number of potential watercourse crossings or modifications of existing crossings and potential watercourse loss. However, the extents of the culvert extensions and widening requirements on bridge crossings would be slightly smaller for Option 2. Option 2 would also involve more grade separated junctions than Option 1 so there would be a potentially higher overall risk to the water environment during construction. This is because the grade separated junctions would require deep foundations which could potentially impact groundwater flow and quality.
- 4.7.76 Both scheme options have the potential for adverse significant effects on the water environment from road construction activities, although the likely water quality and flood risk impacts would be typically temporary, and these effects would be expected to be mitigated through the adoption of best practice engineering measures.
- 4.7.77 Where a loss of a watercourse is proposed, the realignment of the watercourse could mitigate for this. Surveys of the watercourse would be undertaken prior to construction to establish the quality of the watercourse being lost and inform mitigation proposals. Applying this mitigation would reduce the significance of effect on the surface watercourses, groundwater aquifers and floodplains to insignificant resulting in a neutral overall assessment of effects. However, the level of mitigation required to reduce the significance of effect to insignificant would vary between the Options, with Option 1 requiring more mitigation than Option 2.
- 4.7.78 During operation, both scheme options would have an overall significant adverse effect on the water environment without the provision of flood compensatory storage to mitigate the effect of both scheme options Flood Zones 2 and 3. A high-level flood risk compensatory storage study was undertaken, and this study indicated the volumes of compensation required at each Option. Option 1 would require a higher volume of compensatory storage than Option 2.

- 4.7.79 Both scheme options have a similar increase in impermeable road area, however, Option 2 would have the least impact on the water environment and therefore water quality during operation as it does not include the link between the A616 and A617 at the Cattle Market roundabout. The Option 1 link between the A616 and A617 would also result in slightly more floodplain storage compensation being required.
- 4.7.80 For both scheme options, the potential impacts on water quality caused by highway drainage entering watercourses or groundwater could be mitigated through Sustainable Urban Drainage Systems (SuDS) pollution control measures. These solutions, particularly in relation to SuDS that attenuate runoff volumes, would also mitigate an increase surface water flood risk or fluvial flood risk associated with more water entering a watercourse.
- 4.7.81 Applying this water quality mitigation and flood risk compensatory storage mitigation would reduce the potential significance of effect on the surface watercourse, groundwater aquifer and floodplains to insignificant. Option 1 would require the most mitigation, and Option 2 would require the least mitigation.

Climate Effects

- 4.7.82 The scheme has the potential to affect the earth's climate by the emission of GHGs into the atmosphere, which would occur during construction and throughout its operational life. Irrespective of the scheme option selected, the scheme would lead to a negative effect on climate through the generation of GHG emissions.
- 4.7.83 The construction of either of the scheme options would give rise to emissions from the production of materials to be used in construction, their transportation to site, and onsite through construction activities (for example from emissions from diesel-fuelled construction plant). The operation stage of both options would give rise to emissions from road users and operational energy use (for example street lighting). GHG emissions (tCO_{2e}) show an increase in the opening year of between 9,000t and 12,830t, and an increase over the sixty-year assessment period of between 879kt and 1,013kt.
- 4.7.84 In the construction phase, Options 1 and 2 are likely to lead to similar emissions. Operational phase emissions are anticipated to be lower for Option 2. Over the lifetime of the scheme, operational emissions are likely to far exceed construction emissions, and it is therefore considered that Option 2 is the preferable scheme option in terms of the scheme's effects on climate.
- 4.7.85 The NPS NN states that this type of scheme is unlikely to produce a significant effect in comparison to UK total emissions, however it is recommended that design and mitigation measures are put in place to reduce emissions in line with national and Highways England policy. At a scheme level, emissions are strategically mitigated by applying Highways England's carbon reduction hierarchy:
- Avoid/prevent
 - Maximise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required.
 - Explore alternative lower carbon options to deliver the project objectives (i.e. shorter scheme options with smaller construction footprints).

- Reduce
 - Apply low carbon solutions (including technologies, materials and products) to minimise resource consumption during the construction, operation, user's use of the project, and at end-of-life.
 - Construct efficiently, using techniques (e.g. during construction and operation) that reduce resource consumption over the life cycle of the project.
- Remediate
 - Identify, assess and integrate measures to further reduce carbon through on or off-site offsetting or sequestration.

Climate Vulnerability

- 4.7.86 The assessment of the vulnerability of the scheme to climate change showed that climate in the study area is projected to change in the future and that both options would be vulnerable to the impacts of this change during their construction and operation. However, the assessment of each option found that none of these vulnerabilities were significant, as embedded mitigation is expected to sufficiently adapt the design and operational processes to remove or sufficiently reduce all potential adverse climate vulnerability impacts to acceptable levels. In several instances, impacts would be beneficial as the scheme replaces and upgrades older infrastructure that would be less resilient to the projected future climate.

Cumulative Effects

- 4.7.87 Further investigation into other committed developments (relating to Development Plan Site Allocations and Planning Application Permissions) is required before potential cumulative effects in conjunction with the scheme options, either during construction or operation, may reasonably be identified.
- 4.7.88 The nature of cumulative effects will be dependent on the nature, scale, and location of other committed developments. The types of cumulative effects that could occur may relate to amenity effects from other development in close proximity to the scheme options, and traffic effects from other projects located further from the scheme options.

4.8 Social Assessment

- 4.8.1 Social impacts use qualitative and quantitative appraisals to cover the impact on the human experience of the transport system and its impact on social factors, not considered in the economic and environmental assessments.
- 4.8.2 In terms of the accident and physical activity assessments, reported in sections 4.6 and 4.5 respectively, Option 1 effects are likely to be very similar to Option 2.
- 4.8.3 Similarly, Option 2 effects are likely to be similar to Option 1 with respect to security, severance, journey quality, personal affordability and accessibility.
- 4.8.4 As neither option includes any significant public transportation changes, option and non-use values have not been assessed further.
- 4.8.5 A full assessment in accordance with latest standards will be conducted in later stages of the scheme's development.

4.9 Operational and Maintenance Assessment

- 4.9.1 Both of the proposed options would introduce a higher standard of road and would therefore be expected to significantly improve the operation of the road network by:
- Reducing injury and non-injury collisions.
 - Minimising delays and maintaining traffic flows, particularly on the A46 through route.
 - Providing improved current information to road users.
 - Providing community enhancements, including reduced severance for pedestrians and cyclists where existing severance occurs.
- 4.9.2 Replacement of the at grade roundabout at Cattle Market Junction in Option 2 with a grade separated layout will benefit through traffic due to easy movement through the junction but also benefit local traffic, which would be separated out. The improvements at the other junctions in both options would be expected to provide significant operational benefits relative to the existing junction layouts.
- 4.9.3 The design speed and posted speed limit strategy will be the same for both options. Notably, a reduced speed limit would be considered for the section between Cattle Market Junction and A1/A46 Junction due to the below desirable minimum highway geometry.
- 4.9.4 The existing level of use of the A46 dual carriageway by pedestrians, cyclists and equestrians is extremely low. It is assumed that the usage will remain at a similar level after scheme opening.
- 4.9.5 Operation of the A46 would be overseen by the Regional Control Centre (RCC) as is the case at present.
- 4.9.6 Both options are expected to have a net positive impact on driver compliance compared with the existing arrangement due to the replacement of the existing at grade A1 / A46 Junction with partial grade separation.
- 4.9.7 The operation of the junctions in both would be expected to reduce frustration from delays. Like other sections of dual carriageways, a higher standard carriageway on the links between junctions may lead to reduced driver compliance during free-flow periods, which would require appropriate mitigation measures to be identified during design development.
- 4.9.8 Both options would introduce new maintainable assets requiring limited maintenance and repair, in the short to medium term, due to the design life of those assets.
- 4.9.9 Both options can be developed to provide safe and economic operation and maintenance, and with consideration of eliminating the need for future maintenance activities that would impose risks upon those that work on the highway.
- 4.9.10 Where the asset is deemed to be required and in accordance with GD 304, civil engineering design principles will be considered where practicable to:
- Reduce effort when maintaining.
 - Reduce the proximity of maintainers to hazards.

