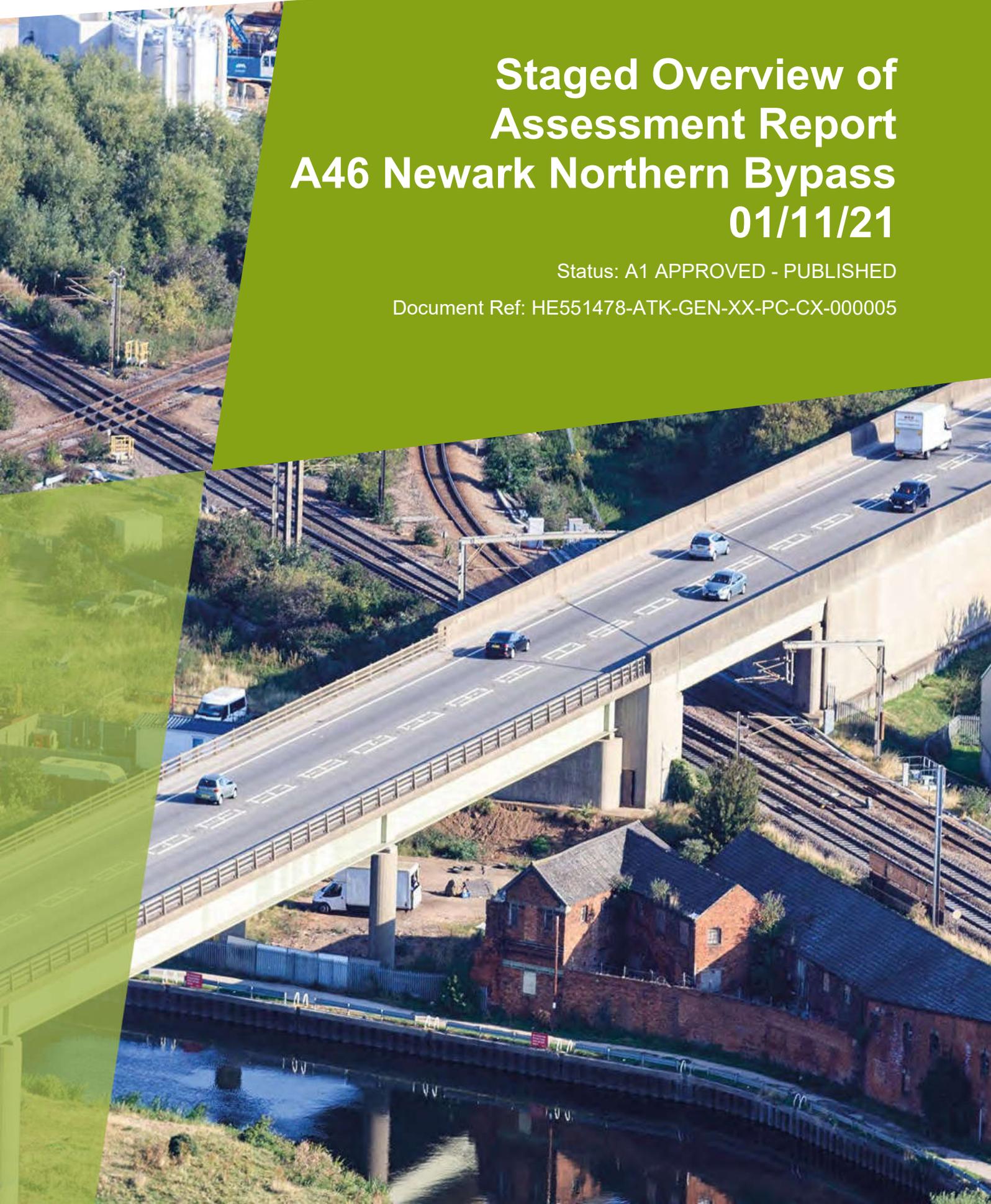


Staged Overview of Assessment Report A46 Newark Northern Bypass 01/11/21

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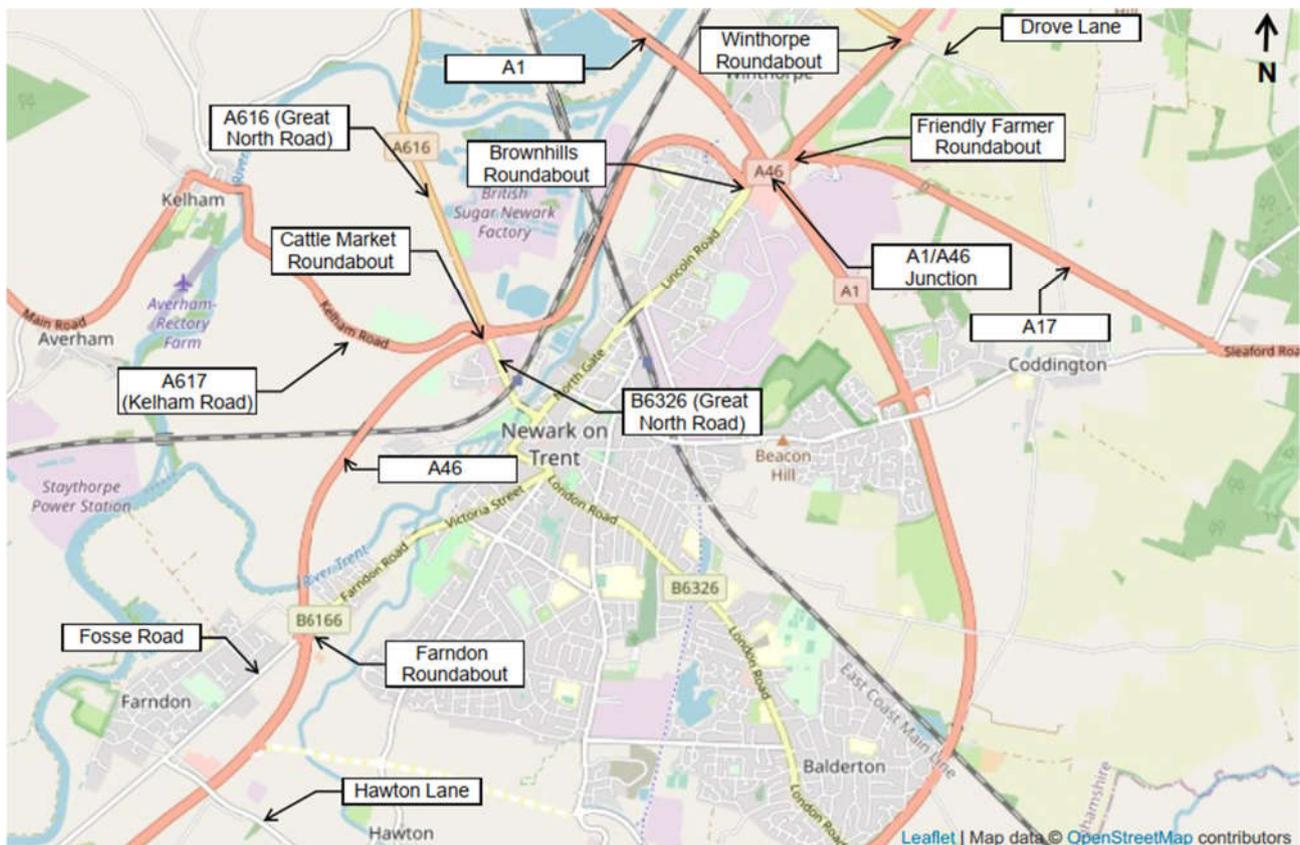
Executive Summary

Introduction

The A46 Newark Northern Bypass scheme covers part of the A46 corridor, which plays a critical role within the Strategic Road Network (SRN), connecting major manufacturing clusters in the Midlands with the Port of Bristol, the Humber Ports and South Wales.

The scheme has been announced as part of the second Roads Investment Strategy (2020-2025), to improve the A46 'Trans-Midland Trade Corridor' between the M5 and the Humber Ports. This section of the A46 is the 'single greatest gap' in this route.

The A46 Newark Northern Bypass 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 between Farndon roundabout and Winthorpe roundabout. The section links the A46 with other routes on the SRN, as well as the local road network.



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

Figure 0-1 A46 Newark Northern Bypass Location Plan

The aim of the scheme is to increase capacity and reduce traffic congestion on the A46 in the vicinity of Newark, improve connectivity from Lincolnshire to the national motorway network, and improve route standard consistency for the A46.

This Staged Overview of Assessment Report is intended to give an overview of the analysis undertaken within Project Control Framework (PCF) Stage 2, Option Selection, including comments and views expressed during the options consultation, to recommend a preferred option for the scheme.

Summary of Options and Public Consultation

Options Presented at Public Consultation

The Option Identification stage considered several different corridors, route options and junction options. The assessment within this stage concluded that two options, Option 1 and Option 2, should be taken forward to options consultation and further assessment in PCF Stage 2, Option Selection.

For both 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, allowing traffic on the A46 to bypass the existing A1/A46 junction and travel on to Winthorpe junction.

The general layout of Farndon junction would not be changed.

In Option 1, shown in Figure 0-2, Cattle Market junction would be signalised, and the layout changed to allow the A46 to pass through the centre of the roundabout. 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. 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. A new link over the A46 would provide access from Friendly Farmer roundabout and the A1 to the A46 eastbound.



Figure 0-2: Option 1

In Option 2, shown in Figure 0-3, 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. 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.



Figure 0-3: Option 2

Findings from Public Consultation

The options consultation lasted for eight weeks from 9 December 2020 until 2 February 2021. An independent company (Accent) reviewed and considered the 1586 responses that the scheme received from stakeholders during the consultation and published findings in the Report on Public Consultation.

The responses received revealed greater overall support for Option 2 than for Option 1, largely due to the proposed grade separation at Cattle Market junction. At the Winthorpe end of the scheme the views were more balanced.

Some stakeholders requested a combination of Option 1 and Option 2. The 1-2 Hybrid Option, with Option 2 at the western end to provide grade separation at Cattle Market junction and Option 1 at the eastern end was assessed in response to consultation feedback.

Key issues raised by respondents included:

- Amendments/improvements required to the proposed options. This covered comments such as:
 - Need to grade separate all junctions.
 - Need to resolve issues caused by roundabouts.
 - Prefer a hybrid of the two options presented.
 - Consideration of Newark Flat Crossing (rail).
 - Scheme options not addressing safety concerns at the A1 junction.
- Noise pollution as a result of the scheme and associated noise mitigation.
- Negative impact on local residents, including visual and setting impacts of residential properties, risk of flooding and water drainage capacity and associated mitigation.

- Environmental/ecological impact and the associated mitigation required.
- Air pollution and carbon emissions.
- Safety and access for cyclists and pedestrians.
- Negative impact of, and disruption during, construction.

Many of the issues raised are not considered in detail at this early stage of the design, but will be developed and assessed further as the scheme progresses. Responses from stakeholders highlighted the need for the A46 Newark Northern Bypass scheme to consider Network Rail's aspirations to grade separate the Newark flat crossing between the Nottingham to Lincoln line and the East Coast mainline. This has resulted in a modification to the A46 Newark Northern Bypass scheme to maximise the space between rail and the road, to ensure that a future rail scheme would not be precluded.

Concerns were voiced that the scheme would have negative environment impacts as well as impacting the conservation area of Winthorpe. Support was given to exploring alternatives in the vicinity of Winthorpe in order to minimise the impact. Option 2 Modified was developed in response to these concerns, with the route of the new A46 link crossing the A1 moved approximately 75 m further from Winthorpe than Option 2, in order to reduce the impact of the scheme on the village. An alternative option was suggested by the 'Think Again' group, which is considered to be very similar to Option 2 Modified and assessed as such.

As part of the consultation process an alternative route for the A46 in the vicinity of Winthorpe was suggested by Winthorpe with Langford Parish Council, in order to minimise the impact of the scheme on the village. The route sees the section of road between the A1 and A1133 being moved south of the current A46. A qualitative assessment within the Option Selection stage concluded that a route to the south of the current A46 would be less favourable in engineering, economic and environmental regards than Options 1 and 2, would present lower value for money and would still bring the proposed A46 route closer to the village of Winthorpe and, therefore, should not be assessed further.

Options Developed and Assessed in Response to Public Consultation

The 1-2 Hybrid Option and Option 2 Modified were developed in response to feedback from the options consultation and have subsequently been assessed within the Option Selection stage.

The 1-2 Hybrid Option, shown in Figure 0-4, would include widening of the A46 between Farndon and the A1, as per Options 1 and 2. It would include the proposed grade separated layout at Cattle Market junction as in Option 2 but would cross the A1 and tie-in to the A46 to the west of Winthorpe junction, using the same layout as in Option 1.



Figure 0-4: Layout of 1-2 Hybrid Option

Option 2 Modified, shown in Figure 0-5, has been developed using the layout for Option 2 as a basis, proposing widening of the A46 between Farndon and the A1 and a grade separated layout at Cattle Market junction. In Option 2 Modified, the two lanes of the ‘old’ A46 eastbound carriageway between Friendly Farmer roundabout and Winthorpe junction would be used to carry the two lanes of the new A46 westbound carriageway. Two lanes to carry the new A46 eastbound carriageway would be constructed immediately north of this. The section of ‘old’ A46 between Friendly Farmer roundabout and Winthorpe junction would be reduced to a single carriageway, utilising the two lanes of the ‘old’ westbound carriageway. The existing wide central reserve between the new dual and single carriageway sections would be retained and become a nearside verge for both carriageways.

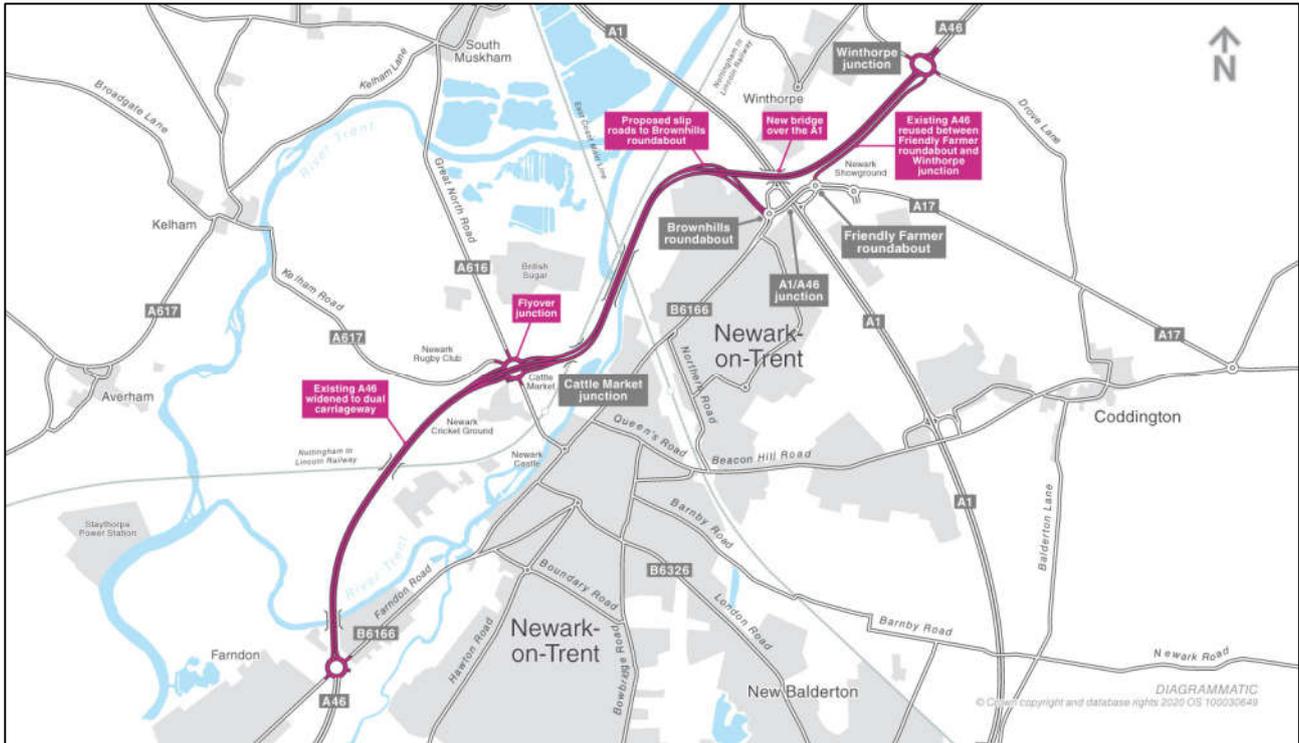


Figure 0-5: Layout of Option 2 Modified

Summary of Assessment, Conclusions and Recommendation

Assessment

The assessment undertaken within the Option Selection stage, and recorded in this report, has been undertaken for Option 1, Option 2, the 1-2 Hybrid Option and Option 2 Modified.

The four options are broadly similar and, as such, several of the topic areas have assessed that there is little to differentiate between each of the options.

The results of the options consultation of Options 1 and 2 revealed greater overall support for Option 2 (64%) than for Option 1 (23%), largely due to the proposed grade separation at Cattle Market junction, which was preferred by 79% of respondents. Given the stronger support for grade separation at Cattle Market junction, the project team has judged that the 1-2 Hybrid Option and Option 2 Modified, which include this grade separated layout, would also be more strongly supported than Option 1. It is also judged that there would be stronger support for Option 2 Modified, since the layout would better address concerns raised about the impact of the scheme on the village of Winthorpe.

In all options, network resilience is improved through the widening of the A46 from a single carriageway to a dual carriageway. The proposed grade separated Cattle Market junction in Options 2 and 2 Modified, combined with separation of the proposed and existing section of the A46, achieves slightly better benefits to local traffic, strategic traffic and resilience, and would generally have greater safety benefits than the layouts in Option 1 and the 1-2 Hybrid Option.

Option 2 and its variants (the 1-2 Hybrid Option and Option 2 Modified) perform similarly with regards to travel time savings due to the grade separation of Cattle Market junction, Economic Efficiency benefits and adjusted BCR, and all perform better than Option 1. The 1-2 Hybrid Option performs marginally better overall in terms of travel time savings, due to

slightly lower delays associated with the layout at Winthorpe junction, and Option 2 performs marginally better overall in terms of adjusted Benefit Cost Ratio (BCR).

Environmentally, Option 2 Modified is the most favourable option and environmentally better than the other three options, with less mitigation required for cultural heritage, landscape and visual, biodiversity, noise and vibration, population and human health, and road drainage and the water environment. The most favourable options for cumulative effects are Option 1 and the 1-2 Hybrid Option. For materials and waste and geology and soils Option 2 Modified is the most favourable option, although it is noted that all options would result in significant effects for agricultural soils and Best and Most Versatile (BMV) land.

Conclusions

The assessment of the four options has highlighted two key areas where measurable differences between the options have been identified:

- Cattle Market junction.
- The route of the A46 in the vicinity of Winthorpe.

The grade separation of Cattle Market junction and signalisation of Farndon roundabout in Option 2 will provide additional capacity on the A46 providing higher overall travel time savings than Option 1 leading to additional journey time benefits.

The separation of the largely strategic A46 traffic from the local traffic network is also considered to offer greater benefits in terms of safety, both to road users and walkers, cyclists and horse-riders. The result of this improvement to safety and journey time benefits is a scheme which delivers better value for money, as indicated in the comparative BCRs.

Responses to the options consultation on Options 1 and 2 revealed greater overall support for Option 2, largely due to the proposed grade separation at Cattle Market junction.

Option 2 Modified was developed as a result of discussions and responses from stakeholders during the options consultation and was, therefore, not consulted on directly. It was developed based on stakeholders' preference for Option 2, with its grade separated junction at Cattle Market, but recognising the continued concerns over the proximity of the proposed route of the A46 to Winthorpe.

Moving the route of the A46 further away from Winthorpe, and partially back 'online' with the existing A46, is assessed to achieve environmental benefits over the other options in terms of:

- Landscape and Visual Effects.
- Noise and Vibration.
- Cultural Heritage.
- Biodiversity.
- Population and Human Health.

Recommendation

The significant safety and economic benefits of the grade separated Cattle Market junction together with the more marginal but still recognisable environmental benefits achieved through the route of the A46 in the vicinity of Winthorpe has led to the recommendation that Option 2 Modified be promoted as the preferred option for the A46 Newark Bypass scheme.

The preferred option shall incorporate a modification to the slip road from the A46 to Brownhills roundabout to maximise the space between the Nottingham to Lincoln railway line and the road.

1. Introduction

1.1 Overview

- 1.1.1 The A46 Newark Northern Bypass scheme covers part of the A46 route, which is approximately 350 km in length from Bath, Somerset to Cleethorpes, Lincolnshire. The A46 corridor plays a critical role within the Strategic Road Network (SRN), connecting major manufacturing clusters in the Midlands with the Port of Bristol, the Humber Ports and South Wales. The scheme was included in the Government's Autumn Statement 2014 and in the Department for Transport (DfT) Road Investment Strategy (RIS) published in March 2015, as a scheme to be developed in RIS1 (2015-2020) for a start of construction in RIS2 (2020-2025).
- 1.1.2 The scheme has been announced as part of RIS2, to improve the A46 'Trans-Midland Trade Corridor' between the M5 and the Humber Ports (see Figure 1-1). This section of the A46 is the 'single greatest gap' in this route, and the proposed dualling improvements 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'. Coupled with upgrades committed in RIS1, the A46 dual carriageway would run unimpeded from Lincoln to Warwick.

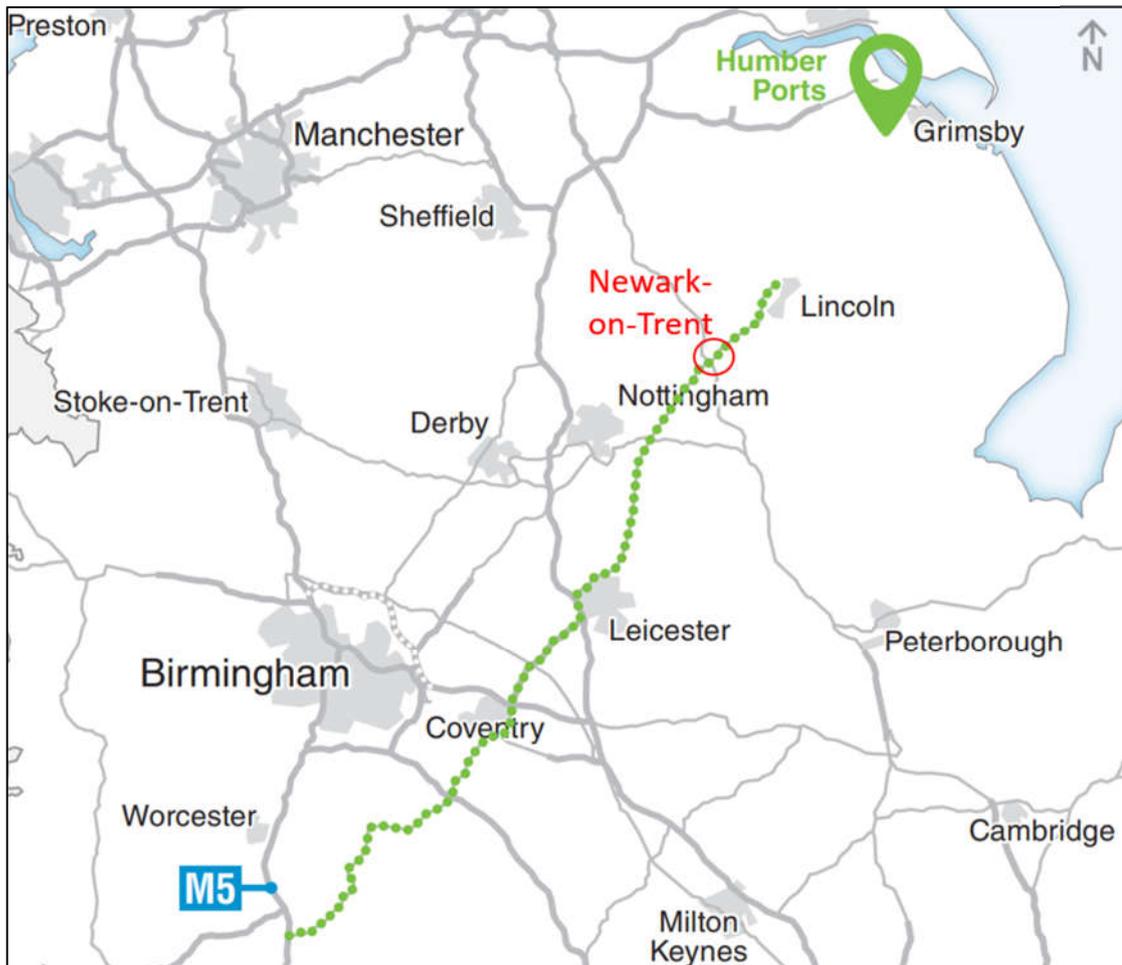


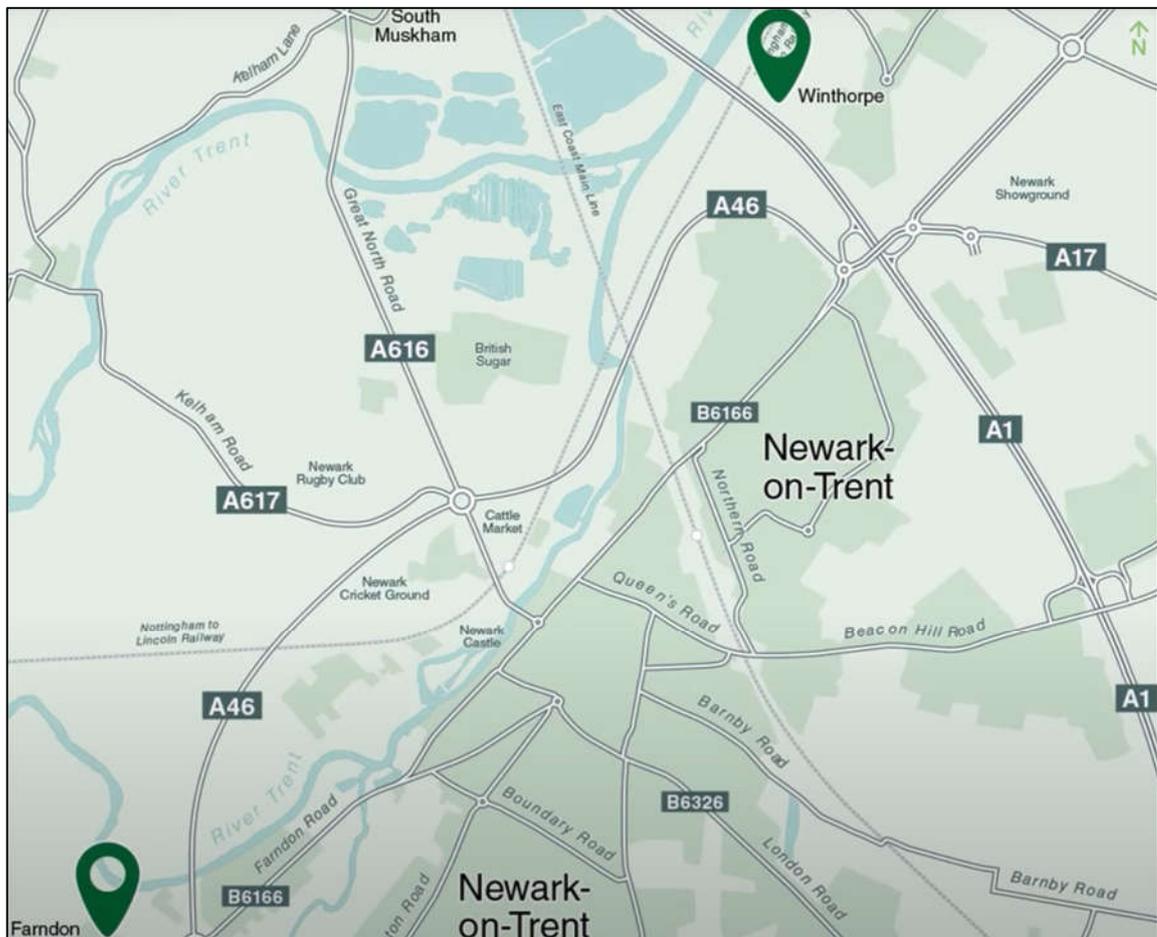
Figure 1-1: A46 Route

1.2 Purpose of the Report

- 1.2.1 The Staged Overview of Assessment Report (SOAR) is intended to give an overview of the analysis undertaken within the stage, including comments and views expressed during the options consultation, to determine a preferred option for the scheme.
- 1.2.2 The preferred option will be recommended to the DfT for approval before making a Preferred Route Announcement.

1.3 Location of the Scheme

- 1.3.1 The A46 Newark Northern Bypass 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 between Farndon roundabout and Winthorpe roundabout. The section links the A46 with other routes on the SRN, as well as the local road network.



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Figure 1-2: A46 Scheme Context

- 1.3.2 The aim of the scheme is to increase capacity and reduce traffic congestion on the A46 in the vicinity of Newark, improve connectivity from Lincolnshire to the national motorway network, and improve route standard consistency for the A46.

1.4 Scheme History

1.4.1 An overview of the scheme history is shown in Figure 1-3.

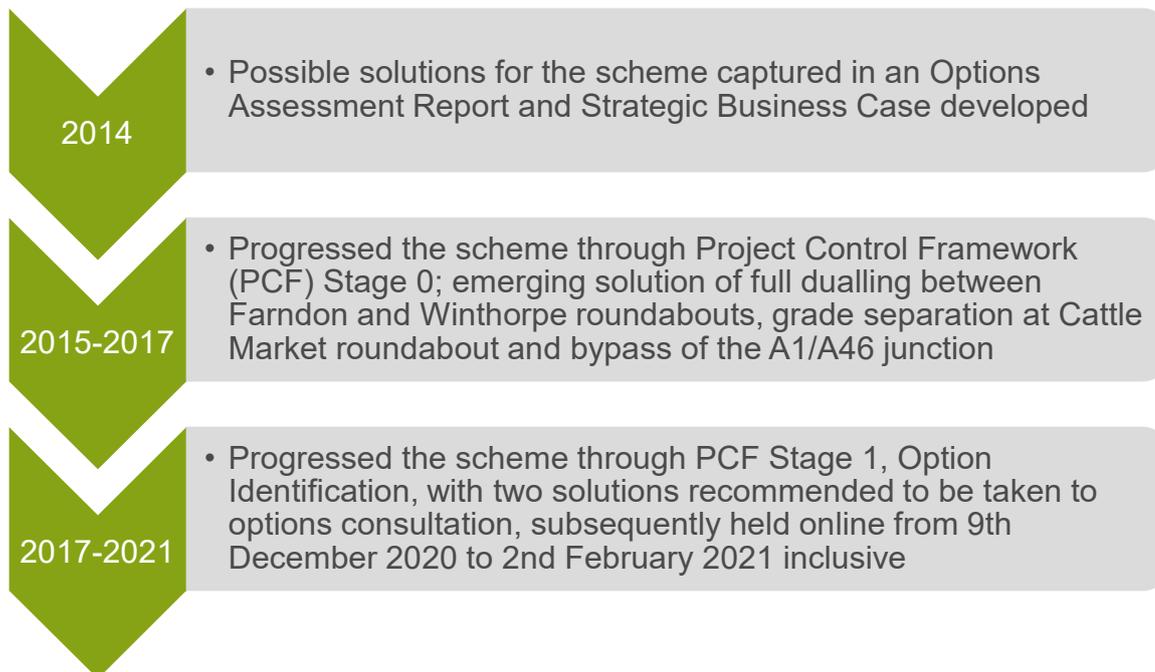


Figure 1-3: A46 Newark Northern Bypass Scheme History

2. Summary of the Existing Conditions

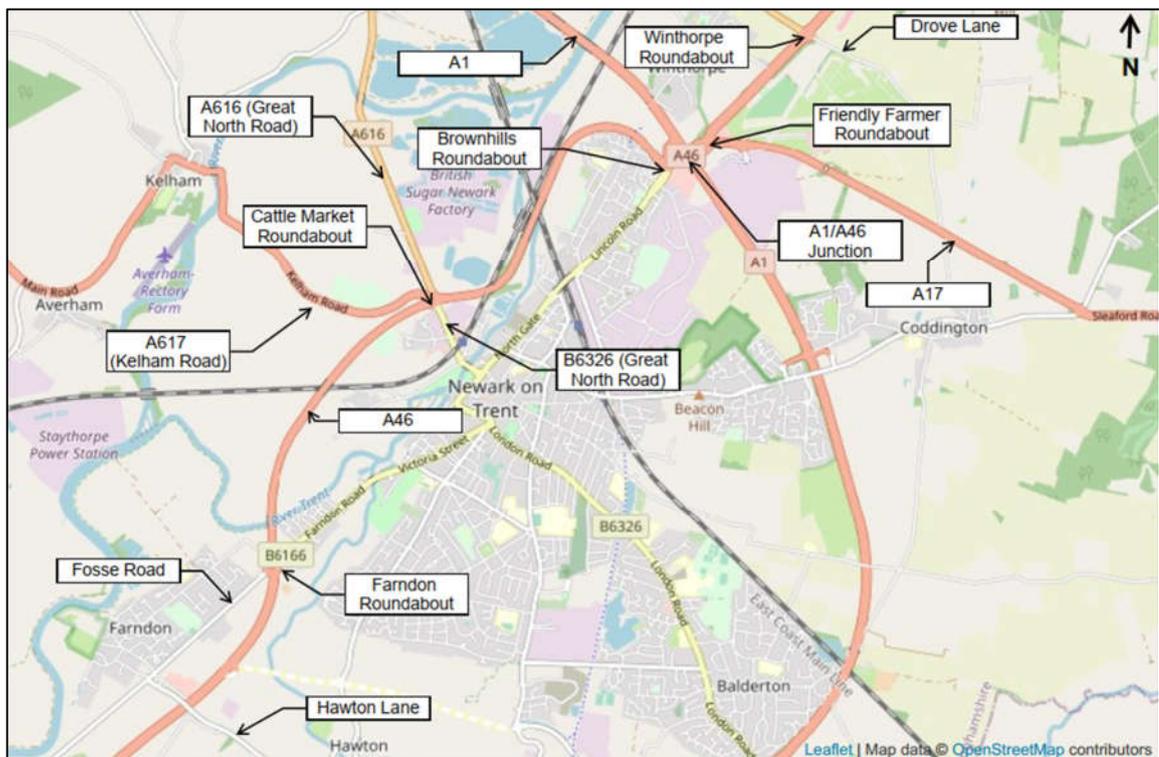
2.1 Overview

2.1.1 This chapter describes the current and future situations in the study area (1 km buffer from the scheme) including opportunities and constraints that have been identified at this stage of the design process.

2.2 Description of the Locality

2.2.1 The section of the A46 at Newark-on-Trent runs in close proximity to residential, agricultural and industrial land. The route also intersects the River Trent, the Nottingham to Lincoln railway line and the East Coast mainline.

Existing Highway Network



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

Figure 2-1: Existing Junctions Location Plan

A46

2.2.2 The section of existing A46 between Farndon roundabout and Brownhills roundabout (A1/A46 junction) is a wide single carriageway (cross section as shown in Figure 2.1.1N1a in the Design Manual for Roads and Bridges (DMRB) CD 127 Cross sections and headrooms), with hatched central road markings to discourage overtaking and is approximately 5 km in length. This section is also designated as a High Load Route¹. The existing A46 between Friendly Farmer

¹ National Highways - High and heavy load grid map for abnormal loads;
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/360533/High_and_Heavy_Load_Grid_Map_for_Abnormal_Loads.pdf

roundabout (A1/A46 junction) and Winthorpe roundabout, is a two-lane dual carriageway approximately 1.2 km in length and is designated as both a Heavy and High Load Route¹. The single and dual carriageway sections have national speed limit of 60 mph and 70 mph respectively. The mainline intersects with several routes on both the local network and the SRN and includes crossings over the River Trent and the East Coast mainline.

Fosse Road

- 2.2.3 Fosse Road is a single carriageway road, with a 40 mph speed limit, which links to the existing A46 by connecting to Farndon roundabout from the west. It runs adjacent to the existing A46 carriageway to the south of Farndon roundabout, providing access to Farndon and other villages.

A617 (Kelham Road)

- 2.2.4 The A617 is a single carriageway road that links to Cattle Market roundabout from the west. It provides access between the existing A46 and Kelham village, to the north-west of Newark-on-Trent, and continues to Mansfield. The road has a speed limit of 50 mph.

A616 (Great North Road)

- 2.2.5 The A616 is a single carriageway road that links to the existing A46, via Cattle Market roundabout, from the north. The route provides access to and from the area north-east of Newark-on-Trent and joins the A1 at junction 30. The section of the A616 that links to Cattle Market roundabout has a 50 mph speed limit.

B6326 (Great North Road)

- 2.2.6 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

- 2.2.7 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.

A17

- 2.2.8 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 are adopted on the single and dual carriageway sections respectively.

A1133

- 2.2.9 The A1133 is a single carriageway road with a posted national speed limit (60 mph) that links to the existing A46, from the north-west, at Winthorpe roundabout. It provides access between the A46 mainline and Winthorpe as well as villages to the north of Winthorpe.

Drove Lane

- 2.2.10 Drove Lane is a single carriageway road that passes to the north and east of Newark Showground and Newark Air Museum, which are located north-east of Newark-on-Trent. The road provides access between Winthorpe roundabout and the A17. There is a national speed limit of 60 mph along the full length.

Existing Junctions

Farndon Roundabout

- 2.2.11 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. It also provides private means of access to properties and a nearby freight business from the 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 widened to two-lane approach to the junction.

Cattle Market Roundabout

- 2.2.12 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.

A1/A46 Junction

- 2.2.13 The A1/A46 junction consists of a dumbbell style arrangement of Brownhills and Friendly Farm roundabouts, linked by a bridge over the A1. Friendly Farmer roundabout provides access to and from the A17 and the A46 northbound. Brownhills roundabout provides access to and from Lincoln Road, towards Newark-on-Trent town centre, and the A46 southbound.

Winthorpe Roundabout

- 2.2.14 Winthorpe roundabout, located east of Winthorpe along the existing A46, is a four-arm, at grade roundabout that connects the A46 to the A1133 to the north and Drove Lane to the south.

2.3 Current Problems and Issues

- 2.3.1 The A46 at Newark-on-Trent currently has the worst performance of any section of the A46 between Leicester and Lincoln and congestion issues negatively impact upon the wider Newark-on-Trent area.

- 2.3.2 The following problems and issues are identified in the locality of the proposed scheme:
- The A46 between Cattle Market roundabout and the A1/A46 junction is a heavily congested stretch of single carriageway meaning that journeys on this road are unreliable and take longer than they should do.
 - Accidents have a direct impact on those involved and also often lead to lane closures and associated reliability issues. The effect of this is experienced on adjacent sections of the road network and through Newark-on-Trent.
 - There is a level crossing on the B6326 between the A46 and Newark-on-Trent. This causes traffic to back-up to the A46 Cattle Market roundabout at times during the day.
 - The junction of the A1/A46 is a major intersection between the A1, A17 and A46, and has previously featured in the list of top 10% casualties per billion vehicle miles on the North and East Midlands Route. The junction also contributes significantly to high variability of journey times which is stated to be of concern to businesses, particularly those in the manufacturing, construction and distribution sectors.

2.4 Strategic Context

- 2.4.1 The A46 is part of the UK's Strategic Road Network. The majority of the route is built to dual carriageway standard between Leicester and Lincoln, with the exception being the single carriageway section around Newark-on-Trent.
- 2.4.2 Nationally, the A46 is important because it links the ports of the Humber and large urban areas between the Humber and Bristol. It is a key export corridor, with 22% of the goods and services produced along the corridor sold abroad.
- 2.4.3 Regionally it serves as a key bypass/ring road for cities such as Coventry, Lincoln and Leicester moving goods and people.
- 2.4.4 In the Newark-on-Trent area it is an important link to the A1 and the M1.

2.5 Existing Traffic Conditions (Accidents and Journey Time Reliability)

Accidents

- 2.5.1 The accident impact analysis is based on 5-year (January 2015-December 2019) STATS19 data provided by the DfT² to identify the number and characteristics of collisions and casualties along the A46 between and including the Farndon roundabout and the Winthorpe roundabout.
- 2.5.2 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. Very few, if any, fatal collisions are not reported to the police; however, it is recognised that a proportion of non-fatal injury collisions are not known to the police and, hence, are not included in the analysis.

² <https://data.gov.uk/dataset/cb7ae6f0-4be6-4935-9277-47e5ce24a11f/road-safety-data>

2.5.3 The A46 through Newark-on-Trent had a total of 146 collisions between 2015 and 2019, giving an annual average of 29 collisions. Of the 146 collisions, 114 occurred at junctions along the A46, as presented in Table 2-1.

Table 2-1: Junction collisions on A46 (2015 – 2019)

Junction Name	Number of Collisions
Farndon Roundabout	15
Cattle Market Roundabout	37
A1/A46 Junction	53
Winthorpe Roundabout	9
Total	114

2.5.4 The A1/A46 junction has the highest number of collisions (53), with the Winthorpe junction having the fewest (nine).

2.5.5 Table 2-2 shows the number of casualties that had fatal, serious, slight and Killed or Seriously Injured (KSI) collisions on the A46.

Table 2-2: Casualty severity for collisions on the A46 (2015-2019)

		Number of A46 Mainline Casualties	Number of A46 Junction Casualties
Fatal	No.	2	0
	%	3.3%	0.0%
Serious	No.	4	11
	%	6.6%	7.5%
Slight	No.	55	136
	%	90.2%	92.5%
KSI	No.	6	11
	%	9.8%	7.5%
Total		61	147

2.5.6 Figure 2-2 shows the casualty locations for collisions on the A46.

2.5.7 There is a cluster of fatal collisions to the north of Farndon roundabout. Of the fatal collisions, one collision had just one casualty (the fatality) and the other collision had two casualties (one fatality and one slight injury), while data on the type and cause of these collisions or what vehicles were involved is not available, the severity of the outcome as well as the distribution of fatalities in these reported collisions suggest that these collisions were not low speed, congestion related collisions but, more likely, high speed collisions.

2.5.8 From the 146 collisions on the A46, there were 208 casualties, giving an average of 1.42 casualties per collision. The maximum number of casualties involved in a collision was nine casualties, which occurred to the north of Farndon roundabout and involved four vehicles.

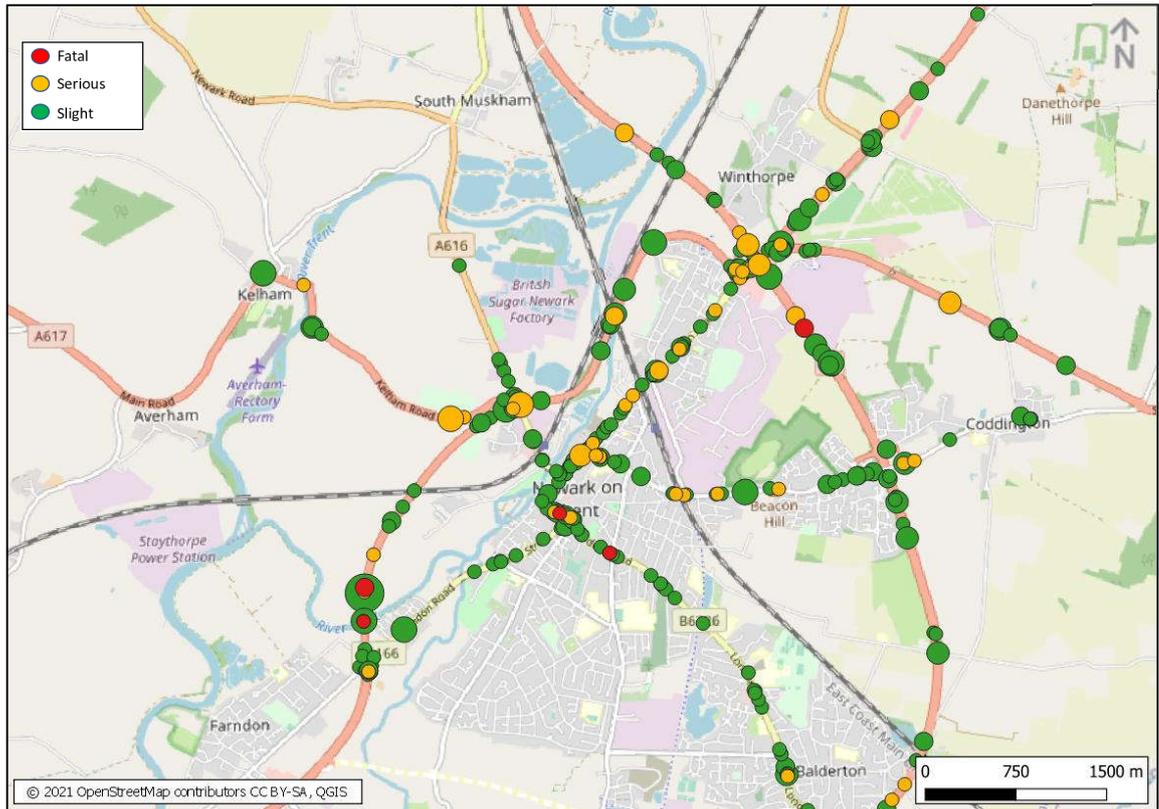


Figure 2-2: Location of casualties for collisions on the A46 (2015-2019)

2.5.9 Table 2-3 gives the number of collisions and casualties at each junction along the A46, as well as the average number of casualties per collision.

Table 2-3: Number of collisions and casualties for junctions on the A46 (2015-2019)

Junction	Number of Collisions	Number of Casualties	Average Casualties per Collision
Farndon Roundabout	15	17	1.13
Cattle Market Roundabout	37	50	1.35
A1 / A46 Roundabout	53	69	1.30
Winthorpe Roundabout	9	11	1.22
Total	114	147	1.29

2.5.10 Table 2-4 shows the number of casualties along the A46 by casualty type. There were no pedestrian collisions, as this road has limited pedestrian activity with no footways alongside the A46 on the section in the study area. The majority of casualties (80%) were car/van passengers, which is as expected as these make up the majority of the traffic flow. Over 12% of the casualties were motorcyclists, suggesting that they could be vulnerable on this road.

2.5.11 There were seven cyclist casualties, five of which occurred at the Cattle Market roundabout and two of which occurred at the A1/A46 junction.

Table 2-4: Number of casualties on A46 by casualty type (2015-2019)

Casualty Type	Number of Casualties
Pedestrian	0
Cyclist	7
Horse rider	0
Mobility scooter rider	0
Motorcyclist	23
Car/Van Passenger	171
Goods and Agricultural Passengers	7
Other vehicle occupant	0
Minibus	0
Bus/Coach	0
Total	208

Summary

- 2.5.12 Using the DfT STATS19 dataset, the analysis considers the current situation (2015-2019) regarding collisions on the A46 between and including the Farndon roundabout and the Winthorpe roundabout.
- 2.5.13 The four junctions were found to have 114 collisions in total, amounting to over 70% of the accidents that occurred on this section of the A46.
- 2.5.14 There were no pedestrian casualties on the A46, due to the limited pedestrian activity; however, there were seven cyclist casualties, which occurred at the Cattle Market roundabout and the A1/A46 junction.

Journey Time Reliability

- 2.5.15 Trafficmaster data provided by the DfT, covering the period from January to September 2017, for the counties of Derbyshire, Nottinghamshire, Lincolnshire and South Yorkshire was analysed to understand the size and variation in journey times along the A46 corridor. The Trafficmaster dataset collects Global Positioning System (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).
- 2.5.16 The A46 journey time route shown in Figure 2-3 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 Northern Bypass scheme location.



Figure 2-3: A46 journey time route

2.5.17 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.

2.5.18 Several timing points have been selected along the route (Figure 2-3), to enable journey time calculations between major junctions.

2.5.19 Table 2-5 presents the mean observed journey times for the A46 corridor route, derived from the Trafficmaster data.

Table 2-5: 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)

2.5.20 The A46 route from the Dalby Interchange to Riby, 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.

2.5.21 The distance-time graph for the A46 route (presented in Figure 2-4 and Figure 2-5) demonstrates additional delay of approximately three minutes during the PM peak period at the north-eastbound approach of the A46/A57 junction at Lincoln, and two minutes during the AM peak at the south-westbound approach. The south-westbound approach of the A46/A617 Cattle Market roundabout is also experiencing two minutes longer travel time during the AM peak, compared to the inter-peak. These delays are absent in the inter-peak periods, accounting for most of the difference in observed journey times for the route.