- Improve access.
- Improve management systems.
- Provide safe and convenient diversion options, where possible.
- Provide identifiers.
- Consider anti-theft/vandalism measures.

4.9.11 Technology assets within the scheme will be integrated into the Highways England traffic management system to be controlled from the RCC. This will enable the appointed maintenance organisation to remotely access technology equipment, in coordination with the RCC, to minimise physical maintenance required on the new section of dual carriageway. It should be noted that the levels of technology included in the scheme is currently expected to be low.

5. Discounted Options

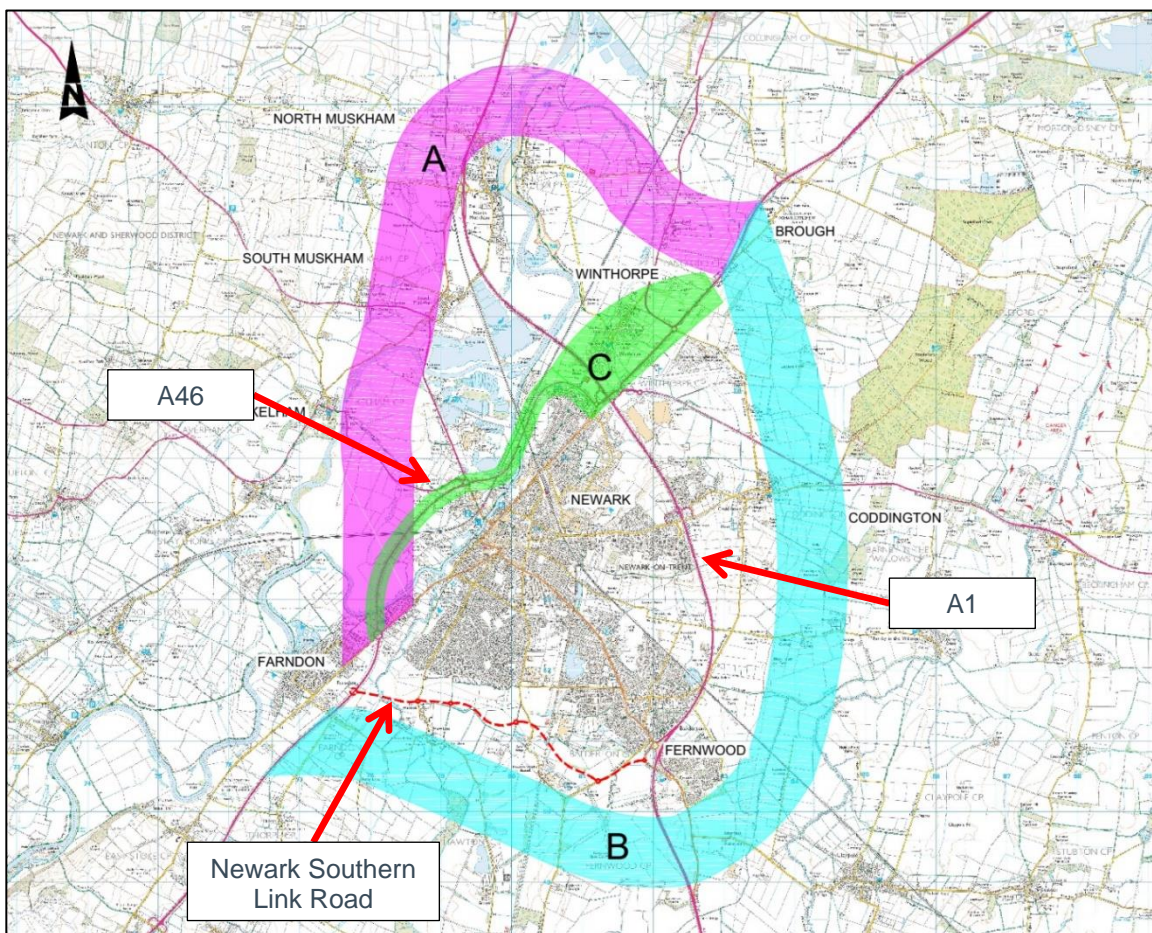
5.1.1 The two options outlined in Chapter 4 have been shortlisted following a thorough option identification and assessment process. This chapter summarises the options identified through this process and the reasons for discounting them.

5.2 Corridors

5.2.1 Three corridors (Corridors A to C) were identified during 'Strategy, shaping and prioritisation' stage and two more corridors (Corridors D and E) were identified in 'Options Identification'.

5.2.2 These corridors (as shown in figures 5.1 and 5.2) were considered and assessed against the Client Scheme Requirements, National Policy Statement for National Networks (NPSNN) and DfT's Early Assessment and Sifting Tool (EAST).

Figure 5.1: Route Corridors A to C

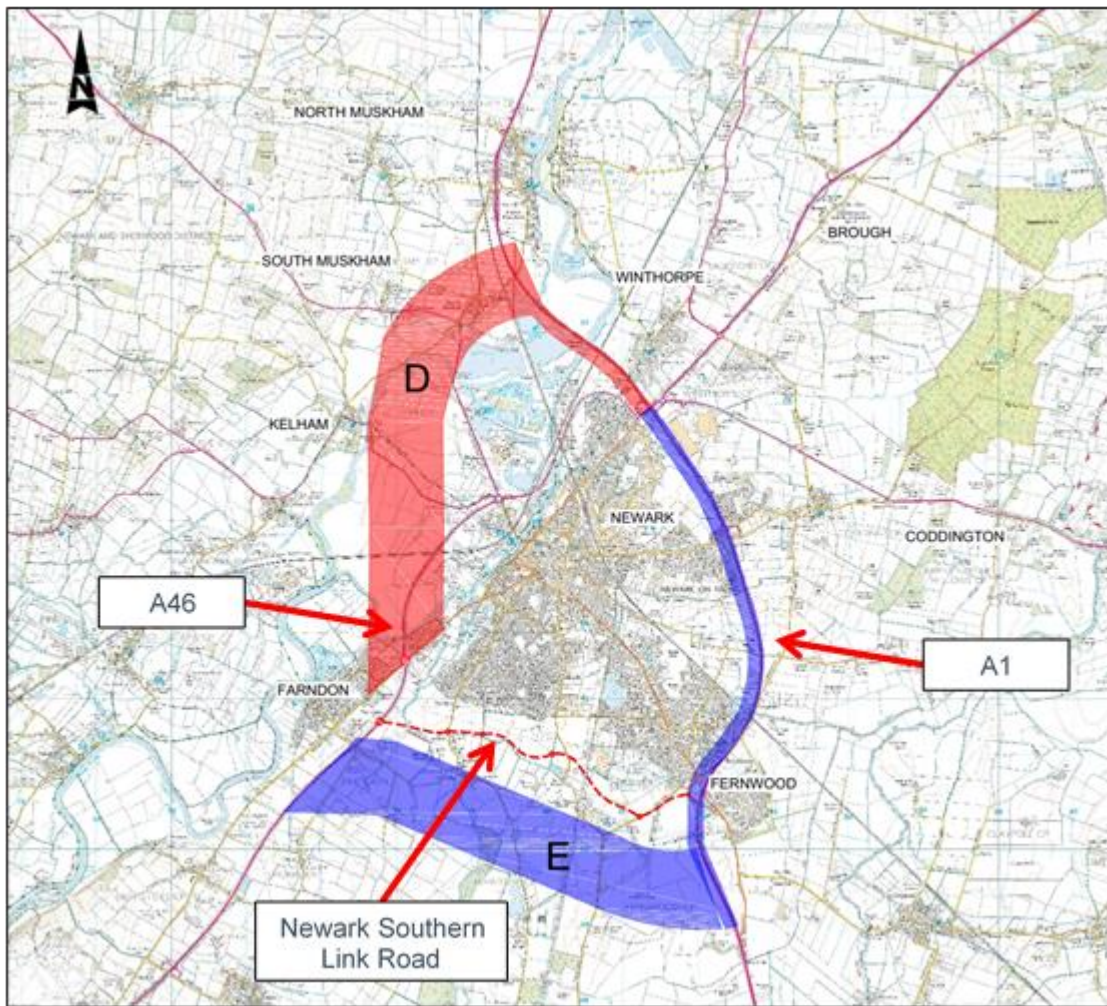


5.2.3 **Corridor A** was developed to avoid the flood zone to the north and north-west of Newark-on-Trent and minimise the impacts on local towns and villages.

5.2.4 **Corridor B** was developed to minimise the effects on Newark-on-Trent and the surrounding villages. It should be noted that this corridor, and corridor E, would not use or widen the partially constructed Newark Southern Link road, as the geometry and frequent junctions required for access to the various developments would not be suitable for strategic through-traffic.

5.2.5 **Corridor C** largely follows the existing A46 corridor, with improvements proposed to the existing A46 mainline and junctions.

Figure 5.2: Route Corridors D & E



5.2.6 **Corridor D** follows a similar route to Corridor A from Farndon, but, connects with the A1 near South Muskham. Connectivity back to the A46 northbound would be provided along the A1, which may need to be widened, and the A1/A46 junction near Winthorpe would need to be improved.

Corridor E follows a similar route to Corridor B from Farndon, but, connects with the A1 near Fernwood. Connectivity back to the A46 northbound would be provided along the A1, which may need to be widened, and the A1/A46 junction near Winthorpe would need to be improved.

Corridor Assessment and Sifting

5.2.7 Corridor C, which uses the existing A46 corridor, was the best performing corridor in terms of user benefits, providing the greatest reductions in journey times, delays and incidents, and improvement in reliability.

5.2.8 The user benefits would be lower for corridors A, B, D and E. With a longer corridor there are less journey time savings and the lower level of diversion from the existing A46 corridor would mean it is unlikely to resolve the capacity issues on the A46 at Cattle Market roundabout, Friendly Farmers roundabout, Brownhills roundabout or Winthorpe roundabout, reducing the benefits for other users.

5.2.9 The overall value for money for Corridor C would be expected to be higher, as the initial capital and operating costs for the corridor are expected to be higher

for a longer corridor, with lower benefits due to the corridor length. Corridors D and E use the A1 for part of the route and, therefore, may add significant traffic volumes to the short section of the A1, which may require widening.

5.2.10 The high-level assessments concluded that Corridor C was the best performing corridor overall and options should be developed within this corridor for further assessment.

5.3 Routes to North of South of Winthorpe

5.3.1 Two route options were developed within Corridor C:

- Route 1, the 'Southern Route', bypasses Winthorpe to the south. Within this route, two variations were developed:
 - Route 1A ties into the existing A46 mainline approximately 700m north of the existing Winthorpe Roundabout (figure 5.3).
 - Route 1B ties into the existing A46 mainline at the existing Winthorpe Roundabout (figure 5.4).
- Route 2, the 'Northern Route', bypasses Winthorpe to the north and would re-join the existing A46 at a new junction located approximately 1600m north-east of the existing Winthorpe Roundabout (figure 5.5).