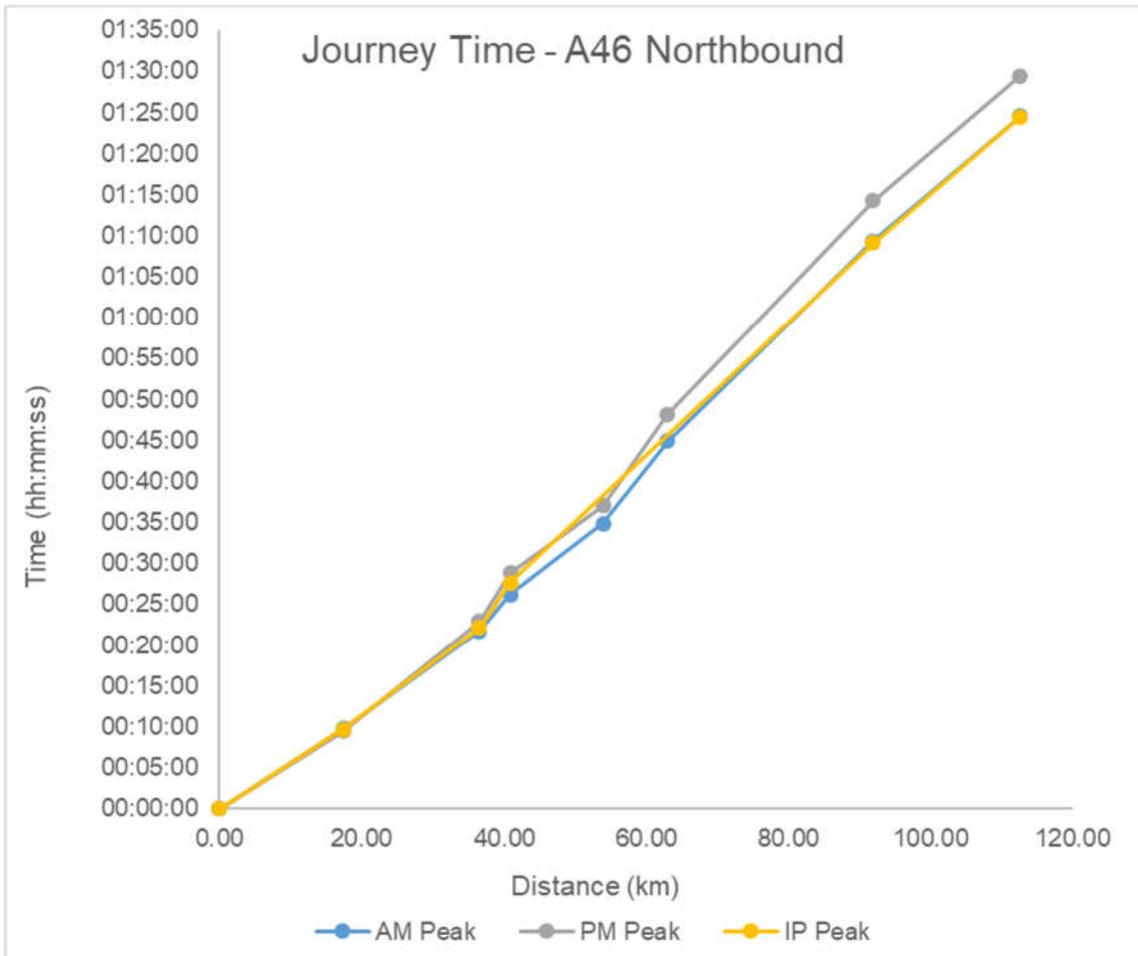


Figure 2-4: Journey time – A46 northbound

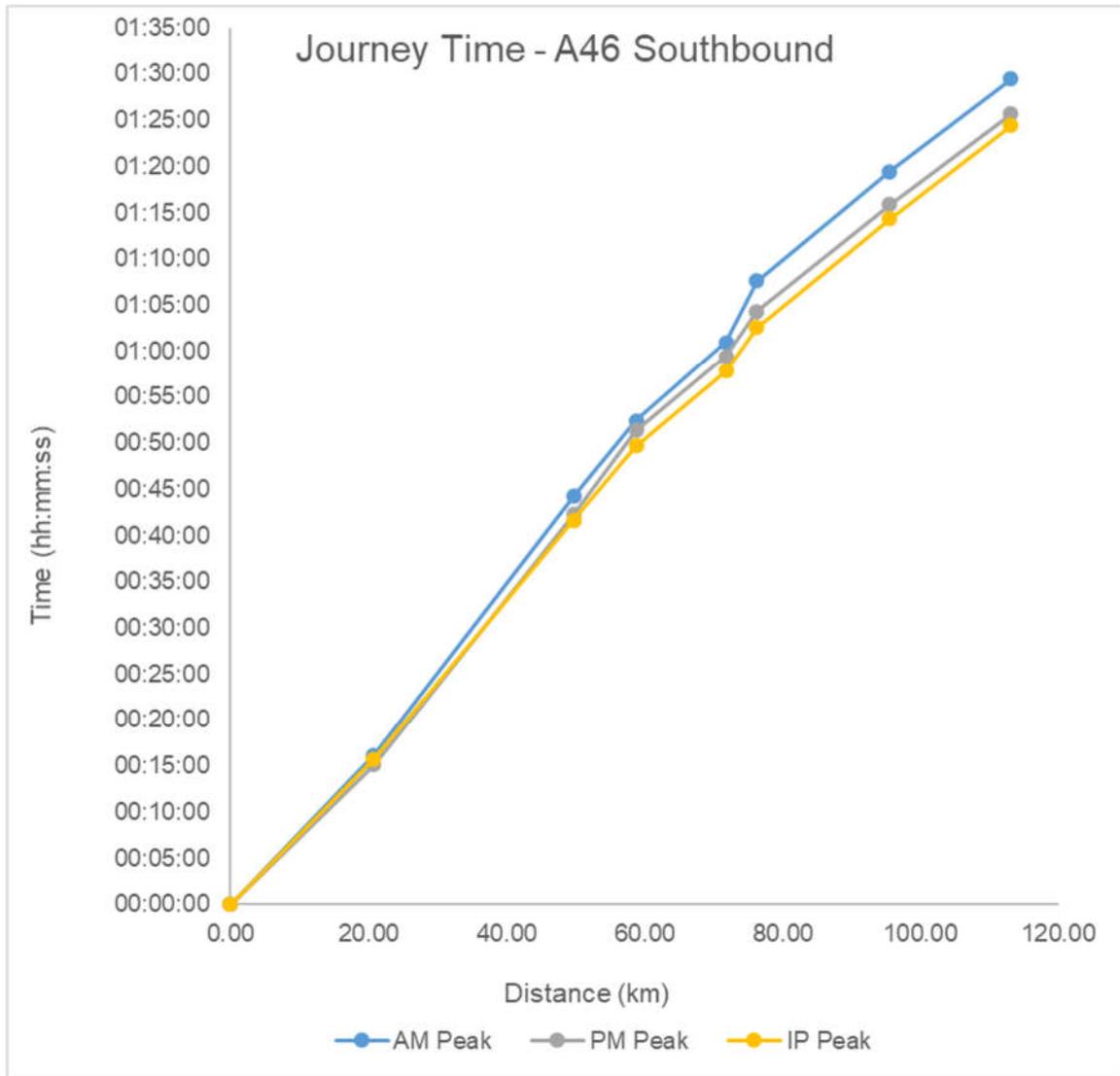


Figure 2-5: Journey time – A46 southbound

- 2.5.22 The standard deviation of the data, shown in Table 2-6, expresses the spread of the data and is given in minutes, which provides a measure of the level of reliability, with a low standard deviation giving an indication of good reliability and a high standard deviation reflecting poor reliability.
- 2.5.23 High standard deviations in journey time data can occur along the links that correspond to congested road sections. The large spread of times due to delays that occur only during specific peak times can give an average journey time far higher than the median. Within congested and urban areas, median journey times are often used as they better represent ‘typical’ network conditions.

Table 2-6: Observed cumulative journey time

Direction	Timing Point	Distance (km)	AM			IP			PM			
			Speed (kph)	Mean Time (hh:mm:ss)	Standard Deviation (hh:mm:ss)	Speed (kph)	Mean Time (hh:mm:ss)	Standard Deviation (hh:mm:ss)	Speed (kph)	Mean Time (hh:mm:ss)	Standard Deviation (hh:mm:ss)	
Northbound	A46/A6006											
	A46/A52	17.35	107	00:09:45	00:00:19	108	00:09:41	00:00:19	110	00:09:27	00:00:18	
	A46/A617	36.53	101	00:21:44	00:00:41	99	00:22:09	00:01:42	95	00:22:57	00:02:13	
	A46/A1133/Drove Ln	40.85	93	00:26:14	00:00:51	89	00:27:41	00:02:14	85	00:28:54	00:02:39	
	A46/Newark Rd/Middle Ln	53.94	93	00:34:56	00:01:15	91	00:35:44	00:02:15	87	00:37:05	00:02:44	
	A46/A57	62.95	84	00:44:58	00:02:14	86	00:44:08	00:02:27	78	00:48:11	00:03:35	
	A46/A1103	91.89	79	01:09:23	00:02:20	80	01:09:08	00:02:44	74	01:14:19	00:04:00	
	A1173/A18	112.59	80	01:24:31	00:02:23	80	01:24:26	00:02:47	76	01:29:26	00:04:01	
	A1173/A18											
	A46/A1103	20.72	77	00:16:11	00:00:30	79	00:15:46	00:00:28	82	00:15:08	00:00:29	
Southbound	A46/A57	49.71	67	00:44:15	00:02:19	72	00:41:40	00:01:30	71	00:42:15	00:02:35	
	A46/Newark Rd/Middle Ln	58.74	67	00:52:27	00:02:24	71	00:49:41	00:01:37	69	00:51:25	00:02:47	
	A46/A1133/Drove Ln	71.85	71	01:00:57	00:02:27	74	00:57:52	00:01:38	72	00:59:28	00:02:48	
	A46/A617	76.25	68	01:07:37	00:02:58	73	01:02:37	00:01:42	71	01:04:20	00:02:51	
	A46/A52	95.49	72	01:19:26	00:03:00	77	01:14:20	00:01:45	75	01:15:54	00:02:53	
	A46/A6006	113.08	76	01:29:28	00:03:01	80	01:24:25	00:01:47	79	01:25:41	00:02:54	

2.6 Existing Engineering Conditions

Topography

- 2.6.1 The existing A46 is on an embankment of varying height across the flood plains of the River Devon at 15 m above ordnance datum (AOD), and the River Trent that falls from 15 m AOD north of Farndon in the south-west to 10 m AOD north-west of the market town of Newark-on-Trent. The Nottingham to Lincoln railway line and the East Coast mainline are also on a raised embankment across the flood plain. The Severn Trent Water sewage works and areas of industrial development like the British Sugar Factory are located at around and just above 10 m AOD.
- 2.6.2 Newark-on-Trent lies on slightly raised ground at above 15 m AOD, which continues to rise to 45 m AOD to the north-east at Beacon Hill before dropping to 15-20 m AOD in the vicinity of Newark Showground and the village of Winthorpe. The undulating landform gently rises above the Trent flood plain to the west up to 50 m AOD and up to 70 m AOD to the north-west of the village of Kelham.

Existing Highway Features

Street Lighting

- 2.6.3 The section of the A46 between Farndon roundabout and Brownhills roundabout is largely unlit, with the exception of lighting on the immediate approaches to the roundabouts. The section between Friendly Farmer roundabout and Winthorpe roundabout is fully lit with twin-bracket lighting columns positioned in the central reservation at approximately 40 m spacings.

Road Restraint System

- 2.6.4 Steel safety barriers are installed along the majority of the route. Along the single carriageway section, between Farndon roundabout and Brownhills roundabout, there are sections of barrier positioned within the nearside verge. Along the dual carriageway section, between Friendly Farmer roundabout and Winthorpe roundabout, a safety barrier runs for the full length on both sides of the central reserve. There are additional sections of safety barrier located sporadically along the route, in locations where there are specific hazards including, but not limited to, traffic signs and embankments.

Traffic Signs

- 2.6.5 Existing signs are located at several locations within the scheme extents. Most notably, large advance direction signs are present on the approaches to the four junctions. Other directional, informatory, warning and regulatory signs provide information to motorists for local directions, tourist destinations, pedestrian facilities and speed restrictions, amongst others.

Lay-bys

- 2.6.6 There are four lay-bys located on the A46 mainline that are designated for parking. One is located adjacent to the northbound carriageway on the approach to Cattle Market roundabout, two are adjacent to the southbound carriageway, one on the approach to Cattle Market roundabout and the other approximately

mid-way between Farndon roundabout and Cattle Market roundabout. The last lay-by is located adjacent to the A46 northbound carriageway on the approach to Brownhills roundabout.

Existing Structures

2.6.7 Several structures exist within the scheme extents; these take the form of highway bridges, underpasses and culverts.

2.6.8 The existing structures that are within the scheme extents are summarised in Table 2-7.

Table 2-7: Existing Structures

Location	Structure	Description
A46	Farndon underpass	This pedestrian/cycleway underpass is located immediately to the north of Farndon roundabout under the A46 carriageway. Precast and in-situ concrete elements form a box structure.
A46	Windmill Viaduct	This structure is located 250 m north of the Farndon roundabout and spans over the River Trent and flood plain. The steel-composite three span bridge is supported by intermediate piers and abutments with piled foundations.
A46	Pipe culvert No. 5	This corrugated-steel pipe flood relief structure is located approximately 500 m north of the Windmill Viaduct.
A46	Farm access underpass	This farm access underpass is located approximately 180 m to the north of Pipe culvert No. 5 under the A46 carriageway and is of in-situ concrete box construction.
A46	Pipe culvert No. 6	This corrugated-steel pipe culvert carries the Old Trent Dyke below the A46 and is located approximately 100 m north of the farm access underpass.
A46	Nottingham to Lincoln railway line west crossing	This three-span bridge is located 1.5 km north of Farndon roundabout and spans over a local track, the Nottingham to Lincoln railway line and a flood dyke with an adjacent accommodation track. The structure consists of precast concrete beams with an in-situ deck construction at an approximately 50° skew angle.
A46	Pipe culvert No. 7	This corrugated-steel pipe culvert is located approximately 300 m north of the Nottingham to Lincoln railway line west crossing.
A46/A616	Cattle Market flood relief culvert	This flood relief culvert crosses below the Cattle Market roundabout from the north-east to the south-west of the island. The culvert is constructed of twin reinforced concrete boxes.
A616	Cattle Market causeway arches	There are three sections of masonry arches located immediately to the north of the Cattle Market roundabout beneath the single-carriageway A616 Great North Road. Going north they consist respectively of one, nine and fifteen arches with brick spandrel walls, parapets and pilasters with stone copings. All three arch structures have been Grade II listed by Historic England in 1971.

Location	Structure	Description
A46	Pipe culvert No. 12	This corrugated-steel pipe culvert is located just to the west of the Nottingham to Lincoln railway line east crossing.
A46	Nottingham to Lincoln railway line east crossing	This bridge spans over the Nottingham to Lincoln railway line, approximately 400 m east of Cattle Market roundabout. It has a single simply-supported span of precast concrete beams with an in-situ deck construction, at an approximately 50° skew angle.
A46	Nether Lock Viaduct	Located approximately 1 km east of the Cattle Market roundabout, this structure carries the A46 over the River Trent and flood plain. The viaduct has five spans of steel-composite ladder deck construction supported by intermediate reinforced concrete columns and abutments with bearings.
A46	Nether Lock railway bridge	This bridge carries the A46 over the East Coast mainline and is located adjacent to the north abutment of the Nether Lock Viaduct. It consists of a single span precast concrete beam deck with an in-situ slab at a 48° skew angle. The south abutment is of cellular construction and is integral with the north abutment of the adjacent viaduct. There is also a section of reinforced concrete retaining wall approximately 40 m in length running from the north-west corner of the bridge and supporting the A46 carriageway.
A46	Sewage works access underpass	This underpass is located approximately 260 m to the north of Nether Lock railway bridge under the A46 carriageway. The structure is an in-situ reinforced concrete box.
A46	Pipe culvert No. 16	This corrugated-steel pipe culvert is located approximately 360 m north of the Sewage works access underpass.
A46	Winthorpe Road subway	This pedestrian/cycle underpass is located approximately 350 m to the north of the Brownhills roundabout under the A46. This underpass links housing to the south of the A46 to a farm access on the north side and beyond to Winthorpe village. The structure is of in-situ reinforced concrete box construction.

Highways Drainage

2.6.9 Existing highways drainage is based on available information on National Highways' Drainage Data Management System (HADDMS).

Surface Water Collection System

2.6.10 The existing highway surface water collection system consists of kerbs and gullies on the main line and a combination of combined kerb drainage systems and gullies at the junctions. The existing drainage to be retained shall be investigated in further detail at PCF Stage 3 (Preliminary Design) or when drainage survey information becomes available in accordance with CS 551 'Drainage Surveys' to determine whether existing drainage is in a suitable structural and service condition to be retained.

Sub-surface Carrier Drain Network

- 2.6.11 At the Option Selection stage there is limited information available on the existing sub-surface carrier drain network. Further inspection of the HADDMS database indicated that for a large part of the road network, gullies are draining directly into ditches at the toe of embankment. It is, therefore, assumed that for these sections there are no existing longitudinal carrier drains.
- 2.6.12 The existing carrier drains and highway drainage ditches to be retained shall be investigated in further detail at PCF Stage 3 (Preliminary Design) or when drainage survey information becomes available in accordance with CS 551 'Drainage Surveys' to determine whether existing drainage is in a suitable structural and service condition to be retained.

Technology

- 2.6.13 There are single Closed-Circuit Television (CCTV) cameras at Farndon and Cattle Market roundabouts and between the Brownhills roundabout and the crossing of the A1. These cameras are mounted on poles and can be slid down to ground level for maintenance purposes.
- 2.6.14 Rotating plank signs have been installed on the A616 and A46 approaches to the Cattle Market roundabout.
- 2.6.15 A CCTV camera is located alongside the A46 close to the Brownhills roundabout. These may be used to trigger adverse camber signs, warning goods vehicle drivers to reduce their speed on the northbound approach to the Brownhills roundabout.
- 2.6.16 A set of traffic loops, powered by solar panels, is present between Cattle Market roundabout and Brownhills roundabout.

Public Utilities

- 2.6.17 An initial utility search was undertaken to identify the presence of utility providers' equipment within the vicinity of the proposed search area (Figure 2-6).
- 2.6.18 30 statutory undertakers and other third-party organisations were contacted to investigate existing public utilities; of these, 20 confirmed that they have equipment in the search area.
- 2.6.19 A review of the information received from the utility providers identified the following assets within the study area:
- Electricity Transmission Tower.
 - High voltage electricity cables.
 - Low voltage electricity cables.
 - Oil pipeline.
 - Gas mains.
 - Foul sewers.
 - Water mains.
 - Telecommunication cables.

- Street lighting infrastructure.
- Highway drainage infrastructure.

2.6.20 These utilities exist predominantly in the vicinity of the Farndon, Cattle Market and Winthorpe roundabouts along the A46 mainline.



Map data: ©2019 Google

Figure 2-6: A46 Newark Northern Bypass Utility Search Area

Maintenance and Repair Statement

Current Maintenance

2.6.21 National Highways is the highway authority (on behalf of the Secretary of State) for the A46 and, via the East Midlands Asset Delivery team, is responsible for the operation, maintenance and improvement works on the A46. Its remit includes:

- Incident response service.
- Highways, footway and cycleway general maintenance.
- Bridge general maintenance.
- Street lighting and road sign maintenance.
- Winter salting and snow clearance.
- Verges and landscape maintenance.

- Highway improvements and safety measures.
- Traffic management.
- Authorising skips and scaffolding.
- Approving abnormal load movements.
- Technical surveys.
- Liaising with police, local authorities and utility companies.
- Liaising with residents and the general public.

2.6.22 There are no known traffic management restrictions for maintenance, other than the high volumes of traffic and delays currently experienced by road users within the study area.

Winter Maintenance

2.6.23 National Highways undertakes winter maintenance, such as gritting, on the A46.

Programmed Works

2.6.24 National Highways has a forward programme of maintenance and upgrade works that include, but are not limited to:

- Structures.
- Road pavement.
- Drainage.
- Street lighting.
- Road markings, traffic signs.
- Traffic signals.

2.6.25 The programme of works has not been reviewed as part of this report. Short-term maintenance activities and inspections will continue as expected on the all-purpose trunk road network.

Existing assets

2.6.26 Routine maintenance and programmed works for drainage, structures and the road pavements are part of the normal activities for National Highways as the operator and maintainer for the asset, although this has not been reviewed as part of this report.

2.6.27 Street lighting systems exist at:

- Farndon roundabout.
- Cattle Market roundabout.
- A1/A46 junction.
- Winthorpe roundabout.

2.6.28 These systems cover the circulatory carriageway and a short length on each approach/exit arm, although the street lighting is continuous along the A46

between the Friendly Farmer roundabout (A1/A46 junction) and Winthorpe roundabout.

- 2.6.29 Throughout the scheme extents, at junctions on the A46 there are bollards on the roundabout splitter islands/central reserves and many of these are illuminated from the bases. In addition, there are several regulatory and warning signs that are illuminated.
- 2.6.30 Routine maintenance and programmed works for street lighting are part of the normal activities for National Highways as the operator and maintainer for the asset.

2.7 Existing Environmental Conditions

- 2.7.1 This section summarises the existing conditions relating to the environmental status of the area. The main environmental features and designations within the study area are shown on the Environmental Constraints Plan (see Appendix A).

Air Quality

- 2.7.2 The local air quality study area is defined as the area within 200 m of the Affected Road Network (ARN). The ARN includes sections of the following key roads: A46, A617, A1 and A17.
- 2.7.3 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 South Kesteven District Council AQMA no.6. This AQMA is located 1.8 km east of the air quality study area and encompasses residential properties along Manthorpe Road, Wharf Road, High Street and London Road through Grantham.
- 2.7.4 There are two statutory designated ecological sites within the air quality study area (Twenty Acre Piece Site of Site of Special Scientific Interest (SSSI) and Devon Park Pastures Local Nature Reserve (LNR)). There are 34 Local Wildlife Sites (LWSs) within 200 m of the ARN.
- 2.7.5 There is a single link within Defra's pollution climate mapping (PCM) in the vicinity of the air quality study area located on the A1 and three PCM links on the A607 Harlaxton Road at Grantham within the air quality study area. The Department for Environment, Food and Rural Affairs (Defra) PCM model data (2018 reference year) indicates that there are no roadside exceedances of the annual mean nitrogen dioxide (NO₂) limit value in the air quality study area in either 2018 or the scheme opening year of 2028.

Cultural Heritage

Designated Heritage Assets

- 2.7.6 The Cultural Heritage study area (1 km buffer from the scheme) contains a landscape dense in cultural heritage, including Scheduled Monuments, Listed Buildings, a Registered Park and Garden, and Conservation Areas.
- 2.7.7 There are 13 Scheduled Monuments located within the study area that include Newark Castle and Town Wall as well as many assets associated with the Civil War

- 2.7.8 One Registered Park and Garden, the Grade II Newark Castle Garden, is located within the study area and is partially concurrent with the Newark Castle Scheduled Monument.
- 2.7.9 The study area includes Newark, Winthorpe and Farndon Conservation Areas.
- 2.7.10 There are 350 Listed Buildings within the study area including concentrations within the historic cores of Newark-on-Trent and Winthorpe, with a number also outside these centres. Of the Listed Buildings there are six Grade I listed, 14 Grade II* listed with the remaining 332 Grade II listed.
- 2.7.11 The vast majority of Grade II Listed Buildings are residential (either former or current), commercial and civic buildings within the centre of Newark-on-Trent, or the Winthorpe Conservation Area, and date from the 18th and 19th centuries. Exceptions to this are the structures associated with the Great North Road and the bridges over the River Trent.
- 2.7.12 The River Trent has a long history of catastrophic floods, resulting in few bridges being built for crossings, with fords and ferries being the historically preferable options for crossing. In 1770, John Smeaton designed a causeway across the floodplain that allowed travellers to cross the entirety of the river and floodplain by road at any time of the year. Nine of the arches, culverts and causeway structures designed by John Smeaton are located within the study area. Four of these structures are within the footprint of the scheme.

Non-designated Heritage Assets

- 2.7.13 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 600 individual records are located within this study area, relating to all periods of human occupation.
- 2.7.14 The Nottinghamshire Historic Landscape Characterisation project (Nottinghamshire County Council, 2016³) 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.
- 2.7.15 With regards to Palaeolithic period (500,000 – 9,500 BC) archaeology, at the southern end of the scheme, lies the late Upper Palaeolithic site of Farndon Fields (M3571). This site, first identified through fieldwalking activities in 1991, is one of the few open-air, late Upper Palaeolithic sites in Britain. It is also one of the most studied due to investigations undertaken as part of the A46 widening to the south. Similar geological conditions to those at Farndon Fields extend into the current study area. If late Upper Palaeolithic activity was occurring nearby, additional sites such as Farndon Fields may be encountered. Should the level of preservation be similar to that at Farndon, such sites would be considered of national or even international importance.

³ http://archaeologydataservice.ac.uk/archives/view/notts_hlc_2016/index.cfm, accessed 17 April 2018

Landscape and Visual

- 2.7.16 At a national landscape scale, the landscape study area (2 km buffer of the scheme) is located within the Trent and Belvoir Vales National Character Area (NCA) 48.⁴ 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.
- 2.7.17 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 (adopted December 2013)⁵, which further subdivides each of these LCA into policy zones and includes a landscape analysis for each policy zone:
- Trent Washlands.
 - East Nottinghamshire Sandlands.
 - South Nottinghamshire Farmlands.
- 2.7.18 In terms of visual amenity, receptors within the scheme's visual study area (1 km) include:
- Residential properties:
 - 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.
 - Residents on the western edge of Hawton village.
 - Recreational users of the extensive network of Public Rights of Way (PRoW):
 - Walkers, cyclists and equestrians using Trent Valley Way, a long-distance walking route and National Cycle Route 64.
 - Recreational users of other Public Footpaths and permissive routes.

⁴ <http://publications.naturalengland.org.uk/publication/7030006>

⁵ [Newark and Sherwood Landscape Character Assessment Supplementary Planning Document](#)

- Users of Holme Marsh Registered Common Land, Farndon Ponds and Devon Park Pastures LNRs.
- Users of recreational facilities:
 - Visitors to Newark Air Museum.
 - Visitors to Newark Castle Scheduled Monument and Registered Park and Garden.
 - Recreational users of the River Trent navigation channel and marina.

Biodiversity

- 2.7.19 There are no European sites or SSSIs within 2 km of the scheme. There are also no European sites where bats are one of the qualifying features within 30 km of the scheme.
- 2.7.20 There is one SSSI within 200 m of the air quality ARN. This is Twenty Acre Piece SSSI, which is designated for its lowland neutral grassland⁶. The SSSI is located adjacent to the A46, approximately 35 km south-west of the scheme. There are two LNRs within 2 km of the scheme. There are no other statutory designated nature conservation sites within 2 km of the scheme. The scheme is not within a SSSI Impact Risk Zone.
- 2.7.21 There are 23 LWSs within 1 km of the scheme. An additional 34 LWSs are within 200 m of the air quality ARN.
- 2.7.22 A review of the Woodland Trust's Ancient Tree Inventory website has identified a pedunculate oak of 'veteran status' within 200 m of the air quality ARN at Coddington. A pedunculate oak of 'notable status' has been identified, associated with Winthorpe House. As a 'notable' tree it does not have obvious ancient or veteran tree characteristics; however, 'notable trees' are usually of worthy of recognition and can be potential, next generation veteran trees.
- 2.7.23 The desk study identified the following four priority habitat types (as listed in Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006) within 1 km of the scheme:
- Lowland mixed deciduous woodland.
 - Wood-pasture and parkland.
 - Coastal and floodplain grazing marsh.
 - Traditional orchards.
- 2.7.24 The River Trent and its floodplain is a key feature of the landscape within Trent and Belvoir Vales NCA and it is the NCA's greatest source of biodiversity. These are habitats identified within the Nottinghamshire Local Biodiversity Action Plan⁷.
- 2.7.25 The pastoral farmland centred around the Cattle Market junction comprises fields of unimproved and semi-improved neutral grassland, some of which comprise a

⁶<https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1002040&SiteName=Twenty+Acre+Piece&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=>

⁷<https://www.newark-sherwooddc.gov.uk/media/newarkandsherwood/imagesandfiles/planningpolicy/pdfs/nottslbap/CD4%20Notts%20LBAP.pdf>

network of LWSs, e.g. Great North Road Grasslands LWS and Kelham Road Grassland II LWS.

2.7.26 Woodland is largely restricted to broadleaved plantations on National Highways soft estate.

2.7.27 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, 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.

2.7.28 The potential presence of badgers and invasive non-native species (e.g. Japanese knotweed), both of which can be a significant constraint during construction, have been identified.

Geology and Soils

2.7.29 The existing baseline has been informed by review of freely available, on-line data sources as well as the Envirocheck Report⁸ purchased for the scheme.

2.7.30 The study area for land contamination comprises the scheme with an additional 250 m buffer from the scheme boundary. The study area for the consideration of effects on agricultural soil and Best and Most Versatile (BMV) land is the engineering footprint of the scheme. BMV land corresponds to the Ministry of Agriculture, Fisheries and Food's 1988 Agricultural Land Classification (ALC) Grades 1, 2 and Subgrade 3a⁹, as defined in paragraph 112 and Annex 2 of the National Planning Policy Framework (NPPF) and Natural England's Technical Information Note 049 (2012)¹⁰.

2.7.31 Topography within the scheme ranges from 11 m to 15 m AOD.

⁸ Landmark Information Group, Envirocheck Report (order no:172582399_1_1 dated 9/07/2018, received June 2018)

⁹ Ministry of Agriculture, Fisheries and Food (1988). Agricultural Land Classification of England and Wales. Revised Guidelines and Criteria for Grading the Quality of Agricultural Land.

<http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/foodfarm/landmanage/land-use/documents/alc-guidelines-1988.pdf> (accessed March 2017)

¹⁰ Natural England (2012) Technical Information Note 049 (TIN049), Agricultural Land Classification: on protecting the best and most versatile agricultural land.

<http://publications.naturalengland.org.uk/file/4424325> (November 2018)

- 2.7.32 Made Ground is not mapped within the study area and is not recorded in the historic boreholes, where available for review. However, it is anticipated to be present in areas of previous and existing development and along the existing highways.
- 2.7.33 The available British Geological Survey (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.
- 2.7.34 Localised superficial deposits comprise alluvium, associated with the River Trent, across the central part of the scheme, and Balderton and Holme Pierrepont Sand and Gravel members at the northern and southern ends.
- 2.7.35 The scheme is situated in an area predominantly classified as loamy and with clayey floodplain soils with naturally high groundwater. Near the A1/A46 junction 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.
- 2.7.36 An ALC soil survey of the scheme study area has shown that in the north of the study area, Subgrade 3a (BMV) and Subgrade 3b (non-BMV) is present. Progressing south in the study area, the land continued to vary between Subgrade 3b and Subgrade 3a, with a few Grade 2 survey points, but non-BMV (Subgrade 3b) dominated the study area.
- 2.7.37 Within the study area there are the following potential contaminative land uses:
- Three fuel stations in the vicinity of the A1/A46 interchange and at Farndon roundabout.
 - Two railway lines, The East Coast mainline, (previously the Great Northern Railway) that crosses the A46 near the centre of the scheme; and the Nottingham to Lincoln railway (Midlands Railway) that crosses the scheme in two locations - in the central and southern sections.
 - Industrial sites including:
 - The British Sugar Factory, including a small 0.164 ha historical landfill area, located immediately east of the Great North Road and north-west of the Cattle Market junction.
 - Briggs scrap metal merchants located immediately west of the Great North Road.
 - DX Freight Service Centre just east of the East Coast mainline.
 - Severn Trent Water sewage works adjacent to the northern boundary of the scheme at Crankley Point.
 - Newark Lorry Wash and associated freight services located approximately 100 m south-east of Cattle Market junction.
 - Numerous farms are located in close proximity to the study area and are assumed to be operational farmsteads.
- 2.7.38 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.

- 2.7.39 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.

Waste and Materials

- 2.7.40 Material assets and waste capacity of waste management facilities form the basis of the existing conditions.

Material assets baseline

- 2.7.41 It is assumed that the types of materials to be used for the Scheme are aggregates, asphalt, concrete and steel with the types of waste being the same with the addition of soil (from excavations) and municipal waste (from littering).
- 2.7.42 The quantities of both material assets and waste are assumed to be low, based on experience from previous schemes.
- 2.7.43 Key construction materials required for the Scheme are not readily available however they would be available from demolition of structures and excavations.

Mineral Safeguarding Area (MSA)

- 2.7.44 The new Nottinghamshire Minerals Local Plan (adopted March 2021)¹¹ does not show the scheme going through any MSAs.

Landfill capacity and waste infrastructure baseline

- 2.7.45 The Construction Demolition and Excavation (CD&E) waste generated by the scheme will predominantly be non-hazardous and inert, with small quantities of hazardous waste (e.g. paints, solvents and contaminated soil).
- 2.7.46 The amount of landfill capacity and waste infrastructure in the study area will fluctuate year on year, based on the number, type and size of construction projects underway. This in turn is heavily influenced by factors such as the economic situation, investment levels and legislative and policy variations.
- 2.7.47 The baseline for landfill capacity and waste infrastructure for the East Midlands was calculated using Environment Agency (EA) data.

¹¹ <https://www.nottinghamshire.gov.uk/media/3656729/countycouncilreportappendixb.pdf>

Table 2-8: Landfill capacity baseline

Waste Stream	East Midlands (m ³)
Inert and non-hazardous	49,582,761
Hazardous	1,049,860

Table 2-9: Waste infrastructure capacity baseline

Waste Stream	East Midlands (tonnes)
Inert and non-hazardous	4,243,730
Hazardous	134,344

Noise and Vibration

- 2.7.48 The land use within 600 m of A46 is a mixture of residential (on the edge of Newark-on-Trent, and at Winthorpe and Farndon) plus agricultural and industrial areas.
- 2.7.49 Noise Important Areas (NIAs) were identified to highlight any particular constraints on the scheme area. These are the areas where 1% of the population are affected by the highest noise levels from major roads, located according to the strategic noise mapping undertaken by Defra under the terms of the Environmental Noise (England) Regulations 2006, as amended.
- 2.7.50 NIAs are located along the A1, A46, A617, Fosse Road and East Coast mainline.

Population and Human Health

Private Dwellings

- 2.7.51 The existing A46 in this area forms the northern boundary of the town of Newark-on-Trent. Many residential properties are located within the study area. These include properties in north Newark and Winthorpe.
- 2.7.52 The following are key receptors associated with the scheme: west of Great North Road (north of Kelham Road), Farndon Road, north of Farndon roundabout, Bridge House, Brae Barn, The Lodge, Kelham Lane, and Tolney Lane.

Community Assets

- 2.7.53 Newark-on-Trent and the surrounding location benefits from numerous community assets including schools, healthcare facilities, a post office, places of worship and recreational, sporting or other outdoor assets. A number of assets are located within 500 m of the scheme.
- 2.7.54 There are also likely to be additional community asset receptors that have catchment areas that extend to within 500 m of the scheme.

Local Businesses

- 2.7.55 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 necessarily limited to fuel stations, multiple retail outlets, a hotel and several restaurants.

Development Land

- 2.7.56 The Newark and Sherwood Allocations and Development Management Development Plan Document (DPD) (adopted July 2013)¹² allocates five site specific policy allocations in the vicinity of the scheme.
- 2.7.57 There are also multiple existing planning permission sites within 500 m of the scheme. A site visit to these planning permission sites will be required as part of the next stage of the scheme development to establish the extent of the implementation.

Walkers, Cyclists and Horse Riders

- 2.7.58 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 the A46 north of Newark-on-Trent.
- 2.7.59 There are seven rights of way that are affected by the scheme, due to either reduced amenity or increased severance.
- 2.7.60 There are five PRow that 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.

Vehicle Travellers

- 2.7.61 The current conditions for vehicle travellers are characterised by congestion at the various junctions along the A46. Driver stress, as a result, is exacerbated by the overall inability to move freely at peak times.

Road Drainage and the Water Environment

- 2.7.62 The Road Drainage and the Water Environment study area consists of a 1 km buffer around the boundary of the scheme.
- 2.7.63 There are five Main Rivers located in the study area. Two of these are crossed by the existing A46. These Main Rivers are reported reaches under the Water Framework Directive (WFD) and fall within the Humber River Basin District (RBD). Under the WFD, certain watercourses are monitored and assigned a status based on their existing conditions. They are also assigned an objective status that is the target to achieve in the future. These watercourses are known as WFD reported reaches. Any development must ensure it does not cause deterioration to these existing conditions or prevent the watercourses reaching their objective status. Therefore, any WFD-reported reaches within the study area must be identified.
- 2.7.64 There are also ordinary watercourses located within the study area, some of which are also crossed by the existing A46. Some of these ordinary watercourses are maintained by the Trent Valley Internal Drainage Board.
- 2.7.65 There are no WFD lake waterbodies in the study area. However, there are numerous non-WFD lakes located in study area.
- 2.7.66 Almost the entire study area to the north-west of the A46 is within Flood Zones 2 and 3. These Flood Zone extents are associated with the River Trent, the River

¹² [Newark and Sherwood Allocations and Development Management Development Plan Document](#)

Trent (Newark Branch), and The Fleet. In the southern extent of the study area there are also Flood Zones 2 and 3 extents associated with the River Devon and Middle Beck. Areas of surface water flood risk are also present, these include (but are not limited to) the watercourses in and around the study area.

Climate Effects

- 2.7.67 It is acknowledged that total global greenhouse gas (GHG) emissions from all sources amount to approximately 50 billion tonnes of carbon dioxide equivalent (CO_{2e})¹³. However, it is not considered representative to compare any UK scheme against this, as the contribution of any one scheme will always be negligible. Instead, it is considered most appropriate to use the national baseline for comparison as its magnitude is more relevant and UK specific. The UK is the world's eighth largest emitter of CO_{2e}, with the total background UK emissions for 2019 (the last reported year), being 455 million tonnes of CO_{2e}¹⁴.
- 2.7.68 Through the Climate Change Act, the government is committed to reducing UK emissions by at least 80% of 1990 levels by 2050. To meet this target, a set of carbon budgets, which currently run to 2037, have been set. These limit the amount of greenhouse gas the UK can legally emit in a five-year period.
- 2.7.69 With an Opening Year of 2028, operation of the scheme will fall in the fifth budget period and beyond. The budget for the fourth budgetary period is 1,950 million tonnes CO_{2e}; the budget for the fifth budget is 1,765 million tonnes CO_{2e}. In June 2019, a target of net zero carbon emissions by 2050 was enshrined in UK law. Recommendations for the 6th Carbon budget (for period 2033-2037) were published by the Climate Change Committee (CCC) in December 2020¹⁵. However, this currently has the status of advice to Government and is not legislated. The following existing sources of operational greenhouse gas emissions are relevant in the consideration of effects on climate:
- Road users' vehicle emissions.
 - Maintenance and refurbishment of the infrastructure.
 - Operational energy use, for example lighting.
- 2.7.70 The total baseline carbon emissions for the area without a scheme being in place have been calculated as follows:
- 2028 Opening Year: 2,862,739 tonnes CO_{2e}
 - 2043 Design Year: 3,150,058 tonnes CO_{2e}¹⁶

Vulnerability to Climate Change

- 2.7.71 It is important to understand the current climate with regard to modelled projections of how it might change in the future.

¹³

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/776083/2017_Final_emissions_statistics_one_page_summary.pdf

¹⁴ 2019 UK Greenhouse Gas Emissions, Final Figures (publishing.service.gov.uk)

¹⁵ <https://www.theccc.org.uk/news-insights/coming-up/#:~:text=The%20Sixth%20Carbon%20Budget%2C%20required,into%20law%20following%20that%20commitment>

¹⁶ The years presented are future years as it is necessary to assess any change in the baseline expected in the area for these years that will occur in these years once the scheme is operational

- 2.7.72 Baseline climate conditions have been presented for the period 1981 to 2010, using regional historical weather data provided by the Met Office. The data shows that the climate in the study area is one of relatively mild winters and warm summers. Across the timeseries, 1981-2010, peak summer (July) average maximum temperatures of 22 °C in the study area are above average for the UK, 20 °C. Meanwhile, rainfall in the study area was found to be low with little seasonal variation. The long-term average monthly rainfall in the study area is notably below average for the UK. February was found to historically have the lowest average monthly rainfall, 1.6 mm. For comparison, across the whole UK between 1981 to 2010, the lowest average February monthly rainfall was 1.5 mm, the average was 2.8 mm and the highest February average was 5.2 mm.
- 2.7.73 Climate projections from the Met Office (UKCP18¹⁷) were used to understand possible future changes to the climate in the vicinity of the scheme. The models showed that the East Midlands region, in which the scheme is situated, is likely to experience hotter and drier summers and warmer, wetter winters. Alongside these changes in average conditions, it is also found that climate change may also alter the frequency and severity of extreme weather events, such as heavy rainfall, storms and heatwaves.

2.8 Social Conditions

Land Use, Property and Industry

- 2.8.1 Between Farndon and Winthorpe roundabouts, the landscape comprises 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 a variety of wetland habitats.
- 2.8.2 The A46 forms the northern boundary of the market town of Newark-on-Trent in Nottinghamshire, with community facilities and many residential properties located in the vicinity, and several local businesses (including service stations) centred around junction locations. Urban fringe and industrial development include: the British Sugar Factory; Briggs scrap metal merchants; Severn Trent Water Sewage Works; and Newark Lorry Wash and associated freight services.
- 2.8.3 North and south-west of the A46, the landscape transitions from urban fringe to an intensely farmed rural landscape with arable and livestock farms, several individual and groups of properties, and small settlements. These include the village of Farndon adjacent to the A46 and west of the Farndon roundabout; the village of Kelham approximately 1.5 km north-west of the Cattle Market roundabout, and Winthorpe that is located approximately 300 m to the north of the A1/A46 junction.
- 2.8.4 Extant planning permissions exist within 500 m of the A46 for unimplemented or partially implemented development. These include, but are not limited to, the construction of a hotel and its associated uses (i.e. parking and a new access road), demolition of existing buildings to construct a care home, a mixed-use commercial estate of up to 50 ha and two primary schools.

¹⁷ <https://www.metoffice.gov.uk/research/collaboration/ukcp>

Mining

2.8.5 The study area is not in an area that is affected by mining (The Coal Authority, 2018). The BGS Mineral Map 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.

2.8.6 A review of information held by Zetica for the study area has indicated that there is a low risk from unexploded ordinance (Zetica, 2018).

Accessibility

2.8.7 The area around the scheme has been the subject of a Walking, Cycling and Horse-Riding Assessment undertaken in accordance with HD 42/17 of the DMRB. This records the findings of the design team's work gathering information regarding the existing conditions for pedestrians, cyclists and equestrians, including the routes of existing facilities and their condition, other related factors such as local policies, public transport provision and recorded usage. The assessment also identifies a number of opportunities for improvements to facilities for these users for the design team to consider as the scheme design work starts. This section provides a brief summary of the findings of the Walking, Cycling and Horse-Riding Assessment.

Public Transport - Train

2.8.8 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 (shown on Figure 2-7):

- Newark Northgate Station on the East Coast mainline.
- Newark Castle Station on the Nottingham to Lincoln railway line.

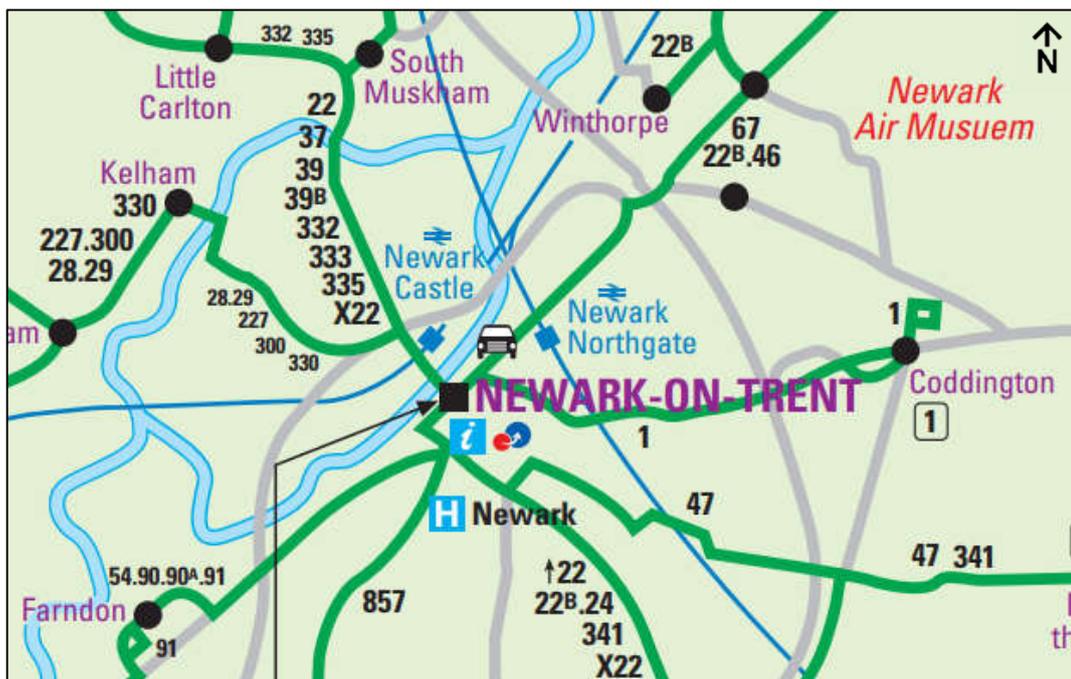


Figure 2-7: Extract of Nottinghamshire bus network map¹⁸

¹⁸ Nottinghamshire County Council: <https://www.nottinghamshire.gov.uk/media/109174/nottinghamshirecountybusmap.pdf>

Public Transport - Bus

- 2.8.9 Figure 2-7 provides an extract from the county bus network plan showing train lines and stations, and bus services within Newark-on-Trent.
- 2.8.10 The main hub for buses is the bus station, which is located off Lombard Street to the south of the town centre; an 11-minute walk from Newark Castle station, and 17 minutes from Northgate Station.
- 2.8.11 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.
- 2.8.12 Local services cross the A46 at Cattle Market roundabout and Farndon roundabout.

Severance

- 2.8.13 The PRoW network in the Newark-on-Trent area is presented in Figure 2-8. There are four crossings of the A46 that are a part of the PRoW network:
- Underpass – River Trent path – a bridleway passing under the river crossing near Farndon.
 - At grade uncontrolled crossing – a little used footpath between Newark-on-Trent and Kelham with the crossing coinciding with a northbound lay-by.
 - Underpass – River Trent path – a bridleway passing under the river crossing near the water treatment works.
 - Underpass – a little used footpath adjacent to the water treatment works.
- 2.8.14 Further opportunities for pedestrians and cyclists to cross the A46 exist through footways/shared-use paths (SUPs) alongside highway links:
- At grade, controlled crossing – at Cattle Market roundabout.
 - Underpass – SUP link on lane between Newark-on-Trent and Winthorpe (Trent Valley Way).
- 2.8.15 The A46 severs a key employment site – British Sugar – from Newark-on-Trent. The British Sugar site is located on the A616 Great North Road north of Cattle Market roundabout. An existing Toucan crossing is provided on the eastern arm of Cattle Market roundabout, although vehicles pass through the crossing at speed and are known to regularly pass through red signals, meaning extreme caution must be used when using the crossing. The quality of onward links on either side of the A46 would benefit from improvement.
- 2.8.16 Key links between Winthorpe, Farndon and Newark-on-Trent are also served by grade separated crossings via underpasses under the A46 – each is of adequate width and although some personal safety concerns will reduce the amenity of the crossing for some users, the separation from traffic is a key benefit at these locations.
- 2.8.17 All other crossings serve rural routes with a primary leisure purpose and do not link significant origins and destinations.

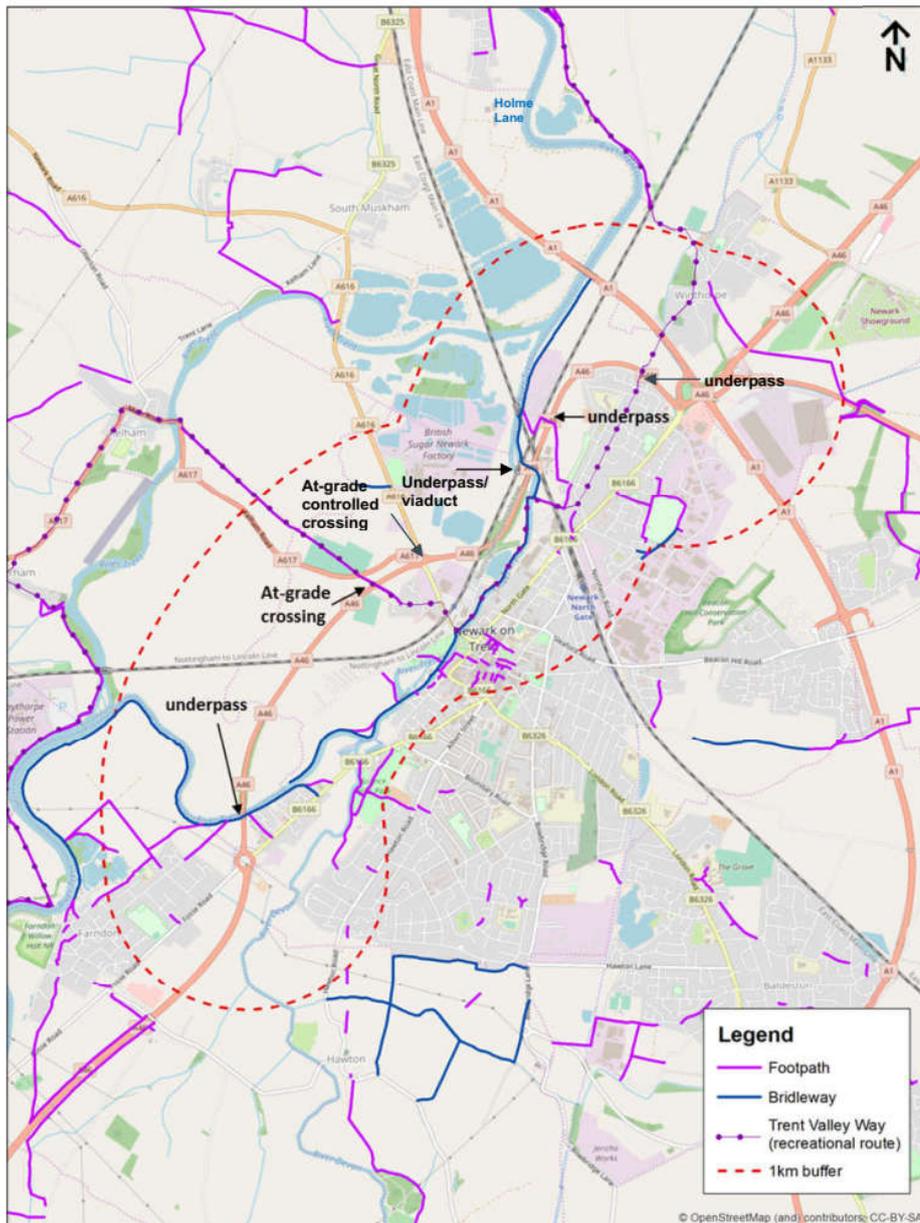


Figure 2-8: Public Rights of Way

Integration

Land Use Policy

- 2.8.18 The A46 Newark Northern Bypass scheme is located within the boundaries of Newark & Sherwood District.
- 2.8.19 The Newark and Sherwood Core Strategy (2011) refers to proposed growth in the Newark-on-Trent Urban Area, described as the “main location for new housing and employment growth in the District”. With 14,800 dwellings required in the District between 2006 and 2026, the Newark-on-Trent Urban Area is expected to accommodate 70% of the overall growth.

2.8.20 The Newark Urban Area is defined as the main built up areas of Newark-on-Trent, Balderton and Fernwood, indicated in pink in Figure 2-9¹⁹. It is expected that these sites are largely enabled by the planned Newark Southern Link Road (NSLR), but the A46 Newark Northern Bypass scheme would complement the NSLR.