Figure 5.3: Route 1A Layout Plan

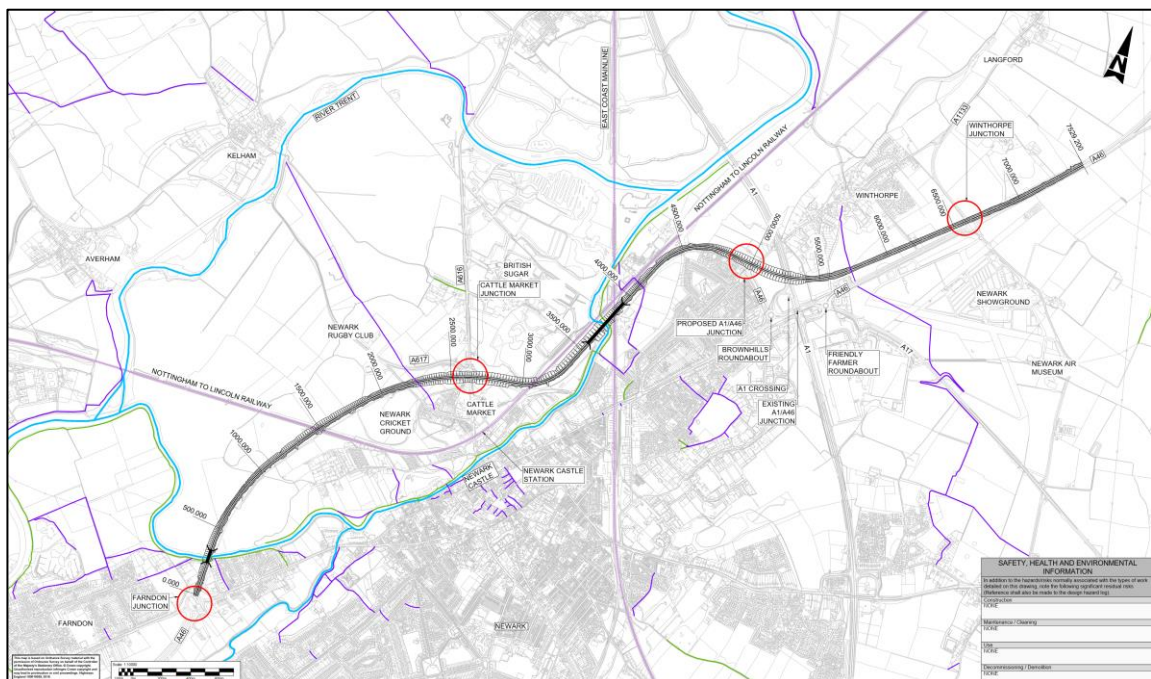


Figure 5.4: Route 1B Layout Plan

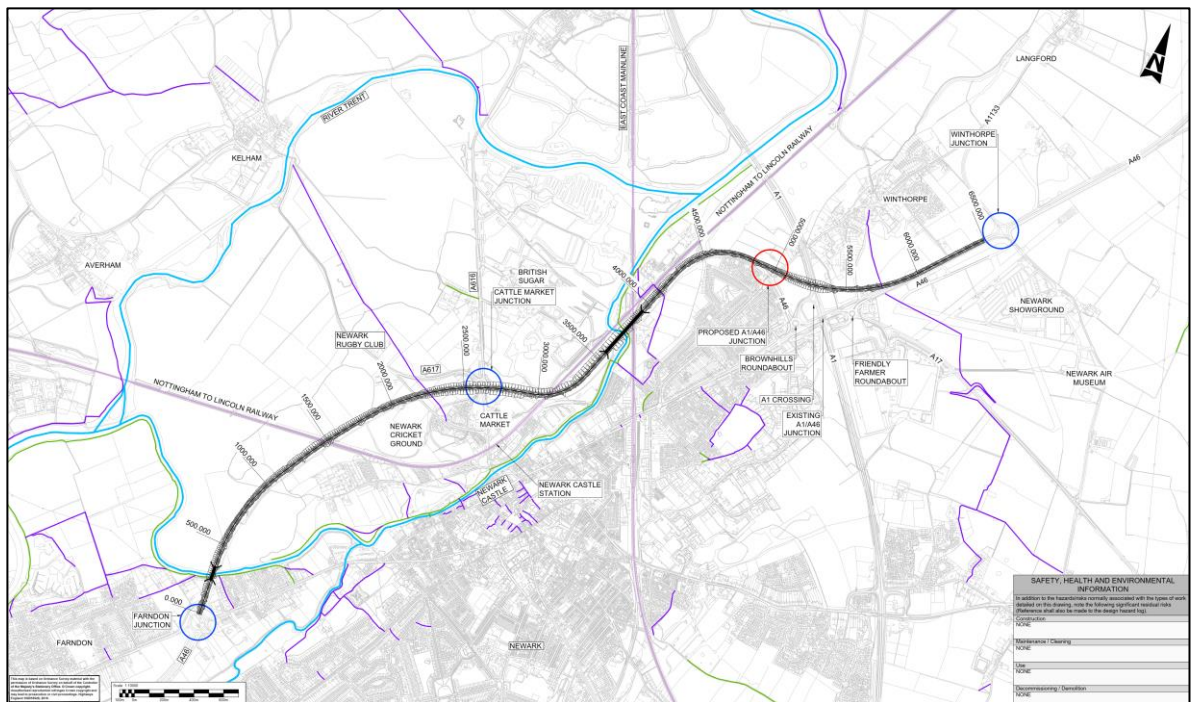
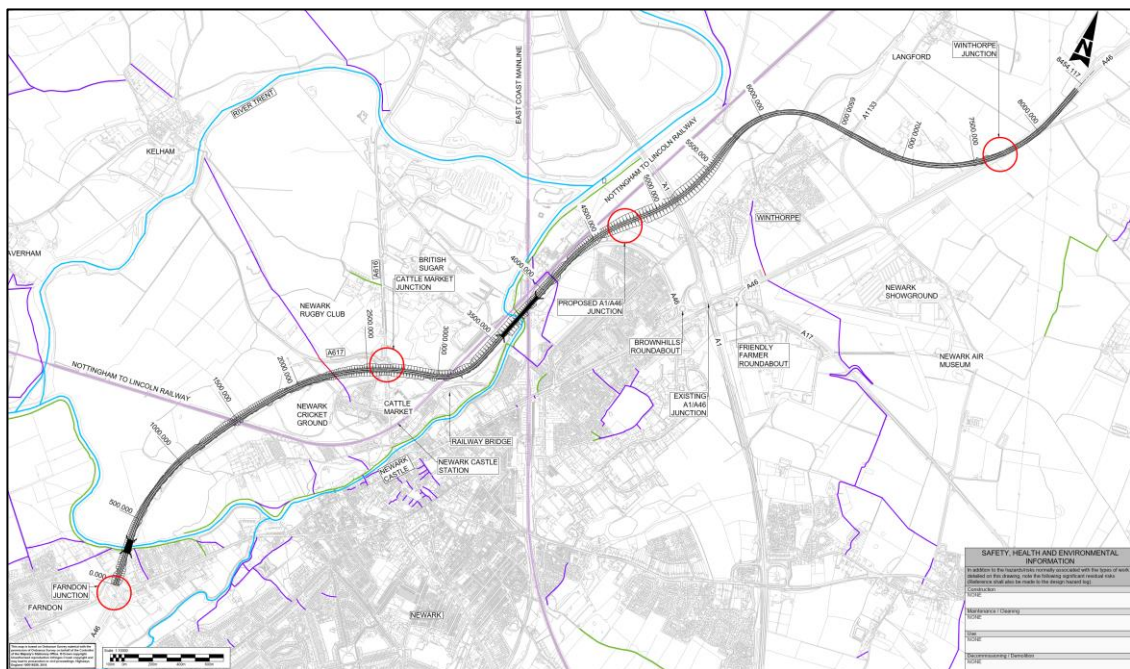


Figure 5.5: Route 2 Layout Plan



Route Sifting

- 5.3.2 Route 2 would incur a significantly higher construction cost compared to Route 1A and 1B, due to the greater construction length and associated land-take requirements, but the traffic model indicated that it would provide no further benefit in terms of improving journey times.
- 5.3.3 In environmental terms, whilst the effects of all route options are similar, Route 1 variants are preferred over Route 2 in terms of water, geology and soils, whereas in the vicinity of Winthorpe the Route 1 variants are also preferred for cultural heritage, noise, and landscape and visual receptors. It is also considered that

Route 2 would have the greatest adverse economic impact on businesses and development.

- 5.3.4 It was, therefore, recommended that Routes 1A and 1B are taken forward for further assessment. Route 2 would not be assessed further.

5.4 Junction Options Sifting

- 5.4.1 Options were developed for each of the four junctions within the routes. Each junction option could be applied to the route in any combination, thus creating options for traffic assessment.
- 5.4.2 Traffic modelling has been used to model traffic flow, delay and capacity for future design years; 2028 for opening year, 2043 for design year and 2051 for horizon year. It provides an insight as to how the proposed options would accommodate traffic movements and predicted future traffic flows. The options were reviewed to appraise traffic flow and consider the scheme objectives, specifically journey time reliability, journey time and delay.
- 5.4.3 The traffic modelling was successful in providing a clear indication of the future level of traffic, congestion and delay for each option. For the rest of the options that were sifted, poor performance due to congestion, delay or failure to meet the scheme objectives were the drivers of the decision to sift them from the scheme.
- 5.4.4 Having determined which route and junction options provided the benefits and improvements sought along the A46, the recommended route and junction options were combined into scheme options to allow them to be assessed. Each scheme option will be assessed holistically, to demonstrate the effect of the combination of junction options.

5.5 Options to Terminate Scheme at the A1

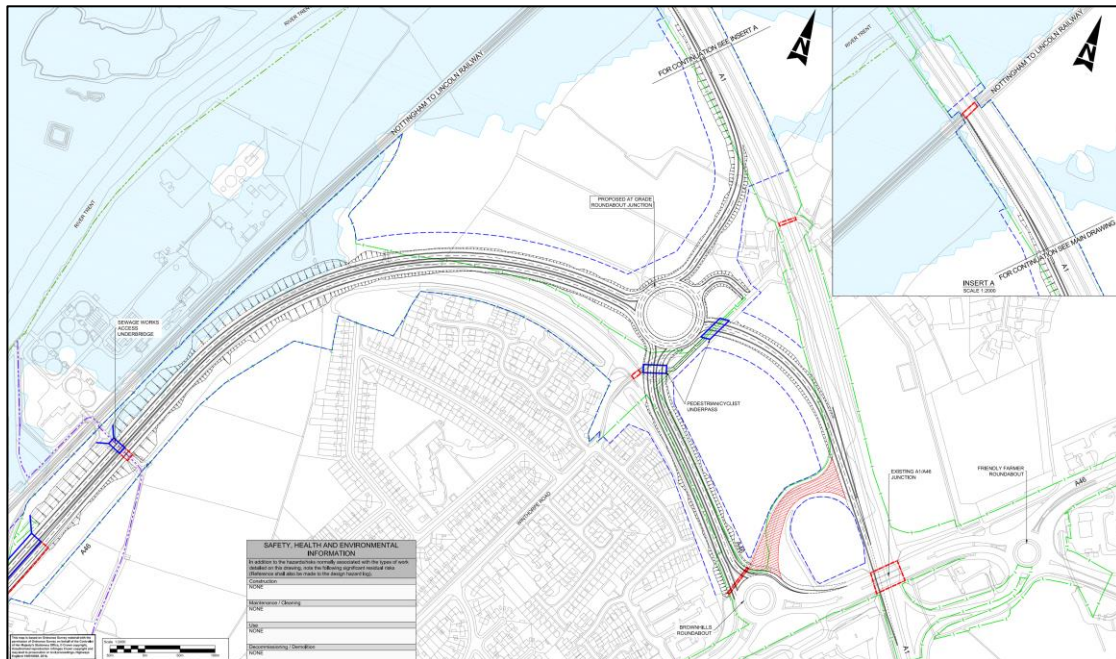
- 5.5.1 Options were considered to terminate the scheme at the A1 in order to provide a lower cost option. Two options were considered and are discussed below.

Widening A46 to Brownhills Roundabout with minor improvements to Brownhills

- 5.5.2 Dualling the A46 and junction improvements at Cattle Market would attract more traffic to the corridor. Without improvements to Brownhills and Friendly Farmer Roundabouts, the existing congestion and road safety issues would be worsened.
- 5.5.3 In order to address the safety issues related to vehicles queuing back onto the A1 northbound, signalling Brownhills Roundabout would likely require the existing roundabout to be made significantly larger to cater for the internal stacking. Any signalisation would create delays for A46 through-traffic which would degrade scheme benefits. This option was therefore not progressed.

New roundabout to the west of the A1

Figure 5.6 Option A1A46-4



- 5.5.4 The existing and forecast junction flows exceed those usually suitable for the compact grade separated standards that the current A1 slips have been constructed to. If the existing slips were to be realigned, they would need to be replaced with full standard slips to and from the A1 northbound. This would provide safety benefits for the road users, however, the costs involved in additional land take and associated structures and earthworks construction is likely to outweigh the benefits.
- 5.5.5 Journey time benefits would likely only be experienced by traffic travelling A1 northbound to A46 westbound and A46 eastbound to A1 northbound. All other vehicle movements, including the A46 through-traffic, would likely experience longer journeys than the existing layout.
- 5.5.6 The initial traffic analysis undertaken at that time indicated the queuing back to the A1 mainline is mainly caused by the limited capacity and performance of the Brownhills and Friendly Farmer roundabouts. This option compared unfavourably with the other options under consideration which all resulted in the removal of A46 through traffic (circa 50% of the junction traffic) from the two roundabouts and reduced instances of traffic queuing back onto the A1 mainline, and therefore was not progressed.

5.6 Lowest Cost Option

- 5.6.1 To ensure that all lower cost alternatives had been considered a 'lowest cost' option was developed to be similar to Option 1, but not include widening of the A46.
- 5.6.2 Traffic modelling demonstrated delays at all junctions and the A46 mainline for this option.
- 5.6.3 It indicated that this option would generate low present value of benefits of approximately £80M, which can be mostly attributed to it remaining single carriageway and not relieving future-year traffic delays. The Present Value of

Benefits (PVB) are TUBA-output Transport User Impacts. These include journey time and vehicle operating costs only, based on inputs from the Enhanced A46 Midlands Regional Traffic Model (MRTM). This early assessment did not, at this stage, include a quantitative monetary assessment for accident reduction impacts, reliability, noise, air quality, greenhouse gas and quantitative assessment of delays during construction.

- 5.6.4 Although only minor improvements are proposed for the junctions, the Present Value of Costs (PVC) would be highly likely to exceed the £82 million PVB, meaning that the cost of the improvements would outweigh the benefits they would provide.
- 5.6.5 Due to the low value of the anticipated benefits, this option was not considered for further assessment.

5.7 Options Assessed in Options Identification Stage

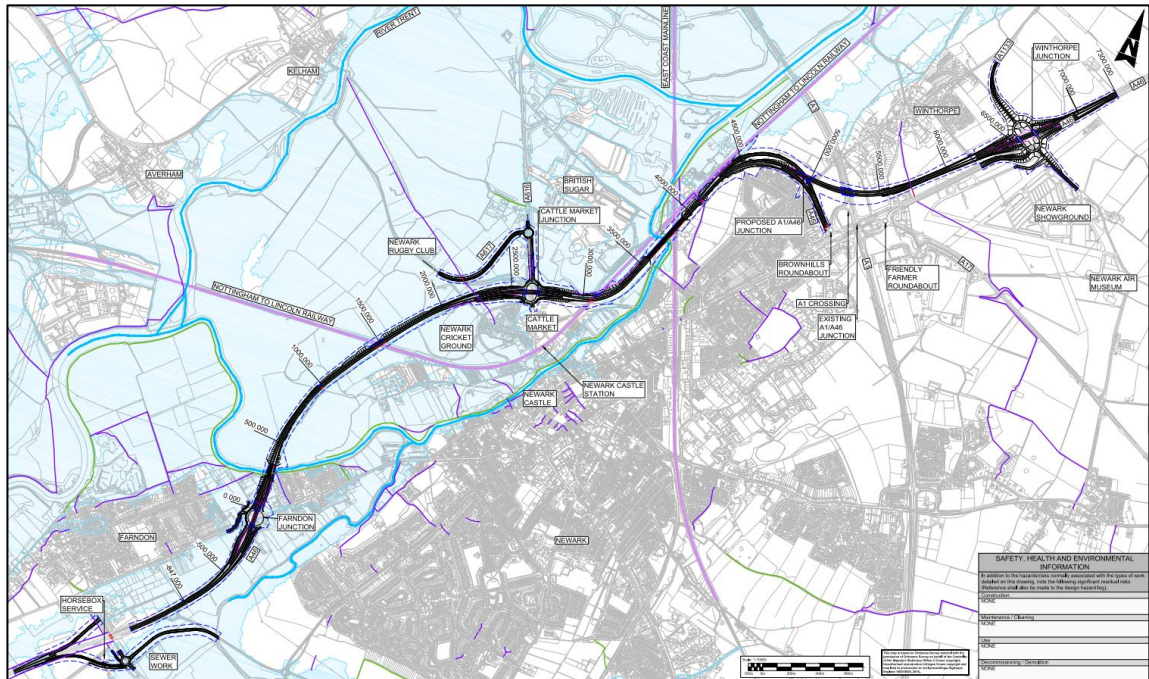
- 5.7.1 Four options were assessed during the options identification stage, as described in Table 5.1.

Table 5.1: Description of Options

Options	Description
A	The proposed A46 would follow the existing A46 mainline from Farndon Roundabout to the north of the existing Trent River Viaduct. From here, it is proposed that the route will diverge away from the existing mainline, bypassing the existing A1/A46 Junction, and cross over the A1 via a new structure. It would then run parallel to the northbound carriageway of the existing A46, to the south of Winthorpe, before tying in to the existing A46 approximately 700 m north of the existing Winthorpe Junction. The four main junctions along the route would all be grade separated.
B	The proposed A46 would follow the existing A46 mainline from Farndon Roundabout to the north of the existing Trent River Viaduct. The route would then diverge away from the existing mainline, bypassing the existing A1/A46 Junction, and cross over the A1 via a new structure. The route would follow the existing A46 mainline closely, south of Winthorpe, and tie in to the existing A46 at the existing Winthorpe Junction. The main junctions along the route will be at grade junctions, except for the A1/A46 Junction, which would be grade separated.
C	This option comprises the works required for Option A and would remove the proposed at grade roundabout junction of the Newark Southern Link Road with the A46, diverting the link road south to a new half junction at Hawton Lane with south-west-facing slips.
D	The proposed A46 would follow the existing A46 mainline from Farndon Roundabout to the north of the existing Trent River Viaduct. The route would then diverge away from the existing mainline, bypassing the existing A1/A46 Junction, and cross over the A1 via a new structure. It would then run parallel to the northbound carriageway of the existing A46, to the south of Winthorpe, and tie in to the existing Winthorpe Junction. The junctions at Farndon and Winthorpe would remain at grade, and the junctions at Cattle Market and the A1 would be grade separated.