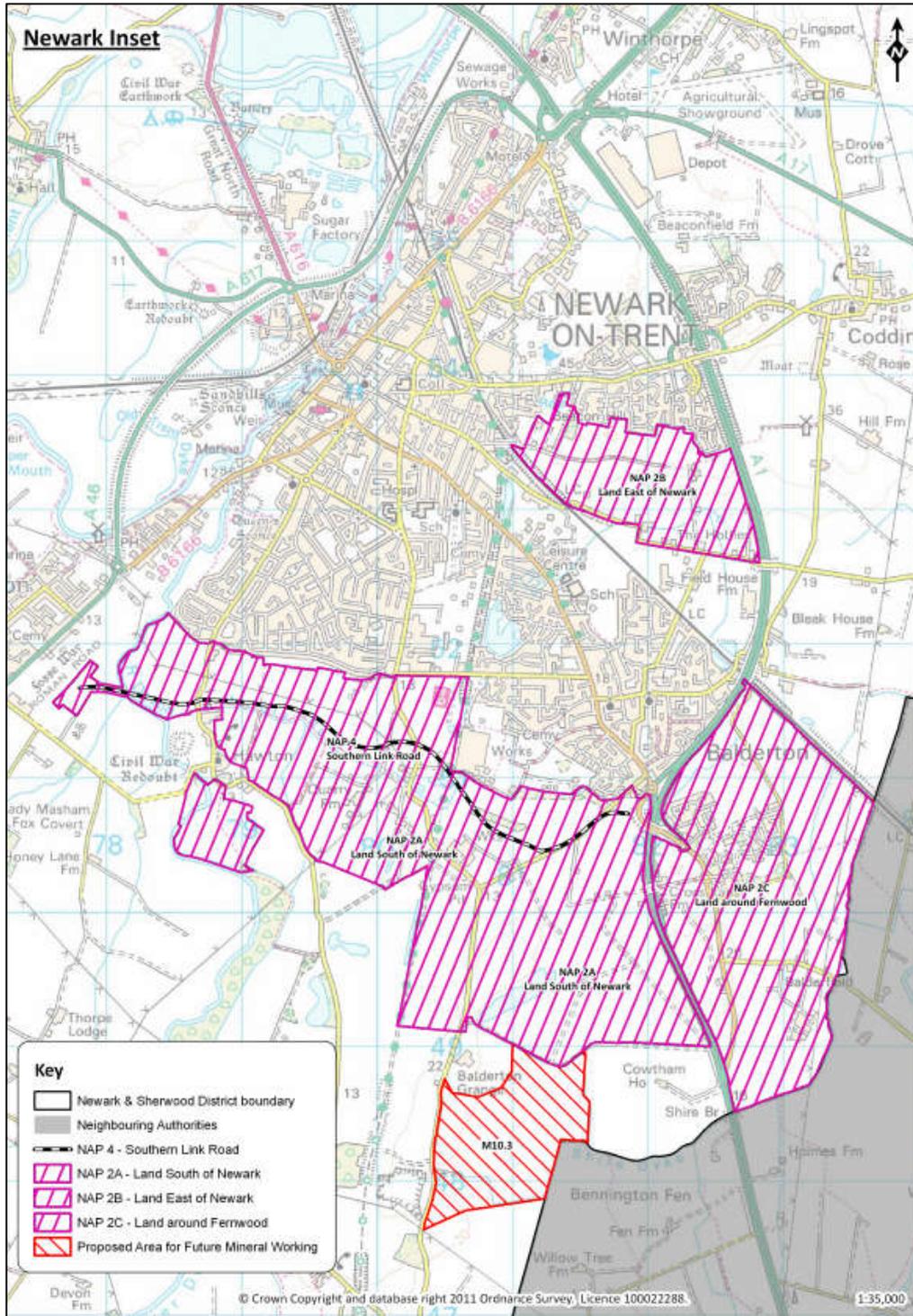


Figure 2-9: Newark Urban Area – Strategic Sites

¹⁹ Newark and Sherwood Proposals Map, available at: <https://www.newark-sherwooddc.gov.uk/media/newarkandsherwood/imagesandfiles/planningpolicy/pdfs/proposalsmap/Proposals%20Map%20Amendments.pdf>

3. Scheme Objectives

3.1 Client Scheme Requirements

3.1.1 The main objectives for this scheme are:

- Safety:
 - Improve safety of the A46 and its junctions, reducing the frequency and severity of incidents along the A46.
- Congestion:
 - Reduce congestion along the A46 and its junctions.
 - Improve links to the A1 by removing A46 through-traffic from the A1/A46 junction.
 - Improve journey times and journey time reliability along the A46 and its junctions between Farndon and Winthorpe.
 - Support the movement of goods and access to transport hubs along the A46 corridor including the Humber Ports and East Midlands Airport.
 - Improve accessibility to Newark-on-Trent and the local area.
 - Enabling economic growth and development in Newark-on-Trent, Nottinghamshire and Lincolnshire.
- Resilience:
 - Increase resilience of the A46 by providing two lanes in each direction separated by a central reserve barrier.
 - Increase resilience of the wider Strategic Road Network (e.g. A1 and M1) by providing a more suitable alternative route when incidents occur
- Environment:
 - Improve noise levels in Noise Important Areas ('noise hotspots') affected by improvements to the A46.
 - Deliver better environmental outcomes through mitigation, protection and enhancement, and contribute to biodiversity.
- Customer:
 - Seek to improve the customer experience and satisfaction of all customers affected by the scheme.
 - Maintain and improve facilities for cyclists, walkers and horse riders where existing facilities are affected.

3.2 Programme

3.2.1 A high-level scheme programme through to project completion has been developed. This section of the report summarises the latest milestone dates, as at the time of writing. Although an estimate of construction duration is given, the construction period will vary depending on the option selected, stakeholder

engagement and the construction methods adopted, and will be assessed in further detail during subsequent stages of the design process:

- Commence construction – Early 2025.
- Scheme open to traffic – RIS3 (2025-2030).

3.2.2 The above programme dates are subject to change.

4. Demographic, Planning and Policy Contexts

4.1 Introduction

4.1.1 This chapter describes the demographics of the major groups of people surrounding the scheme and any local and national policies that have affected the scheme.

4.2 Demographic Context

Overview

4.2.1 According to Office for National Statistics data (2015), Newark and Sherwood have a population of approximately 118,600, with significant growth (15.37%) since 1991. The settlement pattern of the district is dispersed and largely rural in nature, with Newark in the centre and several smaller villages in the surrounding area including, but not limited to Winthorpe, Coddington, Balderton and Farndon. In 2015, the district was home to 46,000 jobs, which have in recent years seen a shift from manufacturing to service-led work.

4.2.2 Socio-demographic data, the Index of Multiple Deprivation (IMD) and the Equality, Diversity and Inclusion sifting Tool (EDIT) have been used to identify demographic data in the area affected by the scheme and also consider the impact of the project on Equality, Diversity and Inclusion (EDI).

Socio-demographic Data

4.2.3 Socio-demographic data for the Newark and Sherwood District is compiled using the Census 2011 data and compared with the England average in Table 4-1.

Table 4-1: Census 2011 data for Newark and Sherwood District and England

Census Statistic		Newark and Sherwood (%)	England (%)
Gender	Male	49.4	49.2
	Female	50.6	50.8
Age	Under 16	18.1	18.9
	16-24	10.0	11.9
	16-64	62.9	64.8
	65 and over	19.0	16.3
Religion	Christian	66.1	59.4
	Buddhist	0.2	0.5
	Hindu	0.2	1.5
	Muslim	0.4	5.0
	Jewish	0.1	0.5
	Sikh	0.1	0.8
	Other	0.3	0.4

Census Statistic		Newark and Sherwood (%)	England (%)
	None/not specified	32.7	31.9
Ethnicity	White	97.5	85.4
	Mixed	1.0	2.3
	Asian	0.9	7.8
	Black	0.4	3.5
	Other	0.1	1.0
Marital status	Civil Partnership	0.2	0.2
	Divorced	9.9	9.0
	Married	52.1	46.6
	Separated	2.5	2.7
	Single	27.6	34.6
	Widow	7.6	6.9
Disability ²⁰	Personal Independence Payment (PIP)	1.6	1.3

4.2.4 2011 Census data provides the following information about the Newark and Sherwood District:

- Statistics for gender and age in Newark and Sherwood are mostly in line with national statistics. 3% more people in the district are 65 and over, compared to the England average.
- There are approximately 7% more people in the district which identify as Christian (66.1%), when compared to the England average (59.4%).
- The percentage of people who identify as Buddhist, Hindu, Muslim, Jewish and Sikh is below the England average.
- Newark and Sherwood district has a high proportion of residents who identify as White (97.5%), when compared to the England average (85.4%).
- Analysis of the marital status of residents in the district shows that more people are married compared to the England average and less people are single.
- The percentage of people claiming Personal Independence Payments (PIP) has been taken as a proxy to illustrate the proportion of people in the area surrounding the scheme that suffer from disabilities. The percentage of people claiming PIP in Newark and Sherwood is 0.3% above the national average.

Index of Multiple Deprivation (IMD)

4.2.5 IMD is the official measure of relative deprivation in England and is part of a suite of outputs that form the Indices of Deprivation (IoD). Seven domains feed into the IMD, these are: income, employment, health deprivation and disability,

²⁰ Please note PIP registrations figures are from 2019 data.

education/skills training, crime, barriers to housing and services and living environment²¹.

4.2.6 The areas of Newark with the highest IMD are mainly concentrated in the most densely populated parts of Newark, for example the Lower Super Output Area (LSOA) south of the town centre which includes Newark Bus Station, Asda and Newark Castle has a score of 44.5. Higher still is the LSOA which contains The Sir Donald Bailey Academy, south of the town centre, which has a score of 49.5.

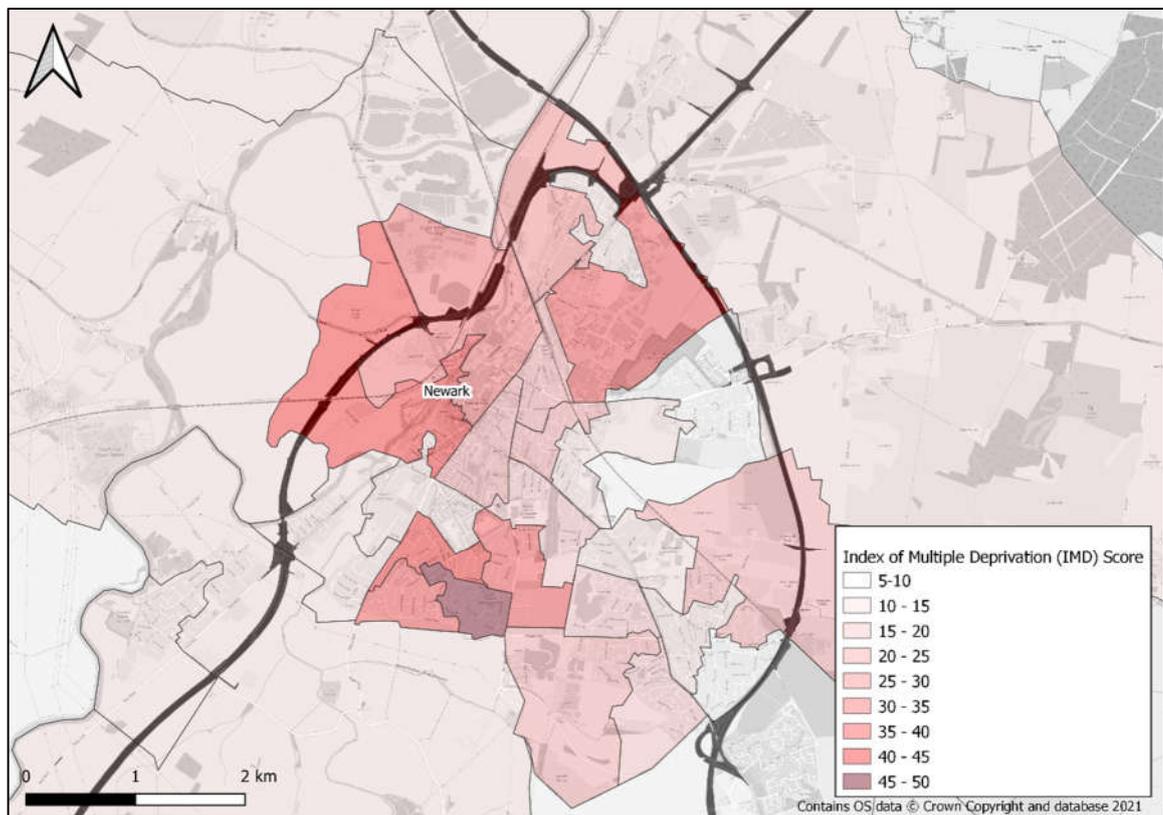


Figure 4-1: IMD Map of Newark

Equality, Diversity and Inclusion sifting Tool (EDIT)

4.2.7 EDIT uses scheme information, research and the wider evidence base to identify the impact which a scheme may have on Equality, Diversity and Inclusion (EDI)²². There are two stages to the tool. The first stage involves demographic equality 'hotspot' mapping. Through this mapping, users of the tool are able to see where the scheme is located in relation to equality hot spots, population hot spots, equality group population and proportion, and trip attractors. Figure 4-2 shows the equality hot spot map used in the assessment. The A46 Newark Northern Bypass scheme is located in:

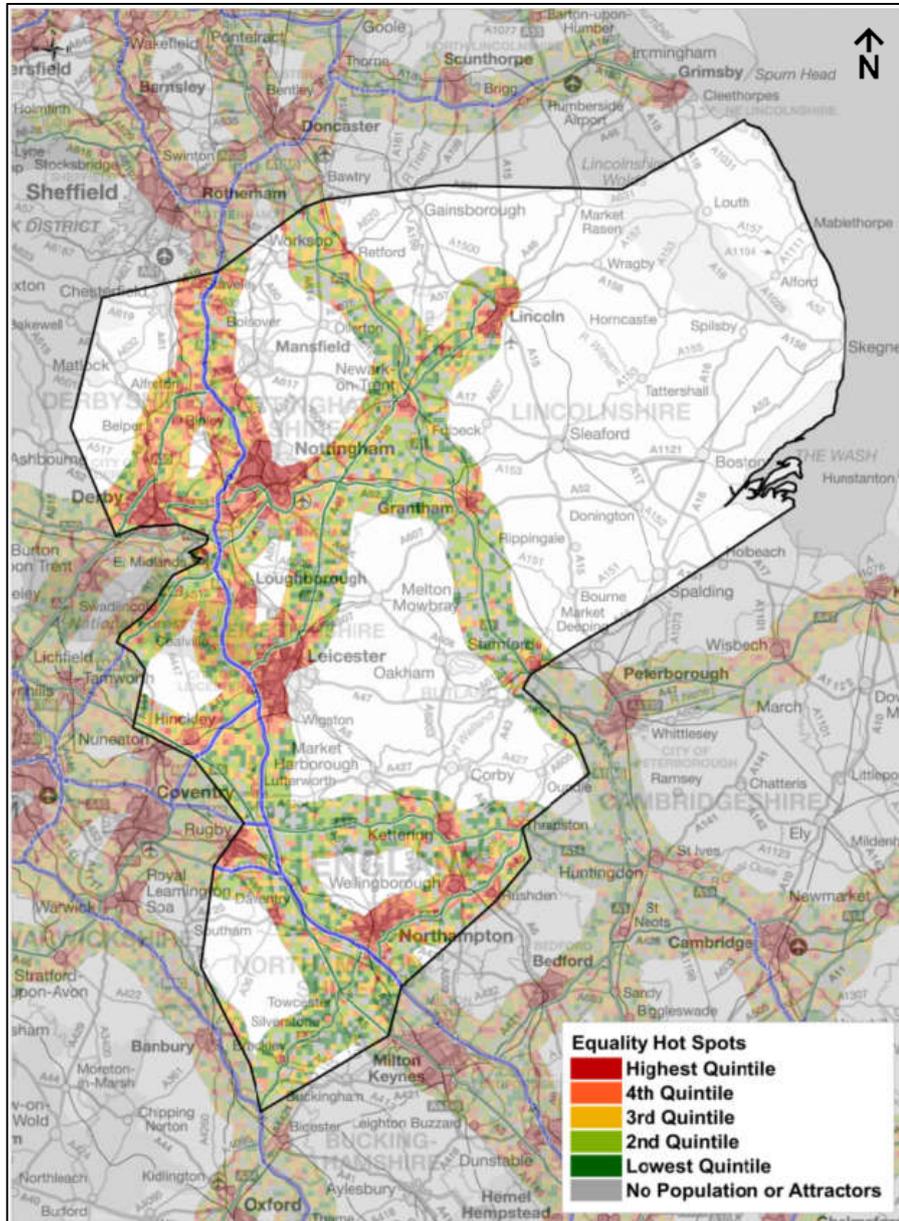
- An equality 'hotspot' area.
- An area of high population density.

²¹

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835115/loD2019_Statistical_Release.pdf

²² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/655913/2017_-_psed_annual_report_-_FINAL.pdf

- An area with large numbers of people from equality groups.
- An area with high proportions of people from equality groups.
- An area with a large number of destinations used by members of equality groups.



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Figure 4-2: Equality Hot Spots map for National Highways Area 7

- 4.2.8 The second stage of EDIT is a data-capture and decision matrix in Microsoft Excel. The person completing the assessment must input information on the effects of the scheme, it's primary beneficiaries, key asset (motorway or trunk road), area type and impact on walkers, cyclists and horse-riders.
- 4.2.9 The overall EDIT score for both sections was 99%. This indicates that EDI issues are likely to be a factor in the effective delivery of the scheme. Further

consideration of development, design and construction measures are required at the next stage of the project.

4.3 Planning and Policy Contexts

Strategic Context

- 4.3.1 In 2017 the DfT published the policy "Transport Investment Strategy - Moving Britain Ahead", which highlighted the following strategic objectives:
- Create a more reliable, less congested, and better-connected transport network that works for the user whom rely on it.
 - Build a stronger, more balanced economy by enhancing productivity and responding to local growth priorities.
 - Enhance our global competitiveness by making Britain a more attractive place to trade and invest
 - Support the creation of new housing.
- 4.3.2 Within the RIS2 (2020-2025)²³ there is a commitment for the widening of the A46 north of Newark-on-Trent to dual carriageway, to improve the capacity of the single carriageway and junctions of the A46 at Newark, and provide better links to the A1.
- 4.3.3 The National Highways Delivery Plan (2020-2025)²⁴ states "We will increase the capacity of the single carriageway and junctions of the A46 at Newark, and provide better links to the A1. As well as improving route consistency, this will increase Lincolnshire's connectivity to the motorway network." The plan commits to a start of works 2024/2025.
- 4.3.4 On a regional scale, in a joint statement between Transport for the East Midlands and Midlands Connect²⁵, the "A46 growth corridor" is referenced as a key strategic priority to support economic and housing growth in the East Midlands. The status of the A46 as a key priority results from its position as one of the UK's most important trade routes. With 2.9 million jobs, 5.5 million people and £115 billion in economic output in the A46 corridor, it is described as a hotbed of industry and provides access to international gateways such as Birmingham Airport and East Midlands Airport, and seaports in Bristol and the Humber. Within this wider regional context, the joint statement also identifies the need to remove the existing bottleneck on the A46 around Newark and prioritises the scheme to upgrade the A46 around Newark-on-Trent in the short term, by 2025.
- 4.3.5 Further reference in regional documentation is made within the 'Midlands Connect Strategy: Powering the Midlands Engine 2017' A46 Corridor Study – Stage One Enhanced Strategic Case. In this document the A46 Newark-on-Trent is referred to as an early priority for being 'Resiliently Connected' and is also acknowledged as a significant road for the boosting of productivity and growth, which would thereby reduce costs to businesses.

²³ <https://www.gov.uk/government/publications/road-investment-strategy-2-ris2-2020-to-2025>

²⁴ <https://www.gov.uk/government/publications/highways-england-delivery-plan-2020-2025>

²⁵ <https://www.midlandsconnect.uk/media/1727/mc-a46-corridor-study-phase-2-final-report-november-2020-with-appendix.pdf>

- 4.3.6 Further ambitions are to create a new economic spine for the Midlands and the UK, and schemes such as the A46 Newark Northern Bypass will be instrumental in supporting the productivity of businesses across the UK, unlocking housing and jobs growth, and improving environmental and safety conditions in the local area. As the underperforming sections of the A46 currently hold back growth in the region, upgrading them will contribute to the efficient movement of people and goods.
- 4.3.7 Locally, the Newark & Sherwood District Council's Infrastructure Delivery Plan, May 2010²⁶, recognises the importance of the A46 and the capacity issues faced by the bypass between Farndon roundabout and the A1. Both the Infrastructure Delivery Plan and the Local Development Framework set out the scheme for explicit implementation. In addition to this, there is a substantial quantity of locally significant housing growth planned in and around the Newark urban area. The proposed scheme will facilitate major housing and employment development within the town by removing the oft-mentioned bottleneck on the road network.

Business Need and Service Gaps

- 4.3.8 As a key strategic south-west to north-east route across the UK, the A46 links urban areas such as Evesham, Warwick, Coventry, Leicester, Lincoln, Grimsby and Newark. The A46 Newark Northern Bypass scheme aims to upgrade the final single carriageway stretch of the A46 between Leicester and Lincoln to dual carriageway, in addition to improving key junctions on this stretch, in order to provide traffic smooth-running in this section. This will provide additional capacity, improve safety and support the local economy by improving journey reliability and reducing journey times along the route.
- 4.3.9 Many globally-significant sectors are clustered around the A46 corridor; battery technology in Warwickshire, Leamington's 'Silicon Spa', as well as food production in Worcestershire and Lincolnshire.
- 4.3.10 Improving the capacity and resilience of the A46 in the region would support the growth plans of existing and potential business and developers, including British Sugar and Dixons Group.
- 4.3.11 Newark Showground is a key events site adjacent to the A1/A46 junction, which relies on the A46 for access.
- 4.3.12 Upgrading this section of the A46 will further improve local productivity and allow for growth and attraction of employees. Indeed, numerous businesses in the locality have voiced a need for urgent improvement along the A46, suggesting that such improvements would significantly boost their productivity. Hence, there is a clear and pressing need for the A46 scheme.

Policy Contexts

- 4.3.13 The key transport and planning policies that apply to the scheme are contained within the following policy documents:
- National Policy Statement for National Networks (NPS NN) (2014).
 - National Planning Policy Framework (NPPF) (2019).

²⁶ <https://www.newark-sherwooddc.gov.uk/evbase/infrastructuredeliveryplan/>

- Nottinghamshire County Council Highway Network Management Plan (2014).
- Nottinghamshire Local Transport Plan 2011-2026 (2011)
- Midlands Connect Strategy (2017).
- Newark & Sherwood Amended Core Strategy DPD (Adopted March 2019).
- Newark & Sherwood Allocations & Development Management DPD (Adopted July 2013).
- Nottinghamshire Waste Core Strategy (Adopted 2013).

4.3.14 Whilst all relevant current planning policies and guidance should be given due consideration, those considered to be of particular relevance to the scheme are outlined in this section of the report.

National Policy Statement for National Networks (NPS NN) (2014)

- 4.3.15 The NPS NN sets out the need for, and Government's policies to deliver, development of Nationally Significant Infrastructure Projects (NSIPs) on the national road and rail networks in England.
- 4.3.16 The thresholds for nationally significant road, rail and strategic rail freight infrastructure projects are defined in the Planning Act 2008 ("the Planning Act") as amended (for highway and railway projects) by The Highway and Railway (NSIP) Order 2013 ("the Threshold Order").
- 4.3.17 The NPS NN provides planning guidance for promoters of NSIPs on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.
- 4.3.18 The NPS NN is directly relevant to highway infrastructure projects on the national road network that are defined as an NSIP. The Scheme is currently considered to fall within the definitions of an NSIP. The NPS NN is therefore the primary planning policy against which an application for a Development Consent Order (DCO) for the Scheme would be judged.
- 4.3.19 Subject to further design, assessment, and the development and implementation of mitigation and compensation measures, all the options are likely to comply with policy in the NPS NN.
- 4.3.20 In terms of possible non-compliance with the NPS NN, there are instances where the Scheme could contravene the policy outlined in the NPS NN. This includes the loss of irreplaceable habitat and best and most versatile agricultural land, substantial harm to the Winthorpe Conservation Area, permanent land take and the loss of land safeguarded in the adopted Newark and Sherwood Local Plan. However, the application of appropriate mitigation measures should ensure compliance with the policy. Furthermore, it is considered that the national need for and the benefits of the Scheme outweigh the policy issues outlined above.

National Planning Policy Framework (NPPF) (2019)

- 4.3.21 The NPPF sets out the government's planning policies for England and how these are expected to be applied. The framework acts as guidance for local planning authorities and decision-makers, both in drawing up plans and making decisions about planning applications.

4.3.22 The NPPF sets out detailed guidance that contribute to delivering sustainable development, including:

- Achieving sustainable development.
- Decision making.
- Building a strong, competitive economy.
- Promoting healthy and safe communities.
- Promoting sustainable transport.
- Making effective use of land.
- Achieving well-designed places.
- Meeting the challenge of climate change, flooding and coastal change.
- Conserving and enhancing the natural environment.
- Conserving and enhancing the historic environment.
- Facilitating the sustainable use of minerals.

Nottinghamshire County Council Highway Network Management Plan (2014)

4.3.23 This Plan sets out policies that are set within the wider context of integrated transport, best value and the corporate vision of the County Council. Its purpose is to collate all the policies, standards and procedures associated with Highway Management into one document.

4.3.24 The objectives of the policies given in the Plan are to ensure network safety, serviceability and sustainability.

4.3.25 The Strategic Plan (2014-18) sets out the following outcomes to achieve the objectives including the following, supported by the work of the Highways Division:

- Casualties on Nottinghamshire's roads continue to reduce.
- The environmental impact of providing County Council Services is reduced.
- The roads and transport infrastructure in Nottinghamshire are fit for purpose.
- Connectivity across the county and into the region will be improved.
- Economic growth is stimulated by unlocking employment sites.
- We have attractive and economically vibrant towns.
- Barriers to growth are minimised by improving countywide infrastructure.

Nottinghamshire Local Transport Plan 2011-2026 (2011)

4.3.26 The Nottinghamshire Local Transport Plan (LTP3) details the transport strategy for the whole of the county of Nottinghamshire for the 15-year period 1 April 2011 to 31 March 2026.

4.3.27 The LTP3 transport goals are to:

- Provide a reliable, resilient transport system that supports a thriving economy and growth whilst encouraging sustainable and healthy travel.

- Improve access to key services, particularly enabling employment and training opportunities.
- Minimise the impacts of transport on people's lives, maximise opportunities to improve the environment and help tackle carbon emissions.

Midlands Connect Strategy (2017)

- 4.3.28 The Midlands Connect Strategy sets out proposals for how Midlands Connect can turn economic potential into growth, such as jobs for local people, more trade and investment for local companies, and more opportunities for businesses to expand. The Strategy has been developed in collaboration with the DfT, Network Rail, National Highways, HS2 Ltd and other key stakeholders.
- 4.3.29 One of the early priorities set out in the Strategy is the delivery of a number of key transport infrastructure projects, including the delivery of the A46 Newark Northern Bypass.

Newark and Sherwood Amended Core Strategy DPD (Adopted March 2019)

- 4.3.30 This Plan sets out the issues that Newark & Sherwood District Council and their public and private sector partners need to address over the next twenty years. It sets a vision and objectives and a number of policies to help deliver the development and change identified.
- 4.3.31 The Core Strategy's Vision states that 'the natural environment will be safeguarded and enhanced' and 'new green and woodland spaces will increase ecology, biodiversity and nature conservation'. Furthermore, it states that development will meet a number of environmental criteria, amongst which includes the requirement to be environmentally sound and water efficient.
- 4.3.32 By 2026, Newark and Sherwood will become an 'area providing a high quality of life, made up of thriving sustainable urban and rural communities where people want to and can, live and work'.

Newark & Sherwood Allocations & Development Management DPD (Adopted July 2013)

- 4.3.33 This DPD sets out allocations of land for new housing, employment and other development in the main settlements in Newark and Sherwood. It also sets out Development Management policies for use in the consideration of Planning Applications.

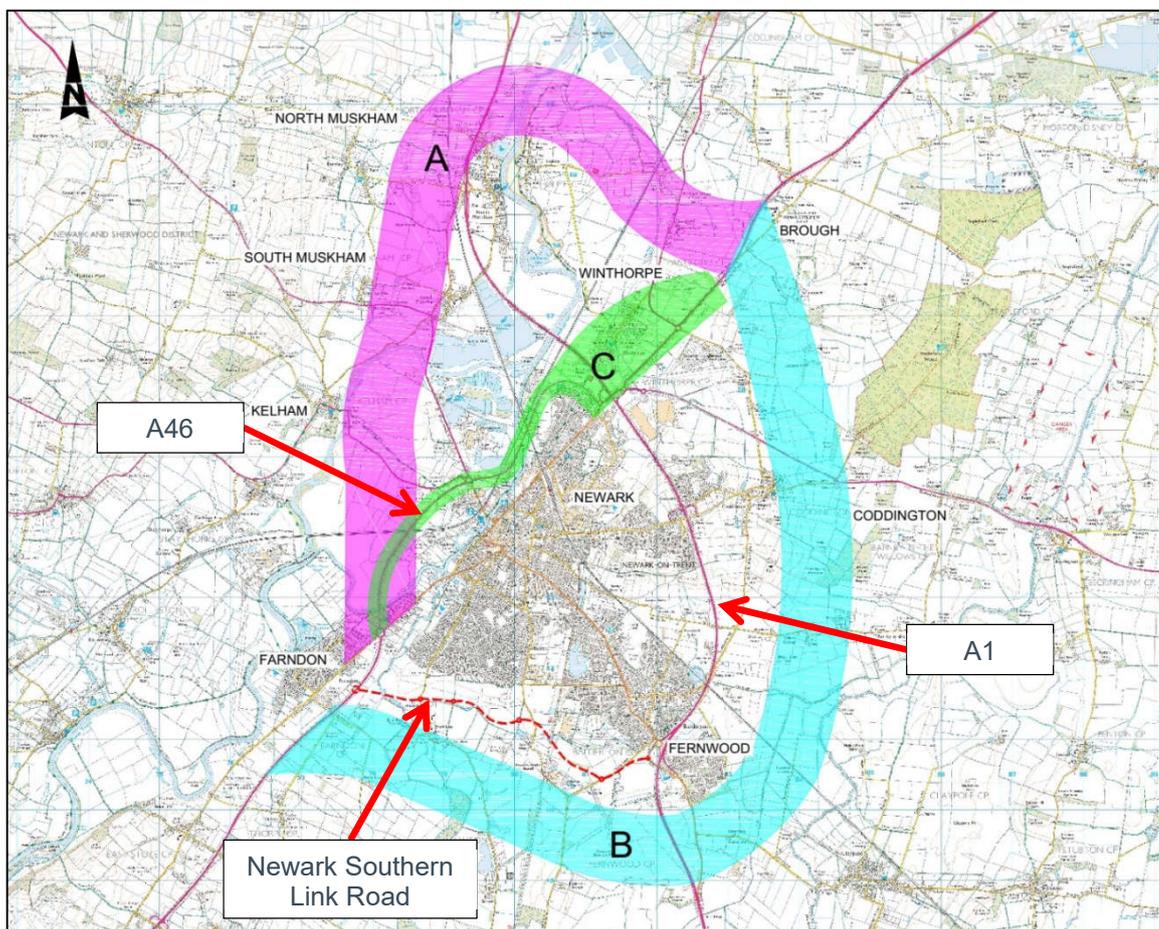
5. Discounted Options

5.1.1 The options presented at options consultation were 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 Figure 5-1 and Figure 5-2) were considered and assessed against the Client Scheme Requirements, NPS NN and DfT's Early Assessment and Sifting Tool.



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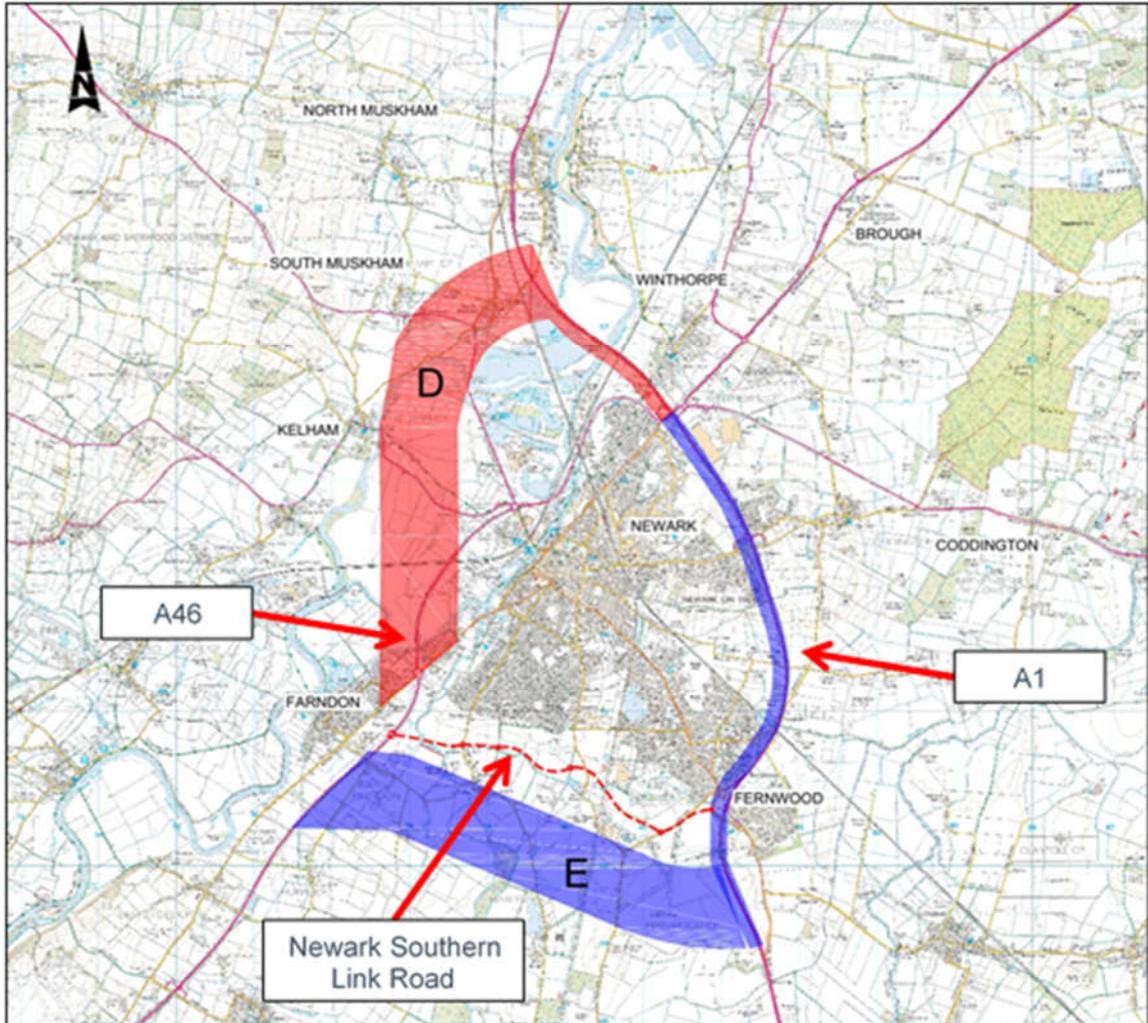
Figure 5-1: Route Corridors A to C

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 NSLR, 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.



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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.

5.2.7 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

5.2.8 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.

- 5.2.9 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 (as this would still remain in place) would mean it is unlikely to resolve the capacity issues on the A46 at Cattle Market, Friendly Farmer, Brownhills or Winthorpe roundabouts, reducing the benefits for other users.
- 5.2.10 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 and replacement of the existing A1/A46 junction between Newark-on-Trent and Winthorpe with a full standard grade separated junction.
- 5.2.11 A high-level economic assessment was completed for Corridor E as a sensitivity test using Transport User Benefits Appraisal (TUBA) which is a software package developed on behalf of the DfT for the appraisal of transport impacts of highway and public transport schemes. The assessment was undertaken for one forecast year 2043 using AM, Inter-Peak and PM peak period assignments. Table 5-1 shows the difference in Present Value of Benefits (PVB) for 2043 between Option B (a Corridor C scheme) and the Corridor E scheme

Table 5-1: Corridor E and Corridor C comparison of PVB (£m) for 2043

Corridor C PVB (£m)	Corridor E PVB (£m)	Difference in Benefits
3.89	0.12	-97%

- 5.2.12 Corridor C would perform slightly better in environmental terms in achieving potential improvements in terms of carbon, noise and the local water environment. Corridor C would be preferential in comparison with Corridors A, and D, and slightly more preferential than Corridors B and E resulting in a moderate risk of potential negative impacts on key environmental constraints, including sensitive, high-value heritage, water, landscape and visual and noise receptors. However, there would still be the requirement to improve performance during option development, ensuring mitigation of potential impacts, including adequate provision for flood compensation.
- 5.2.13 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.

Routes to North of South of Winthorpe

- 5.2.14 Two route options were developed within Corridor C:
- Route 1, the 'Southern Route', bypasses Winthorpe to the south. This Route would move A46 through-traffic away from the existing junction with the A1, though links with the existing junction would be provided (Figure 5-3).

- Route 2, the 'Northern Route', bypasses Winthorpe to the north and would re-join the existing A46 at a new junction located approximately 1.6 km north-east of the existing Winthorpe roundabout (Figure 5-4). As with Route 1, A46 through-traffic would be removed from the existing junction with the A1, with links to and from the existing junction retained. A new junction with the A1 to the north of Winthorpe village would not be created as part of this route option.

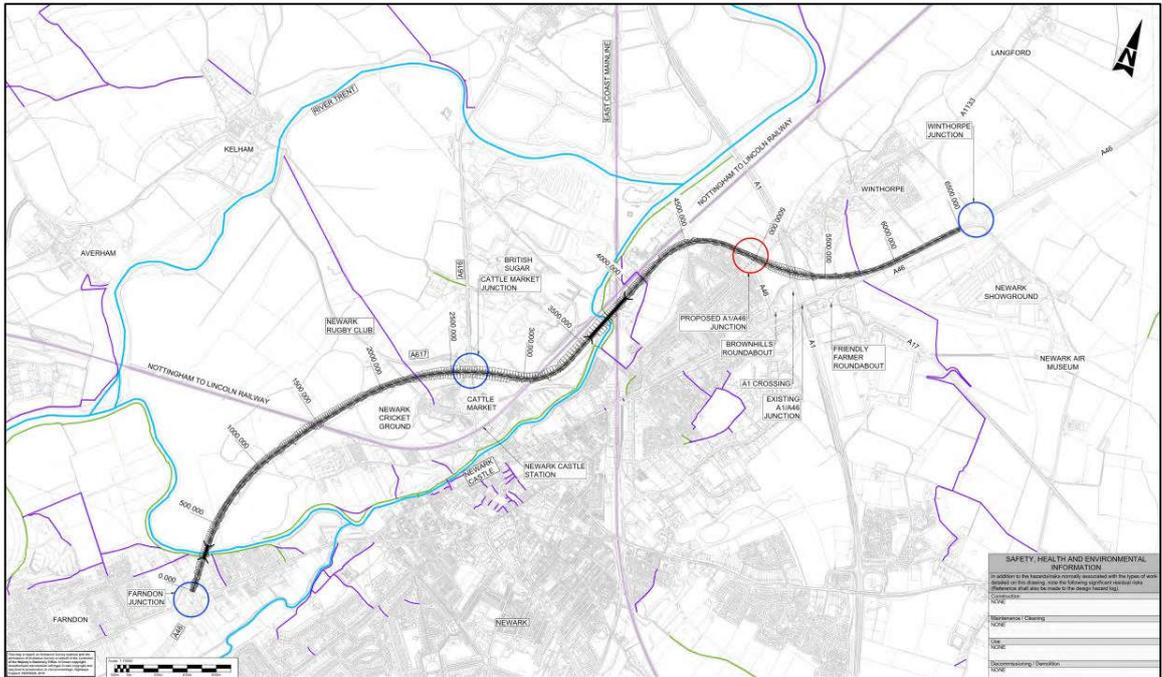


Figure 5-3: Route 1 Layout Plan

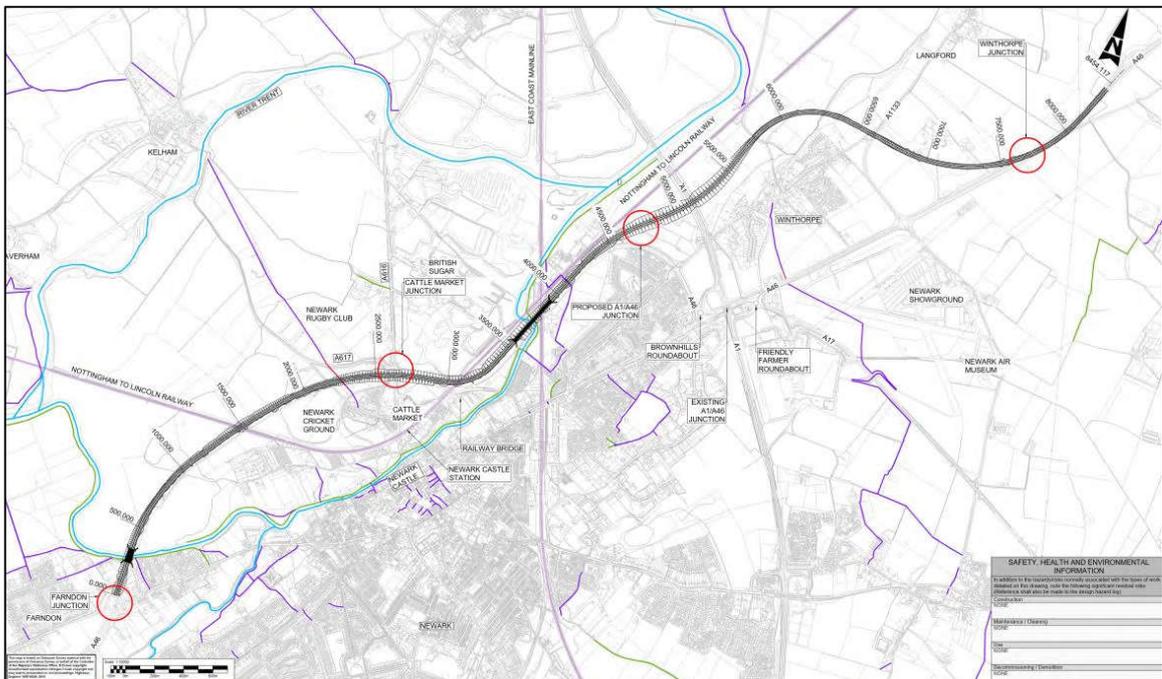


Figure 5-4: Route 2 Layout Plan

Route Sifting

- 5.2.15 The route options were assessed qualitatively based upon the comparative length and likely benefits of each. Route 2 would incur a significantly higher construction cost compared to Route 1, due to the greater construction length and associated land-take requirements. However, the traffic model indicated that Route 2 would provide no further benefit in terms of improving journey times compared to the shorter Route 1.
- 5.2.16 In environmental terms, whilst the effects of both route options are similar, Route 1 is preferred over Route 2 in terms of water, geology and soils. Route 2 would require more construction within the floodplain to the north of Winthorpe. Route 1 would be likely to require less earthworks and ground disturbance than Route 2.
- 5.2.17 In the vicinity of Winthorpe, the Route 1 is also preferred for cultural heritage, noise, and landscape and visual receptors. Route 2 would result in a direct impact on a Scheduled Monument and would impact on the setting of another three Scheduled Monuments, as well as locally significant parks and gardens at Winthorpe and Langford Hall, a Conservation Area and several listed buildings. Route 1 is located on the same side as the existing A46, so would be preferred to Route 2 to the north of Winthorpe village, where it would be expected to have the greatest noise increase.
- 5.2.18 Route 1 would cause new severance and contravene local planning policy designed to keep land between Newark-on-Trent and Winthorpe open to prevent coalescence. While Route 2 would reduce severance and would be more consistent with local plan policy it would potentially have a worse adverse economic impact on businesses and development.
- 5.2.19 It was, therefore, recommended that Route 1 be taken forward for further assessment and that Route 2 would not be assessed further.

5.3 Junction Options Sifting

- 5.3.1 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.
- 5.3.2 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.
- 5.3.3 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.
- 5.3.4 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 was assessed holistically, to demonstrate the effect of the combination of junction options.

5.4 Options to Terminate Scheme at the A1

5.4.1 Two options were considered to terminate the scheme at the A1 in order to consider a lower cost option. These are discussed in this section of the report.

Widening A46 to Brownhills Roundabout with Minor Improvements to Brownhills

5.4.2 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.

5.4.3 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

5.4.4 The existing and forecast junction flows at the A1/A46 junction exceed those usually suitable for the compact grade separated standards that the current A1 slips have been constructed to. Junction Option A1A46-4 (Figure 5-5) would provide a new, larger roundabout to the west of the A1, and would replace the existing slips with full standard slip roads to and from the A1 northbound.

5.4.5 This would provide safety benefits for road users, however, the costs involved in additional land take and associated structures and earthworks construction is likely to outweigh the economic benefits.

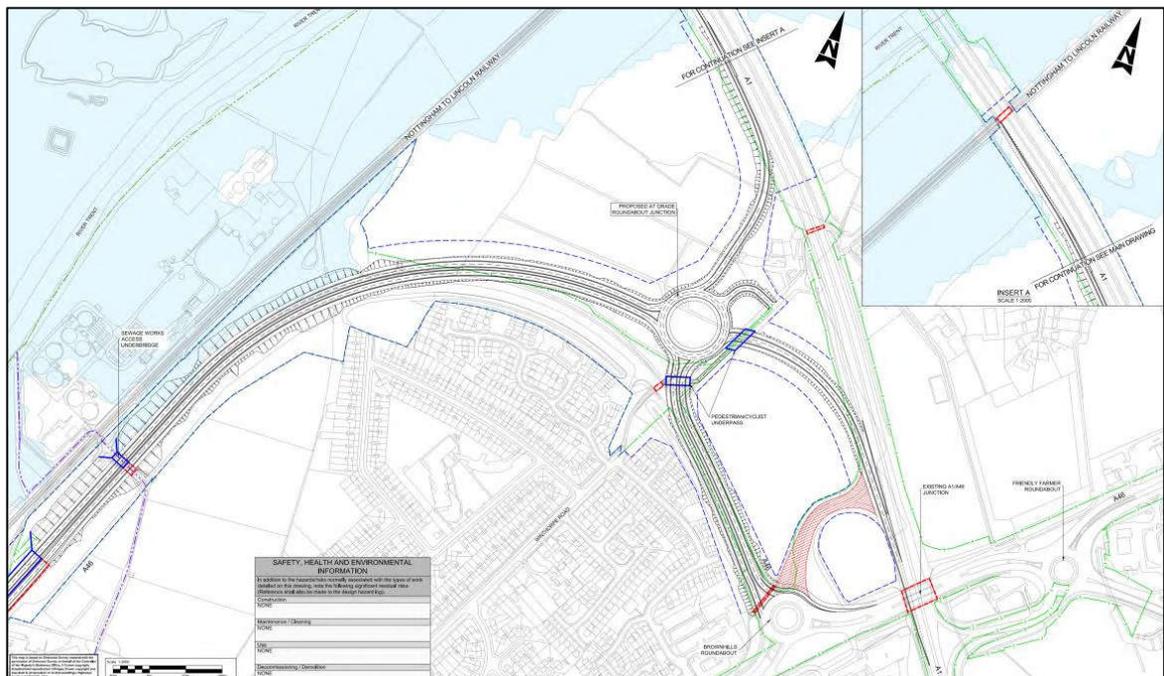


Figure 5-5: Junction Option A1A46-4

- 5.4.6 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.
- 5.4.7 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.

5.5 Lowest Cost Option

- 5.5.1 To ensure that all lower cost alternatives had been considered a 'lowest cost' option was developed. In this option, the A46 would remain a single carriageway, with the roundabout at Cattle Market being altered to allow mainline traffic to pass through the centre, and the A46 bypassing the existing junction with the A1.
- 5.5.2 Traffic modelling demonstrated delays at all junctions and the A46 mainline for this option.
- 5.5.3 It indicated that this option would generate low PVB of approximately £80 million, which can be mostly attributed to it remaining single carriageway and not relieving future-year traffic delays. The 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.
- 5.5.4 Although only minor improvements are proposed for the junctions, the associated costs would be highly likely to be greater than £80 million. The cost of the improvements would be more than the economic benefits that they would provide, and as such would be considered poor value for money.
- 5.5.5 This option was not considered for further assessment due to:
- The low value of the anticipated benefits compared to the anticipated cost.
 - It not performing against the scheme objectives to improve resilience and reduce congestion.
 - It not fulfilling the commitment in the RIS statement to widen the A46 to dual carriageway.

5.6 Options Assessed in Options Identification Stage

- 5.6.1 Four options were assessed during the Options Identification stage (PCF Stage 1), as described in Table 5-2.

Table 5-2: Options assessed during PCF Stage 1

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 NSLR 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.

- 5.6.2 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.
- 5.6.3 Consideration was given to removing the new roundabout and instead realigning the NSLR to tie into the improved Farndon 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.
- 5.6.4 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.
- 5.6.5 All four options were evaluated against:
- Engineering Assessment.
 - Traffic and Economic Assessment.
 - Environmental Assessment.
 - Social Assessment.
 - Safety, Operational, Technology and Maintenance Assessment.

5.6.6 In terms of engineering assessment, Option B and Option D are comparable, requiring the least number of structures and volumes of earthworks, hence they have the lowest scheme costs (see Table 5-3). Options A and C require the greatest number of structures and volumes of earthworks, therefore, incur the highest scheme costs. The grade separated layout proposed at Farndon junction in Options A and C would incur significant project and safety risks associated with the diversion of the electricity lattice tower in the centre of the roundabout. Although Options B and D have lower scheme costs, the grade separated junctions in Options A and C would allow the free flow of traffic along the A46 mainline.

Table 5-3: Most likely forecast outturn estimate and adjusted Benefit Cost Ratio (BCR) for scheme options

Scheme Option	Forecast Outturn	Adjusted BCR
A	£649,500,869	0.92
B	£462,322,327	0.93
C	£661,918,439	0.87
D	£479,887,544	1.23

5.6.7 The land take, including agricultural and 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).

5.6.8 Of the four options, Option D has the marginally highest adjusted BCR.

5.6.9 All options result in the potential for likely significant adverse effects on noise receptors, heritage assets, landscape and visual, biodiversity, material assets and waste.

5.6.10 Overall, Options B and D result in less likely significant adverse effects with mitigation, in comparison with Options A and C. Options B and 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. Options A and C would have significant impacts within an area of known archaeology of international significance at Farndon and more properties would experience increases in noise.

5.6.11 Options B and 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 additional grade separated junctions, area of permeability and increased construction within the floodplain (which would require compensation) in comparison to Options A and C. In addition, Option B has the lowest number of properties potentially affected in terms of air quality.

5.6.12 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.

-
- 5.6.13 All proposed options are expected to have a positive impact upon road safety and contribute to the National Highways target of reducing the number of people killed or seriously injured on the trunk road network, as providing a dualled route would significantly reduce collisions associated with overtaking.
 - 5.6.14 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.
 - 5.6.15 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.
 - 5.6.16 It was, therefore, recommended that Options A and C should not be taken forward to the options consultation.
 - 5.6.17 The options taken forward to consultation were 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.