- 5.7.2 It should be noted that Option C was developed as a sensitivity test to understand the impact of the NSLR junction on the scheme. This option would upgrade the proposed NSLR roundabout and provide grade separated links (see Figure 5.7).

Figure 5.7: Option C Layout Plan



- 5.7.3 Consideration was given to removing the new roundabout and instead realigning the NSLR to tie into the improved Farnon Junction, thus removing congestion that would occur further south on the A46. However, adding a new link to the junction from the east would be impractical due to the limited space, nearby private properties, the River Devon and other environmental constraints.
- 5.7.4 An alternative layout was developed to remove the proposed at-grade roundabout, diverting the NSLR south to a new half junction at Hawton Lane with south-west-facing slips.
- 5.7.5 All four options were evaluated against:
- Engineering Assessment.
 - Traffic and Economic Assessment.
 - Environmental Assessment.
 - Social Assessment.
 - Safety, Operational, Technology and Maintenance Assessment.
- 5.7.6 The key findings from the assessments are described in the following paragraphs.
- 5.7.7 In terms of engineering assessment Option B and Option D are comparable and require the least number of structures and volumes of earthworks, hence they have the lowest scheme costs (see Table 5.2). Options A and C require the greatest number of structures and volumes of earthworks, therefore, incur the highest scheme costs. Although Option B has a lower scheme cost, the grade separated junctions in Options A and C would allow the free flow of traffic along the A46 mainline.

Table 5.2: Most likely forecast outturn estimate for scheme options

Scheme Option	Forecast Outturn
A	£649,500,869
B	£462,322,327
C	£661,918,439
D	£479,887,544

- 5.7.8 The land take, including agricultural and Best and Most Versatile (BMV) land, for Option A and Option C will be greater than for Option B and Option D. Given that much of the area is designated as ‘at flood risk’, there would be a requirement to provide a significant volume of additional flood compensation storage outside the flood risk areas (Flood Zones 2 and 3).
- 5.7.9 Of the four options, Option D has the marginally highest adjusted Benefit Cost Ratio.
- 5.7.10 All options result in the potential for likely significant adverse effects on noise receptors, heritage assets, landscape and visual, biodiversity, material assets and waste.
- 5.7.11 Overall, Option B and Option D result in less likely significant adverse effects with mitigation, in comparison with Option A and Option C. Option B and Option D result in less habitat fragmentation; have fewer heritage assets and a smaller impact on affected listed structures along the A616; and have the least likely significant adverse effects predicted for noise. Option B and Option D also result in less likely significant adverse effects on landscape, townscape and visual receptors, water, mineral resources, waste generation and materials asset use. This is due to the extent of land take, new sections of road and elevated junctions, area of permeability and associated area of flood compensation in comparison to Option A and Option C. In addition, Option B has the lowest number of properties potentially affected in terms of air quality.
- 5.7.12 Option A provides greater benefits in terms of accidents, physical activity, severance and journey quality in comparison with the other options; however, Option A still results in adverse impacts on both security and personal affordability.
- 5.7.13 All proposed options are expected to have a positive impact upon road safety and contribute to the Highways England target of reducing the number of people killed or seriously injured on the trunk road network.
- 5.7.14 Grade separated Options A and C would generally result in lower overall risks during the operation phase of the scheme lifecycle, whilst the more at grade layouts in Option B and Option D would be expected to result in lower overall risks during the construction, maintenance and demolition phases.
- 5.7.15 Whilst all four options would provide benefit to this section of the A46, the forecast outturn estimates for Option A and Option C are significantly more expensive than Options B and D due to the additional construction but do not provide enough additional benefits to justify the increased cost.
- 5.7.16 Option A and Option C also have greater environmental impacts of:

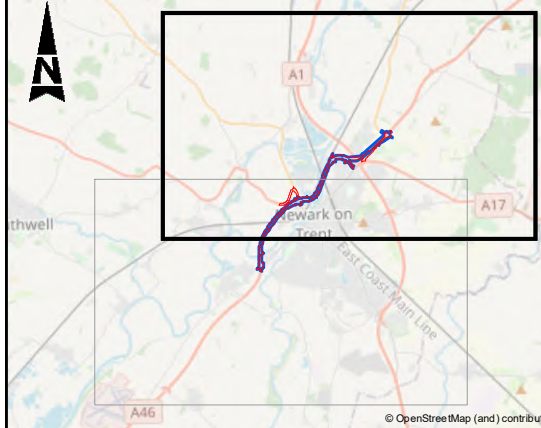
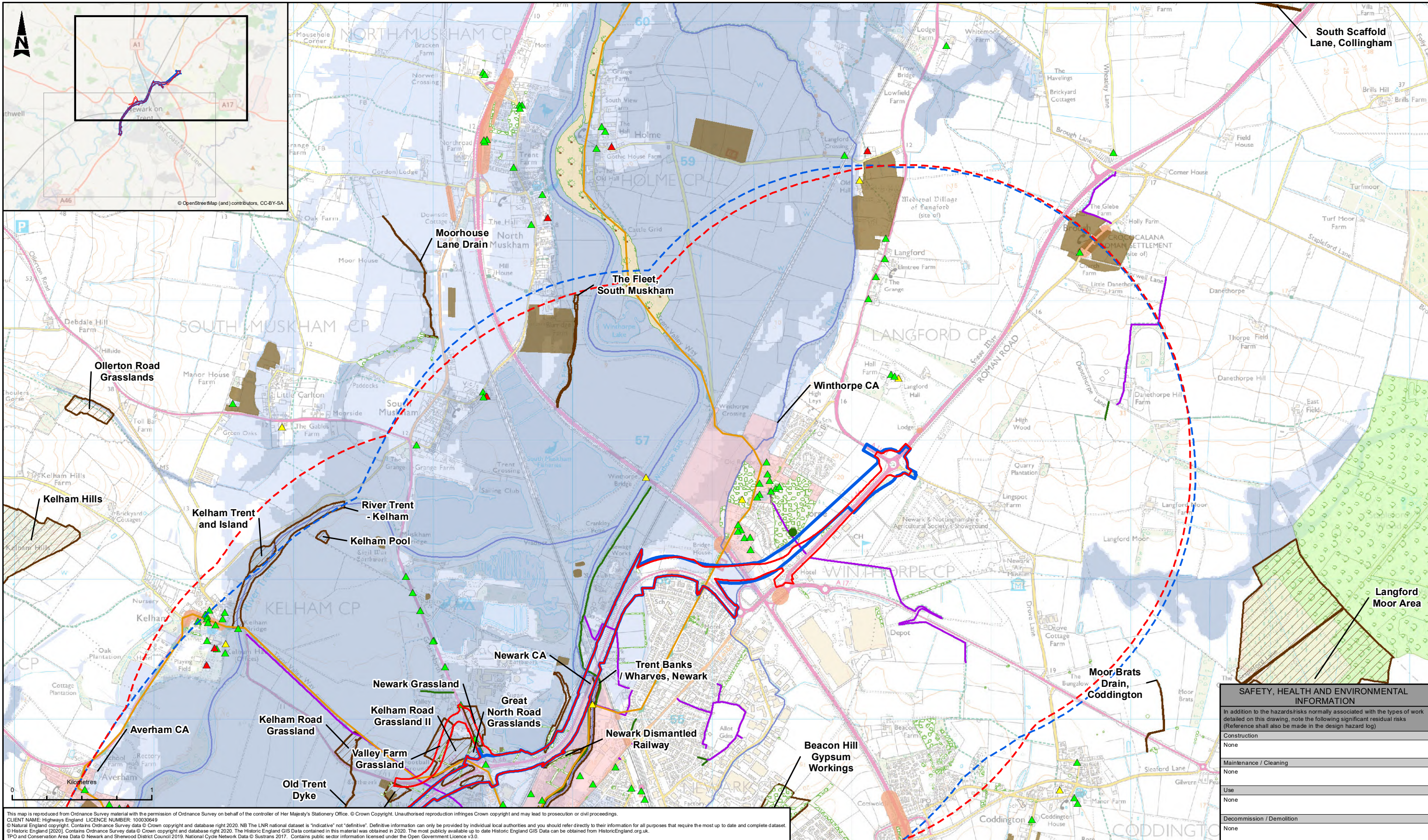
- Increased construction within the floodplain which would require compensating.
- Significant impacts within an area of known archaeology of international significance at Farndon.
- Increased visual impacts associated with the additional grade separated junctions.
- Greater number of properties would experience increases in noise.

It is, therefore, recommended that they should not be taken forward to the options consultation.

5.7.17 The options taken forward to consultation have been renamed to Option 1 and Option 2 in order to simplify the consultation. Option 1 was previously referred to as Option B, and Option 2 was referred to as Option D.

Appendices

Appendix A. Environmental Constraints Plan



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)	
Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

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LEGEND	
	Scheme Boundary - Option 1
	2km Study Area - Option 1
	Scheme Boundary - Option 2
	2km Study Area - Option 2
	Ancient Woodland
	Scheduled Monuments
	Registered Park and Garden
	Tree Preservation Orders
	Registered Common Land
	Selected Local Nature Reserves (LNR)
	Local Wildlife Sites (LWS)
	Conservation Areas (CA)
	Important Areas for Noise
	Air Quality Management Areas
	Flood Zone 3
	Flood Zone 2
	River Network
	Trent Valley Way Long-Distance Path
	Bridleway
	Footpath
	Listed Buildings Grade I
	Listed Buildings Grade II*
	Listed Buildings Grade II
	Notable Tree
Existing Public Rights of Way	

Description	Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date

APPROVED - PUBLISHED A1

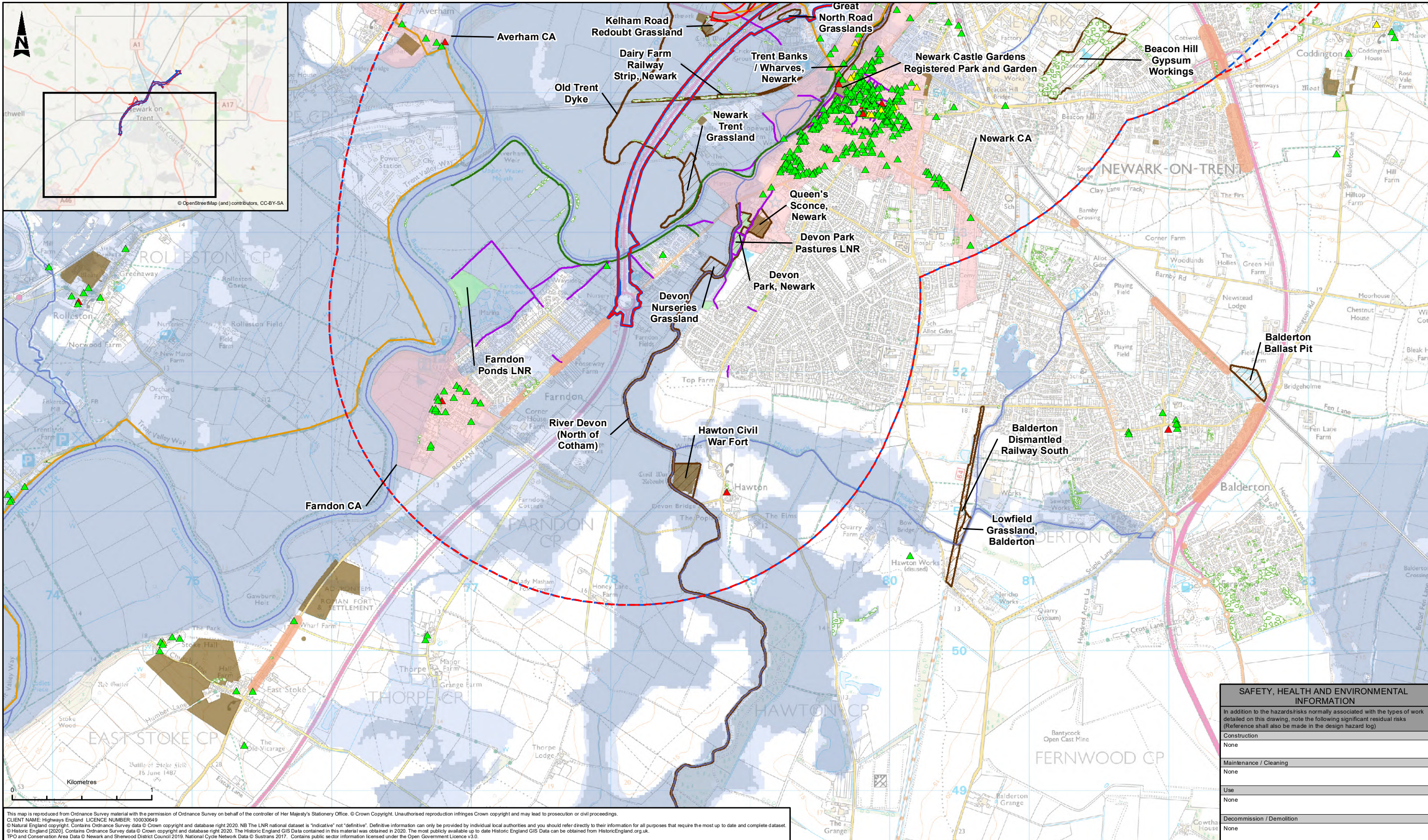
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Project Title		ROAD INVESTMENT STRATEGY A46 NEWARK NORTHERN BYPASS	
Drawing Title		ENVIRONMENTAL CONSTRAINTS PLAN PCF STAGE 2 SHEET 1 OF 2	
Project	Originator	Volume	
HE551478 - ATK - EGN	XX_A46 - RP - LL - 000001		
Location	Type	Rate	Number
A3	Scale	1:25,000	1 of 2
Original Size:	Scale	Project Ref. No.:	Rev. C02



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LEGEND	
	Scheme Boundary - Option 1
	2km Study Area - Option 1
	Scheme Boundary - Option 2
	2km Study Area - Option 2
	Tree Preservation Orders
	Registered Common Land
	Selected Local Nature Reserves (LNR)
	Ancient Woodland
	Scheduled Monuments
	Registered Park and Garden
	Flood Zone 3
	Flood Zone 2
	River Network
	Trent Valley Way Long-Distance Path
	Bridleway
	Footpath
	Listed Buildings Grade I
	Listed Buildings Grade II*
	Listed Buildings Grade II
	Notable Tree
	Local Wildlife Sites (LWS)
	Conservation Areas (CA)
	Important Areas for Noise
	Air Quality Management Areas
	Existing Public Rights of Way

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made in the design hazard log)	
Construction	None
Maintenance / Cleaning	None
Use	None
Decommission / Demolition	None