6. Summary of Options

6.1.1 This chapter describes the options that were recommended through assessment undertaken in PCF Stage 1 to be presented at options consultation.

Option 1

6.1.2 The layout of Option 1 is shown in Figure 6-1.



Figure 6-1: Option 1

6.1.3 In Option 1, the A46 would be widened to a dual carriageway to provide two lanes in each direction between the Farndon and Winthorpe junctions. It would include a new link and a new bridge over the A1 to the north of the existing bridge, allowing traffic on the A46 to bypass the existing A1/A46 junction and travel on to Winthorpe junction.

6.1.4 The general layout of Farndon junction would not be changed.

6.1.5 Cattle Market junction would be signalised, and the layout changed to a 'hamburger' arrangement, 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.

6.1.6 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.

6.1.7 A general arrangement drawing of Option 1 can be found in Appendix B.

Option 2

6.1.8 The layout of Option 2 is shown in Figure 6-2.

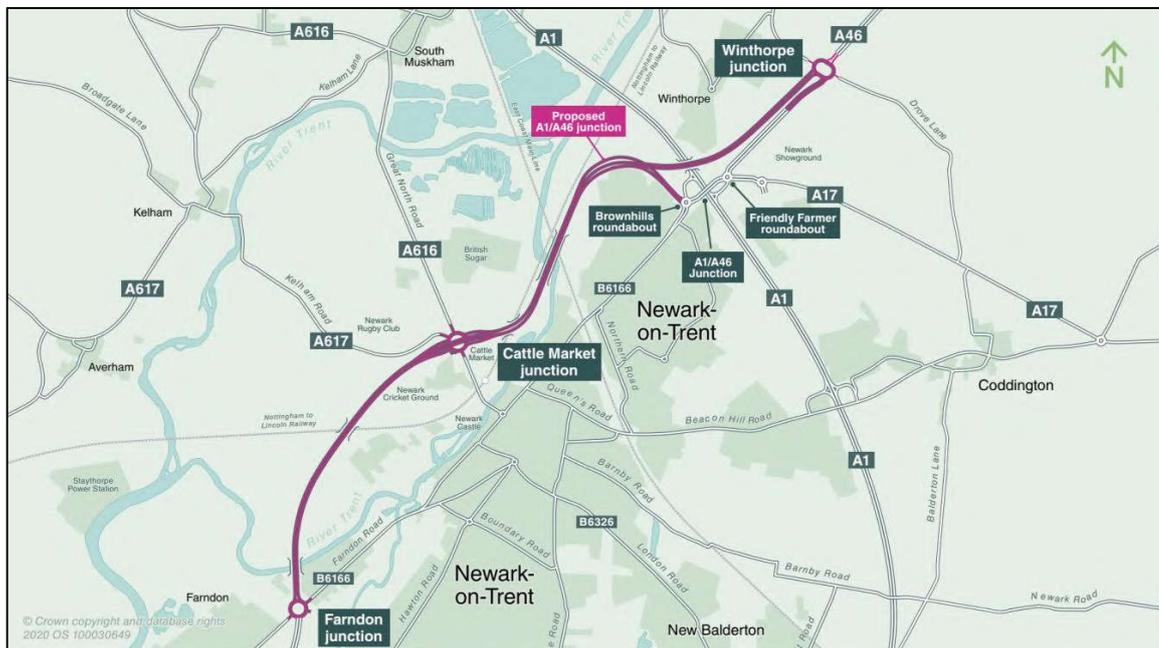


Figure 6-2: Option 2

- 6.1.9 In Option 2, the A46 would again be widened to a dual carriageway to provide two lanes in each direction between the Farndon and Winthorpe junctions. Option 2 would include a new link and a new bridge over the A1 to the north of the existing bridge, allowing traffic on the A46 to bypass the existing A1/A46 junction and travel on to Winthorpe junction.
- 6.1.10 Farndon junction would be signalised to improve flows on the roundabout during peak hours. The geometry of the junction would not be significantly changed for this option.
- 6.1.11 Cattle Market junction would be grade separated, with the A46 elevated to pass over the roundabout. In this option there would be no significant changes to the geometry of the A617 and A616 as had been required for Option 1. 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).
- 6.1.12 A general arrangement drawing of Option 2 can be found in Appendix B.

Summary of Differences between Options

Table 6-1: Key layout differences between the two options

	Option 1	Option 2
Farndon Roundabout	As existing.	Partially signalised

	Option 1	Option 2
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. Signals proposed for footway/cycleway crossings only.
Winthorpe	New section of A46 ties-in to existing A46 to the west of Winthorpe junction. Partially signalised. 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. Partially signalised.

7. Summary of Stakeholder Engagement and Public Consultation

7.1 Overview

7.1.1 This chapter of the SOAR summarises the engagement that happened during PCF Stage 2. The Communications Planning for Major Projects PCF products govern the way in which National Highways and delivery partners communicate with stakeholders about the development of scheme options, the most suitable intervention points for engagement and the principles by which it should be delivered.

7.2 Communications Planning

7.2.1 The planning of communications and stakeholder engagement for this scheme is recorded within the Communications Planning for Major Projects PCF product, which consists of the following documents:

- Key Points Brief and Key Messages House
- Stakeholder Action Tracker
- Consultation Communications Delivery Plan
- Question and Answer Document

7.2.2 The Communications Planning for Major Projects PCF product focuses specifically on the options consultation. The documents outline the approach to consultation, how an inclusive and fair consultation is promoted, and the techniques used to publicise the consultation, the delivery channels to be deployed and the way consultation responses will be gathered and assessed.

7.2.3 All materials that are produced to present the options and engage with stakeholders will feature agreed messaging, ensuring consistent and effective communication of the scheme's objectives.

7.2.4 The Stakeholder Action Tracker and National Highways' Customer Relationship Management system allows interactions with stakeholders to be recorded and monitored, facilitating evidence-based decision-making. The reliable recording of all communications and engagement means that communications can be tailored to individual stakeholder needs and requirements.

7.3 Consultation

7.3.1 The options consultation that took place in PCF Stage 2 was a crucial part of the stakeholder engagement and development of the scheme. It was the first formal opportunity for all stakeholders to contribute their views to ensure the design team understand the local area and any potential impacts the scheme may have on users and the community.

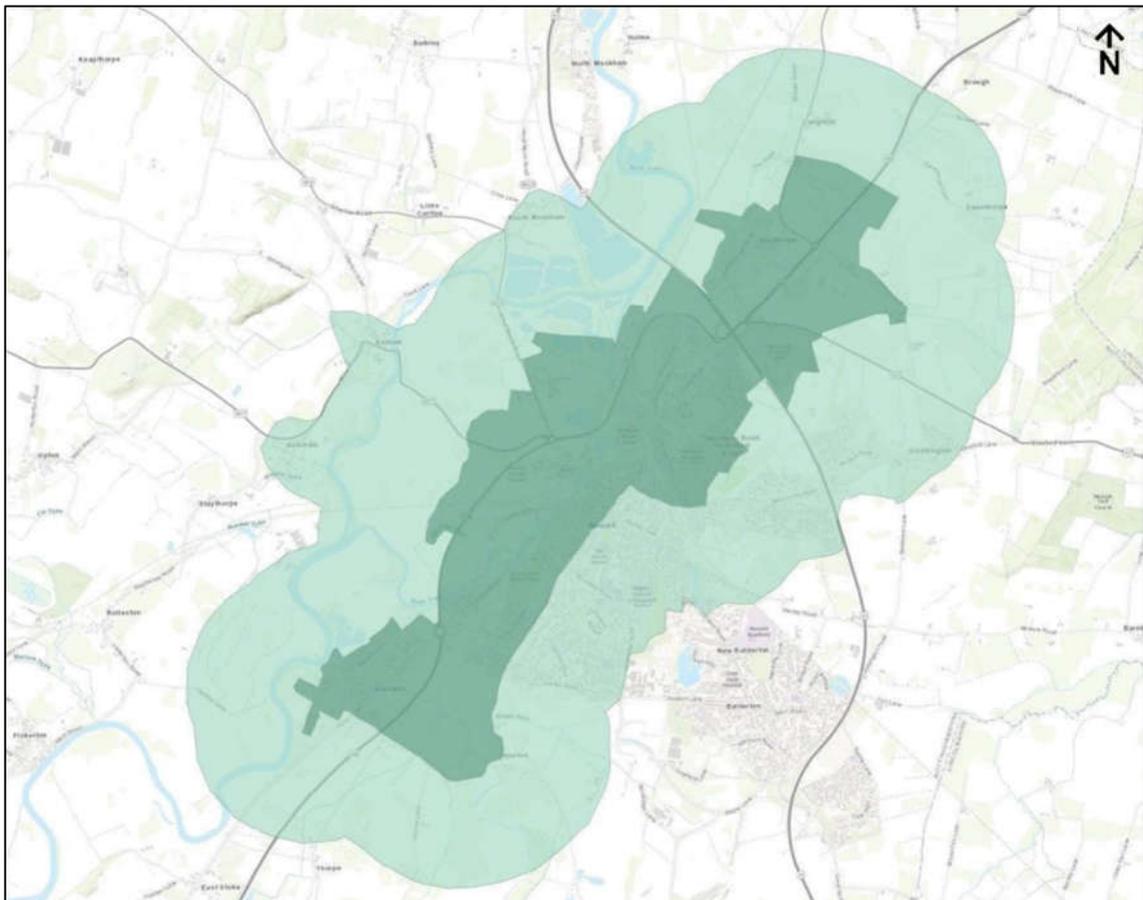
7.3.2 The views and feedback gained from the options consultation has helped to inform scheme development and feed into the decision on a preferred option. The options consultation lasted for eight weeks from 9 December 2020 until on 2 February 2021.

7.3.3 The consultation aimed to:

- Engage with, and inform stakeholders and the general public about the scheme and seek their views.
- Gain feedback and comments to understand the local area as well as the scheme benefits and any potential impacts on road users and the local community.
- Provide the local community and stakeholders with an opportunity to influence the scheme.
- Be as inclusive and accessible as possible to the local community.

Target Audience

7.3.4 The area surrounding the scheme was split into an inner and outer consultation zone (see Figure 7-1) with small extensions to ensure villages or groups of houses were included. The stakeholders identified in these zones were the focus of the consultation and included those living or working within these boundaries.



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Figure 7-1: Inner and Outer Consultation Zones defined for the options consultation

7.3.5 As well as following National Highways' procedures, we have also considered our duty to consult under Section 42 of the Planning Act (PA) (2008), ensuring compliance through engagement with the relevant prescribed consultees

determined under ‘Schedule 1’ of the PA 45. Examples of key stakeholders are detailed in Table 7-1.

Table 7-1: Sample of stakeholders contacted during the consultation

Group	Stakeholder(s)
County Council	Nottinghamshire County Council
District Council	Newark and Sherwood District Council
Town Council	Newark Town Council
MPs	Robert Jenrick (MP for Newark) and MPs for Rushcliffe, South Nottingham, Sleaford and North Hykeham, Grantham and Stamford, Lincoln and Sherwood.
Statutory Environmental Bodies	Environment Agency, Historic England and Natural England
Network Rail	
Department for Transport	
All landowners and occupants affected by the scheme (or their Agents)	
Parish Councils	Collingham Parish Council, Farndon Parish Council, North Muskham Parish Council, Aversham, Kelham & Staythorpe Parish Council, Winthorpe - with - Langford Parish Council,
Emergency Services	Nottinghamshire Police Service, Nottinghamshire Police and Crime Panel, Nottinghamshire Fire Service, East Midlands Ambulance Service
Freight Associations	Road Haulage Association
Local Transport Providers	East Midlands Trains, Transport for East Midlands
Community groups	Think Again group (Winthorpe residents Action Group) Nottinghamshire Area Ramblers, Newark Engineering Society, Rotary Club of Newark, Newark Business Club
Local Environment groups	Nottinghamshire Wildlife Trust, Canal & River Trust – East Midlands Waterways
All other local businesses and stakeholders identified through stakeholder mapping	

7.4 Methodology

7.4.1 A number of methods were used to communicate the scheme options and consultation to the public as seen in Table 7-2. The Coronavirus pandemic presented unique challenges to delivering an inclusive and accessible consultation. The restrictions in place meant that holding face-to-face public consultation events was not possible, and so the following consultation activities were organised instead.

Table 7-2: Methods used to consult with stakeholders

Method	Detail
Scheme webpage	This provided information about the consultation and included electronic versions of all consultation materials as well as a link to the

Method	Detail
	National Highways 'Citizen Space' portal where an electronic version of the response form could be completed. The link to the scheme webpage was shared via social media and with local authorities to publicise as appropriate. 3270 people visited the webpage and 7200 visited Citizen Space during the consultation period.
Engagement van	This advertised the options consultation in public locations near to the scheme on dates at the start and towards the end of the consultation.
Social media	Five organic posts for Facebook and 14 Twitter posts were posted during the consultation period via National Highways' social media channels.
Letters and postcards	8,260 letters were posted to stakeholders within the consultation zone and accompanied with consultation materials. A further 9,419 postcards were sent to the outer consultation zone.
Call back service	The project team provided the opportunity for stakeholders to organise telephone calls with members of the project team to answer any questions they may had about the consultation or the scheme. During the consultation period, 12 landowner meetings, 15 stakeholder meetings and 8 meetings with communities/organisations were held using this channel.
Posters	Posters with details about the consultation were displayed at public locations such as libraries, community centres and council offices that were open and accessible during the COVID- 19 coronavirus pandemic.
Press release	Written communication directed at members of the news media was distributed by the National Highways Press Office to local news and media outlets on key dates throughout the consultation.
Consultation response channels	We provided a consultation period of eight weeks, rather than the usual six weeks to allow people more time to review the information available and respond.

7.5 Consultation Feedback

7.5.1 An independent company (Accent) reviewed and considered the 1586 responses that the scheme received from stakeholders during the consultation and published findings in the Report on Public Consultation.

7.5.2 Overall, more respondents were dissatisfied than satisfied with all elements of the current A46, particularly congestion (1,302 (85%) very dissatisfied or dissatisfied), road layout (1,029 (67%) very dissatisfied or dissatisfied) and journey time (950 (62%) very dissatisfied or dissatisfied).

Option 1 Feedback

7.5.3 Most of the comments received in the open questions about Option 1 were negative. The most frequent negative responses related to it *“not improving congestion/increasing traffic flow”* (334 responses), *“not being in favour of the Cattle Market junction design”* (305 responses), *“issues caused by traffic lights”* (233 responses), it being an *“inadequate solution/design with amendments/improvements required”* (216 responses), *“negative impact on local*

residents” (181 responses), *“issues caused by roundabouts remaining”* (160 responses), *“it needs further grade separation”* (146 responses) and *“increasing noise pollution”* (137 responses).

Option 2 Feedback

- 7.5.4 The main positive comments about Option 2 were being “in favour of Cattle Market junction design” (291 responses), it “reducing congestion/improving traffic flow” (284 responses), it “incorporating grade separation/flyover” (268 responses) and it being the “best or better option” (193 responses). The main negative comments about Option 2 were about it being “a negative impact on local residents” (201 responses), it being an “inadequate solution/design with amendments/ improvements required” (172 responses) it “increasing noise pollution” (147 responses) and “issues caused by roundabouts/junctions remaining” (145 responses).
- 7.5.5 After the specific questions on the two options, questions were posed about different layouts for Cattle Market junction and the link between the A1 and Winthorpe junction.
- 7.5.6 For Cattle Market junction, Option 2 (a flyover with the A46 elevated to pass over the roundabout) was strongly preferred with 1,220 (79%) choosing that compared to 131 (3%) for Option 1 (a roundabout with traffic lights with the A46 passing through the middle and the A616 diverted into the A617).
- 7.5.7 For the link between the A1 and Winthorpe junction, there was a slight preference for Option 2 (the A46 is slightly closer to Winthorpe, closer to ground level) with 593 (39%) choosing that compared to 521 (34%) for Option 1 (the A46 is slightly further from Winthorpe, with a flyover above the A46). 363 respondents (24%) showed no preference, selecting ‘neither’.

Key issues arising from consultation

- 7.5.8 852 respondents gave feedback on concerns about issues in relation to the scheme. The most cited concerns included:
- Amendments/improvements required to the proposed options. This covered comments such as:
 - Need to grade separate all junctions.
 - Need to resolve issues caused by roundabouts.
 - Prefer a hybrid of the two options presented.
 - Consideration of Newark Flat Crossing (rail).
 - Scheme options not addressing safety concerns at the A1/A46 junction.
 - Noise pollution as a result of the scheme and associated noise mitigation.
 - Negative impact on local residents, including visual and setting impacts of residential properties, risk of flooding and water drainage capacity and associated mitigation.
 - Environmental/ecological impact and the associated mitigation required.
 - Air pollution and carbon emissions.

- Safety and access for cyclists and pedestrians.
- Negative impact of, and disruption during, construction.

7.6 Response to the Key Issues Arising from Public Consultation

7.6.1 The project team considered the feedback resulting from the consultation, including the key issues outlined above and used this to inform the development of scheme options as set out in this section.

Grade Separation of All Junctions

7.6.2 An option with all junctions from Farndon to Winthorpe grade separated was considered as part of the option identification process (detailed as Option A in Chapter 5). Whilst this option would provide benefit to this section of the A46, the forecast outturn estimates for Option A was significantly more expensive than Options B and D due to the additional construction but did not provide enough additional benefits to justify the increased cost. This option was, therefore, sifted. There has been no material change to the assessment of this option.

7.6.3 Some responses cited concerns regarding the use of traffic lights at roundabout and the congestion that this would cause. We have undertaken microsimulation of the junctions for the forecast traffic flows in order to understand their operation. This modelling will be further developed in future stages of the scheme and used to optimise the layout of the junctions. Traffic lights will only be proposed where they are predicted to improve operation of a junction and may just be used during peak periods.

7.6.4 There were some concerns raised that the existing issues of traffic queuing back from the level crossing on the Great North Road to the south of Cattle Market junction would not be resolved with the at-grade layout in Option 1. The level crossing on the Great North Road has been included in the traffic modelling undertaken to assess the impact of the scheme options; we will work with train operators to understand any planned changes to train frequencies. The provision of signals at Cattle Market roundabout will provide additional junction capacity, reducing queues and delays and as the scheme is developed further we will investigate opportunities to link the junction traffic lights to the level crossing in order to minimise the impact of the level crossing on surrounding traffic.

7.6.5 We received some responses, including from stakeholders such as Midlands Connect, requesting that the scheme is designed to accommodate potential future grade separation of the remaining junctions at Farndon and Winthorpe. Whilst the scheme cannot make an active provision for a future potential scheme, as the detail of the design is developed, we will consider whether junction layouts can be detailed to 'not preclude' future grade separation.

1-2 Hybrid Option

7.6.6 Some stakeholders, such as Newark Town Council and members of the public, requested a combination of Option 1 and Option 2. The 1-2 Hybrid Option, with Option 2 at the western end to provide grade separation at Cattle Market junction and Option 1 at the eastern end was assessed in response to consultation

feedback. Further description of this 1-2 Hybrid Option is contained within Chapter 8 and details of the assessment of this option and its performance relative to Options 1 and 2 is contained within Chapter 9.

Newark Flat Crossing

- 7.6.7 Responses from Network Rail, local authorities (including Lincolnshire and Nottinghamshire County Councils and Newark and Sherwood District Council), Newark Business Club, TravelWatch East Midlands, Midlands Connect, Transport for East Midlands and members of the public highlighted the need for the A46 Newark Northern Bypass scheme to consider Network Rail's aspirations to grade separate the Newark flat crossing between the Nottingham to Lincoln line and the East Coast mainline.
- 7.6.8 We have discussed the timelines and potential layout of a rail grade separation scheme with both Network Rail and the DfT, to identify and understand any potential conflicts between the schemes, and to consider potential opportunities for joint infrastructure.
- 7.6.9 This work identified a pinch point between the railway and the current proposals for the A46 Newark Northern Bypass immediately to the east of the Sewage Works underpass. The project team have developed a modification to the scheme in which the diverge slip approaching Brownhills junction is moved further east to maximise the space between rail and the road. The grade separation of Newark flat crossing is not currently included within Network Rail's funding period. This modification to the A46 Newark Northern Bypass scheme ensures that a future rail scheme would not be precluded by the scheme and would maximise the space available.
- 7.6.10 We will continue to work closely with Network Rail and the DfT as the design for this scheme is developed further.

The A1/A46 Junction

- 7.6.11 The proposals as part of this scheme would remove A46 through-traffic from the existing roundabouts at Brownhills and Friendly Farmer in order to free up capacity at these junctions.
- 7.6.12 Replacing the existing A1 slip roads was considered and discounted. It would require additional works to create longer slip roads and provide an additional junction with the A46. Friendly Farmer and Brownhills roundabouts would need to be retained to maintain access between the A46 and local roads. The additional costs from the extra land needed, additional bridges, earthworks and road construction, would outweigh the economic benefits.
- 7.6.13 Significant alterations to the A1 junction are therefore beyond the scope of this project. However, we have undertaken microsimulation of the forecast traffic movements at these junctions in order to understand how the new flows and turning movements at these junctions would impact their operation. This modelling will be further developed as the scheme is developed and used to inform modifications to the roundabouts in to optimise their operation such as changes to signing and road markings.

Noise

- 7.6.14 Noise pollution and the need to mitigate this impact was a key issue raised by respondents.
- 7.6.15 The design of noise mitigation, such as environmental bunds and barriers, is not usually included at such an early stage of the scheme design. It is National Highways' policy to install low noise surfacing where practical in noise sensitive areas across the road network and, therefore, the environmental assessment of options as presented in Chapter 9 includes low noise surfacing but does not, at this stage, include any other noise mitigation. Further detailed assessment of environmental impacts and potential mitigation measures will be undertaken in the next stage of the design process. In response to the consultation comments, however, the design team undertook a study to investigate potential mitigation options that could be beneficial on the scheme.
- 7.6.16 A series of noise mitigation measures have been tested within the noise model to determine whether they would benefit the noise sensitive properties close to the scheme, in particular those that are within NIA and those that have the potential for a significant increase in noise. These mitigation measures can take different forms:
- Traditional environmental noise barriers have tended to be close boarded timber fences, but they can also be made of other materials, such as concrete, plastics or metal. Barriers can specifically be designed to reduce reflections to the opposite side of the road, and/or support planting.
 - Environmental bunds are long mounds of earth that are built next to a road, when there is sufficient land available. They can be created using excess materials from the construction of the road and often include planting so that they blend in with the surrounding area.
- 7.6.17 Noise mitigation is at its most effective close to the road, and so tall bunds with wide slopes may not be as effective as a barrier of the same height, due to the distance from the road to the top of the mitigation. However, bunds can be more visually acceptable in green spaces. Sometimes the most effective noise mitigation used on a scheme is a combination of noise bund and barrier.
- 7.6.18 The results of this study show that there are a number of noise mitigation options that would be beneficial to the scheme and should be considered for inclusion in the scheme. Further modelling and assessment will be undertaken as the scheme is developed, with more detailed proposals presented and consulted on in the next stage of the project's development. This would include the location, size and type of mitigation being proposed.

Environmental Impacts at Winthorpe Village

- 7.6.19 Concerns were voiced by Winthorpe with Langford Parish Council, the Think Again group, Newark & Sherwood District Council, Newark Town Council, Nottinghamshire County Council and local residents that Winthorpe village would experience negative environment impacts including noise, vibration, visual impact and light pollution as well as an impact on the conservation area of Winthorpe. Support was given to exploring alternatives in the vicinity of Winthorpe in order to minimise these impacts.

7.6.20 Option 2 Modified was developed in response to these concerns, with the route of the new A46 link crossing the A1 moved approximately 75 m further from Winthorpe than Option 2. This option is described in detail and assessed in Chapters 8 and 9.

Think Again Group Alternative 'Option 3'

7.6.21 The Think Again group, made up of concerned Winthorpe Residents, proposed an alternative 'Option 3' for consideration, in order to minimise the impact of the scheme on the village as shown in Figure 7-2.

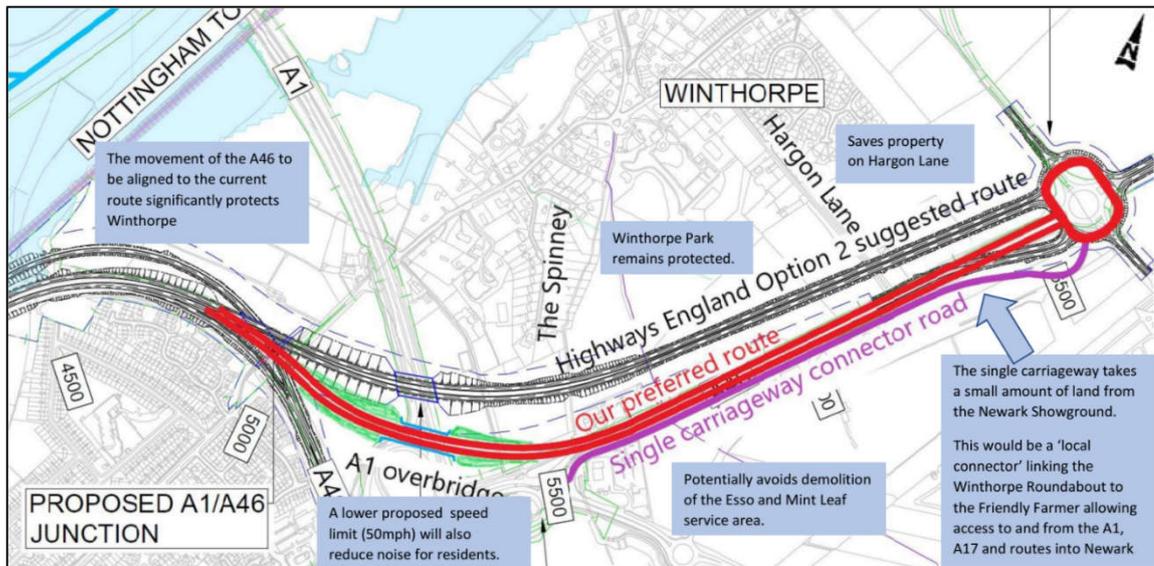


Figure 7-2: Think Again group alternative 'Option 3'

7.6.22 The key elements of this proposed alternative are:

- The new A46 link crossing the A1 would cross the A1 further to the south above the existing A1 access slip roads.
- The horizontal curves would be designed for a 50 mph speed limit (85 kph design speed), using similar curve radii to those in Option 1 and 2 around the north-west of Newark.
- The new A46 link would re-join the existing route of the A46 between the service areas to the north of Friendly Farmer roundabout.
- The new road would remain on the old A46 carriageway up to the enlarged Showground roundabout.
- The Friendly Farmer and Winthorpe roundabouts would be linked by a single carriageway road allowing connection for A1, A17 and Newark-on-Trent traffic to the A46 to and from the East and the A1133, which would be located to the south of the old A46 carriageway.

7.6.23 The Think Again group reported to have had discussions with Newark and Sherwood District Council and local council elected representatives, Nottinghamshire County Council, the Newark Showground Committee and have engaged with the village via two zoom meetings, a talk to the lunch club, and diners at the local pub, Lord Nelson. A Register of Support was started on

Monday 12 April and (at 26 April 2021) was reported to have approximately 100 signatures.

- 7.6.24 Key feedback points have been recorded on the A46 section of the Winthorpe village website for reference. Interest and attendance by villagers at all these opportunities is reported by the Think Again group to have been high, with no adverse comment to the Option 3 proposed.
- 7.6.25 An assessment of the Think Again Option 3 has been undertaken by the project team to review the assumptions of the design. A copy of this assessment can be found in Appendix C.
- 7.6.26 Option 3, as proposed by the Think Again group, is similar in layout to the Option 2 Modified, which is described in detail in Chapter 8 and assessed in Chapter 9. It is noted that the proposed Option 3 moves the new A46 link to cross the A1 further south than Option 2 Modified, but this is not considered a material difference and could be considered through the optimisation of a preferred option in future stages. The assessment of Option 3 is therefore considered to be covered by the assessment of Option 2 Modified and is a viable option.

Winthorpe with Langford PC alternative

- 7.6.27 As part of the consultation process, Winthorpe with Langford Parish Council suggested an alternative route for the A46 in the vicinity of Winthorpe in order to minimise the impact of the scheme on the village. This sees the section of road between the A1 and A1133 being moved south of the current A46, with the aim of reducing the impact of the scheme on the village of Winthorpe.
- 7.6.28 This option would propose to leave the widened dual carriageway section to the west of the A1, crossing to the north of the existing junction via a new structure. From here the new A46 would rise to cross over the existing A46 via a new structure, passing between the fuel stations to the north and south of the existing A46 near Friendly Farmer roundabout. This section would be raised to pass over and retain the existing link between Friendly Farmer and Winthorpe roundabouts as it is.
- 7.6.29 The new A46 would fall to existing ground levels to the south of the existing A46, which is currently within the Newark Showground.
- 7.6.30 The new A46 would bypass Winthorpe roundabout, crossing Drove Lane via a new structure. From here, it would continue north-east and re-join the existing A46 route to the north of Winthorpe roundabout. New slip roads would be required to maintain connectivity between Winthorpe roundabout and the A46 to/from the north-east.
- 7.6.31 A sketch outlining the route of the Winthorpe Alternative Option is shown in Figure 7-3.

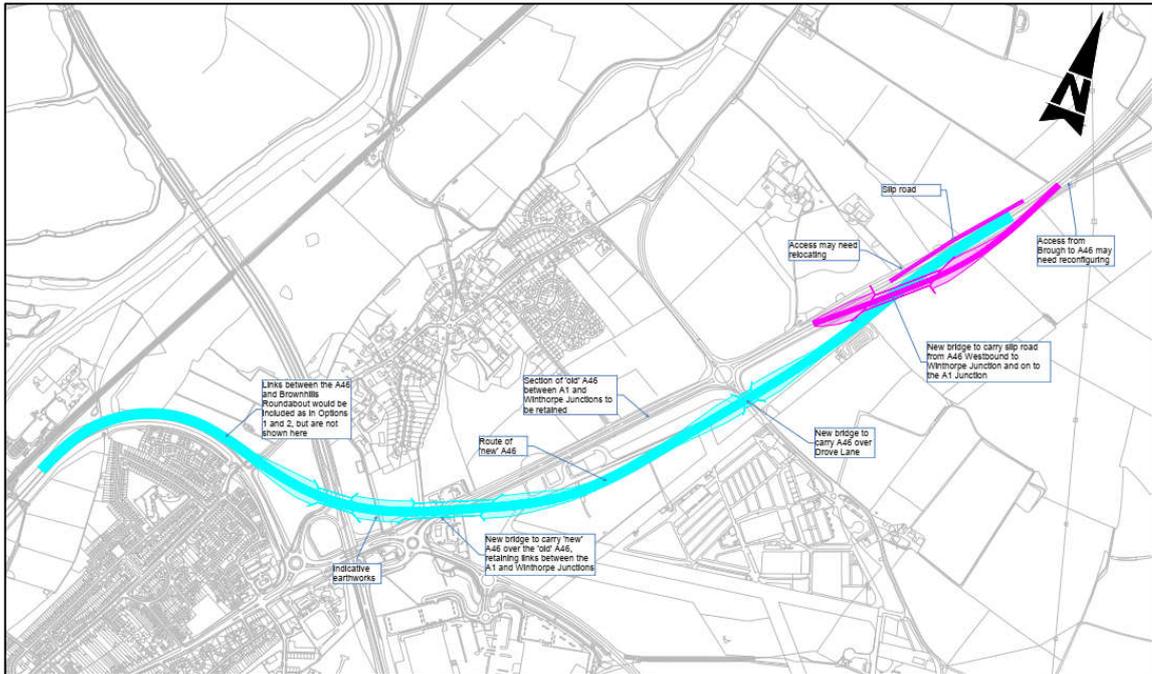


Figure 7-3: Sketch of the Winthorpe Alternative Option

- 7.6.32 The assessment of the option is presented in Appendix D. Whilst there is a potential for some slight benefits to delays and journey times in the Winthorpe Alternative Option, this would be unlikely to be sufficient to offset the significantly higher costs associated with additional structures, land take and earthworks when compared to Options 1 and 2. This would adversely affect the value for money of the scheme, which is already assessed as having low value for money for Options 1 and 2.
- 7.6.33 From an environmental perspective, the Winthorpe Alternative Option is environmentally worse than Option 1 and 2 due to the potential for this option to generate more materials and waste and the additional significant adverse effects it would have on landscape and visual, cultural heritage, development land and businesses, and water quality receptors.
- 7.6.34 Given that the Winthorpe Alternative Option is less favourable in engineering, economic and environmental regards than Options 1 and 2, would present lower value for money and would still bring the proposed A46 route closer to the village of Winthorpe, it is recommended that the Winthorpe Alternative Option should not be assessed further.

Environmental Impact for Local Residents

- 7.6.35 Concerns were raised by local residents that the scheme would have negative environment impacts including noise, vibration, visual impact and light pollution.
- 7.6.36 The environmental impact of the options has been assessed and is summarised in Chapter 9 of this report. At this early stage of the project, the environmental assessment of the options considered:

- Embedded mitigation that has been included in the option design development based on National Highways' design principles to avoid or prevent adverse environmental effects and achieve better environmental outcomes²⁷.
- Potential for essential mitigation measures not currently included in the option design or accounted for in the assessment that would be required to reduce and if possible offset likely significant adverse environmental effects.

7.6.37 An important part of the design philosophy, considered in the environmental assessment of the options, will be to asymmetrically widen the A46 to mitigate the potential impact on views from Newark and the setting of the conservation area. This will be achieved by maintaining the position of the existing edge of carriageway in the southbound direction and proposing drainage solutions that will aim to retain where practical the existing earthworks and screen planting and avoid vegetation clearance. In addition, as described in paragraph 7.6.15, whilst noise mitigation such as environmental bunds and barriers are not included at such an early stage of the scheme design, it is National Highways policy to install low noise surfacing where practical in noise sensitive areas across the road network, which has been included in the environmental assessment of the options.

7.6.38 In the next stage of the scheme, we will hold further consultation which will include further details of the scheme design and environmental mitigation.

Air Pollution and Carbon Emissions

7.6.39 Local residents raised concerns about the impact the scheme could have on air quality. The assessment of air quality for the scheme options is presented in Chapter 9 of this report. As the scheme design is developed, and in response to any future changes in the forecast traffic flows, the air quality model will be updated and refined.

7.6.40 There were additional concerns raised regarding increased carbon emissions as a result of the scheme and questions on how the scheme will achieve UK climate change targets.

7.6.41 The construction of the scheme 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.

7.6.42 Once opened for traffic, the scheme would result in an increase in greenhouse gas emissions generated by vehicles in use. Our model predicts an increase in the year the scheme would be open for traffic (2028) of between 9,000-12,830 tonnes CO₂e. Government policy is helping change the fleet mix to improve those emissions, such as no petrol/diesel cars sold after 2030. So, we would expect the impact to reduce over time in line with the UK's ambition to be Net Zero Carbon by 2030. The government's NPS NN states that this type of scheme is unlikely to materially affect the ability of the UK to meet its carbon budgets, and therefore unlikely to lead to a significant effect on climate.

²⁷ DMRB, LA 104 Environmental Assessment and Monitoring, National Highways, August 2020

- 7.6.43 Requirements relating to the minimisation of GHG emissions are also included in National Highways' Licence from DfT (April 2015). Section 5.23 of the licence specifies that in complying with its general duty National Highways should 'Calculate and consider the carbon impact of road projects and factor carbon into design decisions, and seek to minimise carbon emissions and other greenhouse gases from its operations.'
- 7.6.44 A more detailed assessment of construction emissions will be carried out at a later project stage.

Walkers, Cyclists and Horse-Riders

- 7.6.45 Some concerns were raised through consultation for the safety of walkers and cyclists crossing the scheme at junctions and on PRow. Newark Town Council requested that greater consideration is given to facilities for cyclists and pedestrians in the design of the scheme. Potential personal safety concerns were raised around the proposal to extend the existing underpass under the A46 at Winthorpe Road.
- 7.6.46 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, in accordance with GG 142. A summary of the impacts of each option on walkers, cyclists and horse-riders is included in Chapter 9.
- 7.6.47 As the scheme is developed around a preferred option, there will be opportunity for further consultation with the range of groups who might use a particular route in order to develop a suitable solution.

Concerns During Construction

- 7.6.48 Concerns were raised by local authorities and businesses, as well as members of the public, around how the flow of traffic would be maintained during the construction phase and how disruption would be minimised. For the next stage of the scheme's development, a contractor will be coming on board to start more detailed planning of the construction phase of the scheme. As the scheme is developed further, we will seek to engage with local authorities, business and communities when planning the construction phase and there will be further consultation and opportunity to comment on the plans in the next stage before a Development Consent Order submission.
- 7.6.49 We will publish more details about how we will manage environmental impacts during construction before we start works on the scheme.

8. Summary of Options developed from Public Consultation

8.1.1 This chapter describes the options that were developed in response to feedback from the options consultation, and have subsequently been assessed within the Option Selection stage.

1-2 Hybrid Option

8.1.2 The 1-2 Hybrid Option has emerged as an option to be considered as a result of responses to the options consultation, which showed some support for a combination of Options 1 and 2. The layout is shown in Figure 8-1.



Figure 8-1: Layout of 1-2 Hybrid Option

8.1.3 This option would include widening of the A46 between Farndon and the A1, as per Options 1 and 2. It would include the proposed grade separated layout at Cattle Market junction as in Option 2 but would cross the A1 and tie-in to the A46 to the west of Winthorpe junction, using the same layout as in Option 1.

8.1.4 A general arrangement drawing of the 1-2 Hybrid Option can be found in Appendix B.

Option 2 Modified

8.1.5 Option 2 Modified has emerged as an option to be considered as a result of responses to the options consultation, which voiced concerns about the impact on the village of Winthorpe. The section of the route in the vicinity of Winthorpe is shown in Figure 8-2.

9. Summary of Design and Analysis

9.1 Overview

9.1.1 This chapter of the SOAR describes the assessment undertaken for:

- Option 1.
- Option 2.
- 1-2 Hybrid Option.
- Option 2 Modified.

9.1.2 The 1-2 Hybrid Option and Option 2 Modified have been developed in response to feedback from the options consultation. In some cases, the level of assessment undertaken for these options is not to the same extent as for Options 1 and 2, and is instead based upon judgement and understanding of the performance of the option relative to Options 1 and 2. The 1-2 Hybrid Option and Option 2 Modified are broadly similar to Options 1 and 2, so much of the Environmental Assessment Report (EAR) and other discipline assessments undertaken for Options 1 and 2 are transferrable to these new options.

9.2 Engineering Assessment

Departures from Standards

9.2.1 Both Options 1 and 2 have sought to provide a geometric layout compliant with latest design standards. However, as the design is developed, and constraints become clearer, it may be necessary to utilise relaxations of standards or seek departures from standards. Where the latter is the case, formal technical approval with the overseeing organisation must be sought prior to incorporating the element of design into the scheme.

9.2.2 Departures from standards may allow opportunities for innovation, in order to provide mitigation and overcome complexities in the proposed scheme that would otherwise pose a greater challenge to a compliant design.

9.2.3 Due to the options for the A46 scheme being developed around the widening of an existing carriageway, departures from standards associated with constraints in the existing highway layout are required.

9.2.4 An initial assessment of the design has identified a similar number of departures from standards associated with Options 1 and 2. At this very early stage of the design these departures from standards are only in relation to the geometry of the scheme, since other more detailed design elements have yet to be developed.

9.2.5 As design development progresses, there is scope that the number and/or nature of these departures from standards will change; this is typical during design development. Where departures from standards cannot be removed through design development, appropriate measures to reduce or mitigate the impacts will be required.

Key Departures from CD 109 (DMRB)

- 9.2.6 Assessment of the geometry against CD 109 of the DMRB has identified that, in all options, there would be two below desirable minimum radii horizontal curves included along the A46 mainline, located between Cattle Market junction and Brownhills roundabout. These curves are inherited from the existing A46 layout, which are already below the desirable minimum standards.
- 9.2.7 These two departures from standards were considered fundamental to Options 1 and 2. As such, an early Safety Control and Review Group (SCRG) was convened prior to the options being presented at options consultation.
- 9.2.8 Further assessment of these curves in Stage 2 has concluded that the departures from standards cannot be reasonably removed or reduced without significant additional construction and cost. Appropriate mitigation measures have been considered, and at this stage it is proposed that this section of the A46 would be subject to a reduced speed limit of 50 mph between Cattle Market and Winthorpe junctions. Other mitigation, to be developed in later design stages, may include countdown markers, advance warning signs and road restraint systems.
- 9.2.9 Provisional agreement for these departures from standards and associated mitigation has been granted in Stage 2 with endorsement from the SCRG, but would be subject to National Highways' formal departure approval process in later stages. Approval will be dependent on appropriate justification, mitigation and supporting evidence being provided.

1-2 Hybrid Option and Option 2 Modified

- 9.2.10 An initial assessment of the design has identified that the 1-2 Hybrid Option and Option 2 Modified would have a similar number of geometry departures from standards as Options 1 and 2.
- 9.2.11 Both the 1-2 Hybrid Option and Option 2 Modified would include the key departures from standards relating to the horizontal curvature along the mainline for which provisional agreement has been secured in Stage 2.

Conclusion

- 9.2.12 All options incorporate departures from standards. The associated hazards and appropriate mitigation measures would need to be considered as the design is developed further in order for them to be formally incorporated into the design. The assessment at this stage concludes that no option is more or less favourable in terms of the risk of getting the departures from standard approved.

Structures Assessment

- 9.2.13 The proposed scheme options will incorporate several existing and new structures. The proposals for each structure are discussed in turn, progressing from the southern end of the scheme to the north.

Farndon underpass (existing)

- 9.2.14 In Options 1 and 2, the underpass would need to be extended by approximately 7 m at its western end only. Precast concrete boxes, similar to the original

construction, may be used to form the extensions with an in-situ 'stitch' onto the existing box sections.

Windmill Viaduct (existing and new)

9.2.15 For Options 1 and 2, the existing three-span, steel composite bridge could be retained to carry the A46 southbound carriageway. Only minor modifications would be required to suit the revised verge, carriageway and kerb arrangements.

9.2.16 A new, parallel bridge would be constructed alongside the existing to carry the A46 northbound traffic. The bridge is very likely to take the same form as the existing, with a steel composite deck supported on multiple girders comprising three spans (24 m / 42 m / 24 m). Two intermediate piers and two abutments with piled foundations would be used to support the bridge deck. The height of the new structure is very likely to be the same as the existing.

Pipe culvert No. 5 (existing)

9.2.17 To accommodate the widened A46, the corrugated-steel pipe culvert would need to be extended by approximately 24 m on the west side in both Options 1 and 2. To extend the culvert, new corrugated-steel pipes could be installed and attached to the existing structure, with a new headwall constructed at the new inlet/outlet.

Farm access underpass (existing)

9.2.18 In Options 1 and 2, the concrete box underpass would need to be extended at the west end by approximately 25 m to accommodate the widened A46. The existing 'trough' section approach wing walls on the west side would be demolished and new precast or in-situ box sections and wing walls would be constructed, stitching on to the existing structure.

Pipe culvert No. 6 (existing)

9.2.19 To accommodate the widened A46, the corrugated-steel pipe culvert would need to be extended by approximately 12 m on the west side in both Options 1 and 2. To extend the culvert, new corrugated-steel pipes would be installed and attached to the existing structure, with a new headwall constructed at the new inlet/outlet.

Nottingham to Lincoln railway line west crossing (existing and new)

9.2.20 In both Options 1 and 2, the existing three-span, precast concrete beam bridge over the railway line would be retained to carry the A46 southbound carriageway. Only minor modifications would be required to suit the revised verge, carriageway and kerb arrangements.

9.2.21 A new bridge would be constructed to carry the A46 northbound carriageway over the railway at a similar height to the existing structure.

9.2.22 The new bridge would be offset a minimum of 2 m from the edge of the existing bridge to avoid any conflict between their abutments, however, sections of the existing wing walls and retaining walls may need to be demolished or modified before constructing the new bridge abutments. The extent of the demolition or modification will be determined in the later design stages.

- 9.2.23 The form of the new bridge would be similar to the existing structure, with three continuous spans of 22.6 m / 23.2 m / 22.6 m at approximately 50° skew angle of precast beam deck construction supported on reinforced concrete intermediate piers and end abutments with support bearings.

Pipe culvert No. 7 (existing)

- 9.2.24 To accommodate the widened A46, the corrugated-steel pipe culvert would need to be extended by approximately 17 m on the northbound side in both Options 1 and 2. To extend the culvert new corrugated-steel pipes would be installed and attached to the existing structure, with a new headwall constructed at the new inlet/outlet.

Cattle Market flood relief culvert (existing)

- 9.2.25 This flood relief culvert crosses below the existing Cattle Market roundabout from the north-east to the south-west of the roundabout and is constructed of twin reinforced concrete boxes.
- 9.2.26 Both options at Cattle Market roundabout involve the construction of a new, larger junction. This flood relief culvert would need to be extended by approximately 80 m on the north-east side and 40 m for the south-east side, with new headwalls at both ends.
- 9.2.27 The culvert extensions would use twin precast concrete boxes with in-situ sections to stitch to the existing structure.

Cattle Market Junction bridges (new)

- 9.2.28 In Option 2, two new underbridges are required to carry the A46 mainline, in the form of approximately 27 m wide precast beam decks each with a single span of 28 m with integral reinforced concrete abutments, with a headroom in the region of 5.5 m above the roundabout. The A46 would cross the roundabout at a height in the region of 7.5 m.

Cattle Market Junction approach retaining walls (new)

- 9.2.29 In Option 2, the form and length of the retaining walls associated with the construction of the new bridges will be dependent on highways layout but will likely incorporate the use of reinforced earth. The retaining walls would be approximately 750 m in length with an average height of 4 m.

Cattle Market causeway arches (existing and new)

- 9.2.30 There are three sections of masonry arches located immediately to the north of the existing Cattle Market roundabout beneath the existing single-carriageway A616 Great North Road. All three arch structures have been Grade II listed by Historic England in 1971.
- 9.2.31 In Option 1, the Great North Road would be widened. It is proposed that the existing structures carry the northbound carriageway and they are retained without modification.
- 9.2.32 New flood relief arch structures would be constructed parallel to and separated from the existing masonry arches to carry the southbound carriageway. Precast concrete arch units are proposed (e.g. flexi arches) to give a similar appearance

to the existing arched structure and provide fast and economical construction. Other features such as the number of arches, spans, rises and coping details would be constructed to match the existing structure as far as possible.

Pipe culvert No. 12 (existing)

- 9.2.33 To accommodate the widened A46 and the new slip roads at the Cattle Market junction, the corrugated-steel pipe culvert would need to be extended by approximately 50 m on the northbound side in both Options 1 and 2. To extend the culvert new corrugated-steel pipes could be installed and attached to the existing structure, with a new headwall constructed at the new inlet/outlet.

Nottingham to Lincoln railway line east crossing (existing and new)

- 9.2.34 The existing bridge carries the A46 and spans over Nottingham to Lincoln railway line. The structure is single span, of precast concrete beams with in-situ deck construction, at approximately 50° skew angle, supported on bearings at the two abutments. The deck has a wide verge on the northern side for visibility purposes. This area is considered unsuitable for widening the highway deck due to restrictions on visibility at the central reserve barrier. Hence, it is proposed that the existing bridge will carry the southbound carriageway and a separate bridge is constructed to carry the northbound. Only minor modifications of the existing bridge will be required to suit the revised verge, carriageway and kerb arrangements.
- 9.2.35 The new bridge would be offset approximately 3.5 m from the edge of the existing bridge to avoid any conflict between their abutments, however, sections of the existing wing walls and retaining walls may need to be demolished or modified before constructing the new bridge abutments. The extent of the demolition or modification will be determined in the later design stages.
- 9.2.36 The form of the new bridge would be similar to the existing, with a single span of 20.2 m at approximately 50° skew angle of precast beam deck construction supported on reinforced concrete intermediate piers and end abutments with support bearings. The new deck width would be approximately 35 m, dependent on the visibility influenced by high containment parapets at the deck edge, making the deck area approximately 700 m².

Nottingham to Lincoln railway line east crossing retaining walls (new)

- 9.2.37 In both Options 1 and 2, new retaining walls are proposed to support the elevated A46 on the northern side, leading up to the new railway bridge, so that the earthworks do not encroach on the adjacent railway line. The form of the retaining structures is likely to use reinforced earth with the length approximately 500 m and an average height of 2 m.

Nether Lock Viaduct (existing and new)

- 9.2.38 In both Options 1 and 2, the existing five-span viaduct with a steel-composite ladder-beam deck that spans over the River Trent and flood plain could be retained to carry the A46 southbound carriageway. Only minor modifications would be required to suit the revised verge, carriageway and kerb arrangements.

- 9.2.39 A new viaduct would be constructed in parallel to carry the A46 northbound carriageway at a similar height to the existing structure.
- 9.2.40 The new viaduct is proposed to be of similar construction to the existing, with a steel-composite ladder-beam deck comprising five spans (35 m / 46 m / 46 m / 62 m / 40 m). Four intermediate piers and two abutments with piled foundations would be used to support the viaduct deck. The deck area of the viaduct would be approximately 3080 m².
- 9.2.41 A launching technique could be considered for the erection of the deck girders to minimise disruption to the existing traffic and the river environment.
- 9.2.42 Like the existing viaduct, the north abutment of the new viaduct should be constructed to support the new northbound decks of both the Nether Lock Viaduct and the adjacent Nether Lock railway bridge.

Nether Lock railway bridge (existing and new)

- 9.2.43 The existing Nether Lock railway bridge carries the A46 over the East Coast mainline and is located to the north of Nether Lock Viaduct. The structure consists of a single span with eight precast concrete beams and an in-situ concrete slab forming the deck, supported on reinforced concrete abutments at a 48° skew angle. The skew span of the deck is 27 m between bearings.
- 9.2.44 In both Options 1 and 2, the bridge could be retained to carry the A46 southbound carriageway. Only minor modifications would be required to suit the revised verge, carriageway and kerb arrangements.
- 9.2.45 A new railway bridge would carry the A46 northbound carriageway in parallel with and at a similar height to the existing railway crossing. A suitable form would be similar to the existing structure with a single span of 32 m at approximately 48° skew angle of precast concrete beam deck construction supported on reinforced concrete end abutments with support bearings. The new deck width would be approximately 13.4 m, making the deck area approximately 430 m².
- 9.2.46 There is an existing steel gantry over the railway line to the north-west of the bridge, which will most likely need to be relocated to give way to the new crossing with a new set of supports for the overhead line electrification required.

New Nether Lock railway crossing retaining walls (new)

- 9.2.47 In both Options 1 and 2, new retaining walls are proposed on the west side of the A46 approaches leading to the new Nether Lock railway bridge, retaining the embankment so that the earthworks are contained away from the railway line. The form of the retaining structures is likely to use reinforced earth with the length approximately 160 m and an average height of 3 m.

Sewage Works Access Underpass (existing)

- 9.2.48 In both Options 1 and 2, the concrete box underpass would need to be extended at the west end by approximately 25 m to accommodate the widened A46. The existing wing walls on the west side would be demolished and new precast or in-situ box sections and wing walls would be constructed, stitching on to the existing structure.

Pipe Culvert No. 16 (existing)

- 9.2.49 In both Options 1 and 2, this pipe culvert would need to be extended by approximately 50 m on the north side and 10 m on the south side to accommodate the widened A46 and slip roads to the Brownhills roundabout. To extend the culvert, new corrugated-steel pipes could be installed and attached to the existing structure, with new headwalls constructed at each new inlet/outlet.

Winthorpe Road subways (existing and new)

- 9.2.50 The existing pedestrian/cycle underpass crosses under the current route of the A46 and links housing to the south of the A46 to a farm access on the north side and beyond to Winthorpe village.
- 9.2.51 In both Options 1 and 2, the A46 would be moved to the north and new slip roads to the Brownhills roundabout would pass either side of the existing underpass. As such, the existing underpass becomes redundant and would be demolished to create open space between the slip roads, and a new set of underpasses would be required which would be wider to include the farm access.
- 9.2.52 The new structures would comprise precast concrete boxes under the two A46 slip roads and mainline in three sections. The two open spaces between the boxes would have retaining walls in between. The internal width of the underpass would be 7.5 m, comprising 3 m of footway/cycleway, 3.5 m roadway and 1 m hardened verge, and the minimum headroom is 2.5 m. The total length would be approximately 80 m.
- 9.2.53 Headwalls with parapets or guardrails would be required at both ends of each box section. The underpass should be constructed clear of the abutment for the new slip road flyover abutment and its associated retaining walls.

A1/A46 slip road flyover (new)

- 9.2.54 In both Options 1 and 2, this new flyover carries the A46 mainline over the diverge slip road from the A46. The flyover is proposed to be a single span of steel composite deck construction, with a skew angle of approximately 60° and a skew span length of 34 m. The steel composite deck would give a better construction depth to achieve the required headroom at this location with a tight highway layout. The deck would be simply supported on bearings at the two abutments. The deck area of the bridge would be approximately 1260 m². The A46 would cross the slip road at a height in the region of 8.5 m.

A1/A46 slip road flyover retaining walls (new)

- 9.2.55 In both Options 1 and 2, retaining walls would be required along the approaches to the new flyover on both sides. The type of approach retaining walls could be reinforced concrete walls or reinforced earth. The length, depending on the vertical profile, would be approximately 200 m with an average height of 4 m.

A1/A46 crossing (new)

- 9.2.56 This new bridge would carry the A46 mainline over the A1. The proposed bridge is of steel composite deck construction with integral abutments. The span length is approximately 60 m with a skew angle about 20°, and would accommodate an

access to the parcel of land immediately north of Brownhills roundabout. There would be short wing walls along the approaches to the structure, which can be integral with the abutments.

- 9.2.57 There are two variations of the same structure depending on the scheme option. For Option 1, the deck width would be approximately 40 m and for Option 2 would be approximately 36 m, crossing the A1 at a similar height to the existing structure at the A1/A46 junction.

Bleach House culvert extension (new)

- 9.2.58 A new pipe culvert is required to carry the watercourse that passes to the east of the Friendly Farmer roundabout beneath the A46. The culvert could be constructed of a single corrugated steel pipe of 1.6 m diameter (approximately the same as the existing pipe under the Friendly Farmer roundabout) and would be approximately 100 m long in Option 1 and 45 m long in Option 2.

Friendly Farmer Roundabout / A46 on slip flyover (New)

- 9.2.59 This overbridge is proposed to carry the A46 merge slip road from the Friendly Farmer roundabout over the A46 mainline at approximately 300 m north of the A1 crossing. The bridge would be required for Option 1 only.
- 9.2.60 A two-span (35 m / 35 m) steel composite deck (approximately 20 m wide) 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, crossing in the region of 8.5 m above the new section of A46 mainline carriageway.

Other issues

- 9.2.61 As stated in the Geotechnical Risk Overview (see paragraph 9.2.89), 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.
- 9.2.62 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.
- 9.2.63 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.
- 9.2.64 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 not be underestimated.

1-2 Hybrid Option and Option 2 Modified

- 9.2.65 The majority of structures, and associated risks, required in the 1-2 Hybrid Option and Option 2 Modified will be the same as for Option 2.

- 9.2.66 Compared to Option 2 the 1-2 Hybrid Option will require one additional structure to accommodate the flyover link from Friendly Farmer roundabout to Winthorpe junction, and would require a slightly longer extension at Bleach House culvert, the same as in Option 1.
- 9.2.67 Option 2 Modified is likely to require a larger structure at the A1 crossing than Option 2. This is to accommodate the skew of the A46 bypass as it moves closer to the existing A46 between Friendly Farmer roundabout and Winthorpe junction.
- 9.2.68 The number of structures, cost and complexity of structural solutions is broadly similar for the 1-2 Hybrid Option and Option 2 Modified as for Option 2.

Conclusion

- 9.2.69 Structures can be provided to all options. Where Option 1 does not have the additional grade separated junction at Cattle Market, as in Options 2, 2 Modified and the 1-2 Hybrid Option, it does require additional structural solutions to accommodate widening of the A616 and includes an additional structure at the link between Friendly Farmer roundabout and Winthorpe junction. The 1-2 Hybrid Option also requires a structure for the link between Friendly Farmer roundabout and Winthorpe junction.
- 9.2.70 The number of structures, cost and complexity of structural solutions is broadly similar for both options. There is no significant differentiation of implications for structural engineering solutions between the four options.

Highway Drainage Assessment

- 9.2.71 A high-level drainage assessment, outline drainage strategy and 2D design models have been developed in PCF Stage 2 to confirm the typical drainage solutions that can be provided for the scheme. In most cases these will maximise the reuse of the existing drainage infrastructure for the A46, and have been used to set out the land take requirements for the provision of off-carriageway drainage features such as ponds, swales and ditches.

Outfalls

- 9.2.72 Based on the underlying ground conditions, infiltration to ground alone is unlikely to be a feasible solution. However, it is recommended that infiltration testing in accordance with BRE 365 is undertaken as part of PCF Stage 3 to confirm this assumption. Where possible, proposed outfalls will be existing surface water bodies, with existing outfalls reused where possible. However, there are likely to be instances where outfalls to a surface water body aren't feasible in which case existing highway drainage systems as well as third-party assets such as Network Rail culverts will be investigated to be utilised as outfalls.

Surface Water Collection System

- 9.2.73 Generally, surface water from the carriageway will be collected by gullies discharging to a ditch or swale at the toe of the embankment. In sections where the cross-section of the carriageway is super-elevated, and draining in one direction only, it is proposed to provide a concrete channel in the central reserve, also discharging to a ditch or swale at the toe of the embankment. Ditches or

swales adjacent to the carriageway at the toe of the embankment will collect runoff from the embankment as well as the carriageway.

- 9.2.74 Where required at specific locations such as roundabouts, across structures or along the viaduct, combined kerb drainage systems are proposed for the collection of surface water. It is assumed, at this stage, that the runoff from viaducts can discharge unattenuated and without treatment into the nearby watercourse, but this is subject to confirmation with the Environment Agency as part of the preliminary design.
- 9.2.75 Where minimum gradients for ditches and swales cannot be achieved, surface water runoff would discharge into a piped system in the verge that conveys surface water to outfall.

Sub-Surface Carrier Drain Network

- 9.2.76 At this stage, there is little information available on the existing sub-surface drainage network. Further inspection of the HADDMS database indicated that, for a large part of the road, gullies are draining directly into ditches at the toe of the embankment. It is, therefore, assumed that for these sections, there are no existing longitudinal carrier drains. At the junctions, connection with the existing below-ground carrier system may be required. This will have to be verified by drainage surveys during PCF Stage 3. The proposed scheme would seek to follow the same rationale as the existing for the sub-surface drainage network.

Pre-Earthworks Drainage

- 9.2.77 A separate land drainage system will collect and convey surface water runoff from adjacent catchments that fall towards the proposed highway. It is proposed that land drainage would be in the form of a cut-off ditch, where space permits; where insufficient space is available, filter drains will be used. It is assumed that land drainage systems will be owned and maintained by the adjacent landowner.

Attenuation

- 9.2.78 Attenuation storage will be sized to control the peak discharge rates for up to a “1 in 100 year plus climate change” storm event. To reduce the land take required by the scheme, the required attenuation volumes will be primarily provided within embankment toe ditches / swales. However, where sufficient attenuation volume cannot be provided in the linear ditches / swales, attenuation ponds or oversized pipes will be required, with preference given to ponds over pipes.
- 9.2.79 Indicative locations of attenuation ponds have been identified at this early stage of stage, taking consideration of outfall locations, low points and constraints within the existing floodplain.
- 9.2.80 Detailed hydraulic modelling will be undertaken in future design stages, so at this stage the attenuation ponds are 100% oversized in terms of their volume, based on initial estimates.

Assessment

- 9.2.81 The overall drainage strategy in terms of surface water collection, sub-surface carrier drains, pre-earthworks drainage, and attenuation ponds, is the same for both Options 1 and 2.
- 9.2.82 For both options, it has been assumed that existing drainage assets identified from HADDMS are in a suitable structural and serviceable condition to be reused. However, should survey information in future design stages identify that the existing drainage is not in a suitable condition to be reused, new drainage would be required at those locations.
- 9.2.83 A key assumption for the drainage strategy that applies to both options is that, where possible, drainage solutions on the southern edge of the A46 should not impact on the existing mature vegetation, which currently provides screening for residents of Newark-on-Trent.
- 9.2.84 The surface water catchments from both the carriageway and adjacent land is broadly similar for both options. Option 2 may have a slightly larger catchment than Option 1, owing to the additional section of road between the A1 and Winthorpe junction. However, this would not be significantly greater and overall, the amount and complexity of drainage solutions would be very similar for both options.

1-2 Hybrid Option and Option 2 Modified

- 9.2.85 The level of drainage assessment and modelling undertaken for Options 1 and 2 has not been undertaken for the 1-2 Hybrid Option or Option 2 Modified.
- 9.2.86 However, based on the similarities between all options, with the surface water catchments being broadly the same, it is concluded that:
- The drainage strategy would be the same for all options.
 - The amount and complexity of drainage solutions would be very similar for all options.

Conclusion

- 9.2.87 At this stage, none of the proposed options include features where drainage requirements make any option more or less favourable.

Geotechnical Assessment

Ground Conditions

- 9.2.88 The existing A46 is predominantly raised above the floodplain on embankment up to 13 m high. Some areas in the vicinity of roundabouts are at grade.
- 9.2.89 The scheme area is located within the River Trent flood plain. The superficial geology reflects the proximity of the site to the River Trent and primarily comprises Alluvial deposits (soft clays, silts, sands and gravels). The floodplain contains multiple alluvial channels (relict meanders of the River Trent) and as a result, the thickness of soft ground may be highly variable across short distances. A thin seam of very soft clay occurs consistently across the floodplain

at approximately 2 m depth. Soft alluvial clay was recorded at Nether Lock Viaduct to at least 6 m deep.

- 9.2.90 Superficial deposits of River Terrace Deposits are present. These typically comprise sands and gravels. Specifically, the Balderton Sand and Gravel Member (between the A1/A16 junction and Winthorpe junction) and Holme Pierrepont Sand and Gravel Member (between Farndon junction and the A1/A46 junction) are present. The sand and gravels from these River Terrace Deposits have been exploited locally historically from 'borrow pits' for road building.
- 9.2.91 The bedrock geology is mudstone of the MMG between Winthorpe roundabout and up to approximately 0.5 km south-west of the Cattle Market roundabout. The section between Farndon junction and up to 0.5 km south-west of the roundabout at Cattle Market is recorded to be underlain by mudstone of the Gunthorpe and Edwalton Members (sub-divisions of the MMG).
- 9.2.92 Given the number of water bodies to the north of the A46 and to the east of the A616, 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.

Existing Earthworks

- 9.2.93 The Geotechnical Feedback Report completed following construction of the existing A46²⁸ describes the granular fill material used in the embankments. Various materials were used including marl and mudstone, silty sands and gravels, crushed concrete and silty/clayey sands and gravels from various nearby site cuts and excavations/borrow pits
- 9.2.94 Where earthworks are within the floodplain, they incorporated a layer of rockfill (20 mm-75 mm rockfill) to improve resilience to wave action from standing floodwaters.
- 9.2.95 At Nether Lock Viaduct, 15 m wide granular shear keys were used where a particularly deep area of soft clay was identified to improve earthwork stability.
- 9.2.96 Potential settlement issues resulting from loading of soft Alluvium were mitigated during construction by specifying long settlement periods (staged construction) and surcharging (up to 15 months).
- 9.2.97 The upper layer of the embankment comprises Pulverised Fuel Ash (PFA).
- 9.2.98 The existing highway embankments in some parts of the scheme incorporate three floodbanks to protect housing at Weydale, Farndon and Kelham Road and are designed to prevent horizontal flow of surface water through the embankment. Local marl fill and grout curtain cut-offs were used to create suitably impermeable floodbanks.

Geotechnical Risks and Assessment

- 9.2.99 Due to the presence of soft compressible Alluvium, there is high risk of earthwork instability and excessive total and differential settlement of the proposed widened

²⁸ Geotechnical Feedback Report on Newark Relief Road, Department of Transport East Midland Regional Office, 1991

earthworks along the route. Ground improvement to address the soft alluvium in the footprint of the widened carriageway and earthworks will need to be considered.

- 9.2.100 In addition, ground improvement and/or piling will need to be considered in the area of the deep alluvial filled channel near to Nether Lock.
- 9.2.101 The presence of compressible Alluvium also presents a significant risk of differential settlement along the route in relation to the widening of the existing structures and construction of new structures and earthworks. Pile foundations (driven or bored piles) are likely to be required where the thickness of alluvium precludes the use of shallow foundations. Where the Alluvium thickness is <2 m or absent, the River Terrace Deposits may be a suitable founding stratum for shallow foundations.
- 9.2.102 Where embankments are built near to piled foundations, negative skin friction (down-drag on the pile shaft due to settlement) will need to be considered.
- 9.2.103 The A46 route is known to cross historic 'borrow pits' (quarries used for sourcing sand and gravel) used for construction of the nearby Great North Road. These and other borrow pits associated with construction of the existing A46 have potentially been backfilled with uncontrolled spoil and may result in localised areas of poor ground.
- 9.2.104 There are no recorded active or historical landfills located on site or within 250 m of the scheme.
- 9.2.105 MMG contains gypsum. The gypsum from the MMG mudstone is predominately 'Satin Spar' and is an evaporite mineral which is susceptible to dissolution under certain conditions. The presence of sulphate minerals could lead to sulphate chemical attack on buried steel and concrete and could compromise the structure durability. Adequate mitigation measures are required within the design to protect against sulphate attack on buried steel and concrete. Additionally, treatment or prevention methods will need to be considered to ensure that swell or differential swell does not occur due to the expansion of gypsum.
- 9.2.106 The MMG is known to exhibit a weathering profile and varies between being a weak rock (unweathered) or a sand a firm clay (fully weathered). Classifying the degree and extent of the weathering will be an important consideration for the design of piled foundation and will be identified as part of additional Ground Investigation (GI).
- 9.2.107 Due to the location of the scheme in close proximity to the River Trent and associated watercourses, groundwater is likely to be encountered at a very shallow depth below ground level. Groundwater monitoring standpipes will be installed during GI works to monitor groundwater levels and any seasonal variations. Groundwater will need to be considered when any excavations or piling works are carried out at construction stage
- 9.2.108 Clays within the Alluvium may act as a semi-permeable layer. During flood events, this may prevent groundwater flow upwards from River Terrace Deposit sands and gravels beneath. If these clays are removed during construction, replacement granular fill may need to incorporate an impermeable layer to counter this groundwater upward flow.

- 9.2.109 A requirement to resist wave action during periods of flooding and to prevent the flow of floodwater through the embankment was incorporated into the design of the existing embankments. These considerations will also be relevant to the proposed widened earthworks.
- 9.2.110 Most of the Topsoil volume generated during the proposed works is expected to be re-used again as Topsoil to cover the new widened sections of earthwork slopes.
- 9.2.111 Any excavations associated with the works are likely to be within the superficial Alluvium or River Terrace Deposits. The Alluvium is unlikely to be suitable for re-use, except for landscaping. The River Terrace Deposits are likely to yield granular fill material that may be incorporated into the main embankment fill.
- 9.2.112 No significant volume of structural fill is expected to be generated from the areas of embankment widening as any excavations will be limited to the existing slope surface to allow the formation of benching.
- 9.2.113 A site specific GI will confirm the proportion of the material volume that can be re-used directly, material that can be re-used provided it is treated before re-use, and material that will be deemed unacceptable and will have to be exported.
- 9.2.114 Parts of the proposed widening works will be located within the existing flood area and will therefore reduce the current flood capacity. The flood alleviation strategy is expected to require the excavation of nearby areas by reducing the ground levels by up to approximately 1 m to compensate the flood volume capacity reduction imposed by the proposed earthworks.
- 9.2.115 The risk of groundwater and surface water flooding are a major consideration on this scheme. The strategy for managing water across the site will need to be carefully considered and tied in to local and regional strategy to ensure that flooding or insufficient drainage does not result in the failure of earthworks and structures.
- 9.2.116 Historical geotechnical data records the presence of PFA at the core of the existing embankments in some sections. There is a likelihood that the PFA is either not cemented or there are only few cemented layers within the body of PFA. Exposing layers of PFA that has not been fully cemented may result in localised material loss.
- 9.2.117 Existing H piles, ground anchors, sheet piles are known to have been installed for the existing A46 works. There is a risk of clashes with existing buried/hidden structural elements e.g. ground anchors at Nether Lock viaduct wing wall during site works if proper planning and identification of these is not undertaken.

Assessment

- 9.2.118 Options 1 and 2 use the same route corridor, so the ground conditions are anticipated to be similar. The geotechnical risk and assessment are therefore broadly similar for both options.
- 9.2.119 Options 1 and 2 have similar extents of earthworks and new structures (bridges and retaining walls) and are comparable in terms of geotechnical complexity. Option 2 involves grade separation at Cattle Market junction and the associated need for reinforced soil or retaining walls to form the elevated section of the A46. While Option 1 does not involve the geotechnical solutions associated with grade

separation at Cattle Market junction, it does involve work along the A616 and the link between Friendly Farmer roundabout and Winthorpe junction with the associated earthworks and new structures.

- 9.2.120 Option 2 would involve construction of new build road in fields at Winthorpe adjacent to the existing scheme. No historic GI is available for this area and it is not known to have been built on previously, although ground conditions are not anticipated to vary from those suggested by available BGS mapping. GI will be undertaken to infill any geological knowledge gaps prior to scheme design commencing.
- 9.2.121 The widening of the existing carriageway between the junctions is common to both options, as is the A46 mainline bypass of the existing A1/A46 junction.
- 9.2.122 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. It is likely that the proposed earthworks will comprise granular material and rockfill (where required) with preference to using waste products (glass sand, PFA, crushed concrete) where possible in the interest of sustainability. The amount of fill required for Options 1 and 2 is likely to be similar.

1-2 Hybrid Option and Option 2 Modified

- 9.2.123 The ground conditions for the 1-2 Hybrid Option and Option 2 Modified will be similar to Option 2.
- 9.2.124 It is anticipated that the extent of earthworks and new structures (bridges and retaining walls) in the 1-2 Hybrid Option will be similar to, but slightly greater than for Options 1 and 2. The extent of fill required to construct the 1-2 Hybrid Option may be slightly more than for Options 1 and 2.
- 9.2.125 It is anticipated that the extent of earthworks and new structures (bridges and retaining walls) in Option 2 Modified will be similar to Option 2. The extent of fill required to construct Option 2 Modified may be slightly less than Option 2.
- 9.2.126 The land take for the 1-2 Hybrid Option and Option 2 Modified will be broadly similar to Options 1 and 2.
- 9.2.127 The 1-2 Hybrid Option and Option 2 Modified present no significant differentiation of implications for geotechnical risk and engineering solutions compared with Options 1 and 2.

Conclusion

- 9.2.128 There is no significant differentiation of implications for geotechnical risk and engineering solutions between the four options.

Street Lighting Assessment

- 9.2.129 An assessment of the specific requirements of street lighting will be undertaken at a later stage of the design development.
- 9.2.130 At this early stage of the design, several assumptions have been made regarding the likely location of street lighting, which applies to both Options 1 and 2:
- The A46 carriageway in the vicinity of the proposed junctions, as well as the junctions themselves, are likely to require illumination.

- The section between Friendly Farmer roundabout and Winthorpe is currently lit and would be retained as such, subject to assessment in future design stages.
- Any other existing street lighting provision, e.g. side roads, would likely be retained, subject to assessment in future design stages.

1-2 Hybrid Option and Option 2 Modified

9.2.131 The assessment for the 1-2 Hybrid Option and Option 2 Modified with regards to the provision of street lighting would be the same as for Options 1 and 2.

Conclusion

9.2.132 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.

9.2.133 At this stage, none of the proposed options include features where illumination requirements result in any option being more or less favourable.

Impact on Existing Utilities

9.2.134 C2 searches were undertaken at the end of Stage 1, which identified apparatus that may be affected by the scheme proposals. A review of the information received from the utility providers identified that, of the nineteen who responded as having apparatus within the search areas, six could be directly affected.

9.2.135 The known utility assets interacting with the proposed options include:

- Gas mains (Cadent Gas Ltd).
- Telecommunications cables (Instalcom, BT Openreach, and Virgin Media).
- Water mains (Severn Trent Water).
- Sewage pipes (Severn Trent Water).
- High voltage electricity cables (Western Power Distribution).

9.2.136 C3 estimates were obtained in Stage 2 to gain an early indication of the utility providers who were identified as being directly affected and whose assets may need to be diverted as a result of the proposed options (Options 1 and 2). The returned estimates totalled £6.7 million for Option 1 and £5.4 million for Option 2.

9.2.137 No existing utility assets would be affected by the proposed Farndon junction for Options 1 and 2.

9.2.138 The proposed improvements to Cattle Market roundabout, widening of the A46 mainline and the diversion of the A617 Kelham Road would affect several utilities that run adjacent to or under the carriageways for both options. The higher estimate provided for Option 1 is as a result of the proposed diversion of the A617 into the A616, which will interact with two 12 inch cast iron mains and a 600 mm main that may require diversionary/protective works.

9.2.139 There are utilities in the vicinity of the A1/A46 junction that would be affected by the proposed slip roads and widened A46 mainline for both options.

9.2.140 Underground and overhead electricity cables are present in the vicinity of Winthorpe roundabout and would be affected by the proposed alterations to the junction for both options. In Option 1, the additional diversionary works generating cost are associated with two water mains that are believed to supply the Winthorpe service area only (Mint Leaf restaurant & Esso fuel station). The estimates at this stage are conservative and reflect the cost associated with diverting these mains. There is an opportunity for the overall estimate for Option 1 to be reduced subject to further estimates and surveys confirming that these can be abandoned rather than diverted.

1-2 Hybrid Option and Option 2 Modified

9.2.141 C3 estimates have not been requested for the 1-2 Hybrid Option or Option 2 Modified at this stage.

9.2.142 The 1-2 Hybrid Option contains elements of Options 1 and 2. It would be expected to have fewer diversionary works associated with the layout at Cattle Market junction than Option 1, since it adopts the grade separated layout in Option 2. However, this option would include the same layout between the A1 and Winthorpe junction as Option 1 and would be subject to the same confirmation of the water main supply to the Winthorpe service area as Option 1. Costs the diversion of utilities associated with the 1-2 Hybrid Option would be expected to be greater than Option 2 but less than Option 1.

9.2.143 Option 2 Modified would interact with the Winthorpe service area in a similar way to Option 1 and the 1-2 Hybrid Option and has the same layout as Option 2 and the 1-2 Hybrid Option at Cattle Market junction. Like the 1-2 Hybrid Option, Option 2 Modified would, therefore, be expected to have greater costs associated with the diversion of utilities compared to Option 2 but less than Option 1.

Conclusion

9.2.144 The level of impact of existing utility services and the associated diversion requirements will be assessed and confirmed throughout the subsequent design development.

9.2.145 The C3 estimates indicate that Option 1 would have the greatest impact on utilities and the associated costs of diverting these, with Option 2 having the least impact. These impacts have been included in the latest scheme estimates but remain similar enough that none of the four options is significantly more or less favourable in this regard.

Technology Assessment

9.2.146 At this stage, the specific technology elements of the proposals have not yet been designed. However, at this stage of options assessment, it is noted that various technology systems would be beneficial to the Regional Control Centre and Traffic Officer Service (TOS) during operation of the scheme including, but not limited to:

- Environmental sensors to identify weather conditions such as ground temperature to identify potential freezing road surfaces.

- Vehicle detection via induction loops in the carriageway to identify changes to traffic flows.
- CCTV systems to support incident assessment and monitoring.
- Variable traffic signs and signals for traffic control and the provision of road user information.

9.2.147 At this early stage, an outline strategy of which junctions would be signalised for both Options 1 and 2 has been developed. A summary of this can be found in Table 9-1.

Table 9-1: Summary of signalisation at junctions

Junction	Option 1	Option 2
Farndon Roundabout	No signals proposed.	Partially signalised.
Cattle Market Roundabout	Signalised to allow A46 traffic to pass through the centre of the roundabout. Also new roundabout on A616 to be signalised.	Signals proposed for footway/cycleway crossings only.
A1/A46 (Brownhills and Friendly Farmer) Roundabouts	No signals proposed.	No signals proposed.
Winthorpe Roundabout	Partially signalised.	Partially signalised.

9.2.148 Broadly, the requirement for signals is similar for both options. Both Options 1 and 2 would be signalised at Winthorpe roundabout, Farndon roundabout would be signalised in Option 2 only, and Cattle Market roundabout would be signalised in Option 1 only. Where signals are proposed, this would generally be for the A46 approaches and on the circulatory as required.

9.2.149 In Option 1, there would also be an additional roundabout along the A616 to the north of Cattle Market junction, which would be signalised.

9.2.150 The number and complexity of signal requirements is likely to be similar for Options 1 and 2.

1-2 Hybrid Option and Option 2 Modified

9.2.151 Specific technology elements have not yet been designed for the 1-2 Hybrid Option and Option 2 Modified, and the overall strategy for signals at this stage would be the same as for Option 2.

Conclusion

9.2.152 The provision of technology, overall, applies equally for all options; hence no option is more or less favourable in this regard.

9.3 Safety Assessment

Impact on Road User

Assessment Methodology

- 9.3.1 This safety assessment reviews the proposed options with reference to the road safety targets contained within the National Highways 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.
- 9.3.2 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.
 - Other highway features.
- 9.3.3 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, steps should be taken to design out any issues identified in this chapter or appropriate mitigation measures provided to reduce any risks to as low as reasonably practicable as part of the design process.
- 9.3.4 As the scheme is currently at the Option Selection stage, the Road Safety Audit process has not yet been commenced (this would normally start at PCF Stage 3).

Delivery Plan and National Incident and Casualty Reduction Plan

Policy Context

- 9.3.5 The National Highways Delivery Plan 2020-2025 (and, subsequently, the National Incident and Casualty Reduction Plan) contains a Government Key Performance Indicator to reduce the number of collisions involving fatal or serious injuries on the National Highways network to support a decrease of at least 50% by the end on 2025, against the 2005-09 average baseline.

Collision History

- 9.3.6 Personal injury collision data for the A46 for the five-year period 2015 to 2019 has been obtained from the DfT. The extents of the A46 considered includes the existing Farndon and Winthorpe roundabouts. Over this length of the existing A46 there were 2 recorded fatal personal injury collisions and 15 serious personal injury collisions. The focus upon fatal and serious injury collisions is driven by the reduction target; the fatal and serious personal injury collisions occurred in the following locations:

- Two serious collisions at Farndon roundabout.
- Two fatal and two serious collisions on the A46, between Farndon roundabout and Cattle Market roundabout.
- Two serious collisions at Cattle Market roundabout.
- One serious collision on the A46, between Cattle Market roundabout and the existing A1/A46 junction.
- Seven serious collisions at the existing A1/A46 junction.
- One serious collision on the A46, between the existing A1/A46 junction and Winthorpe roundabout.

9.3.7 The occurrence of serious injury collisions at the existing A1/A46 junction could reasonably be expected to reduce through the proposed bypass in Options 1 and 2, and at the Cattle Market junction could reasonably be expected to reduce through the provision of grade separation in Option 2.

9.3.8 Serious and fatal collisions linked to overtaking manoeuvres could reasonably be expected to be reduced substantially through provision of dualling in Options 1 and 2.

Safety Review

Overall Layout

9.3.9 Option 1 includes a diversion of the A617 between Newark Rugby Club and a proposed new signalised roundabout on the A616 Great North Road north of Cattle Market junction. This realigned road includes a new tighter radius bend near the Newark Rugby Club and this layout will be the subject of mitigation, including traffic signs and road markings to inform road users.

9.3.10 For Options 1 and 2, the proposed A1/A46 grade separated junction would remove A46 through-traffic from the existing at grade areas of the junction. In addition, the horizontal and vertical layout and associated forward visibility would be expected to be maintained or improved relative to the existing situation, whilst traffic volumes using the retained elements of the existing layout would be expected to drop significantly. The separation of local traffic from through-traffic (by the use of grade separation) would reduce the number of conflicts involving trunk road vehicles and would be expected to lead to a decrease in the number of collisions on both the trunk road and local road network. Specifically, the fatal and serious injury collision rate would be expected to decrease due to the reduction of conflict points between flows.

9.3.11 For Options 1 and 2, every junction option, regardless of it being at grade or grade separated, would be expected to deliver an improvement on the existing layout due to being designed to provide higher capacity and thus reduce delays and frustration. Therefore, despite Options 1 and 2 being essentially on-line designs, the cumulative benefit of each junction improvement is expected to greatly contribute to the improvement of the A46 traffic flow and driver safety by reducing congestion at each junction. At the grade separated junctions, this benefit would be driven by the reduction in conflict points, and at the at grade junctions there would be reduced frustration and thus a more considered approach to gap acceptance.

- 9.3.12 Both Options 1 and 2 follow the layout of the existing single carriageway, so include some relatively tight curves and restricted visibility. Active consideration of risk control measures and the appropriate safe speed for the section between Farndon and the A1/A46 junction will be incorporated in design development in future stages.
- 9.3.13 The proposed layout of the A46 main carriageway in proximity of the crossing over the A1 is similar for Options 1 and 2. To tie in with the A46 either side of the A1 some relatively tight curves would be required; this would be safety risk assessed and mitigation measures identified as appropriate as the design develops in future stages. The overall risk due to the layout at this location is expected to be significantly better than existing as A46 through-traffic no longer needs to traverse the A1/A46 junction.
- 9.3.14 In Option 1, the layout between the A1 and Winthorpe junction creates relatively short sections for lane changes to take place. This applies in both directions and would be safety risk assessed with appropriate mitigation measures identified as the design develops in future stages.
- 9.3.15 For both Options 1 and 2, gradients for the proposed options are in accordance with current design standards and do not raise concerns for road safety either in isolation or in combination with other design elements.
- 9.3.16 For both Options 1 and 2, there are no other general road safety concerns relating to the layout on the assumption that appropriate parapets and road restraint systems are incorporated into the design.
- 9.3.17 The route for both options generally does not lie on a direct east-west alignment and, therefore, there would be expected to be limited impact from the rising or setting sun.

General Highway Design Features

- 9.3.18 Forward visibility and associated widening on bends will be in accordance with design standard requirements so far as reasonably practicable. Where constraints or curvature in the road could prevent this, for example at the locations identified in paragraph 9.3.9 through 9.3.17, safety risks will be assessed and mitigation measures identified.
- 9.3.19 The proposed A46 main carriageway cross-section is expected to be a standard rural all-purpose dual carriageway (D2AP, in accordance with CD 127) formed of two standard 7.3 m wide carriageways in each direction, consisting of two lanes each 3.65 m wide, with a central reserve and 1.0 m hard strips. The nearside hard strip, amongst other functions, would be expected to accommodate gullies as part of a drainage system where a kerb is present. In addition, during heavy rainfall events, any areas of standing/running water would be accommodated within the hard strip to avoid any impact upon live traffic lanes.
- 9.3.20 The choice of central reserve road restraint system, currently proposed as a vertical concrete barrier, would be influenced by several factors including National Highways trunk road requirements, and the safety performance of the different options. However, it is noted that vertical concrete barriers have the benefit of significantly reducing the potential for 'cross-over' collisions between vehicles travelling in opposite directions as well as directing errant vehicles involved in a glancing blow onward in their original direction of travel.

- 9.3.21 Street lighting would be provided at each junction and on the immediate approaches, including retention of lighting on any unaffected approaches/exits. Away from junctions, lighting provision would be decided by an appraisal of potential safety benefits weighed against costs and environmental impact.
- 9.3.22 During the continued development of landscaping proposals, the consideration of their impact upon road users will be advanced stage by stage to incorporate any potential mitigation into the design and ensuring that sufficient land take is identified in a timely manner.
- 9.3.23 Traffic signs and other roadside features will, where possible, be located away from high risk areas or sited on passively-safe posts where errant vehicles may be more likely to leave the carriageway. Additionally, the likelihood of these features being struck and thus the need to include road restraint systems will be considered as the design is developed. However, the key focus will be upon avoiding hazards in the first instance and only providing protection as mitigation measure when the hazard cannot be designed out.
- 9.3.24 The Road Restraint Risk Assessment Process will be used to identify the locations through the scheme where road restraint systems will be required. Further consideration of the types and locations of road restraint systems will be given as the design is developed.

Junction Strategy

- 9.3.25 Clear traffic signs to identify routes for unfamiliar users would be critical to the successful operation of both layouts. Whilst this is common to all new schemes, the strategy for these signs is critical and would need to be developed with the National Highways asset team and, potentially, the local highway authority. These will ensure the traffic leaving or joining the trunk road network does so at the appropriate junction and other subsequent or preceding traffic signs are consistent.
- 9.3.26 The addition of new structures at the A1/A46 junction, for Options 1 and 2, would introduce new points to diverge and merge from/to the A46. The diverges would be expected to be signed and marked appropriately to safely forewarn motorists of earlier exits than in the existing layout, and updated information would be made available to mapping companies upon opening.
- 9.3.27 Roundabouts can present additional hazards to on-carriageway cyclists, as highlighted in CD 116 Geometric design of roundabouts. For Options 1 and 2, the designs of all the proposed junctions would need to take account of the needs of both on-carriageway and off-carriageway cyclists.
- 9.3.28 There would be a benefit at Cattle Market junction to on-carriageway cyclists in Option 2 compared to Option 1, due to the removal of A46 through-traffic from the junctions. For both Options 1 and 2, at the Farndon and Winthorpe junctions, cyclists on the roundabout circulatory would be negotiating A46 through-traffic as well as local traffic; suitable on-carriageway facilities for cyclists at the at grade junctions will be assessed during preliminary design.
- 9.3.29 Where off-carriageway cycle facilities exist, most cyclists would be expected to be using these based upon site visit observations and results from a walking, cycling and horse-riding survey undertaken in 2018. However, it is acknowledged that the choice between on-carriageway and off-carriageway

routes is dependent upon a number of factors including cyclist experience, journey purpose and convenience/ease of use of the route. Any off-carriageway cycle facilities will be designed to contemporary standards to provide a clear and understandable route as well as safe crossing points that are designed to accommodate cycles.

9.3.30 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 mean more arms at the Cattle Market junction compared to Option 1. This could increase the likelihood of conflicts at the junction but is likely to be largely offset by the avoidance of conflicts at the second roundabout to the north proposed in Option 1.

9.3.31 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.

Tie-in Points

9.3.32 A benefit of the proposed options is that the connections to the local road network would all occur on existing roads of a good standard, largely away from property accesses.

9.3.33 The A46 south-western and north-eastern tie-ins, for Options 1 and 2, have a horizontal layout that is relatively straight with good forward visibility. Similarly, the vertical profile is relatively constant; forward visibility does not appear to be compromised and this means there are no obvious road safety concerns regarding the tie-in points.

Severance and Implications for the Local Highway Network

9.3.34 There are several locations where the proposed options may affect existing severance issues or introduce new problems:

- For 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.
- To the west of the existing Cattle Market roundabout there is currently a footpath that crosses the A46 single carriageway. The introduction of a dual carriageway would mean that the footpath would almost certainly require diversion, probably via the Cattle Market junction.
- At the site of the existing Cattle Market roundabout, the existing SUP across the A46 needs to be catered for when the junction is modified. This junction is proposed to be signalised for Option 1, hence the incorporation of a re-configured SUP should be possible. For Option 2, the crossings of the A46 would be signalised crossings of the A616 and east-facing slip roads, as through-traffic would be separated out.

- To the north of Friendly Farmer roundabout there is an existing footpath already severed by the A46 dual carriageway. This route will be re-assessed in the Preliminary Design stage and reasonable alternatives provided in accordance with local need.
- Elsewhere along the route there are other routes for pedestrians and cyclists that cross the A46 and these would be maintained – or improved – where possible.

Other Highway Features

- 9.3.35 There are several field or private accesses on the existing A46 and alternative means of access will be confirmed in the next phase of design following the selection of a preferred option. It is unlikely that continued access provision from the dual carriageway will be included in the scheme. This is expected to have safety benefits by removing traffic movements into and out of the accesses on a high-speed road, but the safety of users on the alternative routes will need to be taken into account.
- 9.3.36 There are four existing laybys along the A46 – two in each direction. Stopping provision will be further considered in the next stage of design in line with latest design principles and wider provision along the A46 and in the local area.

1-2 Hybrid Option and Option 2 Modified

- 9.3.37 The 1-2 Hybrid Option includes the grade separated layout as Option 2 at Cattle Market junction and the same layout as Option 1 between the A1 and Winthorpe junction. All options have the same layout at Farndon junction.
- 9.3.38 The additional grade separation at Cattle Market junction in the 1-2 Hybrid Option would have a greater benefit than the at grade layout in Option 1 and would have similar benefits to Option 2 in this regard. However, the layout between the A1 and Winthorpe junction, with links to and from Friendly Farmer roundabout, would create a short section for lane changes between the junctions, and so would be less favourable than the layout in Option 2.
- 9.3.39 Option 2 Modified is broadly similar to Option 2. The main difference is at the section between the A1 and Winthorpe junction. The separation between the new A46 bypass and the exiting route of the A46 would be significantly reduced. The proposal to retain the existing wide central reserve which would become a verge between the new dual and single carriageway sections within this layout. The verge would provide a reasonable place of relative safety in the event of a collision or breakdown on the new A46 southbound carriageway or the section of single carriageway between Friendly Farmer roundabout and Winthorpe junction.
- 9.3.40 Option 2 Modified would have a greater benefit than Option 1, due to the additional grade separated junction that would separate A46 through-traffic from local traffic and would have similar benefits to Option 2.-

Conclusion

- 9.3.41 All options would be expected to have a positive impact upon road safety and contribute to the National Highways target of reducing the number of people killed or seriously injured on the trunk road network. The provision of a dualled route would significantly reduce collisions associated with overtaking. The safety

benefits are expected to extend to all user groups including vulnerable users, for whom appropriate facilities and route will be investigated in future design stages. Whilst the options present several differences in possible road safety implications, none of the scheme options raise significant concerns.

- 9.3.42 Whilst it will offer benefits for all user groups, Options 2, 2 Modified and the 1-2 Hybrid Option would have a greater benefit than Option 1, due to the additional grade separated junction that would separate A46 through-traffic from local traffic. Additionally, the layout in the 1-2 Hybrid Option between the A1 and Winthorpe would be less favourable than Options 2 and 2 Modified owing to the short section for lane changing on the approach to Winthorpe junction.

Impact During Construction, Maintenance, Operation and Demolition

- 9.3.43 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 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.
- 9.3.44 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.
- 9.3.45 Key design hazards identified for the operation phase of the proposed 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.
 - Merge and diverge slip roads will be of an appropriate width to allow maintenance activities to take place with suitable safety zones whilst they remain open to traffic.
 - the design of grade separated and at grade junctions throughout the scheme for all options will take account of the safety needs of all types of user.
 - The horizontal layout, vertical profile and stopping sight distance for each option will follow design standards, where possible, to ensure the highest possible level of operational safety within the scheme parameters. Where it is not possible to meet design standard requirements, relaxations from standards may be required and the approval of Departures from Standards will be sought as necessary.
 - 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.

- 9.3.46 Key construction hazards identified for the proposed options are:

- Working in or near live traffic, as the proposals are 'on-line' and would be expected to have impacts upon A46 through-traffic and local road traffic.
- The grade separation proposed at Cattle Market junction in Option 2 would, however, 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 with a subsequent impact of construction-related traffic upon other road users.
- Working in proximity to water bodies and watercourses.

9.3.47 In terms of maintenance of the scheme, on balance, the options are broadly similar. Option 1 introduces the diversion of the A617, widening of the A616 and a flyover link between Friendly Farmer roundabout and Winthorpe junction, including the additional associated structures. Whilst Option 2 does not include these features, in contrast it introduces grade separation at Cattle Market junction, and the associated structures, and an additional length of carriageway between the A1 and Winthorpe junction.

9.3.48 Additional structural maintenance operations would be anticipated for both options and, whilst these are routine operations on the network, they would be expected to increase the likelihood of incidents. Mitigation measures would be used to reduce the risks to an acceptable level. However, it may be possible to utilise the grade separated layout of Cattle Market junction in Option 2 in a positive manner during other maintenance operations as there would be greater options for diverting traffic than in the at grade layout of Option 1.

9.3.49 During the demolition phase, the grade separated Cattle Market junction in Option 2 would be expected to have higher associated risks than Option 1 where this junction is at grade, due to the need to remove or amend a greater number of structures, particularly at junctions, where the majority of traffic movements would be focussed.

9.3.50 Further design assessment and the consideration of construction, maintenance, operation and demolition implications will be undertaken at the Preliminary Design stage. This will develop further understanding of the specific hazards and the opportunity to mitigate them. A key factor that will be considered as the design progresses is the maintenance of the asset using safe working practices, which can be significantly affected throughout the design process.

1-2 Hybrid Option and Option 2 Modified

9.3.51 The 1-2 Hybrid Option and Option 2 Modified is broadly similar to Option 2 and, therefore, has a similar impact during the construction, operation, maintenance and demolition phases.

9.3.52 The grade separated junction at Cattle Market in the 1-2 Hybrid Option and Option 2 Modified would generally result in lower overall risks during the operation phase of the scheme lifecycle than Option 1, but would be expected to result in higher overall risk during the construction and demolition phases.

Maintenance risks associated with all options would differ but, on balance, would be comparable in terms of their overall level of risk.

Conclusion

- 9.3.53 The impacts outlined during construction, operation, maintenance and demolition vary between each option. The additional grade separated junction in Options 2, 2 Modified and the 1-2 Hybrid Option would generally result in lower overall risks during the operation phase of the scheme lifecycle whilst the at grade layouts in Option 1 would be expected to result in lower overall risks during the construction and demolition phases. Maintenance risks associated with all options would differ but, on balance, would be comparable in terms of their overall level of risk.

Walking, Cycling and Horse-Riding Assessment and Review

- 9.3.54 For both options there are implications for existing walking, cycling and horse-riding routes, including footpaths, SUPs, 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.
- 9.3.55 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, in accordance with GG 142.

Observations applicable to Farndon Junction

- 9.3.56 The existing SUP following the B6166 Farndon Road passes under the A46 via an underpass. A grade separated crossing will be retained at this location for Options 1 and 2 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.
- 9.3.57 For Options 1 and 2 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.
- 9.3.58 There is an opportunity 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. This is relevant to Options 1 and 2. It is currently of a sub-standard width and provides a low-quality route primarily due to the numerous crossings.

Observations applicable to Cattle Market Junction

- 9.3.59 There would be a significant negative impact on an uncontrolled footpath crossing south of Cattle Market junction (FP14) in Options 1 and 2 – the provision of an at grade crossing on a dual carriageway would be considered inappropriate at this location. Both options present an opportunity to divert the footpath to the north via the A617 Kelham Road. For Option 1 this would follow the route of the stopped-up section of the A617, and for Option 2 this would follow the A617 as per existing. The route diverted route would tie in to the roundabout at Cattle Market junction, where an improved crossing of the A616 northern arm would be required.
- 9.3.60 In a grade separated layout in Option 2, 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 would be included to help improve the safe use of these crossings.
- 9.3.61 For Option 1 with an amended at grade signalised roundabout, there is an opportunity to improve the existing signal-controlled Toucan crossing of the A46 at this location. At present there is anecdotal evidence of high vehicle speeds and regular instances of vehicles passing through red signals which puts users of the crossing at risk of being struck. There are opportunities to upgrade the crossing and this could include a grade separated layout. 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.
- 9.3.62 There is an opportunity to improve the quality of the existing SUP linked to this crossing on the A616 on both sides of the A46, to provide a safer, more convenient, link from the town centre to the British Sugar site although such improvements would lie outside the immediate scope of the scheme.
- 9.3.63 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.

Observations applicable to the Newark-Winthorpe link

- 9.3.64 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.

Observations applicable to A1/A46 Junction

- 9.3.65 There is an opportunity to retain the footbridge parallel to the A1 which provides access from the A46 to the industrial park to the north of the A1. This could include improving 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.
- 9.3.66 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 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.
- 9.3.67 There is also an opportunity to reconnect the PRow either side of the A46 to the north of Friendly Farmer roundabout, with Option 1 presenting a better opportunity than Option 2, where the proposed flyover link between Friendly Farmer and Winthorpe junction could be utilised by incorporating a suitable footway on the structure.
- 9.3.68 Options 1 and 2 are not 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 and pedestrian collisions occurred on these links and therefore upgraded facilities are likely to be of significant benefit to users.

1-2 Hybrid Option and Option 2 Modified

- 9.3.69 At Cattle Market junction the observations applicable to walking, cycling and horse-riding facilities in the 1-2 Hybrid Option are the same as for Option 2, since it adopts the same grade separated layout. There would be a greater opportunity for walkers in the vicinity of the A46 to the north of Friendly Farmer roundabout, since the layout adopted in the 1-2 Hybrid Option includes the same link from the roundabout to Winthorpe junction, which could be utilised to reconnect the existing PRow in this area.
- 9.3.70 The observations applicable to walking, cycling and horse-riding facilities for Option 2 also apply to Option 2 Modified.

Conclusion

- 9.3.71 The removal of through-traffic from Cattle Market junction in the grade separated layouts of Options 2, 2 Modified and the 1-2 Hybrid Option would make them slightly more favourable for walkers, cyclists and horse-riders in safety terms.
- 9.3.72 The layout in Option 1 and the 1-2 Hybrid Option between the A1 and Winthorpe would present an additional opportunity for walkers, with the proposed flyover link providing an opportunity to reconnect the severed PRow to the north of Friendly Farmer roundabout.
- 9.3.73 Overall, the impact on walkers, cyclists and horse-riders would be similar for all options. The grade separated layout at Cattle Market in the 1-2 Hybrid Option combined with the opportunity for walkers in the layout between the A1 and

Winthorpe junction make it slightly more favourable than the other options in this regard.

9.4 Operational Assessment

9.4.1 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 community enhancements, including reduced severance for pedestrians and cyclists where existing severance occurs.

9.4.2 Replacement of the at grade roundabout at Cattle Market junction in Option 2 with a grade separated layout will benefit strategic traffic due to easy movement through the junction but would also benefit local traffic, which would be separated from strategic traffic. Although this separation would not be achieved in Option 1, the improvements at the junctions in this option would also be expected to provide significant operational benefits relative to the existing junction layouts.

9.4.3 The existing level of use of the A46 by pedestrians, cyclists and equestrians appears to be extremely low, with occasional use by on-carriageway cyclists being the only likely use. This conclusion is supported by the results of a user survey undertaken in September 2018.

9.4.4 The needs of pedestrians, cyclists and equestrians is included in Section 9.3 and will continue to be incorporated into the design process for subsequent scheme development stages.

9.4.5 The adopted design speed for the A46 dual carriageway is 120 kph, with an associated posted national speed limit of 70 mph for most of the route. A reduced speed limit would be considered for the section between Cattle Market junction and Winthorpe junction due to the reduced standard geometry proposed. Other connecting and local roads, and the roundabout at the proposed grade-separated Cattle Market junction in Option 2, would be subject to lower design speeds and speed limits. Speed limits at the at grade junctions in Options 1 and 2 would be assessed and selected as the design detail progresses.

9.4.6 Operation of the A46 would be overseen by the East Midlands Regional Operations Centre (ROC) as is the case at present.

Network Resilience

9.4.7 The frequency of collisions is lower on dual carriageway compared to single carriageway A-roads, therefore, an inherent benefit of the scheme is a reduction in the occurrence of network-compromising incidents which could challenge resilience.

9.4.8 Both Options 1 and 2 would improve network resilience through the widening of the A46 from a single to dual carriageway. Increasing the number of lanes from

one to two in each direction improves resilience of the A46 when incidents occur and would also provide a more suitable alternative route when incidents occur on the wider SRN.

- 9.4.9 Separation of the proposed A46 bypass at the junction with the A1 and the existing section of dual carriageway between Friendly Farmer and Winthorpe roundabouts in Option 2 would provide additional resilience to the network, compared to Option 1.
- 9.4.10 The proposed grade separation at Cattle Market junction in Option 2 would also provide some additional resilience to the A46 and / or local routes when incidents occur. This local improvement would not be achieved in Option 1.

Driver Compliance

- 9.4.11 The layout of Options 1 and 2 is expected to have a net positive impact on driver compliance compared with the existing arrangement. This is primarily due to the replacement, in Options 1 and 2, of the existing at grade A1/A46 junction (for A46 traffic) with partial grade separation and, consequently, a reduction in conflict points and driver frustration, which are expected to be a significant cause of existing driver non-compliance through failing to observe junction priorities and lane discipline.
- 9.4.12 For Options 1 and 2, the operation of the remainder of the junctions would be expected to reduce frustration from delays. However, a higher standard carriageway on the links between the junctions may lead to reduced driver compliance during free-flow periods. The use of traffic signs would assist road users in understanding what to expect and what is expected of them. It is noted that a greater proportion of drivers (and motorcyclists) could elect to travel at speeds above the posted speed limit with a free-flowing dual carriageway arrangement compared to the existing single carriageway layout, although this possibility already exists on the sections of A46 dual carriageway adjoining the scheme. Mitigation is likely to comprise engineering to ensure the posted speed limit appears appropriate to road users for the visible road environment ahead. For example, if the posted speed limit is reduced locally due to curve radius north of Cattle Market junction, bend warning signs would also be included. During subsequent design stages, liaison will be undertaken with Nottinghamshire Police to determine their views on compliance and enforcement.
- 9.4.13 The design of the tie-ins of Options 1 and 2 to the existing A46 is aimed at ensuring, wherever possible, that the carriageway design in accordance with the DMRB standards would be as intuitive as possible for road users, to limit potential for driver non-compliance. A benefit of both Options 1 and 2 is that the connections to the local road network would all occur on existing roads of a good standard, largely away from property accesses.
- 9.4.14 In Option 2, the current section of dual carriageway between Friendly Farmer and Winthorpe roundabouts would be retained. If this section is perceived as a lightly trafficked sub-urban link it could lead to misuse for unauthorised stopping or parking, potentially exacerbated by the nearby Newark Showground venue. Subsequent design stages will identify whether mitigation measures such as restrictions would be required.