Description		Drawing Suitability	Status	Project Title					
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date	APPROVED - PUBLISHED	A1	ROAD INVESTMENT STRATEGY A46 NEWARK NORTHERN BYPASS
Description							 Member of the SNC-Lavalin Group The Axis 10 Holliday Street Birmingham West Midlands B1 1TF Tel: +44 (0) 1214835000 Fax: +44 (0) 1214835252 Copyright © Atkins Limited (2020) www.atkinsglobal.com	Drawing Title	ENVIRONMENTAL CONSTRAINTS PLAN PCF STAGE 2 SHEET 2 OF 2
Description									Client
Description							Drawing Number		Project: HE551478 - ATK - EGN Originator: XX_A46 - RP - LL - 000001 Volume: 2 of 2
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date	Original Size: A3		Scale: 1:25,000
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date	Project Ref. No: ---		Sheet: 2 of 2
Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date	Rev: C02		

Appendix B. Scheme Options General Arrangement Drawings

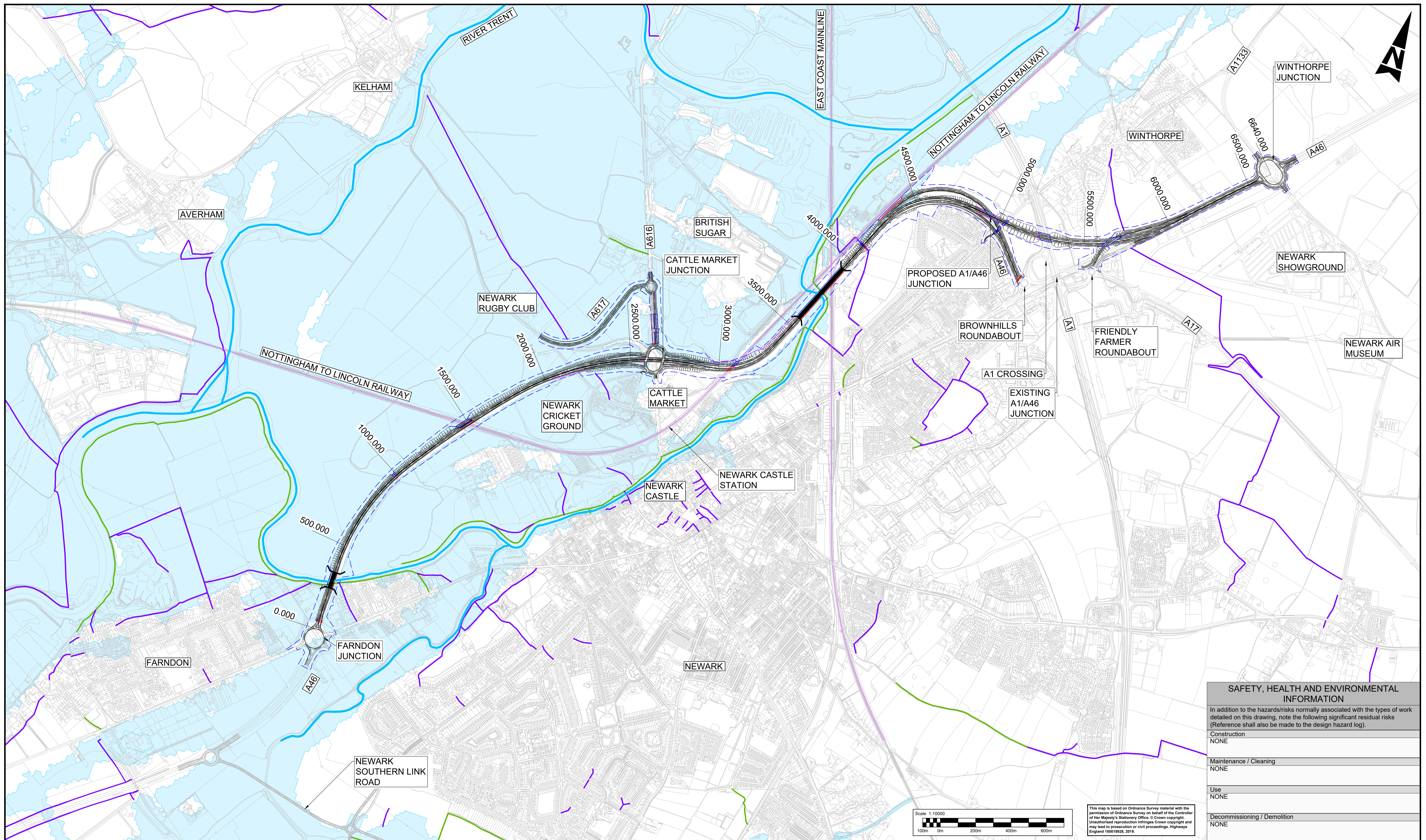
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- B.2 HE551478-ATK-GEN-OP1-DR-ZH-000002 – A46 General Arrangement Option 2**

DO NOT SCALE

Millimetres

0 10

100



SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION	
In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).	
Construction	NONE
Maintenance / Cleaning	NONE
Use	NONE
Decommissioning / Demolition	NONE

- NOTES:**
- ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
 - FOR JUNCTION GENERAL ARRANGEMENT DRAWINGS REFER TO:
HE551478-ATK-HGN-OP1_B6166_Z-DR-CH-000001
HE551478-ATK-HGN-OP3_A616_Z-DR-CH-000001
HE551478-ATK-HGN-OP1_A46A1_Z-DR-CH-000002
HE551478-ATK-HGN-OP1_A1133_Z-DR-CH-000002
 - ANY RETAINING WALLS AND BRIDGE DECKS SHOWN IN PLAN ARE INDICATIVE ONLY.

KEY :

	RIVER CROSSING STRUCTURE		PUBLIC RIGHTS OF WAY
	RIVER NETWORK		EXISTING BRIDLEWAY
	RAILWAY TRACK		EXISTING FOOTPATH
	ASSUMED PROJECT BOUNDARY		FLOOD ZONE 3
	PROPOSED RETAINING WALL		
	PROPOSED BRIDGE		
	EXISTING BRIDGE TO BE RETAINED		

Description	Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date

Drawing Suitability: **APPROVED - PUBLISHED** Status: **A1**

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Drawing Title	GENERAL ARRANGEMENT OPTION 1		
Drawing Number	HE551478	Originator	ATK
Project	OP1	Volume	GEN
Location		Type	DR - ZH - 000001
Original Size	A1	Scale	AS SHOWN
Project Ref. No.	5162675	Sheet	1 of 1
Rev.	C01		

Appendix C. Glossary & Abbreviations

Table X.3: Glossary

Term	Description
CO _{2e}	Carbon dioxide equivalent
g	grams
ha	hectares
km	kilometres
M	million
m	metres
NO ₂	Nitrogen dioxide
PM ₁₀	Particulate matter 10 micrometres or less in diameter
t	tonnes
μ	micro (1x10 ⁻⁶ or 0.000001)

Table X.4: Abbreviations

Term	Description
AQMA	Air Quality Management Area
BCR	Benefit Cost Ratio
BMV	Best and Most Versatile
CCTV	Closed-Circuit Television
COBA-LT	Cost and Benefit to Accidents - Light Touch
Defra	Department for Environment Food & Rural Affairs
DfT	Department for Transport
FCA	Flood Compensation Area
FMA	Fully-Modelled Area
GHG	Greenhouse Gas
HGV	Heavy Goods Vehicle
LGV	Light Goods Vehicle
LNR	Local Nature Reserve
LWS	Local Wildlife Site
MMG	Mercia Mudstone Group
MRTM	Midlands Regional Traffic Model
NIA	Noise Important Area
NPS NN	National Policy Statement for National Networks
NSLR	Newark Southern Link Road
PCM	Pollution Climate Mapping
PVB	Present Value of Benefits

PVC	Present Value of Costs
RCC	Regional Control Centre
RIS	Road Investment Strategy
RRS	Road Restraint Systems
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Urban Drainage Systems
SUP	Shared-Use Path
TAG	Transport Analysis Guidance
TUBA	Transport User Benefit Appraisal
WFD	Water Framework Directive

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