1-2 Hybrid Option and Option 2 Modified

- 9.4.15 The 1-2 Hybrid Option and Option 2 Modified are both broadly similar to Option 2, achieving the same operational benefits to local traffic, strategic traffic and network resilience that arise from:
- The widening of the existing single carriageway to a dual carriageway.
 - The proposed grade separation at Cattle Market junction.
- 9.4.16 Option 2 Modified achieves additional operational benefits compared to the 1-2 Hybrid Option, owing to the separation of the proposed bypass from the existing section of A46 between the A1 and Winthorpe junction.
- 9.4.17 Benefits in terms of network resilience would be slightly less in Option 2 Modified than in Option 2 due to the proposal for the link between Friendly Farmer and Winthorpe roundabouts to be a single carriageway rather than dual carriageway. However, there is still a resilience benefit compared to the existing road layout and compared to Option 1 and the 1-2 Hybrid Option.

Conclusion

- 9.4.18 All four options can be developed to provide safe and economic operation and maintenance. In all options, network resilience is improved through the widening of the A46 from a single carriageway to a dual carriageway with two lanes in each direction.
- 9.4.19 The proposed grade separated Cattle Market junction in Options 2, 2 Modified and the 1-2 Hybrid Option achieves slightly better operational outcomes than the at grade layout in Option 1, in terms of benefits to local traffic, strategic traffic and resilience.
- 9.4.20 Separation of the proposed and existing sections of the A46 between the A1 and Winthorpe junction in Options 2 and 2 Modified would provide additional resilience to the network. There are potential risks of misuse or parking on this section, but these could be addressed through reasonable mitigation measures.
- 9.4.21 Design of the preferred option will be developed in close consultation with National Highways and the TOS to optimise the operational characteristics of the scheme. A more detailed 'Combined Operations' report will be prepared for the selected preferred option at a later stage in the design development.

9.5 Maintenance Assessment

Maintenance and Repair Strategy for Civils Infrastructure

- 9.5.1 Both Options 1 and 2 would introduce new maintainable assets requiring limited maintenance and repair, in the short to medium term, due to the design life of those assets.
- 9.5.2 At this early stage of the design process there is not sufficient detail to fully appreciate all anticipated maintenance challenges and issues, however, it is anticipated that maintenance activities associated with both options would be broadly similar.

- 9.5.3 The selected option will be designed in accordance with the DMRB maintenance design standards and will prioritise eliminating the need for future maintenance activities that would impose risks upon those that work on the highway. At this stage of development, there are no known departures relating to the maintenance and repair strategy for civil or technology assets on any of the proposed options.
- 9.5.4 Where the asset is deemed to be required and in accordance with GD 304, civil engineering design principles will be considered where practicable to:
- Eliminate the need for routine maintenance, i.e. a rigid concrete central reserve barrier which does not need regular re-tensioning.
 - Reduce the effort when maintaining i.e. avoid using hard to reach locations such as the underside of bridges for mounting point for maintainable assets such as lighting.
 - Reduce the proximity of maintainers to hazards i.e. drainage to be designed to avoid locating manholes on running lanes or hard shoulders.
 - Improve access i.e. walkways and ladders provided at structures.
 - Improve management systems i.e. improve asset management standards to reduce site visits where possible by storing records of bolt types, fitting, lengths, etc.
 - Provide safe and convenient diversion options, where possible.
 - Provide identifiers i.e. reduce time exposure to risk during maintenance by improved labelling of maintainable assets for rapid identification.
 - Anti-theft/vandalism i.e. minimise triggers for maintenance by considering anti-graffiti coatings.
- 9.5.5 Options 1 and 2 do not introduce any unusual features which would be unfamiliar to an experienced maintainer. The assets and access facilities which are anticipated are similar to those provided either on the existing layout or at other locations on the network.
- 9.5.6 For both options, the network occupancy periods for maintenance and quantity of maintenance procedures is expected to be minimised, reducing the exposure of workers to the hazards associated with working adjacent to live traffic.

Maintenance and Repair Strategy for Road-Side Technology

- 9.5.7 As detailed in the Technology Assessment in this report, technology assets within the scheme will be integrated into the National Highways traffic management system to be controlled from the ROC. This will enable the appointed maintenance organisation to remotely access technology equipment, in coordination with the ROC, 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.

1-2 Hybrid Option and Option 2 Modified

- 9.5.8 The 1-2 Hybrid Option and Option 2 Modified, like Options 1 and 2, would introduce new maintainable assets. Maintenance activities associated with the

1-2 Hybrid Option and Option 2 Modified are broadly similar to Options 1 and 2, requiring the employment of maintenance techniques that are already engaged on adjacent sections of the network.

- 9.5.9 The main difference between Option 2 Modified and Option 2 is at the section of carriageway between Friendly Farmer and Winthorpe roundabouts. In Option 2, the existing section of dual carriageway is retained, but in Option 2 Modified this is converted into a single carriageway. The single carriageway in Options 2 Modified would present a slight reduction in asset to be maintained, however, maintenance activities on a single carriageway would be slightly more challenging than the dual carriageway in Option 2, which would facilitate better traffic management solutions if required.

Conclusion

- 9.5.10 All options would enable the maintenance requirements for an all-purpose dual-carriageway trunk road to be implemented, based on GD 304. The options can be developed to provide safe and suitable access to all maintainable assets on the new network, resulting in reduced health, safety and welfare risks.
- 9.5.11 Maintenance activities associated with all options are broadly similar, and none of the options are expected to propose the employment of new or complex techniques. It is concluded that the scheme, irrespective of which option is selected, will require the employment of maintenance techniques that are already engaged on adjacent sections of the network and will not present any technical difficulties to any maintainer.
- 9.5.12 There is no significant differentiation of implications for maintenance between any of the four options.

9.6 Options Estimates

- 9.6.1 Options estimates for all options have been produced. These are prepared to give an estimate of the most likely forecast outturn cost of each scheme option and are input into the scheme's economic analysis.
- 9.6.2 The estimates holistically consider the costs from early development stages of the scheme through to the scheme being open to traffic. The estimates were refreshed in 2021 based on the latest scheme design and using the latest available cost intelligence.
- 9.6.3 Table 9-2 shows the most likely forecast outturn estimate for the A46 scheme options, which includes the following:
- Pre-construction costs, e.g. design development, surveys, land acquisition.
 - Indirect works costs, e.g. traffic management, site mobilisation, site compounds.
 - Direct works costs, i.e. construction of the scheme.
 - Risk and uncertainty.
 - Inflation.

Table 9-2: Most likely forecast outturn estimate for scheme options (excluding portfolio risk)

Scheme Option	Forecast Outturn
Option 1	£474,680,886
Option 2	£471,784,015
1-2 Hybrid Option	£489,490,988
Option 2 Modified	£474,588,543

9.6.4 The options estimates for all options are broadly similar, therefore, making none of the options more or less favourable in this regard.

9.7 Traffic Assessment

9.7.1 This section sets out the traffic assessment which has been undertaken using the Enhanced A46 MRTM to determine the impact of the scheme options on traffic flows and delays. Traffic forecasts have been used to inform the economic appraisal, the scheme design and the environmental assessment.

Base Model Development

9.7.2 The base transport model is the Enhanced A46 MRTM which has its foundation in the National Highways MRTM. The MRTM, developed by National Highways with a base year of 2015, is one of a family of five Regional Traffic Models (RTMs) covering the National Highways SRN and has been used as the basis for the development of several transport models for use in the assessment of a variety of highway schemes.

9.7.3 The Enhanced A46 MRTM model comprises three different sub-areas with different levels of detail included, based upon expected impacts of the scheme:

- Area of Detailed Modelling: The area in which significant effects are certain to occur resulting from the scheme. Nearly all roads and junctions are included in detailed simulation coding with detailed zone loading points.
- Rest of the Fully Modelled Area: The area over which impacts are expected but are likely to be somewhat smaller than those in the area of detailed modelling. All A and B roads are included in this area with accurate simulation coding at junctions and speed-flow curves included along all links.
- External Area: Impacts are assumed to be negligible in this area. Zones and loading points are coarse and some of the network is coded as buffer.

9.7.4 Figure 9-1 presents the boundary for each of the three areas.

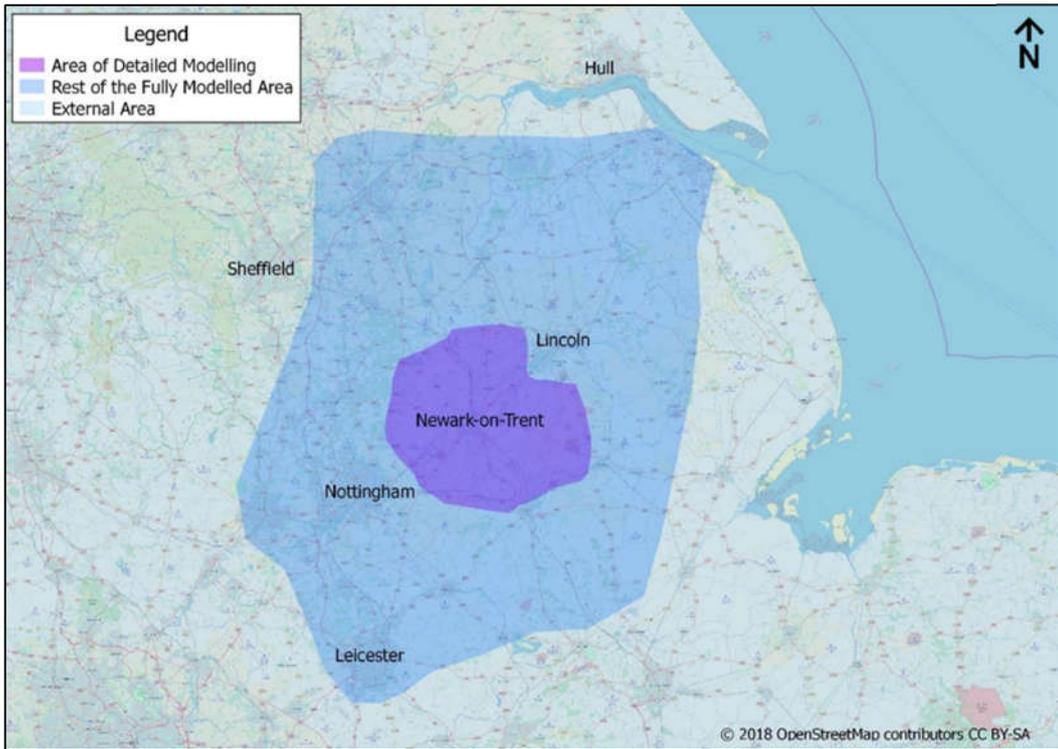


Figure 9-1: Enhanced A46 MRTM – Modelled Areas

9.7.5 The Enhanced A46 MRTM Area of Detailed Modelling is shown in Figure 9-2.

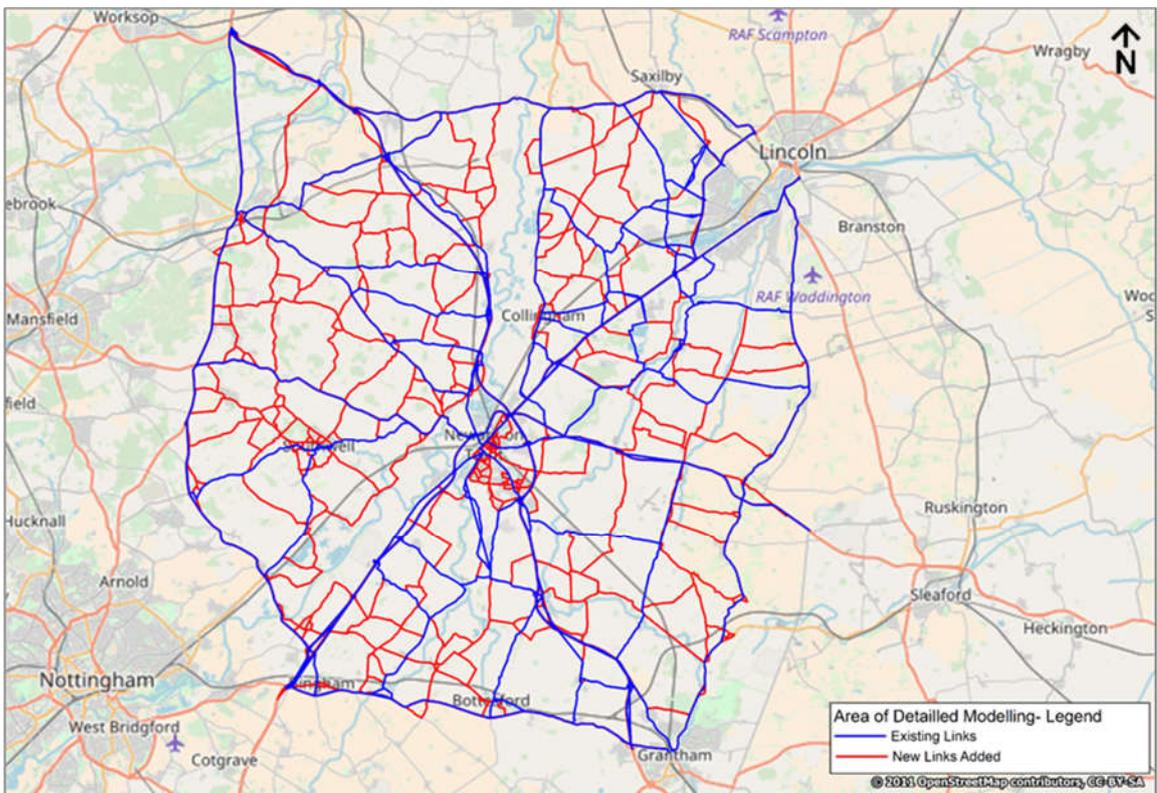


Figure 9-2: Enhanced A46 MRTM – Network in Area of Detailed Modelling
Data Collection

9.7.6 Key data sources for development of the Enhanced A46 MRTM include:

- MRTM, Trans-Pennine South Regional Traffic Model and Newark-on-Trent Visum Model.
- 2011 Census Population and Employment Data.
- Count data sourced from the National Highways WebTRIS database.
- Count data provided by local authorities.
- Trafficmaster GPS journey time data.

9.7.7 Traffic counts used for the calibration and validation of the Enhanced A46 MRTM at both a screenline and individual link level were sourced from the National Highways WebTRIS database and from local authorities including Nottinghamshire and Lincolnshire County Councils. Traffic counts include automatic traffic counts and manual classified turning counts (within the area of detailed modelling). Various checks were undertaken to ensure the robustness of the count dataset, including analysis of confidence intervals and consistency checks between adjacent links.

9.7.8 Traffic journey time data, for use in the validation of journey times on key routes, was derived from the Trafficmaster dataset (covering the counties of Nottinghamshire and Lincolnshire) for the period January to September 2017. The Trafficmaster dataset collects GPS data from tracked vehicles to derive information on travel times across individual links of the Integrated Transport Network. The dataset provides observations in fifteen-minute intervals and includes all vehicle classes (cars, LGVs, HGVs, buses, taxis, motorised caravans, other).

9.7.9 Analysis of the journey time data identified the average journey times within modelled time periods for 7 routes across the study area, and the variability, to provide a measure of journey time reliability. The Trafficmaster dataset provides high sample rates on all key routes considered and is, therefore, considered suitable for use in model validation.

Prior Matrices

9.7.10 The Enhanced A46 MRTM prior matrices have been developed from the original MRTM matrices, which have been derived from mobile phone data as detailed in the MRTM Model Validation Report (March 2016). For the enhanced zoning system in the area of detailed modelling, 2011 Census population and employment data at a LSOA level was used to disaggregate demand movements.

Calibration and Validation

9.7.11 The model convergence meets Transport Analysis Guidance (TAG) criteria for all years and time periods.

9.7.12 At a screenline level, almost all screenlines achieve the desired criteria of modelled flow within $\pm 5\%$ of observed values demonstrating a strong level of correlation with observed data.

9.7.13 At a link level, considering all of the flow calibration and validation counts, the TAG benchmark (85% of links passing) is exceeded in all model periods for all

vehicles and cars. There is a good level of validation on the A46 and in the Newark-on-Trent area.

- 9.7.14 The model performs strongly against journey time validation criteria in all time periods. All 14 routes achieve the required standard for all three time periods.
- 9.7.15 Realism testing has been undertaken in line with TAG guidance. Fuel and journey time elasticity tests demonstrate that the Enhanced A46 MRTM responses to changes in travel costs are consistent with results observed in other approved variable demand traffic modelling undertaken in the UK. The variable demand model utilises the DfT Dynamic Integrated Assignment and Demand Modelling v6.3.3 software.
- 9.7.16 In conclusion, it is considered that the 2017 base year highway assignment model developed for the A46 Newark Northern Bypass PCF Stage 2 analysis calibrates and validates to within acceptable margins of the 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 Model Forecasting

- 9.7.17 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 scheme options.
- 9.7.18 The forecasts have used the DfT's National Trip End Model (TEMPRO 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.
- 9.7.19 The traffic forecasts have been undertaken using a variable demand modelling approach.
- 9.7.20 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.
 - Five scenarios – Do Minimum, Do Something: Option 1, Option 2, 1-2 Hybrid Option and Option 2 Modified.

Forecast Results for Options 1 and 2

Journey Times

- 9.7.21 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:
- Route 1: A46 from NSLR to Winthorpe.

- Route 2: A1 from Grantham to Wadworth Interchange.
- Route 3: A617 from A38 to A46.
- Route 4: A17 from A46 to A15.
- Route 5: A46 from A606 to A158.

- 9.7.22 There is a significant time saving on the A46 through Newark (Route 1) for both options 1 and 2. These savings are due to the scheme upgrades at each of the A46 junctions. The time savings are similar for the two options.
- 9.7.23 The full A46 route (Route 5) has seen moderate decreases in journey times for all options. These journey time savings on the longer A46 route show that the improvements to the A46 in Newark are not causing significant delays north and south of the scheme in spite of the additional traffic attracted to the scheme.
- 9.7.24 Options 1 and 2 both have minimal impact on the A1 (Route 2) and slightly increase journey times on the A617 westbound (Route 3). In the reverse direction however, there has been a slight decrease in journey time for both options 1 and 2.
- 9.7.25 The A17 (Route 4) has seen a slight increase in journey times for both options in the eastbound direction. This increase in travel time is distributed along the entire length of the route, with no individual junction nor model link experiencing a marked increase. Westbound, the A17 has seen a decrease in journey time for both options.

Traffic Flows

- 9.7.26 Table 9-3 shows the 2043 AADT flows on key roads affected by the proposed schemes.

Table 9-3: Link Flows (AADT) on Key Roads

Road	Direction	2017 Base	2043 AADT (Vehicles)				Option 2 Modified
			Do Min	Option 1	Option 2	1-2 Hybrid Option	
A46 south of Farndon roundabout	NB	18,309	20,506	24,085 (17%)	23,306 (14%)	23,357 (14%)	23,374 (14%)
	SB	17,391	19,150	23,855 (25%)	23,473 (23%)	23,497 (23%)	23,548 (23%)
A46 between Farndon roundabout and Cattle Market roundabout	NB	15,226	19,137	25,494 (33%)	25,408 (33%)	25,468 (33%)	25,487 (33%)
	SB	14,881	17,535	26,637 (52%)	27,329 (56%)	27,350 (56%)	27,366 (56%)
A46 between Cattle Market roundabout and A1 Junction	EB	14,517	13,924	24,014 (72%)	24,503 (76%)	24,419 (75%)	24,940 (79%)
	WB	14,463	14,125	23,600 (67%)	23,957 (70%)	24,112 (71%)	24,107 (71%)
Existing A46 between A1 Junction and A1133 Junction	EB	19,518	23,930	14,244 (-40%)	12,673 (-47%)	13,967 (-42%)	11,668 (-51%)
	WB	20,331	25,765	10,115 (-61%)	10,192 (-60%)	10,115 (-61%)	9,780 (-62%)
New A46 between A1 Junction and A1133 Junction	EB	-	-	13,723	14,099	13,915	14,558
	WB	-	-	16,331	16,130	16,430	16,229
A46 east of A1133 Junction	EB	17,631	22,611	25,166 (11%)	24,290 (7%)	25,266 (12%)	23,907 (6%)
	WB	17,966	23,248	24,651 (6%)	24,342 (5%)	24,634 (6%)	24,110 (4%)
Farndon Road at Farndon roundabout	EB	5,896	4,587	5,080 (11%)	4,957 (8%)	4,962 (8%)	4,957 (8%)
	WB	5,828	5,200	3,988 (-23%)	2,569 (-51%)	2,572 (-51%)	2,615 (-50%)
A617 at Cattle Market roundabout	EB	9,582	9,870	10,102 (2%)	12,176 (23%)	12,167 (23%)	12,183 (23%)
	WB	8,344	8,507	9,239 (9%)	10,699 (26%)	10,717 (26%)	10,691 (26%)
A616 Great North Road	NB	6,121	7,750	5,788 (-25%)	7,686 (-1%)	7,661 (-1%)	7,636 (-1%)
	SB	6,475	7,440	8,147 (10%)	9,982 (34%)	9,924 (33%)	9,977 (34%)
B6326 Great North Road	NB	8,041	8,409	8,108 (-4%)	9,380 (12%)	9,286 (10%)	9,647 (15%)
	SB	8,676	8,595	9,759 (14%)	10,683 (24%)	10,802 (26%)	10,762 (25%)
A1 north of A46 Junction	NB	21,828	31,709	34,449 (9%)	31,980 (1%)	31,905 (1%)	31,993 (1%)
	SB	22,393	31,903	32,727 (3%)	29,521 (-7%)	29,763 (-7%)	29,503 (-8%)
A1 south of A46 Junction	NB	21,015	34,051	30,616 (-10%)	30,097 (-12%)	30,450 (-11%)	29,885 (-12%)
	SB	20,935	31,370	28,012 (-11%)	27,503 (-12%)	27,475 (-12%)	27,442 (-13%)
A17 at A1 / A46 Junction	EB	6,834	4,713	9,300 (97%)	9,560 (103%)	9,368 (99%)	9,711 (106%)
	WB	6,224	4,611	9,328 (102%)	9,398 (104%)	9,315 (102%)	9,479 (106%)
B6166 Lincoln Road	NB	7,903	8,591	13,501 (57%)	12,814 (49%)	13,137 (53%)	12,506 (46%)
	SB	8,550	12,052	13,359 (11%)	12,922 (7%)	12,875 (7%)	12,897 (7%)

9.7.27 Table 9-3 shows that without any changes being made, traffic flows are predicted to increase on most routes as a result of general increases to the number of journeys being made in the local area and wider region. This can be seen by comparing the 2017 Base flows to the 2043 Do Minimum flows. The 'Do Something' options (Options 1 and 2, the 1-2 Hybrid Option and Option 2 Modified) increase capacity on the A46 corridor around Newark, and thus are predicted to attract more traffic to the corridor with a predicted reduction in traffic on alternative routes.

9.7.28 The key impacts on traffic flow of the options are as follows:

- The highest increase in traffic flow on the A46 is predicted to occur between the Cattle Market roundabout and the A1 with an increase in daily traffic flow of 72% and 76% eastbound for Options 1 and 2 respectively. There is predicted to be an increase of 67% and 70% westbound for Options 1 and 2, respectively. This section of the A46 has been upgraded from single carriageway to dual-carriageway for both options. It can be observed that the increase in traffic flow is slightly higher for Option 2 due to the grade-separation of Cattle Market roundabout.
- 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. For Option 1, there is predicted to be a reduction in traffic flow on the old A46 of 40% eastbound and 61% westbound. For Option 2, there is predicted to be a reduction in traffic flow on the old A46 of 47% eastbound and 60% westbound.
- The reduction in traffic flow on the A46 through Friendly Farmer roundabout results in additional capacity for the A17, resulting 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 both options and in both directions of approximately 50%. The A17 in contrast has an increase in traffic flow of 97% eastbound and 102% westbound in Option 1. For Option 2, there is an increase in traffic flow of 103% eastbound and 104% westbound.
- On the A46 between Farndon roundabout and Cattle Market roundabout, there is a 33% increase in the northbound traffic flow and a 52% increase in the southbound traffic flow for Option 1 due to the improvements to the A46 scheme junctions, in particular Cattle Market. For Option 2, there is a similar change in traffic flow with an increase in northbound traffic flow of 33% and an increase in southbound traffic flow of 56%.
- On Farndon Road, there is a reduction in traffic flow westbound of approximately 23% for Option 1 and 51% for Option 2 as traffic re-routes via the A46 due to the additional capacity provided by the scheme.
- The B6326 Great North Road has an increase in traffic flow of 14% southbound in Option 1 and 24% in Option 2 due to the additional capacity provided at Cattle Market roundabout. In the northbound direction, there is a slight reduction in traffic flow in Option 1 of 4% as traffic re-routes to Lincoln Road. In Option 2 there is an increase northbound of 12% due to the higher capacity of the Cattle Market grade-separated junction.

- There is an increase in traffic flow southbound along the A616 and westbound along the A617 as traffic re-routes through the improved Cattle Market junction for both options. In Option 1, there is an increase in southbound traffic flow of 10% on the A616 and 9% westbound on the A617. For Option 2, there is a more significant increase in southbound traffic flow of 34% on the A616 and 26% westbound on the A617 due to the grade-separated roundabout at Cattle Market.
- The road network in the area is predicted to accommodate the increase in traffic as a result of the additional capacity provided by the scheme.

Forecast Results for 1-2 Hybrid Option and Option 2 Modified

- 9.7.29 The 1-2 Hybrid Option has slightly shorter journey times than Option 2 on the A46 for the scheme extent. This is due to this option having the four-arm Winthorpe junction arrangement from Option 1 which has less delays than the five-arm arrangement in standard Option 2.
- 9.7.30 Option 2 Modified has very similar journey times to standard Option 2 indicating that having a single carriageway between Friendly Farmer roundabout and Winthorpe roundabout does not significantly impact journey times.
- 9.7.31 The 1-2 Hybrid Option has similar traffic flows to Option 2 from Winthorpe to the A1. Traffic flows to the east of the A1 are similar to Option 1 which is due to the Winthorpe junction arrangement being the same as Option 1.
- 9.7.32 Option 2 Modified has similar traffic flows to Option 2. The traffic flow on the old A46 between Friendly Farmer roundabout and Winthorpe roundabout is slightly lower in Option 2 Modified, compared to Options 1 and 2, as this road is single-carriageway as opposed to dual carriageway.

Conclusion

- 9.7.33 The grade separation of Cattle Market junction and signalisation of Farndon roundabout in Option 2 will provide additional capacity on the A46 providing higher overall travel time savings than Option 1.
- 9.7.34 The 1-2 Hybrid Option has slightly higher travel time savings than Option 2 due to the 4-arm arrangement at Winthorpe junction which has lower delays than the 5-arm arrangement in Option 2.
- 9.7.35 Option 2 Modified has similar traffic flows and travel time savings to Option 2. However, the single carriageway on the old A46 between Friendly Farmer and Winthorpe will result in an increase in delays on this approach to Winthorpe junction compared to Option 2.
- 9.7.36 The traffic outcomes are very similar for Option 2 and its variants (1-2 Hybrid Option and Option 2 Modified), which all perform better than Option 1. The 1-2 Hybrid Option marginally has the best operational traffic impacts, although the distinction between Option 2 and its variants is very small and should not be a driver of option selection.

9.8 Economic Appraisal

Overview

- 9.8.1 This section contains an outline of the components of the economic appraisal of the A46 options. It identifies the elements for which quantitative and qualitative assessments have been undertaken, the assumptions made, the values of parameters adopted, and the sources of input values. Each of the key components of the economic appraisal is considered in turn.
- 9.8.2 Table 9-4 identifies the approach adopted to appraise the economic impacts of the A46 Newark Northern Bypass options.

Table 9-4: Overview of Economic Assessment Methodology

Element of Economic Appraisal	Assessment Method
User benefits	TUBA software (version 1.9.14) using parameters from the DfT's Transport Analysis Guidance (TAG) Databook version 1.14 (July 2020 Sensitivity Test)
Accident reduction impacts	Cost and Benefit to Accidents – Light Touch (COBA-LT) software (version 2013.2) using economic parameters file version 2020.2
Journey time reliability benefits	TAG Urban Roads method set out in TAG Unit A1.3
Delays during construction	Qualitative approach
Environmental impacts	Approach set out in TAG Unit A3 Chapters 2-4 Chapter 2 – Noise impacts Chapter 3 – Air quality Chapter 4 – Greenhouse gas emissions
Dependent Development	Qualitative approach

9.8.3 The application of the above methods to the economic assessment of the scheme is summarised in this section of the report.

Approach

9.8.4 The approach to the economic assessment of the A46 Newark Northern Bypass is summarised in this section of the report.

User Benefits

9.8.5 The quantification of the user benefits for each option was undertaken through the DfT TUBA software (version 1.9.14) using parameters from the DfT's TAG Databook version 1.14 July 2020 Sensitivity Test.

9.8.6 The Enhanced A46 MRTM formed the basis for the inputs to TUBA, providing the trip matrices, time and distance skimmed matrices for each time period (AM Peak, Inter-peak and PM Peak), future year (2028, 2043 and 2051) and user class.

9.8.7 The annualisation factors for the three modelled time periods were derived by:

- AM Peak – model represents the average hour within the three-hour weekday period with the resulting annualisation of 759 (253 working days * 3 hour modelled period).
- Inter-peak – model represents the average hour within the six-hour weekday period with the resulting annualisation of 1518 (253 working days * 6 hour modelled period).
- PM Peak – model represents the average hour within the three-hour weekday period with the resulting annualisation of 759 (253 working days * 3 hour modelled period).

- 9.8.8 These annualisation factors exclude the following time periods:
- Weekday off-peak/overnight period (19:00-07:00).
 - Weekends.
- 9.8.9 For PCF Stage 2, the benefits for the weekend have been included. These have been derived as follows:
- Long-term traffic counts on the A46 in the scheme area have been used to determine the number of hours at the weekend which have traffic flows that are 90% or above the average Inter-Peak hourly traffic flow. This analysis gave a value of 15 hours.
 - The annualization factor for the Weekend period is [52 weekends x 15 hours = 780 hours].
 - The Inter-Peak model skims have been used as a proxy for the weekend journey times and distances. The Inter-Peak demand skims journey purpose split has been adjusted to be consistent with the weekend journey purpose split given in Table A1.3.4 of the TAG databook (July 2020 Sensitivity Test).
- 9.8.10 Travel time savings are calculated using the ‘rule of half’ applied to the generalised time skims from the Enhanced A46 MRTM. Since parking costs are not included in the Enhanced A46 MRTM, generalised time equates solely to in-vehicle time.
- 9.8.11 Vehicle operating costs are calculated for both fuel and non-fuel elements, based on formulae set out in the DfT TAG Databook. All assumptions relating to fuel costs, duty and vehicle efficiency were based on values contained in the default TUBA economics file.
- Accident reduction impacts
- 9.8.12 The accident benefits assessment was undertaken using the DfT’s Cost Benefit Analysis – Light Touch (COBA-LT) spreadsheet model, in accordance with TAG guidance. The latest version of the COBA-LT software (2013.2) and economic parameters file (version 2020.2) were used for the assessment.
- 9.8.13 The COBA-LT assessment provides an analysis of the likely impact of a highway scheme on the number and severity of accidents, including a monetised impact for inclusion in the BCR and Value for Money assessment.
- 9.8.14 COBA-LT forecasts the number of accidents on each road link for the Do Minimum and Do Something scenarios, by summing, over the 60-year appraisal period, the product of the accident rate, the road length and the forecast annual traffic flow. Relationships and data contained in COBA-LT take account of changes in accident and casualty rates over time.
- 9.8.15 The “link and junction combined” approach has been adopted, which is the standard approach for developing a COBA-LT assessment from data extracted from strategic models.
- 9.8.16 24-hour annual average daily traffic (AADT) flows for all links in the study area for the Base, Do Minimum and the three Do Something scenarios have been derived from the Enhanced A46 MRTM. Link details, including link length, speed limit and link type, have been determined from the Enhanced A46 MRTM

network details. Observed accident rates have been calculated using DfT STATS19 accident data and traffic counts.

Journey time reliability benefits

- 9.8.17 Journey time reliability refers to the extent that unpredictable travel time variations are experienced by transport users as a result of congestion or incidents and non-recurring events.
- 9.8.18 National Highways has developed the MyRIAD software for assessing the journey time variability impacts of dual-carriageway schemes. However, MyRIAD mainly focuses on capturing the impacts of motorway widening and technology schemes, and therefore the TAG “Urban Roads” method has been considered more appropriate for the appraisal of the A46 scheme which centres around improvements to junctions, in line with guidance in TAG Unit A1.3.
- 9.8.19 The scheme’s impact on the variability of journey times is represented through changes in the standard deviation.
- 9.8.20 All economic and scheme-specific parameters used for the calculation of the reliability impacts (such as values of time, annualisation factors, user class definition, etc) are consistent with the TUBA assessment of the scheme.
- 9.8.21 The value of time for business purpose car trips has been calculated using the varying values of time by distance method, as in the TUBA assessment of the scheme. The extents of the study area cover all movements within the cordoned area of the model.

Delays during Construction

- 9.8.22 A quantified assessment of delays during construction has been undertaken for PCF Stage 2. The proposed traffic management measures have been modelled for the relevant year using the Enhanced A46 MRTM model. Demand, time and distance skims from the model have been used in TUBA to determine the resulting economic disbenefits to road users.

Environmental impacts

- 9.8.23 Net benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the appropriate TAG Workbook. The value of these benefits over 60 years, in 2010 prices discounted to 2010 for each of the three appraised scheme options was prepared for the following variables:
- Greenhouse gases.
 - Air quality – nitrogen dioxide, nitrogen oxides and particulate matter.
 - Noise.
- 9.8.24 Each of the assessments was based on the individual models developed to estimate the volume of impacts for each scheme in terms of the change in emission levels. These volumes were then converted into monetary impacts using standard parameters specified within the corresponding TAG guidance.

Dependent Development

- 9.8.25 Dependent development refers to developments (residential and non-residential) which require a complementary transport scheme to accommodate the additional trips and maintain reasonable transport levels of service for existing and new traffic. Given the location of the scheme in the eastern corner of the Newark and Sherwood district, the relevant local policy documents were reviewed to establish whether these authorities considered developments in their area to be dependent on the scheme.
- 9.8.26 A qualitative assessment was undertaken to establish whether any developments in the near vicinity of the A46 Newark Northern Bypass scheme were likely to be directly dependent on the scheme.
- 9.8.27 As determined through analysis of the relevant policy documents, particularly Newark and Sherwood District’s ‘Core Strategy’ and ‘Development Framework’ documents, there are no developments in the districts that are explicitly stated as being dependent on the A46 Newark Northern Bypass scheme; however, developments in the area will benefit from the improvements offered by the scheme when it is completed as discussed in the district Core Strategy.

Distributional Impacts

- 9.8.28 The distributional impact assessment considered the variance in the impacts of the alternative options (Option 1, Option 2 and Option 2 Modified) across different social groups and was undertaken in accordance with the guidance in TAG Unit A4.2.
- 9.8.29 The distributional impact approach identifies eight indicators to be considered: accessibility, severance, personal security, accidents, air quality, noise, user benefits and personal affordability. The approach comprises three stages, as outlined in Table 9-5.

Table 9-5: Stages in the Distributional Impact (DI) Process

Step		Description	Output
Screening	1	Identification of likely impacts for each indicator	Screening Proforma
Full appraisal	2	Assessment: <ul style="list-style-type: none"> Confirmation of the area impacted by the transport intervention (impact area) Identification of social groups in the impact area (such as transport users, people living in those areas affected by the scheme) Identification of amenities in the impact area 	DIs social groups statistics and amenities affected within the impact area. The impact area will be specific to each indicator
	3	Appraisal of impacts: <ul style="list-style-type: none"> Core analysis of the impacts (including providing an assessment score for each indicator based on a seven-point scale: Full appraisal of DIs and input into Appraisal Summary Tables (AST) 	Appraisal tables and AST Inputs

9.8.30 As a result of the screening process in Step 1, the accessibility indicator was not considered further; the remaining seven criteria were then assessed through Steps 2 and 3 in the full appraisal.

Scheme costs

9.8.31 The scheme capital costs have been estimated by the National Highways Commercial team. The costs were limited to the capital costs for each option; whole life operational, maintenance and renewal costs were not available. The supplied costs were refined in line with the guidance in TAG Unit A1.2 in order to comply with the requirements of the economic appraisal.

9.8.32 The costs received from National Highways identified separate elements for preparation, construction works, supervision and land costs and included the impacts of a quantified risk assessment. In addition, the costs are outturn values, taking into account construction price inflation.

9.8.33 The costs were distributed throughout the preparatory and construction period, from 2019 to 2033, opening in 2028. The costs were converted to 2010 prices using the GDP deflator, discounted to 2010 present values using the HMT's social time preference rates (standard discount rate of 3.5% for 30 years and 3.0% for the remainder of the appraisal period), and converted to market prices using a factor of 1.19 to reflect the average rate of indirect taxation in the economy.

Results

Summary of Benefits and Costs

9.8.34 The appraisal results following the application of the approaches outlined above are summarised in Table 9-6. This highlights the Initial and Adjusted BCR for each of the options.

9.8.35 The following assumptions should be noted:

- Standard carbon values have been used rather than the high carbon values for the greenhouse gas emissions.
- The delays during construction for road users from TUBA have been combined with the standard scheme TUBA outputs for the Economic Efficiency and Wider Public Finances.
- Economic outputs based on the July 2020 TAG Databook v1.14 Sensitivity Test economic parameters have been utilised.
- The improved journey times that result from the scheme could help improve business productivity by reducing business costs and these impacts would represent potential output change in imperfectly competitive markets. The values of this effect have been assumed to amount to 10% of the business benefits from TUBA (excluding delays during construction) and have been treated as a wider benefit used in the Adjusted BCR.
- For the 1-2 Hybrid Option, the air quality, noise, greenhouse gas emissions and construction delays have been assumed to be the average of Options 1 and 2 as this option has not been assessed for these elements of the appraisal.

Table 9-6: Analysis of monetised costs and benefits (£,000)

Appraisal Element	Option 1	Option 2	1-2 Hybrid Option	Modified Option 2
Economic Efficiency: Consumer Users: (Commuting)	29,199	40,985	40,272	38,704
Economic Efficiency: Consumer Users (Other)	47,251	63,426	64,723	59,801
Economic Efficiency: Business Users and Providers	118,580	152,088	154,637	146,040
Wider Public Finances (Indirect Taxation Revenues)	7,341	7,674	7,540	8,276
Accident Reduction Impacts	-4,290	1,310	340	880
Air Quality Impacts	-8,831	-8,239	-8,535	-8,232
Noise Impacts	1,140	574	864	652
Greenhouse Gases Impacts	-29,771	-26,364	-28,068	-26,308
PVB	160,619	231,454	231,774	219,814
Broad Transport Budget Present Value of Capital Costs	236,757	237,756	244,867	238,344
Initial BCR	0.68	0.97	0.95	0.92
Reliability Benefits	9,833	12,641	11,891	11,565
Wider Impacts	12,016	15,287	15,582	14,761
Adjusted PVB	182,468	259,382	259,247	246,140
Adjusted BCR	0.77	1.09	1.06	1.03

9.8.36 It can be observed from Table 9-6, that Option 2 would have the highest BCR, with an adjusted BCR of 1.09. Option 1 would have the lowest adjusted BCR with a value of 0.77. The 1-2 Hybrid Option has slightly higher benefits than Option 2 but due to the higher costs has a lower BCR. Option 2 Modified has lower benefits than Option 2 and similar costs resulting in a lower BCR.

9.8.37 The results of the Distributional Impact Assessment for Option 1, Option 2 and Option 2 Modified are summarised in Table 9-7. The assessments for each scheme have been included in the Appraisal Summary Tables (AST).

Table 9-7: Summary of Distributional Impact Assessment

Appraisal Element	Option 1	Option 2	Option 2 Modified
Accessibility	Not Assessed		
Security	Slight Adverse	Slight Adverse	Slight Adverse
Severance	Slight Beneficial	Slight Beneficial	Slight Beneficial
Collisions	Slight Beneficial	Slight Beneficial	Slight Beneficial
Air quality	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Noise	Slight Adverse	Moderate Beneficial	Moderate Beneficial
User benefits	Large Beneficial	Large Beneficial	Large Beneficial
Affordability	Moderate Adverse	Moderate Adverse	Moderate Adverse

9.8.38 The 1-2 Hybrid Option has not been assessed to the same level as Options 1, 2 and 2 Modified. However, based upon the general layout it is expected that the distributional impact assessment for the 1-2 Hybrid Option would be similar to the results for Options 2 and 2 Modified, noting that the differences between options are for the air quality and noise appraisal elements only.

Profile of User Benefits

9.8.39 This section discusses the profile of user benefits over the appraisal period, and the user benefits disaggregated by journey purpose and by time period.

Profile across 60 year appraisal period

9.8.40 Figure 9-3 shows the profile of PVB across the 60-year project lifetime and demonstrates that, for all options, the PVB rises between 2028 (opening year) and 2051 (final modelled year) which is due to the higher levels of traffic flow and hence congestion on the A46 without the scheme.

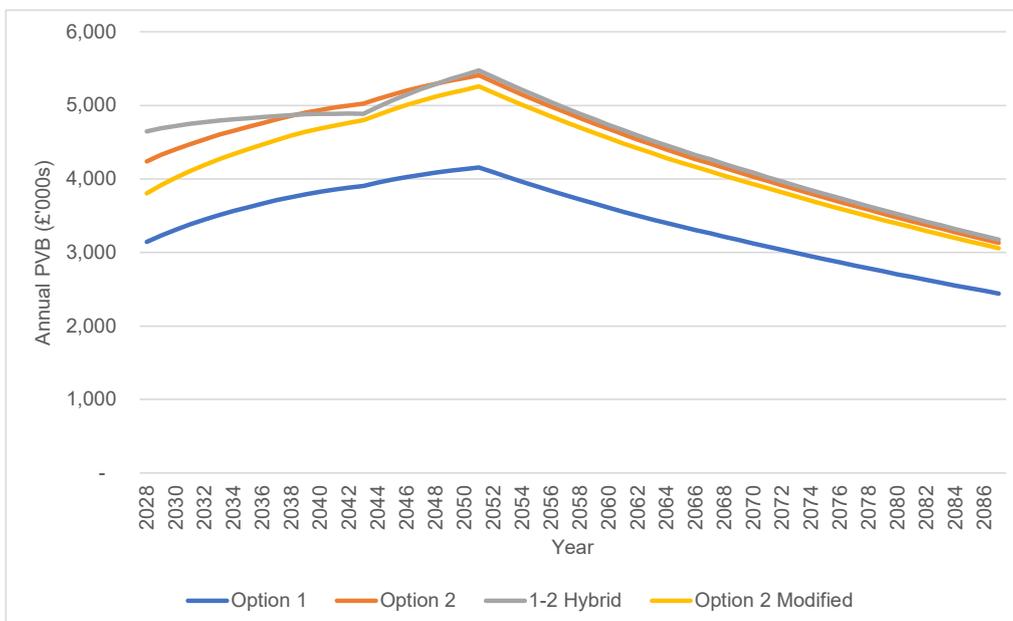


Figure 9-3: Sixty Year Profile of Benefits (PVB)

- 9.8.41 Figure 9-3 shows the profile of PVB across the 60-year project lifetime for each option. It can be observed that Options 1 and 2 have similar profiles with the PVB rising between 2028 (opening year) and 2051 (final modelled year) which is due to the higher levels of traffic flow and hence congestion on the A46 without the scheme. The benefits for Option 1 are lower than for Option 2 for all years.
- 9.8.42 The 1-2 Hybrid Option and Option 2 Modified have similar profiles to Option 2 with slightly higher benefits for the 1-2 Hybrid Option and slightly lower for Option 2 Modified.
- 9.8.43 The annual PVB decreases from 2051 onwards due the impact of discounting over time. TUBA assumes a flat benefits profile beyond the final modelled year, but the impact of discounting (beyond any increase in value of time) means the annual benefit falls. It is noted that this still means there are benefits, merely of a lower value.

Benefits by Journey Purpose

- 9.8.44 Consideration of the user economic benefits by journey purpose is presented in Figure 9-4, which shows that the benefits to business users are significantly higher than those attributed to commuters and other trips. This is due to the significantly higher value of time associated with business trips compared to the other vehicle purposes.

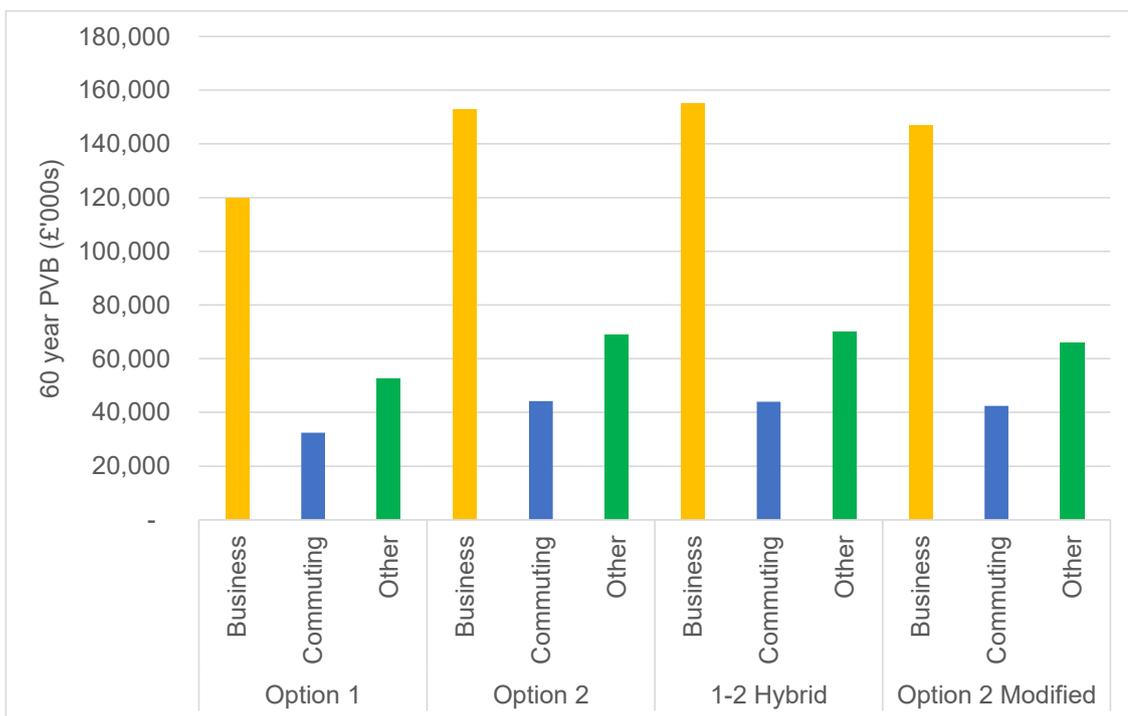


Figure 9-4: User Benefits by Journey Purpose

Temporal Distribution of Benefits

- 9.8.45 Figure 9-5 presents the average PVB per hour, by time period, over the 60-year period, with the benefits divided by the number of hours that the time periods represent per day, i.e. three hours for the AM Peak, six hours for the Inter Peak and three hours for the PM peak.

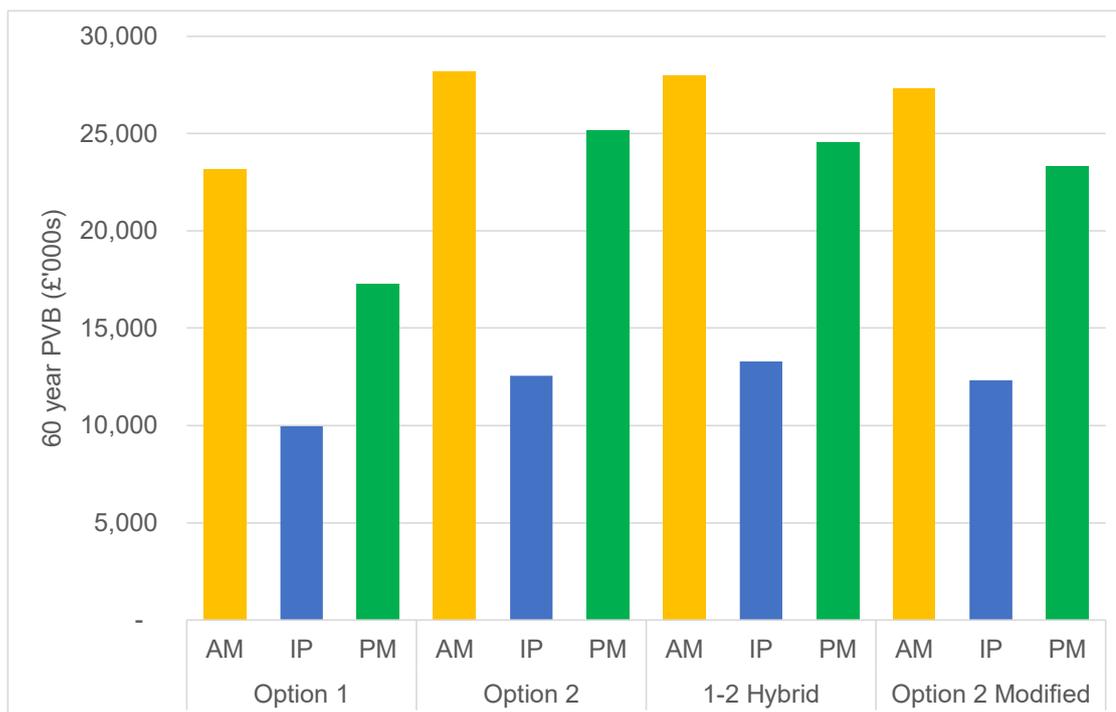


Figure 9-5: Benefits (PVB) Disaggregated by Time Period by hour

9.8.46 It can be observed from Figure 9-5 that for all three options the AM and PM peak periods have the highest levels of benefits per hour due to the higher level of congestion, compared to the Inter-Peak.

Summary of Core Economic Analysis Outputs

9.8.47 An assessment of scheme costs and benefits has been undertaken for the two scheme options (Options 1 and 2), the 1-2 Hybrid option and Option 2 Modified.

9.8.48 All options produce moderate Economic Efficiency benefits over the 60-year appraisal period with benefits of £195m for Option 1 and £256m for Option 2. The variants of Option 2 have similar benefits to Option 2 with Economic Efficiency benefits of £260m for the 1-2 Hybrid Option and £245m for Option 2 Modified.

9.8.49 There is a similar split of benefits between business, commuting and 'other' journey purposes for all four options. Approximately 58% of benefits are attributed to business users, who have the highest value of time. Approximately 16% and 26% of benefits are attributed to commuter and 'other' trips, respectively. Although commuter trips have a higher value of time than 'other' trips, there are a significantly higher volume of 'other' trips, resulting in the higher level of benefits.

9.8.50 All scheme options are estimated to result in net travel time benefits for both short (under 25km) and long-distance trips. For all options, 42-44% of the scheme benefits occur for trips over 100km. This is due to both the high proportion of long-distance trips and the higher value of time for long distance trips for business.

9.8.51 For all options the AM and PM peak periods have the highest level of benefits per hour due to the higher level of congestion compared to the Inter-Peak.

- 9.8.52 Option 2 is forecast to have the highest BCR, with an adjusted BCR of 1.09. Option 1 would have the lowest adjusted BCR with a value of 0.77. The 1-2 Hybrid Option has slightly higher benefits than Option 2 but due to the higher costs has a lower BCR. Option 2 Modified has lower benefits than Option 2 and similar costs resulting in a lower BCR.
- 9.8.53 Option 2 performs marginally better overall in terms of adjusted BCR, however, this should not form the basis of option selection as the variance between Option 2 and its variants is very small.

Sensitivity Tests

- 9.8.54 A limited set of sensitivity tests were undertaken to identify the robustness of the scheme benefits.
- 9.8.55 Sensitivity tests have been undertaken for low and high growth assumptions in line with TAG Unit M4. These sensitivity tests have been undertaken for all options.
- 9.8.56 A sensitivity test has also been undertaken which excludes the A46 / NSLR roundabout from both the Do-Minimum and Do-Something. This test has only been undertaken for Option 2.
- 9.8.57 The impact of these sensitivity tests on the scheme benefits has been assessed using TUBA.

Summary of Forecast Outputs

- 9.8.58 The results of the sensitivity tests have focused on the following:
- Overcapacity queuing delay changes across the network.
 - Traffic flow changes on the A46.
 - Changes in journey time on the A46.
- 9.8.59 As would be expected, the high growth scenario has higher traffic flows on the A46 resulting in longer journey times compared to the Core scenario. The low growth scenario in contrast has lower traffic flows and shorter journey times.
- 9.8.60 The sensitivity test with the A46 / NSLR roundabout excluded results in higher traffic flows on the A46 south of Farndon due to the re-routeing of traffic from the NSLR to the A46 via Farndon. There is also a higher reduction in journey times along the A46 due to the scheme.

Summary of Sensitivity Test Economic Outputs

High Carbon Costs

- 9.8.61 Table 9-8 highlights the Initial and Adjusted Benefit Cost Ratio (BCR) for each of the options, with high carbon values used for the greenhouse gases impacts.

Table 9-8: Analysis of monetised costs and benefits (£'000) – High Carbon Costs

Appraisal Element	Option 1	Option 2	1-2 Hybrid Option	Modified Option 2
Economic Efficiency: Consumer Users: (Commuting)	29,199	40,985	40,272	38,704
Economic Efficiency: Consumer Users (Other)	47,251	63,426	64,722	59,801
Economic Efficiency: Business Users and Providers	118,580	152,088	154,637	146,040
Wider Public Finances (Indirect Taxation Revenues)	7,341	7,674	7,541	8,276
Accident Reduction Impacts	-4,290	1,310	340	880
Air Quality Impacts	-8,831	-8,239	-8,535	-8,232
Noise Impacts	1,140	574	864	652
Greenhouse Gases Impacts	-46,185	-40,867	-43,526	-40,792
Present Value Benefits (PVB)	144,205	216,950	216,314	205,329
Broad Transport Budget Present Value Capital Costs (PVC)	236,757	237,756	244,867	238,344
Initial Benefit to Cost Ratio (BCR)	0.61	0.91	0.88	0.86
Reliability Benefits	9,833	12,641	11,891	11,565
Wider Impacts	12,016	15,287	15,582	14,761
Adjusted PVB	166,054	244,879	243,787	231,655
Adjusted BCR	0.70	1.03	1.00	0.97

9.8.62 Table 9-8 demonstrates that there is a significant reduction in the BCR when high carbon values are assumed. However, the adjusted BCRs for Option 2 and the 1-2 Hybrid Option are still greater than 1.00. The adjusted BCRs for Option 1 and Option 2 Modified would be less than 1.00.

Low Traffic Growth

9.8.63 Table 9-9 highlights the Initial and Adjusted Benefit Cost Ratio (BCR) for each of the options, with low traffic growth. For this sensitivity test, the TUBA outputs, air

quality and greenhouse gases have been updated. The construction delays, accidents, reliability and noise benefits have not been updated and the core scenario values have been utilised.

Table 9-9: Analysis of monetised costs and benefits (£'000) – Low growth

Appraisal Element	Option 1	Option 2	1-2 Hybrid Option	Modified Option 2
Economic Efficiency: Consumer Users: (Commuting)	21,056	23,340	23,080	26,970
Economic Efficiency: Consumer Users (Other)	29,307	34,682	35,243	40,084
Economic Efficiency: Business Users and Providers	86,998	100,258	102,078	103,879
Wider Public Finances (Indirect Taxation Revenues)	6,315	5,380	6,151	3,041
Accident Reduction Impacts	-4,290	1,310	340	880
Air Quality Impacts	-7,519	-7,002	-7,261	-7,447
Noise Impacts	1,140	574	864	652
Greenhouse Gases Impacts	-28,698	-26,055	-27,377	-28,224
Present Value Benefits (PVB)	104,309	132,486	133,118	139,835
Broad Transport Budget Present Value Capital Costs (PVC)	236,757	237,756	244,867	238,344
Initial Benefit to Cost Ratio (BCR)	0.44	0.56	0.54	0.59
Reliability Benefits	9,833	12,641	11,891	11,565
Wider Impacts	8,857	10,104	10,326	10,545
Adjusted PVB	122,999	155,232	155,335	161,945
Adjusted BCR	0.52	0.65	0.63	0.68

9.8.64 Table 9-9 demonstrates that with low traffic growth all BCRs would be less than 1.00.

High Traffic Growth

9.8.65 Table 9-10 highlights the Initial and Adjusted Benefit Cost Ratio (BCR) for each of the options, with high traffic growth. For this sensitivity test, the TUBA outputs,

air quality and greenhouse gases have been updated. The construction delays, accidents, reliability and noise benefits have not been updated and the core scenario values have been utilised.

Table 9-10: Analysis of monetised costs and benefits (£'000) – High growth

Appraisal Element	Option 1	Option 2	1-2 Hybrid Option	Modified Option 2
Economic Efficiency: Consumer Users: (Commuting)	62,699	60,225	65,057	64,203
Economic Efficiency: Consumer Users (Other)	108,568	104,674	117,631	111,490
Economic Efficiency: Business Users and Providers	175,592	192,987	212,193	196,078
Wider Public Finances (Indirect Taxation Revenues)	2,610	4,233	5,150	5,144
Accident Reduction Impacts	-4,290	1,310	340	880
Air Quality Impacts	-11,346	-12,021	-11,684	-12,120
Noise Impacts	1,140	574	864	652
Greenhouse Gases Impacts	-39,844	-42,227	-41,035	-42,640
Present Value Benefits (PVB)	295,129	309,755	348,516	323,687
Broad Transport Budget Present Value Capital Costs (PVC)	236,757	237,756	244,867	238,344
Initial Benefit to Cost Ratio (BCR)	1.25	1.30	1.42	1.36
Reliability Benefits	9,833	12,641	11,891	11,565
Wider Impacts	17,717	19,377	21,337	19,765
Adjusted PVB	322,679	341,773	381,744	355,017
Adjusted BCR	1.36	1.44	1.56	1.49

9.8.66 Table 9-10 demonstrates that with high traffic growth, Option 1, Option 2 and Option 2 Modified would all have adjusted BCRs between 1.00 and 1.50. The 1-2 Hybrid Option would have a higher adjusted BCR of 1.56.

Southern Link Road Sensitivity Test

9.8.67 Table 9-11 shows the Initial and Adjusted Benefit Cost Ratio (BCR) for Option 2 for the core scenario and for a sensitivity test with the A46/Southern Link Road roundabout excluded from the Do-Minimum and Do-Something. For this sensitivity test only the TUBA outputs have been updated. The air quality, greenhouse gases, construction delays, accidents, reliability and noise benefits have not been updated and the core scenario values have been utilised.

Table 9-11 NSLR Sensitivity Test (£'000s) – Option 2

Appraisal Element	Option 2	Option 2 SLR Sensitivity Test
Economic Efficiency: Consumer Users: (Commuting)	40,985	43,955
Economic Efficiency: Consumer Users (Other)	63,426	69,327
Economic Efficiency: Business Users and Providers	152,088	207,441
Wider Public Finances (Indirect Taxation Revenues)	7,674	10,825
Accident Reduction Impacts	1,310	1,310
Air Quality Impacts	-8,239	-8,239
Noise Impacts	574	574
Greenhouse Gases Impacts	-26,364	-26,364
Present Value Benefits (PVB)	231,454	298,829
Broad Transport Budget Present Value Capital Costs (PVC)	237,756	237,756
Initial Benefit to Cost Ratio (BCR)	0.97	1.26
Reliability Benefits	12,641	12,641
Wider Impacts	15,287	20,823
Adjusted PVB	259,382	332,292
Adjusted BCR	1.09	1.40

9.8.68 Table 9-11 demonstrates that with the SLR/A46 roundabout excluded, the adjusted BCR for Option 2 would increase from 1.09 to 1.40.

9.9 Environmental Assessment

Environmental impact assessment and appraisal of Options 1 and 2

9.9.1 At this Option Selection stage (PCF Stage 2) the Environmental Impact Assessment (EIA) has provided a proportionate environmental assessment of the likely significant effects of Options 1 and 2. This assessment has taken into consideration available traffic data and design information including embedded mitigation measures, and potential mitigation and enhancement measures that

could form part of the scheme, and the existing environmental conditions of the local area (as described in Section 2.7). The EIA is reported in the PCF Stage 2 Environmental Assessment Report. It is noted that floodplain storage compensation will be required to mitigate the scheme within the floodplain and will be considered as part of the EIA at the at PCF Stage 3 (Preliminary Design).

9.9.2 The PCF Stage 2 EIA has had full consideration of the Infrastructure Planning EIA Regulations 2017, and the current National Highways standard, the DMRB, and best practice. In particular, DMRB LA 104 Environmental assessment and monitoring²⁹ (DMRB LA 104) and DMRB LA 103 Scoping projects for environmental assessment³⁰ (DMRB LA 103).

9.9.3 For each environmental topic, the relevant DMRB process has been followed. Table 9-12 provides a summary of the topics that have been considered in the PCF Stage 2 EIA of Options 1 and 2 and the level of assessment determined.

Table 9-12: Scope of environmental assessment summary

Topic	Scoped In / Out	Any aspects of assessment scoped out?
Air Quality	✓	The detailed dispersion modelling and full assessment undertaken at PCF Stage 1 was not updated at PCF Stage 2 to ensure the approach to the PCF Stage 2 air quality assessment is proportionate to the stage of assessment.
Cultural Heritage	✓	No
Landscape	✓	No
Biodiversity	✓	No
Geology & Soils	✓	There are no designated or non-designated geological sites within the geology and soils study area. Therefore geological features of local, regional, national or international importance were scoped out of the assessment at this stage.
Materials and Waste	✓	Change in demand for material assets associated with planned/ unplanned maintenance during the operational phase was scoped out as a minimal impact was envisaged during the operational stage of the scheme. Change in baseline waste capacity during the operational phase was scoped out as a minimal impact was envisaged during the operational stage of the proposed improvements. Change in demand for key construction materials associated planned/unplanned maintenance with during the operational phase has been scoped out because a minimal impact was envisaged during the operational stage of the scheme. Change in baseline regional waste arisings during the operational phase was scoped out because a minimal impact was envisaged during the operational stage of the scheme.

²⁹ DMRB, LA 104 Environmental assessment and monitoring, National Highways, August 2020.

³⁰ DMRB, LA 103 Scoping projects for environmental assessment, National Highways, January 2020.

Topic	Scoped In / Out	Any aspects of assessment scoped out?
Noise and Vibration	✓	No
Population and Health	✓	No
Road Drainage and Water Environment	✓	No
Climate	✓	No
Major Accidents and Disasters	✓	No
Transboundary Impact Screening	✗	No likely significant transboundary effects were anticipated due to distance and the likely magnitude of impacts from the scheme. It was therefore scoped out of further assessment at this stage.
Heat and radiation	✗	It is considered that as a highway improvement scheme, the scheme would not generate any notable emission of heat and/or radiation from the proposed works, technology or operation that could result in likely significant effects on the environment. Therefore, further consideration or assessment of heat and radiation was scoped out of the EIA at this stage.

9.9.4 The environmental assessment has been used to inform the appraisal of the environmental performance of the options in accordance with the DfT's Transport Analysis Guidance (TAG). The environmental appraisal methodology for environmental factors is described in TAG Unit A3, Environmental Impact Appraisal (DfT, 2015). TAG provides information on the role of transport modelling and appraisal, and how the transport appraisal process supports the development of investment decisions to inform the business case. The findings of this appraisal process are summarised under the Environmental Objective of the AST, which are then used to present the results of a transport scheme appraisal as part of the Value for Money business case and based on quantitative and qualitative assessment as required by TAG Unit A3.

9.9.5 Topics covered within the TAG Environmental Impact Appraisal include Air Quality, Greenhouse Gases, Historic Environment (referred to as Cultural Heritage in this report), Landscape and Townscape, Biodiversity, Noise and Vibration and Road Drainage and the Water Environment.

Comparative assessment of Options 1 and 2 against Option 2 Modified and 1-2 Hybrid Option

9.9.6 Because the level of design detail and traffic modelling available is different across the scheme's options, the level of the environmental assessment has varied for each option. This is summarised in Table 9-13.

Table 9-13: Assessment and appraisal of options

Option	PCF Stage 2 EIA	TAG Environmental Appraisal	Environmental assessment in SOAR
Option 1	✓	✓	✗ A summary of the detailed EIA and TAG appraisal is provided.
Option 2	✓	✓	✗ A summary of the detailed EIA and TAG appraisal is provided.
Option 2 Modified	✗	✓ Including quantitative air quality, GHG and noise appraisal	✓ A summary of the TAG appraisal is provided for the relevant environmental topics. For non-TAG environmental topics, a high-level qualitative assessment has been provided in the SOAR.
1-2 Hybrid Option	✗	✗	✓ A high-level qualitative assessment has been provided in the SOAR for all topics.

Summaries of Option 1 and 2 assessment and appraisal and comparative assessment with Option 2 Modified and the 1-2 Hybrid Option

- 9.9.7 The PCF Stage 2 EIA for each environmental topic is summarised in this section of the report for Options 1 and 2 and provides an overview of approach, assumptions and limitations including potential design, mitigation and enhancement measures.
- 9.9.8 A comparative assessment of Options 1 and 2, and of Options 1 and 2 in comparison with Option 2 Modified and the 1-2 Hybrid Option, are provided for each topic under the relevant sections of this report, and a summary of the TAG appraisal findings for relevant environmental topics for Options 1 and 2, and Option 2 Modified is also included.

Air Quality

Summary of approach

- 9.9.9 The PCF Stage 2 Air Quality assessment has been undertaken in line with DMRB LA 105 Air Quality³¹ (DMRB LA 105 Air quality) and has involved relatively minor updates focused on scheme design changes with impacts on traffic response. The detailed dispersion modelling and full assessment undertaken at PCF Stage 1 was not updated at PCF Stage 2 because the update to the traffic model for PCF Stage 2 did not materially impact traffic flows with regards to air quality change criteria.

³¹ DMRB, LA 105 Air Quality, National Highways, November 2019

Assessment assumptions and limitations

- 9.9.10 Any air quality model has inherent areas of uncertainty, including: the traffic data used in the air quality model, the suitability of emissions data, background concentrations, and meteorological data and simplifications in model algorithms and empirical relationships used to simulate complex physical and chemical processes in the atmosphere. Uncertainty associated with these parameters has been minimised by using validated models and data and following best practice.
- 9.9.11 The uncertainties associated with not updating the PCF Stage 1 dispersion model to account for minor changes to traffic data and the recent release of relevant air quality assessment tools and datasets (updates to the Department for Environment, Food and Rural Affairs (Defra) tools and datasets, and National Highways' speed band speed band emission rates) have been addressed through sensitivity tests to confirm that neither set of updates would materially impact the air quality assessment conclusions or option selection at PCF Stage 2. The air quality assessment will however be fully updated at PCF Stage 3, where relevant.
- 9.9.12 The effects of any additional construction traffic or disruption to traffic during construction has not been assessed as detailed information is not yet available. The effects of construction traffic are temporary, and the effects of any changes are unlikely to significantly affect local air quality. The potential effects of construction traffic will be considered further at PCF Stage 3 as further details become available.

Summary of design, mitigation and enhancement measures

- 9.9.13 As there are not expected to be any significant adverse effects on human health or designated ecological sites, essential measures to mitigate operational impacts are not required.
- 9.9.14 Good practice measures to control dust during construction would be specified within contract documentation and incorporated into an Environmental Management Plan. The precise measures would depend on the intended construction methods and the degree of dust generation at each site.

Comparative assessment

Options 1 and 2

- 9.9.15 The assessment has shown that it is expected that there would not be any significant adverse effects human health receptors or ecological sites with statutory designations (SSSI, SAC, SPA and LNR) under Option 1 or Option 2.
- 9.9.16 Six non-statutory LWSs are expected to exceed the DMRB LA 105 designated habitat screening criteria for nitrogen deposition under Option 1 and three non-statutory LWSs under Option 2. However, these sites were further assessed by biodiversity experts who found the potential effects on biodiversity resources during operation to be either neutral or slight adverse, and therefore not significant.
- 9.9.17 Therefore, neither Option 1 or Option 2 are considered to be environmentally worse or better than the other with respect to air quality.

Option 2 Modified

- 9.9.18 In terms of air quality, Option 2 Modified is very similar to Option 2 and as such the impact on traffic flows whilst operational are unlikely to be materially different. It can therefore be assumed that Option 2 Modified would have the same air quality effects as those reported for Option 2 and would therefore not be expected to result in significant adverse effects on human health or designated ecological sites.
- 9.9.19 Compared to Option 1 and 2, there may be an additional improvement in air quality concentrations at The Spinney and Winthorpe due to a greater distance between the road source and receptors with Option 2 Modified. However, given that there are no significant adverse effects on air quality expected at these locations under any option, Option 2 Modified would not be considered environmentally worse or better than Option 2 in relation to air quality.

Summary of findings from TAG Environmental Impact Appraisal for Option 1, Option 2 and Option 2 Modified

- 9.9.20 The air quality TAG appraisal of Option 1, Option 2 and Option 2 Modified indicates that Option 2 is the best performing option (from the central scenarios), although the difference between Option 2 and Option 2 Modified is very small. Option 1 is the worst performing option with the largest increase in nitrogen oxides (NO_x) and PM₁₀ emissions (disbenefit).

1-2 Hybrid Option

- 9.9.21 The 1-2 Hybrid Option is comparable to Option 1 north of the viaduct where the East Coast mainline crosses the Nottingham to Lincoln railway line and comparable to Option 2 south of this boundary.
- 9.9.22 As neither Option 1 or Option 2 are expected to result in significant adverse effects on human health or designated ecological sites, the 1-2 Hybrid Option is also considered likely to have no significant adverse effects for human health or designated ecological sites.
- 9.9.23 The 1-2 Hybrid Option is therefore considered not to be environmentally worse or better than Option 1, Option 2 or Option 2 Modified with respect to air quality.

Cultural Heritage

Summary of approach

- 9.9.24 The PCF Stage 2 cultural heritage assessment has been undertaken in line with DMRB LA 104 and DMRB 106 Cultural heritage assessment³² (DMRB LA 106). The assessment includes the identification of the sensitivity (value) of heritage assets and an examination of the magnitude of impacts proposed by Options 1 and 2 to arrive at an assessment of the significance of effects.
- 9.9.25 Examining the potential effects of both the construction and operation of the scheme, the assessment considered physical impacts as well as impacts caused by changes introduced into the settings of designated and non-designated heritage assets.

³² DMRB, LA 106 Cultural heritage assessment, National Highways, January 2020.

9.9.26 Site visits were conducted at PCF Stage 1, to assess the condition, significance, and setting of the Grade II listed causeways, culverts, and bridges associated with the Great North Road at Cattle Market junction.

Assessment assumptions and limitations

9.9.27 The cultural heritage assessment is based on the assumption that the HER data has not changed considerably since it was acquired in January 2019. An update of the HER data should be conducted in PCF Stage 3 to account for any recently recorded heritage assets.

9.9.28 Aside from visits to inspect the Grade II listed causeways and culverts associated with the Great North Road in July 2018, no other site visits or surveys have been conducted at this stage. It is assumed that the on-ground conditions have not changed noticeably since that time with regards to the location and condition of heritage assets.

9.9.29 The archaeological impacts were considered to be equally weighted across Options 1 and 2. Therefore, no archaeological survey or evaluation trenching was conducted at PCF Stage 2.

Summary of design, mitigation and enhancement measures

9.9.30 All options have been designed to minimise the direct physical impacts on known designated and non-designated heritage assets. It will not be possible to avoid all impacts on the historic environment. At PCF Stage 2 no off-setting essential mitigation has been developed as part of the design of the options for those impacts that cannot be avoided. This will be developed at PCF Stage 3.

9.9.31 To fully identify and evaluate as-yet unknown archaeological remains, and to minimise the harm done by the scheme, additional archaeological works are recommended. A robust Archaeological Management Plan (AMP) is advised to be developed at PCF Stage 3 in consultation with the Nottinghamshire County Archaeologist and Historic England. This live document should act as an overarching Written Scheme of Investigation (WSI) to guide the identification, evaluation, recording and preservation of archaeological remains impacted by the scheme (including FCA) and can be updated throughout the lifecycle of the scheme.

9.9.32 Options 1 and 2 would introduce changes to the landscape that would alter the settings of nine Scheduled Monuments related to the English Civil War. An assessment of the setting and significance of these Scheduled Monuments should be conducted at PCF Stage 3 to aid in the identification of specific impacts, based on the objectives identified by the relevant archaeological research frameworks for the area. Consultation with the Nottinghamshire County Archaeologist have raised the suggestion that an update to the 1964 publication Newark-on-Trent: The Civil War Siegeworks by the Royal Commission on Historical Monuments (England) should be considered as a way to offset impacts to the settings of these Scheduled Monuments through additional interpretation and public benefit by publication. It is expected that such work would also complement archaeological investigations on archaeological remains from this period.

Comparative assessment

Options 1 and 2

- 9.9.33 Option 1 would have direct physical impacts on the Grade II listed causeways and culverts associated with the Great North Road. Due to the additional link road that would connect the A616 and A617, Option 1 would also require earthworks and construction activities in close proximity to the Scheduled Monuments near the Newark Cricket Club on Kelham Road, introducing additional elements into the settings of these Scheduled Monuments and increasing the risk of impacting as-yet unknown archaeological remains of schedulable quality. Option 1 would also remove part of the open space within the Winthorpe Conservation Area that contributes to the character of the conservation area. Overall, Option 1 would result in a moderate adverse effect on the historic environment and cultural heritage resource, which is significant.
- 9.9.34 Option 2, by comparison, does not include the new link road connecting the A616 and A617 and therefore would have lesser impacts on the Grade II listed causeways and culverts associated with the Great North Road and the Scheduled Monuments near the Newark Cricket Club. However, Option 2 would remove a larger area of open space contributing to the character of the Winthorpe Conservation Area, as well as bringing the road infrastructure closer to the boundaries of the conservation area in general. Overall, Option 2 would result in a moderate adverse effect on the historic environment and cultural heritage resource.
- 9.9.35 Options 1 and 2 would result in major adverse effects on known and as-yet unknown archaeological remains, with a strong likelihood of encountering nationally significant remains.
- 9.9.36 Option 2 is preferred to Option 1 due to the lesser impacts on only two of the four Grade II listed causeways and culverts associated with the Great North Road. Although Option 2 encroaches into the Winthorpe Conservation Area to a greater extent than Option 1, neither option presents direct impacts to any contributing buildings within the conservation area. Also, the extent of the essential offsetting measures required to lessen the significant adverse effects of Option 1 would need to be more extensive than other options to address the impacts along Kelham Road. Whereas, essential offsetting measures may be able to lessen the effects of Option 2 to a slight adverse effect, which is not significant.

Option 2 Modified

- 9.9.37 Option 2 Modified, compared with Option 2, would lessen the impacts on the Winthorpe Conservation Area by bringing the scheme closer to the route of the existing A46. Impacts to other heritage assets are expected to be the same as those for Option 2. Therefore, Option 2 Modified would result in a moderate adverse effect on the historic environment and cultural heritage resource, which is significant. Option 2 Modified would likely require less extensive essential offsetting measures than Options 1 and 2 to potentially lessen the effects to slight adverse, which is not significant.

Summary of findings from TAG Environmental Impact Appraisal for Option 1, Option 2 and Option 2 Modified

9.9.38 The TAG appraisal found the following summary assessments:

- Options 1 and 2: moderate adverse effect
- Option 2 Modified: moderate adverse effect

9.9.39 Whilst each of the options differ in the types and number of impacts that would have on the historic environment and cultural heritage resource, the overall effect is the same for all three options.

1-2 Hybrid Option

9.9.40 Compared to Option 1, 1-2 Hybrid Option would lessen the impact on the Grade II listed culverts and causeways associated with the Great North Road. However, 1-2 Hybrid Option would impact the Winthorpe Conservation Area to a greater extent compared to Option 2 Modified. This is because the 1-2 Hybrid Option includes an additional overbridge connecting the A46 and the A1. The 1-2 Hybrid Option retains all other impacts on heritage assets associated with Option 1. Therefore, the 1-2 Hybrid Option would result in a moderate adverse effect on the historic environment and cultural heritage resource, which is significant.

Landscape and Visual

Summary of approach

9.9.41 The landscape and visual assessment has been undertaken in line with DMRB LA 107 Landscape and visual effects³³ (DMRB LA 107). The DMRB LA 107 methodology is based on the 2013 Guidelines for Landscape and Visual Impact Assessment³⁴ (GLVIA3), and therefore the principles of the GLVIA3 have also been considered.

9.9.42 Landscape receptors under consideration include landscape designations, national and local landscape character and physical landscape features (such as trees and woodlands).

9.9.43 Visual receptors include:

- Users of recreational facilities, such as open access land, and visitors to leisure and tourist destinations.
- Recreational users of PRoW.
- Residential properties.
- Commercial and public buildings.
- Users of roads.

Assessment assumptions and limitations

9.9.44 The location and size of site compounds, potential storage/borrow areas and proposed signage, lighting or other built elements associated with the project, such as noise or environmental barriers, are unknown at this stage and have not

³³ DMRB, LA 107 Landscape and visual effects, National Highways, February 2020.

³⁴ Guidelines for Landscape and Visual Impact Assessment Third Edition 2013 Landscape Institute and IEMA

been assessed. In addition, full details of the engineering designs and land take for construction have not been finalised. These elements have the potential to increase the magnitude of adverse impacts on the landscape and on visual receptors both during the construction and operation phases.

9.9.45 The assessment has been undertaken on the basis that cutting slopes will be graded to 1:2 and embankments to 1:3. However, there is the potential for beneficial shaping of the proposed earthworks to integrate the scheme into the existing terrain, which will entail the use of flowing slopes at a range of gradients, depending on the space available and the design intentions.

9.9.46 The visual assessment has largely been informed by broad baseline site surveys undertaken at PCF Stage 1, in combination with the study of topography, aerial images and 'street view' images. Access to land to walk the trace of the options has not been gained nor has access to residential properties that might be affected been sought. As such, the assessment has been limited to views in and from publicly accessible land; however the level of analysis has allowed the professional judgement of a landscape architect to be made regarding the likely impacts that the scheme will have on the visual amenity of the various receptor groups when considered as a whole.

Summary of design, mitigation and enhancement measures

9.9.47 Landscape and visual effects during construction could be mitigated to some extent with the adoption of appropriate embedded mitigation and essential mitigation measures that include:

- Environmental bunds that are proposed as part of the permanent works could be constructed as early as is practicable to provide screening to the construction work.
- Retention of existing trees and vegetation wherever possible in accordance with current best practice.
- Sensitive consideration of designated TPO's and notable trees located within works boundary.
- Restoration of land that will be used temporarily; this would be returned to a condition suitable for the continuation of its original use, or enhanced.
- Advanced planting where land is not required for other construction activities.

9.9.48 Landscape and visual effects during operation could be mitigated to some extent with the adoption of appropriate embedded mitigation and essential mitigation measures that include

- Careful integration of earthworks where required into the landscape to minimise conflicts of existing vegetation and the PRoW network.
- Alignment of all new and extended junctions and new highway with the existing topography as far as possible to reduce landscape and visual impacts, and avoiding location of fence lines at the top of any cutting embankment slopes where they could dominate the skyline.

- Rounding off the crests and toes of all embankments and FCA to achieve better integration with the surrounding landform, and slopes graded out and returned to agriculture use to retain the open character of the area.
- Development of appropriate design solutions for structures (bridges and culverts), control buildings, highways signage, fencing, pylon and lighting that minimises landscape and visual impacts while meeting highways safety and user needs, and provides an overall positive contribution to the area as it passes through.
- Limiting the lengths of embankments that cut across the natural topography of the area.
- Where appropriate and necessary, new highway planting to avoid having a negative impact on the local setting and use species native to the Midlands.
- Development of a landscape strategy for the Scheme that is responsive to the local landscape character of the area that the option routes run through, that enhances biodiversity and that adopts an uncluttered approach to design and materials. The strategy will also seek to mitigate impact on the physical landscape by minimal cut and fill adjustments of the natural topography.
- Where appropriate and in keeping with the character of the immediately surrounding landscape, the planting of hedgerows with trees, geometric woodland blocks and short sections of woodland belts to screen particularly detracting elements of the options and/or reduce the magnitude of impact for sensitive receptors who may otherwise experience significant adverse visual effects.

9.9.49 Potential enhancement measures could include:

- Establishment of open grassland and species rich grassland in locations suitable for establishment to integrate with adjacent landscape character and enhance local biodiversity;
- Retention and enhancement of hedges along the highway boundary where appropriate to ensure that existing field boundaries remain intact and wildlife corridors are not severed; and
- Consideration of opportunities for habitat creation to increase biodiversity where drainage ditches, balancing ponds and attenuation areas are required.

Comparative assessment

Options 1 and 2

9.9.50 During construction, both Options 1 and 2 would result in short term adverse significant effects on landscape character largely due to the vegetation clearance within the existing road corridor, primarily focused on the north bound carriageway edge. In addition, residential properties, users of recreational facilities and nearby PRow are likely to experience short term adverse visual significant effects particularly for some residential properties on the northern and western edges of Newark-on-Trent between Newark Crossing (of the two mainline railway tracks), Cattle Market Junction and the A1/A46 junction, the village of Winthorpe, and users of the PRow network (especially Trent Valley Way).

- 9.9.51 During operation, Option 1 would have a greater adverse effect in the Kelham Road/Great North Road area because of the creation of the link road to divert the A617 Kelham Road to a new junction on the A616 Great North Road link to the north of Cattle Market junction. This link between the A616 and A617 is not proposed as part of Option 2, and the existing separate connections directly into Cattle Market are retained. This would reduce the extent of impact on the Cattle Market Junction area. However, Option 2 includes a grade separated junction at Cattle Market junction, which would impact on views and may result in less screening opportunities. At Winthorpe, Option 2 realigns the A46 much closer to the Conservation Area, presenting limited potential for mitigation. Whereas Option 1, although further away, includes a bridge over the A46 that will also impact on visual amenity.
- 9.9.52 During operation, Options 1 and 2 have the potential to result in a significant adverse effect on a range of visual receptors in close proximity due to the raised profile of the carriageway, new link sections and the removal of existing vegetation within the existing road corridor. However, much of the existing tree belts offering screening to receptors immediately south of the option will remain intact and with mitigation could reduce this effect to non significant after 15 years.
- Option 2 Modified*
- 9.9.53 Option 2 Modified would have a similar effect during construction and operation on the landscape and visual resources as Options 1 and 2. However, in comparison with Option 2 and Option 2 modified, Option 1 would have a more significant adverse effect on the landscape because of the diversion of the A617 Kelham Road.. However, both Option 2 and Option 2 Modified would have a more significant adverse effect on views due to the elevation of the grade separated junction at Cattle Market that is unlikely to be fully screened from view.
- 9.9.54 Option 2 would have a more significant adverse effect on the landscape character on the edge of Winthorpe Conservation Area compared to Option 1 and Option 2 Modified due to the proximity of the realigned A46 to Winthorpe. Option 2 Modified would not include a bridge over the realigned A46 in this location and by following the existing route of the A46 would be further away from the edge of Winthorpe, thereby lessening the adverse impact on the on the landscape character on the edge of Winthorpe Conservation Area . All options have an overbridge over the A1 which is likely to have some impacts on Winthorpe that may not be fully mitigated, although Option 2 Modified is slightly further away which may provide greater opportunities to mitigate potential impacts.
- 9.9.55 Overall, from a landscape and visual perspective, Option 2 Modified would have the least significant adverse environmental effect compared with Option 1 and Option 2, due to the comparatively smaller footprint and utilisation of the existing A46 south of Winthorpe resulting in fewer adversely affected landscape and visual resources and greater opportunity to mitigate potential impacts.

Summary of findings from TAG Environmental Impact Appraisal for Option 1, Option 2 and Option 2 Modified.

9.9.56 A TAG Environmental Impact Appraisal has been undertaken which considered Options 1, 2 and 2 modified. The results of which were:

- Option 1: slight adverse effect.
- Option 2: slight adverse effect.
- Option 2 Modified: slight adverse effect.

9.9.57 All options have the potential to result in significant direct effects with opportunities to embed mitigation in the scheme design to avoid, minimise and offset these effects. This includes the asymmetrical widening to the north and west of Newark to maintain the screening effect of existing planting between Farndon and the A1. For Option 1, the new junction layouts, A617 link road and elevated section of road across the A1 and A46 to the west and south of Winthorpe could result in a significant effect as a result of adverse localised and small scale impacts on the landscape character and visual amenity. The scope to mitigate these and to integrate this option post year 15 reducing significant effects to slight adverse varies slightly between options. However, there is still some uncertainty given that the environmental design and mitigation strategy is still to be developed as part of PCF Stage 3 increasing the potential significance of effect at PCF Stage 2 to Moderate Adverse.

1-2 Hybrid Option

9.9.58 The 1-2 Hybrid Option would have a similar effect during construction and operation on the landscape and visual resources as Option 1, Option 2 and Option 2 Modified.

9.9.59 Option 1 has a more significant adverse effect on the landscape in the Kelham Road/Great North Road area. Whereas Option 2, Option 2 Modified and the 1-2 Hybrid Option would have a more significant adverse effect on views due to the elevation of the grade separated junction at Cattle Market that is unlikely to be fully screened from view.

9.9.60 Like Option 1, the 1-2 Hybrid Option includes the bridge across the realigned A46 at Winthorpe, resulting in a more significant landscape and visual effect than Option 2 Modified. Therefore, from a landscape and visual perspective, in comparison with Options 1 and 2, and the 1-2 Hybrid Option, Option 2 Modified would have the least adverse environmental impact, due to the comparatively smaller footprint and utilisation of the existing A46 south of Winthorpe resulting in fewer adversely affected landscape and visual resources and greater opportunity to mitigate potential impacts.

Biodiversity

Summary of approach

9.9.61 An assessment of the effects on the scheme on biodiversity resources has been undertaken in line with the requirements and advice provided within DMRB LA

108 Biodiversity³⁵ (DMRB LA 108) and guidance provided by the Chartered Institute of Ecology and Environmental Management (CIEEM)³⁶. The assessment has provided an initial understanding of the baseline ecological conditions and the likely ecological constraints associated with the scheme, e.g. the presence of designated nature conservation sites and protected or priority habitats and species.

- 9.9.62 The assessment has been informed by desk study and preliminary surveys undertaken in accordance with DMRB LD 118 Biodiversity design³⁷ (DMRB LD 118). Assessment of other environmental topics including noise and vibration, air quality, and road drainage and the water environment have been taken into account to inform the assessment on biodiversity resources.

Assessment assumptions and limitations

- 9.9.63 The assessment has been informed by desk study and preliminary surveys of accessible land within 250 m of the scheme. Access for the preliminary surveys has been limited to National Highways' soft estate and third-party land where access had been agreed with the landowner. Where land access has not been available, every effort has been made to map habitats and identify the possible presence of protected and priority species from adjacent land. Subject to future land access, preliminary surveys at PCF Stage 3 of land not yet accessed could identify additional ecological constraints such as irreplaceable habitat, for example, ancient and veteran trees.
- 9.9.64 Environmental assessment undertaken to date has identified potential impacts to LWSs, priority habitats and protected and priority species. Further assessment shall be undertaken at PCF Stage 3 following the preferred route announcement. This will include further protected species surveys, aquatic ecology surveys of watercourses and waterbodies, and arboriculture surveys (to record ancient and/or veteran trees). The results of these surveys shall be used to design appropriate embedded mitigation and to identify the requirement for essential mitigation. Where it is not possible to completely address habitat loss within the final scheme boundary, an alternative mechanism to offset residual habitat loss shall be secured.
- 9.9.65 The assessment has taken into account the adoption of construction good practice and measures required to avoid nuisance or to ensure wider legislative compliance, e.g. protected species licensing.

Comparative assessment

Options 1 and 2

- 9.9.66 The assessment of effects from Options 1 and 2 on biodiversity resources has concluded the following.
- 9.9.67 There would not be any effects on statutory designated nature conservation sites, e.g. SSSIs, or ancient woodland or ancient and veteran trees, by Option 1 or Option 2.

³⁵ DMRB, LA 108 Biodiversity, National Highways, March 2020.

³⁶ Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine, version 1.1, CIEEM, 2018, Winchester.

³⁷ DMRB, LD 118 Biodiversity design, National Highways, March 2020.

- 9.9.68 Habitat loss and fragmentation under Option 1 could result in moderate adverse effects on eight LWSs, which is significant:
- Old Trent Dyke LWS.
 - Dairy Farm Railway Strip LWS.
 - Great North Road Grasslands LWS.
 - Kelham Road Grassland II LWS.
 - Newark Grassland LWS.
 - Valley Farm Grassland LWS.
 - Kelham Road Redoubt Grassland LWS.
 - Newark (Beet Factory) Dismantled Railway LWS.
- 9.9.69 Option 2 could result in moderate adverse effects on four LWSs, which is significant:
- Old Trent Dyke LWS.
 - Dairy Farm Railway Strip LWS.
 - Great North Road Grasslands LWS.
 - Newark (Beet Factory) Dismantled Railway LWS.
- 9.9.70 Habitat loss and fragmentation under Option 1 could result in moderate adverse effects on four priority habitats types, which is significant:
- Lowland mixed deciduous woodland.
 - Coastal and floodplain grazing marsh.
 - Lowland meadow.
 - Lowland fen.
- 9.9.71 Option 2 could result in moderate adverse effects on two priority habitats types, which is significant:
- Lowland mixed deciduous woodland.
 - Lowland fen.
- 9.9.72 Habitat loss and fragmentation under Options 1 and 2 could result in moderate adverse effects on a main river (the River Trent (Newark Branch)) and an ordinary watercourse (Old Trent Dyke), which is significant.
- 9.9.73 Habitat loss and degradation under Option 1 could result in moderate adverse effects on four ponds, which is significant. Option 2 could result in moderate adverse effects on three ponds.
- 9.9.74 Habitat loss and fragmentation under Options 1 and 2 could result in moderate adverse effects on populations on the following species/species groups, which is significant:
- Bats.
 - Otter.

- Great crested newt.
- Water vole.
- Common species of reptile.
- Priority bird species, particularly rapidly declining farmland bird species.

9.9.75 Six non-statutory LWSs are expected to exceed the DMRB LA 105 designated habitat screening criteria for nitrogen deposition under Option 1 and three non-statutory LWSs under Option 2. However, these sites were further assessed and the potential effects on biodiversity resources during operation are found to be either neutral or slight adverse, and therefore not significant.

9.9.76 Overall, in the absence of appropriate mitigation, Option 1 would have a greater effect on biodiversity resources than Option 2. This is because Option 1 could have the greatest loss of land within a network of LWSs centred on the Cattle Market junction. There are slight differences between Options 1 and 2 in the extent of open channel habitat loss along watercourses. This is particularly pronounced on the Winthorpe Beck where a proposed culvert extension is expected to be 100 m for Option 1 and 45 m for Option 2.

9.9.77 Additional adverse effects of slight significance have been identified. However, with the adoption of construction good practice measures, residual effects of slight significance would not be considered to be material in the decision-making process. Following appropriate embedded mitigation, e.g. environmentally sensitive designs of landscaping, watercourse crossings, drainage and lighting, and the security of compensation for habitat loss, it is expected that all residual effects would be reduced to neutral. Because the effects of habitat loss and fragmentation on important biodiversity resources are greatest for Option 1, Option 1 would require greater mitigation to address impacts to LWSs and priority habitats.

Option 2 Modified

9.9.78 Compared to Option 2, Option 2 Modified would result in less land take of the Great North Road Grassland LWS. There would also be no loss of wood-pasture and parkland priority habitat associated with Winthorpe House. Option 2 Modified would also require a lesser amount of lowland mixed deciduous woodland priority habitat and open channel habitat being lost along Winthorpe Beck.

9.9.79 Overall, Option 2 Modified would result in a moderate adverse effect on important biodiversity resources, which is significant. However, with the adoption of construction good practice measures, appropriate embedded mitigation, and the security of compensation for habitat loss, it is expected that all residual effects would be reduced to neutral.

9.9.80 In comparison, the effects of habitat loss and fragmentation on important biodiversity resources are greatest for Option 1 and least for Option 2 Modified. Option 1 would require greater mitigation to address impacts to LWSs and priority habitats.

Summary of findings from TAG Environmental Impact Appraisal for Option 1, Option 2 and Option 2 Modified

- 9.9.81 The appraisal of Option 1 has resulted in an overall assessment score of large adverse. This has been given based on a number of moderate adverse effects on LWSs, particularly on the suite of LWSs supporting grassland habitat centred on Cattle Market junction. It is considered that, cumulatively, this would result in a large adverse effect on these ecological features of county importance.
- 9.9.82 The appraisal of both Option 2 and Option 2 Modified has resulted in overall assessment scores of moderate adverse. This is based on the most adverse assessment of the ecological features affected.

1-2 Hybrid Option

- 9.9.83 The 1-2 Hybrid Option would have a lesser adverse effect on biodiversity resources compared to Option 1. This is because it is similar to Option 2 in that it avoids the loss of habitat within LWSs to the north of Cattle Market junction.
- 9.9.84 Similar to Option 1, the 1-2 Hybrid Option would not result in the loss of wood-pasture and parkland priority habitat associated with Winthorpe House and would result in a lesser amount of lowland mixed deciduous woodland priority habitat being lost along Winthorpe Beck. However, the loss of lowland mixed deciduous woodland and open channel habitat along Winthorpe Beck would be greater for the 1-2 Hybrid Option compared to Option 2 Modified.

Geology and Soils

Summary of approach

- 9.9.85 A desk based qualitative assessment has been undertaken in line with DMRB LA 109 Geology and soils³⁸ (DMRB LA 109). Relevant and readily available baseline soils and geology data has been collated to identify the likelihood and potential severity of the impacts of the options on geology and soils, to determine the likely effects.
- 9.9.86 The assessment of effects on land contamination are based on the potential presence of sources of contamination and sensitive receptors, and the likelihood of potential existing contamination linkages.
- 9.9.87 The assessment of effects on agricultural soils and loss of BMV land follows that of DMRB LA 109. BMV land is ALC Grades 1 and 2 (very high sensitivity) and Subgrade 3a (high sensitivity). Permanent loss of more than one hectare of BMV land is a significant effect. At PCF Stage 2 the identification of soils and ALC was based on a desk-top review of published geological, soil and ALC maps, and satellite imagery. An ALC soil survey has also been undertaken in advance of PCF Stage 3 to de-risk preliminary design, which slightly revised the areas of BMV land, which has been considered as part of the PCF Stage 2 assessment.

Assessment assumptions and limitations

- 9.9.88 No ground investigation data has been collected as part of the PCF Stage 2 assessment. As such, a realistic assumption on ground conditions and impacts

³⁸ DMRB, LA 109 Geology and Soils, National Highways, October 2019.

has been made, based on the data available at the time of reporting i.e. the Envirocheck report and publicly available desk based/website data.

9.9.89 DMRB LA 109 states that a soil resource and / or ALC survey should be undertaken to inform the baseline scenario and assessment conclusions where data is incomplete / unavailable. The desk-top review and the advanced PCF Stage 3 ALC soil survey are believed to be sufficiently robust to enable a comparative assessment of the options at PCF Stage 2. A further field survey will be carried out in PCF Stage 3. As well as identifying the soil and ALC characteristics of the preferred option, the data gathered will inform a scheme-wide soil handling and management plan and opportunities for creating biodiversity.

9.9.90 It has been assumed that appropriate embedded mitigation and essential mitigation measures would be included within the scheme including the design, construction, and operation of the scheme in accordance with statutory guidance and best practice.

Summary of design, mitigation and enhancement measures

9.9.91 Embedded mitigation and essential mitigation measures to minimise potential impacts are likely to include:

- Design of the proposed development in accordance with statutory guidance and best practice.
- Further assessment of the ground conditions through ground investigation is currently being undertaken, however no data is currently available. Incorporation of mitigation/remedial measures to reduce risks associated with land contamination will be implemented if required.
- Implementation of appropriate pollution incident control and implementation of appropriate and safe storage of fuel, oils and equipment during construction.
- Management of earthworks in accordance with relevant legislation to allow the re-use of suitable soils, where appropriate.
- Operation of the development in accordance with the relevant regulations, best practice guidance and pollution prevention.

9.9.92 As stated above, there is no environmental mitigation for permanent land-take. Land acquired and disturbed temporarily during construction will be restored to its original capability.

Comparative assessment

Options 1 and 2

9.9.93 Where Option 1 and Option 2 are located predominantly on existing roads (from Farndon junction to the existing River Trent Viaduct), it is assumed that there will be limited disturbance of soils. Where Options 1 and 2 diverge away from existing roads, it is assumed that in these areas there will be disturbance of soils. For Option 1 this is to the northeast of the existing River Trent Viaduct where the option is located on undeveloped agricultural land bypassing the A1/A46 junction and crossing over the A1 via a new structure before re-joining the existing roads

to the west of Winthorpe junction. This is the same for Option 2 up until the crossing of the A1 where this option then runs north of the existing A46 before tying into Winthorpe junction.

- 9.9.94 Due to limited disturbance of soils in areas using existing roads, and assumed mitigation measures in these areas and areas where there is proposed disturbance of soils, limited contamination impacts are anticipated. Land contamination effects from Options 1 and 2 are therefore considered to be neutral or slight adverse, and therefore not significant. As such, there is little to distinguish the residual land contamination effects of the two options.
- 9.9.95 The total permanent agricultural land-take of Option 1 is approximately 12.5 ha, of which 5.75 ha is likely to be of BMV quality. For Option 2, the total permanent agricultural land-take of Option 2 is approximately 17.25 ha of which 4 ha is likely to be of BMV quality. The BMV land for both options is in the vicinity of the Sugar Factory and just west of the A1. Therefore, although the total loss of agricultural land is 4.75 ha greater under Option 2, the loss of BMV land is 1.75 ha less. Overall, the residual effect on soils and agricultural land from Options 1 and 2 is assessed as large adverse, and therefore significant. There is little to distinguish the residual effects of the two options. It should be noted that there is no environmental mitigation appropriate for permanent land-take. Land acquired and disturbed temporarily during construction will be restored to its original capability.

Option 2 Modified and 1-2 Hybrid Option

- 9.9.96 Similar to Options 1 and 2, for Option 2 Modified and the 1-2 Hybrid Option limited contamination impacts are anticipated, and therefore land contamination effects are considered to be neutral or slight adverse, and therefore not significant. As such, there is little to distinguish this option from the other options with respect to land contamination.
- 9.9.97 The total permanent agricultural land-take of Option 2 Modified is approximately 11.25 ha of which 4 ha is likely to be of BMV quality. The total land-take would be 6 ha less than Option 2, but the loss of BMV land is the same and the residual effect would also be large adverse, and therefore significant.
- 9.9.98 The 1-2 Hybrid Option would take approximately 10 ha of agricultural soils, which is less than Option 1 (12.5 ha), Option 2 (17.5 ha) and Option 2 Modified (11.25 ha). The loss of BMV land is 4 ha, which is the same as Option 2 and Option 2 Modified, but less than Option 1 (5.75 ha). Although the residual effect would still be large adverse, which is significant, in terms of loss of agricultural soils and BMV land, the 1-2 Hybrid Option is the most favourable of the four options.

Materials and Waste

Summary of approach

- 9.9.99 An assessment has been undertaken in line with DMRB LA 110 Material assets and waste³⁹ (DMRB LA 110), to assess the impacts of material asset use and waste generation from the scheme during its CD&E phases.

³⁹ DMRB, LA 110 Material assets and waste, National Highways, August 2019.

9.9.100 The assessment process has included the following tasks:

- Review of relevant waste legislation and guidance to identify material asset and waste management objectives and targets.
- Establish the baseline for material assets use, waste generation, capacity of waste management infrastructure and location of mineral sites and peat resources.
- Establish the information available at this stage for the scheme on key quantities of material reuse on site, recycled content of materials used and wastes to be generated during construction.
- Identify and assess the impacts of the scheme by comparing the information available at this stage on key quantities against the baseline.
- Identify essential mitigation measures to reduce, re-use, recycle and/or recover material assets and wastes from the scheme.

Assessment assumptions and limitations

9.9.101 The material assets used, and waste generated through construction of the scheme have been estimated from the available design information. The material assets and waste baselines have used publicly available data.

9.9.102 All material assets and waste quantities have been converted into tonnes or cubic metres, from the design information provided, using industry standard conversion rates. All material assets have also been grouped according to main material types.

9.9.103 Indirect impacts, such as those from the offsite manufacture of products or extraction of minerals were scoped out of the assessment. Operational material asset use and waste generation were also scoped out of the assessment.

9.9.104 Impacts associated with the transport of material assets and waste have been considered in their respective environmental topic assessments, including air quality, noise and vibration, population and human health, and climate.

Summary of design, mitigation and enhancement measures

9.9.105 The design of the scheme will ensure that material use and wastage is minimised and resource efficiency maximised throughout its lifecycle.

9.9.106 Steps would be taken, during preliminary design at PCF Stage 3 and will continue during detailed design, to minimise the use of material assets and generation of waste, through application of the waste hierarchy to reduce, reuse, recycle and recover. At the design stage these steps include but are not limited to consideration of off-site manufacture of components and use of modular construction and other modern methods of construction.

9.9.107 Discussions would also take place with the supply chain to use reusable packaging and take back unused material assets, instead of them being disposed of. Decisions made in the design stage would also support the circular economy through specifications to use recycled material in off-site manufacture of components.

- 9.9.108 Impacts would be managed during construction, for example, the appointed contractor(s) would be required to:
- Promote opportunities for the potential re-use and recycling of all material assets and waste.
 - Sort and segregate waste into different waste streams (where technically and economically feasible).
 - Manage material use to maximise its re-use within the scheme, providing an environmental benefit over off-site management.

Comparative assessment

Options 1 and 2

- 9.9.109 The impact the estimated material asset volumes to be used for the construction of Options 1 and 2 on baseline sales of materials would be small, however Option 2 does have a slightly higher impact on aggregates. It is likely that both options would have a slight adverse effect, which is considered not significant.
- 9.9.110 At this stage the only waste volumes known to be generated by the scheme is soil from excavation. The volumes of soil required for Options 1 and 2 and the percentage impact this will have on the capacity of waste facilities baselines would be small, however, Option 1 has a slightly higher impact. It is likely both options would have a slight adverse effect, which is not significant.

Option 2 Modified and 1-2 Hybrid Option

- 9.9.111 Based on a qualitative assessment of the volume of material assets required and the waste generated during construction, the 1-2 Hybrid Option is similar to Option 1 and worse than Option 2. In comparison, Option 2 Modified is better than both Option 1 and the 1-2 Hybrid Option, and similar to Option 2. This means that the impact on landfill capacity and waste infrastructure is small for Option 2 Modified, resulting in a slight environmental effect, which is not significant.

Noise and Vibration

Summary of approach

- 9.9.112 The noise and vibration assessment was carried out in accordance with DMRB LA 111 Noise and vibration⁴⁰ (DMRB LA 111).
- 9.9.113 The construction noise and vibration assessment was a high level desk study, carried out in broad accordance with BS 5228:2009+A1:2014.
- 9.9.114 The operational noise assessment was carried out using a 3D noise model, created using scheme and mapping information, with prediction points at all properties within 600 m of the scheme.

Assessment assumptions and limitations

- 9.9.115 A high level construction noise assessment was carried out, which determined that without temporary noise mitigation in place, potential significantly adverse

⁴⁰ DMRB, LA 111 Noise and vibration, National Highways, May 2020.

effects were likely at properties that are 50 m from the works during the day, 100 m from the works during the evening or weekend, and 300 m from the works at night. A more detailed assessment will be carried out at PCF Stage 3 that will include an assessment of potential impacts from construction vibration when more information on construction plant and programme is available.

- 9.9.116 A daytime operational noise assessment was carried out that demonstrated that for Option 1, Option 2 and Option 2 Modified, potential significant adverse noise effects are predicted at a small number of noise sensitive receptors either due to moderate or major increases in noise, or due to minor exceedances above the Significant Observed Effect Level (SOAEL), the level above which significant adverse effects on health and quality of life occur. There were assessments of the short term (comparing noise levels with and without the scheme in the opening year) and the long term (comparing with the scheme 15 years after opening).
- 9.9.117 The assessment included predicting the change in noise at NIAs. At PCF Stage 3, where necessary, essential operational mitigation such as environmental noise barriers and bunds will be included in the scheme design. This is in addition to the lower noise surfacing that has already been proposed along the scheme as part of the embedded mitigation at PCF Stage 2.

Summary of design, mitigation and enhancement measures

- 9.9.118 The EAR included generic advice on best practicable means (BPM), community and stakeholder liaison, temporary mitigation and the potential for a Section 61 agreement with the LPA.
- 9.9.119 The operational noise assessment was undertaken under the assumption that all new or altered roads would be resurfaced with a low noise surfacing as part of the embedded mitigation included in the scheme design. No additional noise mitigation measures were considered in the assessment, however, additional work was carried out during the development of Options 1 and 2 leading to the consultation period to determine where mitigation could be effective.
- 9.9.120 Environmental noise mitigation was tested using the noise models from the environmental assessment. A 1400 m long and 2 m high environmental noise bund and/or barrier, situated between the A46 and the Village of Winthorpe was included in the investigation. With Option 1, the noise mitigation offers a minor improvement at the closest residential receptors within the village, and a moderate improvement at Brae Barn. With Option 2, the noise mitigation offers a minor improvement close to the A1 and at properties further back from the road, but a moderate improvement at those closest to the road, such as The Spinney and Brae Barn.
- 9.9.121 A 1200 m long and 2 m high environmental noise barrier, situated alongside the old A14 to the north of Newark-on-Trent, was investigated and for Options 1 and 2 a moderate improvement was predicted at the closest receptors.
- 9.9.122 An 80 m long and 3 m high environmental noise barrier, situated alongside the new A616/A617 junction, for Option 1 only, was also investigated. This barrier would offer a minor improvement at the properties on the Great North Road, but would reduce the impact at these properties from major to moderate in the long term.

Comparative assessment

Options 1 and 2

- 9.9.123 A number of potential significant effects were identified for Option 1 due to moderate or major increases in noise, plus minor exceedances above the SOAEL. The assessment of Option 1 predicted that two residential properties would experience a moderate or major increase in noise due to Option 1 in the short term, and three residential properties in the long term. Two of these changes are on Newark Road in the long term only, with the remainder close to the proposed A616 and A617 junction.
- 9.9.124 Option 1 has also identified eight residential properties that are predicted to experience a minor increase in noise in areas with noise levels that exceed the SOAEL, in the long term. These potentially significant effects are mainly as a result of changes in traffic on non-scheme roads in Newark-on-Trent Town Centre.
- 9.9.125 The assessment for Option 1 predicts that 118 properties would experience a minor decrease in noise upon the scheme opening, with no properties experiencing a decrease in the long term. The assessment included low noise surfacing, but did not include any environmental noise barriers or bunds which will be assessed as part of PCF Stage 3.
- 9.9.126 Of the seven NIAs within the noise study area, a minor change in noise was predicted within NIA 7847 and NIA 7846 under Option 1. This change would affect 53 of the properties on Fosse Road in Farndon, in the long term only. Of the remaining locations at Newark-on-Trent, NIA 8220, NIA 7839 and NIA 7840 are predicted to experience a minor benefit at the facades closest to the old A46, with a negligible change predicted at NIA 7838 and the NIA 7834 at Langford.
- 9.9.127 A number of potential significant effects were identified for Option 2 due to moderate or major increases in noise, plus minor exceedances above the SOAEL. The assessment for Option 2 predicted that one residential property would experience a moderate or major increase in noise due to the scheme in the short term, and three residential properties in the long term on Newark Road.
- 9.9.128 Option 2 has also identified 63 residential properties that are predicted to experience a minor increase in noise in areas with noise levels that exceed the SOAEL, in the long term. These potentially significant effects are mainly as a result of changes in traffic on non-scheme roads in Newark-on-Trent Town Centre. In particular, for Option 2, Hawton Road includes 53 potentially significant effects.
- 9.9.129 The assessment for Option 2 predicts that 115 properties would experience a minor decrease in noise upon the scheme opening, with one property experiencing a decrease in the long term. The assessment included low noise surfacing, but did not include any environmental noise barriers or bunds which will be assessed as part of PCF Stage 3.
- 9.9.130 Of the seven NIAs within the noise study area, a minor change in noise was predicted within NIA 7847 and NIA 7846 under Option 2. This change would affect 34 of the properties on Fosse Road in Farndon, for the long term only. Of the remaining locations at Newark-on-Trent, NIA 8220, NIA 7839 and NIA 7840,

and the NIA 7834 at Langford, are predicted a minor benefit at the facades closest to the old A46, with a negligible change predicted at NIA 7838.

- 9.9.131 Overall, both Options 1 and 2 have a similar effect on noise, with both option having the potential to cause significant adverse effects. The main difference between the options is that Option 1 is predicted to cause a potential significant adverse effect close to the proposed A616/A617 junction, whereas Option 2 is predicted to have a potential significant effect on the existing A46 Fosse Road, Winthorpe.
- 9.9.132 Comparing Option 2 with Option 1, it includes more properties that are predicted to experience a potentially significant adverse effect as a result of a minor increase in noise, in areas where noise levels exceed the SOAEL. The majority of these changes were on Hawton Road, where increases in noise were predicted in both options, but only exceeded the threshold for Option 2. Mitigation measures, such as environmental barriers or bunds, have the potential to improve noise at Winthorpe Village, North of Newark-on-Trent (close to the existing A46) and the A616/A617 junction (for Option 1 only).

Option 2 Modified

- 9.9.133 The Option 2 noise model was used as the basis for the assessment of Option 2 Modified.
- 9.9.134 A number of potential significant effects were identified for Option 2 Modified due to moderate or major increases in noise, plus minor exceedances above the SOAEL. The assessment predicted that there would be three residential properties with a moderate or major increase in noise in the long term, these changes are on Newark Road.
- 9.9.135 Option 2 Modified has also identified 63 residential properties that are predicted to experience a minor increase in noise in areas with noise levels that exceed the SOAEL, the long term. Like Options 1 and 2, these potentially significant effects are mainly as a result of changes in traffic on non-scheme roads in Newark-on-Trent Town Centre.
- 9.9.136 The assessment for Option 2 Modified predicts that 121 properties would experience a minor decrease in noise upon the scheme opening, with two properties experiencing a decrease in the long term. The assessment included low noise surfacing, but did not include any environmental noise barriers or bunds.
- 9.9.137 Of the seven NIAs within the noise study area, a minor change in noise was predicted within NIA 7847 and NIA 7846. This change would affect 34 of the properties on Fosse Road in Farndon, in the long term only. Of the remaining locations at Newark-on-Trent, NIA 8220, NIA 7839 and NIA 7840, and the NIA 7834 at Langford, are predicted a minor benefit at the facades closest to the old A46, with a negligible change predicted at NIA 7838.
- 9.9.138 As a result of the scheme moving further from Winthorpe, predictions of noise within Winthorpe are up to 2dB lower with Option 2 Modified compared to Option 2. The largest benefits are at those properties closest to the new A46, such as at The Spinney. The noise level at Brae Barn with Option 2 Modified is at least 6dB lower than with Option 2. At Brae Barn it was predicted that Option 2 could lead

to a moderate increase in noise, a potentially significant adverse effect, whereas Option 2 Modified results in a minor decrease in noise.

- 9.9.139 Comparing Option 2 Modified with Option 1 at The Spinney, predicted noise levels are similar, if not marginally better. The noise level at Brae Barn with Option 2 Modified is predicted to be 0.5dB higher than Option 1, but still a minor benefit.
- 9.9.140 With the Option 2 Modified, it is expected that the only remaining moderate or major increases in noise found in Option 1 or Option 2 would be on Newark Road, and in the long term only.

Summary of findings from TAG Environmental Impact Appraisal for Option 1, Option 2 and Option 2 Modified

- 9.9.141 It was predicted that Option 1 would have a Net Present Value (NPV) of £1,140k, including £860k for sleep disturbance, £90k for amenity, £340k for AMI, -£360k for stroke and -£89k for dementia.
- 9.9.142 It was predicted that Option 2 would have an NPV of £588k, including £620k for sleep disturbance, -£140k for amenity, £310k for AMI, -£80k for stroke and -£120k for dementia.
- 9.9.143 It was predicted that Option 2 Modified would have an NPV of £652k, including £660k for sleep disturbance, -£130k for amenity, £300k for AMI, -£80k for stroke and -£110k for dementia.

1-2 Hybrid Option

- 9.9.144 Near the Great North Road, the 1-2 Hybrid Option is likely to be environmentally better than Option 1 in terms of noise impacts, with those properties that are located close to the new (Option 1) A616 /A617 junction, no longer expected to have a significant adverse effect.
- 9.9.145 Comparing the 1-2 Hybrid Option with Option 1 at properties to the south of the new Cattle Market junction, noise levels are predicted to be marginally higher due to the flyover at the junction. However, the 1-2 Hybrid Option is not likely to be environmentally worse than Option 1 in terms of noise impacts at these properties.
- 9.9.146 At Winthorpe, the 1-2 Hybrid Option would remove the significant adverse effects found in Option 2 at Brae Barn. The 1-2 Hybrid Option layout would also change the magnitude of noise change at The Spinney, in the village of Winthorpe, from minor to negligible.
- 9.9.147 With the 1-2 Hybrid Option it is expected that the only remaining moderate or major increases in noise found in Option 1 or Option 2 would be on Newark Road, and in the long term only. As a result, the 1-2 Hybrid Option is likely to be environmentally better than Option 2 in terms of noise impacts. However, it is expected that there would still be minor increases on roads within Newark Town centre that could lead to potentially significant adverse effects, in areas where noise levels already exceed SOAEL.

Population and Human Health

Summary of approach

- 9.9.148 The population and human health assessment ascertains the likely beneficial and adverse effects of the construction and operation of the scheme, and opportunities for improving health and reducing inequalities.
- 9.9.149 The methodology for the population assessment has followed DMRB LA 112 Population and human health⁴¹ (DMRB LA 112), which sets out the key land use and accessibility considerations. The human health assessment considers the effects of the scheme on both the health of the population likely to be affected by the scheme overall, and the distribution of those impacts within the affected population.
- 9.9.150 In terms of population, Options 1 and 2 have been assessed against the following topics:
- Private property and housing.
 - Community land and assets.
 - Development land and local businesses.
 - Agricultural land holdings.
 - Walkers, cyclists and horse-riders.
- 9.9.151 In terms of human health, Options 1 and 2 have been assessed against the following health determinants:
- Health profiles of the affected communities.
 - Access to community, recreational and educational facilities.
 - Access to healthcare facilities.
 - Access to employment sites.
 - Access to open green space/recreational facilities.
 - Air pollution.
 - Noise pollution and vibration.
 - Sources of pollution (e.g. light, odour, contamination).
 - Landscape amenity.
 - Changes to the existing spatial characteristics of the transport network and usage.
 - Transport user safety.
- 9.9.152 The baseline and community health profile has been established from analysis of local socio-economic, demographic and health data in comparison with subregional and national data.

⁴¹ DMRB, LA 112 Population and Human Health, National Highways, January 2020.

Assessment assumptions and limitations

- 9.9.153 No consultation has been carried with agricultural landowners at PCF Stage 2. Engagement will be required at PCF Stage 3 to assess in detail the impacts of the scheme on farming operations and to refine the proposed mitigation.
- 9.9.154 No user surveys or consultation regarding community land or assets have been undertaken as part of the assessment. This will be included in future stages of assessment, as appropriate.
- 9.9.155 The health statistics used to inform the baseline conditions for human health do not include data on deaths from respiratory diseases or pre-existing health issues such as respiratory disease/chronic obstructive pulmonary disease. Although these data sets were not available to include in the assessment, they do not influence option selection at PCF Stage 2.
- 9.9.156 Whilst it is possible to identify changes to some of the determinants of health likely to arise from the options, health outcomes are dependent on multiple factors, some of which rest with individuals and / or outside the powers or influence of physical infrastructure and / or planning decisions. Identifying health effects of the scheme and their significance is therefore a qualitative exercise.

Summary of design, mitigation and enhancement measures

- 9.9.157 Land-take from private dwellings and sites allocated for development or benefitting from planning permission should be avoided or minimised where possible.
- 9.9.158 A clear and consistent signage strategy would be designed to direct users of footpaths and cycleways along diversions during construction. Signage and traffic management will guide road users during construction. These measures will ensure safe access to community, recreational facilities and businesses is maintained.
- 9.9.159 During the operational phase clear lighting and signage provision, as well as appropriate walking, cycling and horse-riding crossing facilities, should reduce the fear of accidents and the extent to which accidents occur.
- 9.9.160 The proposed pedestrian/cycle underpass linking Winthorpe Road and Gainsborough Road should be fully accessible for all users and should be equipped with appropriate lighting and CCTV infrastructure in order to maintain and encourage its safe use, particularly at night.

Comparative assessment

Options 1 and 2

- 9.9.161 Once operational, Options 1 and 2 will reduce congestion thereby improving access for existing residents. Residents in Winthorpe and Newark-on-Trent are likely to experience increased ease of access to open space, recreational facilities, healthcare facilities and employment sites. A positive health outcome is predicted. Increased traffic flow during the operational phase may result in decreased amenity for users of the PRoW due to increased noise. This may result in a negative health outcome.

- 9.9.162 The stopping up of the PRow to the north of the Friendly Farmer roundabout will permanently increase community severance for Winthorpe residents seeking to access facilities and services in Newark-on-Trent under Options 1 and 2. The proposed diversion of the A617 in Option 1 will involve land take from the eastern section of Newark Rugby Club. However, Option 1 will improve access to community land and assets by alleviating congestion on the A46.
- 9.9.163 The PRow to the east of the Friendly Farmer roundabout has already been severed by the existing A46 and thus there is no PRow across the A46 in this location. However, in the vicinity of this PRow there are gaps in the barrier within the central reserve. These gaps mean that it is physically possible for pedestrians from Winthorpe to cross the A46 to access Newark Showground and Newark itself. Without mitigation, the effect on the users is assessed as significant for both options.
- 9.9.164 Construction of Option 1 will result in the permanent land take and demolition of the fuel station and the restaurant adjacent to the northeast bound carriageway of the A46 beyond the Friendly Farmer roundabout. The adverse effect would be significant. The reduction in congestion at junctions within Option 1 will improve access to businesses and development land.
- 9.9.165 The proposed route for Option 2 will encroach on to the grounds of the property at Brae Barn, Hargon Lane. The effect would be significant. The implementation of noise mitigation measures into the scheme design in proximity to this property would reduce the residual effect to slight adverse, which would not be significant.
- 9.9.166 Agricultural land-take for Option 1 would be around 12.5 ha and 17.25 ha for Option 2. From Farndon to Cattle Market junction (and east of Winthorpe for Option 1) the land-take is beside the existing A46 carriageway. Option 1 crosses open countryside on diverted A617 link road and east and west of the A1, south of Winthorpe. Farm vehicles will be able to cross the diverted A617 link road so no land will be permanently severed by this Option 1. Option 2 crosses open countryside east and west of the A1, and 3.5 ha of farmland is permanently severed between the old and new carriageway between the filling station and Winthorpe roundabout, the residual effect is assessed as moderate adverse.
- 9.9.167 The Trent Valley Way long distance path and the National Cycle Network Route Number 64 will be temporarily stopped up by Options 1 and 2. The resultant effect on the users is assessed as significant for both options.
- 9.9.168 Under Option 1 the signalised junctions proposed at Farndon, Cattle Market and Winthorpe roundabouts will improve crossing provision for walkers, cyclists and horse-riders. The resultant beneficial effect is significant. Under Option 2 the altered junctions proposed at Farndon, Cattle Market and Winthorpe roundabouts will improve crossing provision for walkers, cyclists and horse-riders at these junctions. The resultant beneficial effect is assessed as significant.
- 9.9.169 Under Option 2, a negative health outcome has been identified for residents to the south of Winthorpe, at the Spinney, due to the proximity of the revised route of the A46 to the residential properties located there. A negative health outcome is predicted to endure, even with mitigation measures implemented during operation of the option. A negative health outcome has also been identified for residents of the properties on Hargon Lane (Brae Barn and Pine Cottage) due to a combination of noise, visual and air quality effects. A negative health outcome

is predicted to endure, even with mitigation measures implemented during operation of the option.

9.9.170 The following comparison summaries can be made for Options 1 and 2:

- Relating to private property and housing, Option 1 is environmentally better due to Option 2 encroaching on to the grounds of the property at Brae Barn, Hargon Lane.
- Option 1 will result in the partial land take of the eastern section of Newark Rugby Club so this option is environmentally worse in terms of community land and assets.
- Option 2 is environmentally better in terms of development land and businesses due to the proposed route of Option 1 resulting in the permanent land take and demolition of the fuel station and the restaurant adjacent to the northeast bound carriageway of A46 beyond the Friendly Farmer roundabout
- In terms of agricultural land holdings, the loss of agricultural land is significant for both Options 1 and 2. Option 2 will involve the loss of 7.5 ha more land than Option 1 and so is the least favourable.
- The walking, cycling and horse-riding assessment concludes that there is little to distinguish in terms of severance from PRow and affected journey lengths for each option. However, Option 1 would result in one further significant adverse effect than Option 2, so Option 2 is environmentally better.
- Once operational, both Options 1 and 2 are considered to increase ease of movement when accessing open space/recreational facilities, employment sites and the wider transport network.
- Option 1 is environmentally better to Option 2 due to the anticipated permanent negative health outcome of Option 2 for residents of Brae Barn, Pine Cottage and The Spinney.

9.9.171 Overall, Option 1 is environmentally better from a Population and Human Health perspective.

Option 2 Modified

9.9.172 With respect to private property and housing, Option 1 and Option 2 Modified are environmentally better in comparison to Option 2 because the latter encroaches on to the grounds of the property at Brae Barn, Hargon Lane.

9.9.173 Option 1 will result in the partial land take of the eastern section of Newark Rugby Club, so in terms of community land and assets, Option 2 and Option 2 Modified are environmentally better than Option 1.

9.9.174 Option 2 is environmentally better in terms of development land and businesses because the proposed routes of Option 1 and Option 2 Modified result in the permanent land take and demolition of the fuel station and the restaurant adjacent to the northeast bound carriageway of A46 beyond the Friendly Farmer roundabout

9.9.175 The effects of Options 1 and 2 on agricultural land holdings are assessed as significant. Land-take under the Option 2 Modified is 11.25 ha, which is less than

Option 1 (12.5 ha) and Option 2 (17.25) and there is no permanent severance. The effect is assessed as not significant and so this option is the least damaging to agricultural land holdings.

- 9.9.176 Once operational, Option 1, Option 2 and Option 2 Modified are considered to increase ease of movement when accessing open space/recreational facilities, employment sites and the wider transport network.
- 9.9.177 Option 1 and Option 2 Modified are environmentally better from a physical health perspective, due to the permanent negative health outcome of Option 2 at Brae Barn and Pine Cottage.
- 9.9.178 Option 1 and Option 2 Modified are environmentally better in comparison with Option 2 from an amenity perspective. This is because the proximity of the proposed route of Option 2 adversely affects the current relative tranquillity at Brae Barn which in turn gives rise to a negative health outcome. When compared to Option 2, the proposed route of Option 2 Modified runs further south from the properties at The Spinney. This is likely to reduce any adverse health outcomes as a result of changes to amenity effects.
- 9.9.179 Overall, Option 2 Modified is environmentally better from a Population and Human Health perspective.

1-2 Hybrid Option

- 9.9.180 With respect to private property and housing, Option 2 is environmentally worse as it encroaches on to the grounds of the property at Brae Barn, Hargon Lane. The 1-2 Hybrid Option avoids land take at Brae Barn so is environmentally better than Option 2.
- 9.9.181 Option 1 will result in the partial land take of the eastern section of Newark Rugby Club, so this is environmentally worse in terms of community land and assets. The 1-2 Hybrid Option avoids land take at Newark Rugby Club so is better than Option 1 in this regard.
- 9.9.182 Construction of the 1-2 Hybrid Option will result in the permanent land take and demolition of the fuel station and the restaurant adjacent to the northeast bound carriageway of the A46 beyond the Friendly Farmer roundabout. Therefore, in terms of businesses, the 1-2 Hybrid Option is environmentally worse than Option 2, which avoids the fuel station and the restaurant.
- 9.9.183 Agricultural land-take for the 1-2 Hybrid Option would be around 10 ha. From Farndon to Cattle Market junction and east of Winthorpe the land-take is beside the existing A46 carriageway. The option only crosses open countryside just east and west of the A1, and there is no permanent severance. There is no mitigation for land-take apart from financial compensation which is outside the scope of an environmental assessment. With no permanent severance and most land-take beside the existing A46 the effect of this option is not significant. This option takes the least agricultural land (10 ha) and so is assessed as the least damaging to agricultural land holdings, compared to Option 1 (12.5 ha), Option 2 (17.25 ha) and Option 2 Modified (11.25 ha).
- 9.9.184 Once operational, the 1-2 Hybrid Option is considered to increase ease of movement when accessing open space/recreational facilities, employment sites

and the wider transport network. In this regard, the 1-2 Hybrid Option is equal to Option 1, Option 2 and Option 2 Modified.

- 9.9.185 Overall, the 1-2 Hybrid Option, Option 1 and Option 2 Modified are environmentally better than Option 2 from a physical health perspective, due to the permanent negative health outcome of Option 2 at Brae Barn.

Road Drainage and the Water Environment

Summary of approach

- 9.9.186 DMRB LA 104 and DMRB LA 113 Road drainage and the water environment⁴² (DMRB LA 113) have been used to establish the potential impacts on surface water (quality and hydromorphology), groundwater (quality, levels and flows), flood risk and Groundwater dependent terrestrial ecosystems (GWDTEs).
- 9.9.187 A preliminary WFD compliance assessment has also been produced in line with DMRB LA 113 to:
- Review the proposed works for each option against the requirement of the WFD.
 - Develop a set of principles that will guide later design phases towards compliance with the directive.
 - Consider what further information is required to complete a more detailed WFD compliance assessment.

Floodplain Compensation

- 9.9.188 Floodplain storage compensation is a requirement of the scheme irrespective of the option selected at PCF Stage 2 to mitigate any development within the floodplain that involves ground raising or potential displacement of flood water downstream.
- 9.9.189 The potential storage required to mitigate changes in flood risk due to the scheme has been calculated at PCF Stage 2 using water elevations for the 1% annual exceedance probability (AEP) inclusive of 50% climate change (2080 upper end allowance) to demonstrate that flood compensation requirement could be provided for the scheme.
- 9.9.190 This climate change allowance has been used as it meets the sensitivity requirements of the DMRB LA 113, floodplain compensation requirement of NPPF, and CIRIA C624 Development and flood Risk – Guidance for the Construction Industry. It was also considered at this early stage of the project that this precautionary upper end allowance should be utilised over the lowest level of requirement of central allowance of 20%.
- 9.9.191 An additional 10% allowance has also been included for surface water and temporary works which are yet to be determined.
- 9.9.192 It is noted that floodplain storage compensation will be required to mitigate any development within the floodplain that involves ground raising or potential displacement of flood water downstream. A FCA study has been undertaken to

⁴² DMRB, LA 113 Road drainage and the water environment, National Highways, March 2020.

investigate the potential direct compensatory storage required to mitigate changes in flood risk due to the scheme.

- 9.9.193 This established that there are very few suitable locations for compensation which fulfil the flood risk requirements (level for level), which are in close proximity to the losses in floodplain and which can naturally fill and empty without engineered structures (other than an additional culvert).
- 9.9.194 A number of potential locations for flood compensation have been identified taking into consideration environmental constraints (see Environmental Constraints Plan in Appendix A), and other factors including the extent of Flood Zone 2 and location outside the floodplain, landform, and proximity of existing development and infrastructure. These potential locations have been excluded from the EIA reported in the PCF Stage 2 Environmental Assessment Report (EAR) as they have been identified with view to demonstrating that irrespective of the option selected at PCF Stage 2 the flood compensation requirement can be provided for the scheme.
- 9.9.195 At PCF 3, the potential locations of FCA will be optimised with further consideration of the environmental constraints and potential opportunities for enhanced environmental outcomes at PCF Stage 3 Preliminary Design as part of the scheme development resulting in the identification of a preferred FCA (or FCAs). It is noted that it is possible that additional environmental receptors will be identified as part of this process at PCF Stage 3 either through desk study or site survey that would need to be considered to determine the impact of the scheme on the receiving environment. These include but not limited to unknown heritage assets, visual receptors, priority habitats, protected and priority species, farmland assemblages of birds, agricultural land and farm holdings, and cumulative effects. Once identified, the preferred solution will form part of the PCF Stage 3 EIA for the scheme and will be reported in the PCF Stage 3 Environmental Statement (ES).
- 9.9.196 It is noted that consultation with the Environment Agency is progressing to determine if the climate change central or upper allowance should be used to inform the calculations in PCF Stage 3. EA have advised that updates to climate change guidance in 2021 could impact on the calculation of the flood compensation requirement and scheme design as it is developed as part of PCF Stage 3.

Assessment assumptions and limitations

- 9.9.197 Due to the absence of specific quantitative data, water quality assessments using the National Highways Water Risk Assessment Tool have not been undertaken. At PCF Stage 3 the data required to complete the assessments using this tool will be available which means the assessment can be refined.
- 9.9.198 At PCF Stage 3 detailed flood risk modelling will be completed and the result can be used to refine the assessment of impacts on flood risk.
- 9.9.199 At this stage of the assessment a detailed Flood Risk Assessment has not been completed. This will be completed in PCF Stage 3 using the latest climate change allowances published by the relevant authority.
- 9.9.200 The importance criteria for watercourses which is documented in DRMB LA 113 Table 3.70 is based on WFD classification and Q₉₅ flow. However, Q₉₅ flow data

were not readily available for a number of the watercourses located in the study area. Where Q_{95} flow data were not readily available an assumption has been made based on professional judgement. At PCF Stage 3 actual Q_{95} flow data should be sought for all watercourses in the study area and the importance assigned to each watercourse reviewed and amended as necessary.

- 9.9.201 Potential effects on hydromorphology have been assessed based on desk study information (as obtained from WFD classification data and local mapping) and observations from a site walkover undertaken in PCF Stage 1 on 15 and 17 July 2019. Various locations within the survey area were not able to be accessed as landowners had not granted permission, however each of the watercourses within both option footprints were visited in at least one location. Further survey may be required at PCF Stage 3 at specific locations to update the baseline.

Summary of design, mitigation and enhancement measures

- 9.9.202 Essential mitigation measures for the scheme that will be developed during PCF Stage 3 are likely to include but is not limited to the following:

Surface water and groundwater

- Adopting good working practices to mitigate the risk of pollution. This measure also applies to groundwater.
- Bunding areas which generate contaminated water and ensuring they have water discharged to self-contained units with treatment facilities. This measure also applies to groundwater.
- Undertaking tests to ensure contaminated material is identified, isolated and reworked or removed to special landfill to avoid any leachate problems. This measure also applies to groundwater.
- Limiting in-channel working as much as possible, with work being undertaken from the bank top. If in-channel working is required, specific mitigation may be needed to ensure that temporary impacts are minimised.
- Minimising riparian vegetation removal and leaving tree root balls in place, where possible, to aid bank stability.
- Preparing a piling risk assessment to assess and manage the potential risk to controlled waters in accordance with Environment Agency guidance.

Flood risk

- Minimising floodplain working and locating compounds outside of Flood Zones 2 and 3 as far as possible.
- Requiring a temporary Flood Risk Activity Permit or Ordinary Watercourse Consent from the Environment Agency and/or Internal Drainage Board (IDB)/Lead Local Flood Authority (LLFA). This would need to demonstrate method statements, working practices and control measures that are suited to the sensitive location of the works. The Permit/Consent would also control any stockpiling of material, which should avoid floodplain areas where possible.

- Requiring the appropriate consent from the EA and IDB/LFA for temporary outfalls, temporary diversions of a watercourse or culverting of a watercourse and ensuring these activities do not increase flood risk to third parties.
- Ensuring appropriate management of sediment runoff from the site to reduce risk of blockage in existing structures downstream of temporary outfalls.
- Ensuring any ponds constructed to hold water to manage sediment are constructed and/or located to avoid the risk of flooding watercourses or adjacent land in the event of overtopping or a breach.
- Developing Flood Preparedness Plans where necessary to ensure the development site is safe operationally and that operational activities do not detrimentally impact flooding in the event of a flood. These should be informed by the EA Flood Warning system.
- Ensuring temporary watercourse crossings are designed to minimise flood risk impacts on site and eliminate flood risk impacts off site.
- Ensuring temporary land-take required for construction includes adequate areas of land set aside for robust control measures such as sustainable drainage control.
- Ensuring temporary FCA are put in place in advance of any earthworks resulting in loss of floodplain.
- Incorporating sustainable drainage systems, where ground conditions allow, with the aim of returning groundwater to its source. Other mitigation may need to be considered to maintain groundwater levels.
- Ensuring construction work which has drainage implications, the proposed drainage system should comply with the National Standards, such as Schedule 3 under the Flood and Water Management Act 2010. In addition, any consent and associated planning obligations, would need to make provision for the adoption and maintenance of any permanent Sustainable Urban Drainage Systems, including any necessary access rights to property.

9.9.203 Embedded mitigation measures to manage surface water, flood risk and water-dependant designated sites as part of the scheme design will be developed as part of the PCF Stage 3.

Comparative assessment

Options 1 and 2

9.9.204 Options 1 and 2 are very similar and therefore have similar potential adverse effects on the water environment during the construction and operation.

9.9.205 Both options have the same number of watercourse crossings. The type of watercourse crossings (bridge or culvert) proposed for each option are the same. However, during construction, impacts on the water environment would be slightly greater for Option 1 compared to Option 2. This is because Option 1 requires a longer culvert extension for Winthorpe Beck, which would mean hydromorphology impacts are potentially greater. In addition, Option 1 includes more features, which require deep foundations which would potentially mean impacts on groundwater quality, flow and levels are greater.

- 9.9.206 During operation, impacts on the water environment would also be slightly greater for Option 1 compared to Option 2. This is because Option 1 has a greater increase in impermeable road area due to the additional works on the Great North Road (A616) and Kelham Road (A617) at Cattle Market junction. This would increase the volume of road runoff entering watercourses and/or groundwater, potentially causing a deterioration in water quality and increasing flood risk. The works on the Great North Road (A616) and Kelham Road (A617) at Cattle Market junction also means Option 1 has a larger encroachment into the floodplain compared to Option 2, meaning Option 1 would require more floodplain storage compensation. Also, because Option 1 requires a longer culvert for Winthorpe Beck hydromorphology impacts on watercourses (e.g. on-going shading of the watercourse resulting in habitat depletion) would be greater for Option 1 compared to Option 2.
- 9.9.207 It should be possible to mitigate, compensate or offset all the adverse effects for both options, but the level of mitigation required to ensure adverse effect are not significant would be greater for Option 1 compared to Option 2.
- 9.9.208 Overall, from a water environment perspective Option 2 would have the least adverse effect and requires less mitigation, compensation and offsetting to ensure all adverse effects are not significant.

Option 2 Modified

- 9.9.209 Option 1, Option 2 and Option 2 Modified are very similar and therefore have similar adverse effects on the water environment during the construction and operation phases.
- 9.9.210 All options have the same number of watercourse crossings and the type of watercourse crossings (bridge or culvert) proposed for each option are the same. However, during construction impacts on the water environment would be slightly greater for Option 1 compared to Option 2 and Option 2 Modified due to the longer culvert extension for Winthorpe Beck, which would mean hydromorphology impacts would be potentially greater. Also, Option 1 would still have the greatest likely impacts on groundwater quality, flow and levels as it includes more features which require deep foundations.
- 9.9.211 During operation, impacts on the water environment would also be slightly greater for Option 1 compared to Option 2 and Option 2 Modified. Option 2 has a slightly larger increase in hard standing area compared to Option 2 Modified due to the Option 2 Modified making use of the existing A46 eastbound carriageway between Friendly Farmer roundabout and Winthorpe roundabout.
- 9.9.212 The volume of floodplain storage compensation required for Option 2 and Option 2 Modified would be similar.
- 9.9.213 It is anticipated that all adverse effects from Option 2 Modified can be mitigated, compensated or offset for, like Options 1 and 2. However, the level of mitigation, compensation or offsetting required to ensure adverse effects are not significant would be greater for Option 1 compared to Option 2 and Option 2 Modified. Option 2 and Option 2 Modified would require a similar level of mitigation, compensation and offsetting.

9.9.214 Overall, from a water environment perspective Option 2 Modified would have the least adverse effect due to a smaller increase in hard standing area, followed by Option 2 and then Option 1.

Summary of findings from TAG Environmental Impact Appraisal for Option 1, Option 2 and Option 2 Modified

9.9.215 A TAG Environmental Impact Appraisal has been undertaken which considered Options 1, 2 and 2 modified. The summary assessment score for each option (with mitigation) is:

- Option 1: neutral.
- Option 2: neutral.
- Option 2 Modified: neutral.

9.9.216 All options would result in similar effects overall on water quality (surface and ground), hydromorphology, flood risk and groundwater levels and flows. If mitigation, compensation and offsetting is applied all effects can be reduced to neutral.

1-2 Hybrid Option

9.9.217 Like all the other options, the 1-2 Hybrid Option involves eight watercourse crossings. The types of crossings proposed (bridge or culvert) for this option are the same as the other options. The construction of new crossings or modification of existing crossing structures could potentially result in adverse effects on hydromorphology. Like Option 1, the 1-2 Hybrid Option would involve a longer culvert extension for Winthorpe Beck compared to Option 2 because of the additional works linking the Friendly Farmer roundabout to the new section of A46, which would result in a greater adverse effect compared to Option 2 and Option 2 Modified.

9.9.218 Like all other options, the 1-2 Hybrid Option would result in the potential loss of watercourses (particularly around Cattle Market junction) and would involve construction works within the floodplain.

9.9.219 Features which require deep foundations would need to be constructed for the 1-2 Hybrid Option. It would include the main grade separated structures from Options 1 and 2. Therefore, in terms of impacts on groundwater quality, flow and levels, this option would potentially have a more adverse impact on groundwater than Option 1, Option 2 and Option 2 Modified.

9.9.220 The 1-2 Hybrid Option has less new road area compared to Options 1 and 2 due to there being no additional works on the Great North Road (A616) and Kelham Road (A617) and due to the option re-joining the existing A46 once it has crossed over the A1. Therefore, the volume of road runoff discharged to watercourses and/or groundwater would be less for this option, which would mean potentially a less adverse effect on water quality (surface water and groundwater). The area of new road compared to Option 2 Modified is very similar.

9.9.221 If any of the structures which require deep foundations were to intercept the water table, there could potentially be a localised impact on groundwater levels and flow direction. As the 1-2 Hybrid Option potentially includes more structures

requiring deep foundations compared to Options 1, Option 2 and Option 2 Modified, the impact would be worse.

- 9.9.222 Like all other options, the 1-2 Hybrid Option has potential for morphological changes to watercourses with ongoing effects as a result of new watercourse crossings, which have been constructed or existing crossings that have been modified. As this option includes a longer culvert at Winthorpe Beck, the impacts are potentially going to be greater compared to Option 2 and Option 2 Modified but the same as Option 1.
- 9.9.223 The 1-2 Hybrid Option encroaches into Flood Zones 2 and 3 and as a result there is the potential for an increase in flood risk. Compared to the other options, this option encroaches into the Flood Zones a similar amount to Option 2 and Option 2 Modified, but less than Option 1. This means the impact on flood risk would be less for this option compared to Option 1, and similar to Option 2 and Option 2 Modified.
- 9.9.224 It is anticipated that the potential adverse effects can be mitigated but the level of mitigation, required to ensure adverse effects are not significant for the 1-2 Hybrid Option would be potentially greater compared to the other options.

Climate Effects

Summary of approach

- 9.9.225 The climate effects assessment estimates the scale and nature of GHG emissions during the construction and operation stages of the project life cycle, for each of the options in compliance with DMRB LA 114 Climate⁴³ (DMRB LA 114).
- 9.9.226 For the construction phase, a substantial proportion of emissions typically come from the extraction, processing and transport of key bulk materials which are required in large quantities (for example aggregates, asphalt and concrete). With high-level materials data available, we assess the quantity of GHG emissions, denominated in CO₂e amounts, for each material through a carbon factor which identifies the emissions intensity for each material. This is calculated using National Highways' Carbon Tool.
- 9.9.227 For the operational phase, road user emissions were calculated for the Opening Year and Design Year as specified by DMRB LA 114, using the best available assumptions about how future fleets will be composed from the Emissions Facts Toolkit (v10) provided by Defra. Carbon factors are applied in a similar way, to evaluate the GHG emissions from each vehicle-kilometre expected due to the scheme, for each type of vehicle expected to be using the scheme. These emissions have been modelled in accordance with the DMRB LA 105.
- 9.9.228 For other emissions arising from supporting operation of the scheme, such as maintenance and refurbishment, a proportional approach has been taken based on published data regarding other highway improvement schemes⁴⁴.
- 9.9.229 The assessment of significance is based on whether emissions from the construction and operation of the options is likely to materially affect the UK

⁴³ DMRB, LA 114 Climate, National Highways, October 2019.

⁴⁴ Welsh Government (2016). M4 Corridor around Newport, Environmental Statement: Volume 3, Appendix 2.4 Carbon Report

Government's ability to meet its carbon reduction targets, as set out in its carbon budgets. This considers the policy set out in the NPS NN.

Assessment assumptions and limitations

- 9.9.230 To provide a conservative assessment, it has been assumed that no cut material can be reused onsite and will instead be sent to landfill. There is an opportunity to refine this during PCF Stage 3, and the climate effects will be adjusted in accordance with the proportion of cut material that can be re-used within the scheme.
- 9.9.231 Due to lack of information at this early stage of the scheme design, we have not been able to assess:
- Construction process stage (including transport of workers to/from works site).
 - Land use change during construction.
 - Land use during operation.
 - Avoided GHG emissions from the potential recovery, reuse and recycling of materials.
 - Potential benefits and loads of additional functions associated with the study system.
- 9.9.232 The Defra emission factors used for the operational assessment contain projections for low-emissions vehicles, which do not currently account for government commitments to changes in fleet makeup, for example the phasing out of conventional fuel cars and vans by 2030. This means that the assessment is likely to lead to an overestimation in operational emissions. For the operational assessment, the study area is all roads within the Traffic Reliability Area (TRA). The ARN is within the TRA.
- 9.9.233 As the assessment is currently only informed by a partial construction dataset, this does not represent the total contribution the scheme will make to the fourth carbon budget and as such the results should be treated as an underestimation of emissions. A full quantitative assessment will be carried out at PCF Stage 3.

Summary of design, mitigation and enhancement measures

- 9.9.234 Design and mitigation should be carried out in line with DMRB LA 114, which uses the principles set out in PAS 2080:2016 'Carbon Management in Infrastructure'. DMRB LA 114 states that: '*Projects shall seek to minimise carbon emissions in all cases to contribute to the UK's target for net reduction in carbon emissions*'.
- 9.9.235 Emissions should be mitigated by applying the carbon reduction hierarchy set out in DMRB LA 114: Avoid / Prevent, Reduce, Remediate.
- 9.9.236 If the scheme wishes to achieve Net Zero carbon emissions, offsetting of residual emissions would be required, either through on-site measures or third-party projects. The non-exhaustive list of measures to be taken forward for consideration at PCF Stage 3 include:

- Maximise vegetation cover to enhance carbon sequestration. Give careful thought to the species selected, as sequestration rates vary, and also to how vegetation will be managed on an ongoing basis. Vegetation which requires frequent intervention (grass cutting, hedge trimming) may generate more emissions than it sequesters.
- Install renewable energy technologies which exceed the consumption requirements of the scheme and feed into the National Grid to offset emissions.
- Once opportunity to sequester GHG emissions within the development boundary has been maximised, consideration may need to be given to financing third-party projects. Approaches may include collaboration with organisations such as the local Wildlife Trust, nature partnerships and other groups trying to achieve similar goals, to support local projects by incorporating them into the development; green funds and external offsets may also be considered.

Comparative assessment

Options 1 and 2

- 9.9.237 Option 1 would result in 47,544 tonnes CO₂e emissions from the construction phase, contributing 0.0024% to the fourth carbon budget. Option 2 would result in 49,972 tonnes CO₂e emissions from the construction phase, contributing 0.0026% to the fourth carbon budget advised by the Committee on Climate Change and defined in legislation.
- 9.9.238 For Option 1, operation in the Opening and Design Years respectively would generate 9,781 and 11,864 tonnes CO₂e emissions, contributing 0.0028% to the fifth carbon budget. Option 1 is therefore unlikely to generate a significant effect on climate.
- 9.9.239 For Option 2, operation in the Opening and Design Years respectively would generate 10,411 and 10,261 tonnes CO₂e emissions, contributing 0.0030% to the fifth carbon budget. This is similar to Option 1 in terms of the magnitude of its impact on the climate.
- 9.9.240 All emissions represent a small proportion of their carbon budgets, and so are unlikely to materially affect the UK meeting its carbon budgets. This is in line with the position set out in the NPS NN (paragraph 5.17): *'It is very unlikely that the impact of a road project will, in isolation, affect the ability of Government to meet its carbon reduction plan targets.'* Therefore, neither option is considered likely to have a significant effect on climate, and both options have similar scope of mitigation of GHG emissions during design and construction.

Option 2 Modified and 1-2 Hybrid Option

- 9.9.241 A quantitative assessment of GHG has not been carried out for Option 2 Modified or the 1-2 Hybrid Option. However, based on the conclusions of the assessment for Options 1 and 2, and the policy set out in the NPS NN, it is unlikely that either option would be environmentally worse or better than Options 1 and 2.

Vulnerability to Climate Change

Summary of approach

- 9.9.242 It is important to understand the current climate with regard to modelled projections of how it might change in the future. Where the climate change impact on project receptors is potentially significant, a risk assessment has been undertaken in the PCF 2 Stage 2 EIA of Options 1 and 2 in line with DMRB LA 114.
- 9.9.243 Baseline climate conditions have been examined for the period 1981 to 2010, using regional historical weather data provided by the Met Office.
- 9.9.244 Climate projections from the Met Office (UKCP18) were used to understand possible future changes to the climate in the vicinity of the scheme.

Assessment assumptions and limitations

- 9.9.245 The UKCP18 projections do not provide a single precise prediction of how weather and climate will change years into the future. Instead UKCP18 provides ranges that aim to capture a spread of possible climate responses. This better represents the uncertainty of climate prediction science. It should also be noted that the level of uncertainty of the projections is dependent on the climate variable, for example, there is greater confidence around changes in temperature than there is in wind.
- 9.9.246 The climate vulnerability assessment is based on data from the Relative Concentration Pathway (RCP) 8.5. This is a greenhouse gas concentration trajectory under which it is assumed that emissions continue to rise throughout the 21st century. There is considerable uncertainty regarding if, how far and how quickly emissions will be reduced in the future. Using RCP8.5 represents a conservative position.
- 9.9.247 Other key caveats and limitations of UKCP18 data are presented on the Met Office website⁴⁵.

Summary of design, mitigation and enhancement measures

- 9.9.248 The scheme will implement a wide range of climate vulnerability mitigation measures. They primarily include design adaptations (embedded mitigation), such as the inclusion of a climate change allowance in the selection of the design storm size that the drainage infrastructure will be built to withstand. These will be developed during PCF Stage 3.

Comparative assessment

- 9.9.249 Without a detailed assessment, that would require design information that is not currently available, it is not possible to assess the potential impacts in a way that enables differentiation of the climate vulnerability between Options 1 and 2, Option 2 Modified and 1-2 Hybrid Option. Any variations in climate vulnerability between the different options, that a detailed assessment would produce, are expected to be small and after mitigation they would likely all be classified as not significant.

⁴⁵ www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-guidance---caveats-and-limitations.pdf

9.9.250 Each of the options comprises a similar set of new assets, which would be built using similar construction methods. For each option the construction and operation of these assets would generate broadly similar types of environmental impact. With regard to climate vulnerability, there are two key differences between the options.

Location

9.9.251 Each option is in a different location. This could affect climate vulnerability by altering the scheme's climate exposure and the proximity of receptors to climate impacts. The relatively small distances between the options, compared to the larger scale at which climate varies, means that the location differences would be unlikely to generate different assessment outcomes. That isn't to say that the different locations would not generate significantly different exposures of the new assets to climate impacts.

9.9.252 Of greater relevance is the varying proximity of receptors between the options. In particular, some options are closer than others to watercourses and areas at risk of flooding. The significance of these variations is picked up in detail by other environmental topic assessments but is relevant here as some related impacts could be enhanced by climate change. The wide range of potential design mitigation options available means that, after mitigation, the differences in the impacts between the options that varying proximities to receptors would cause, is not expected to generate any significant climate vulnerability impacts.

Scale

9.9.253 There is also variation between the options with regard to their scale, specifically their length. From a climate vulnerability perspective, this would be most relevant with regard to the different surface water runoff quantities that each option would generate and how impacts associated with these, e.g. effecting flood risk or the water environment, could vary in the future because of climate change. However, because the variations in length between the options are small in comparison to the total length of the scheme, and there are a wide range of design mitigation options available for surface water related impacts, a detailed climate vulnerability assessment would be unlikely to differentiate between the options based on their scale.

9.9.254 Therefore, after mitigation, the differences in vulnerability impacts between the options that were generated by scale variations are not expected to generate significant climate vulnerability impacts.

Cumulative Effects

Summary of approach

9.9.255 In-combination effects are a combination of environmental effects within the same project on a single resource or receptor. Cumulative effects occur as a result of the combined action of a number of different projects cumulatively with the project being assessed on a single resource or receptor. Both types of effect have been assessed in this instance.

- 9.9.256 The principle of the cumulative effects assessment is based on the four-stage assessment, as outlined in Advice Note 17: Cumulative effects assessment relevant to nationally significant infrastructure projects:
- Stage 1: Establish the scheme's Zone of Influence (ZOI) and Long List of 'Other Development'.
 - Stage 2: Identify Shortlist of 'Other Development' – apply threshold criteria based on temporal scope, the scale and nature of other development and any other relevant factors to assist in deciding whether to include or exclude 'other development'.
 - Stage 3: Information Gathering – compile detailed information on the 'other development' shortlisted, including proposed design and location, programme of construction, operation and decommissioning and environmental assessment information.
 - Stage 4: Assessment – assess the cumulative effects of the scheme with the 'other development' based on factors including duration of effect, extent of effect, type of effect, frequency of the effect, value and resilience of receptors and likely success of mitigation.
- 9.9.257 The committed developments have been captured in the traffic modelling, therefore any cumulative environmental effects arising from changes in operational traffic (air quality and noise) will already be factored into those assessments.

Assessment assumptions and limitations

- 9.9.258 The absence of detailed information on construction traffic for the scheme at this stage and detailed information on other committed development is a limiting factor in assessing any associated cumulative effects.
- 9.9.259 It has been assumed that for all options, and in the event that the respective construction phases coincide, the cumulative effects from traffic could be mitigated.

Summary of design, mitigation and enhancement measures

- 9.9.260 During the construction and operation of the scheme and the identified committed developments, it is expected that potential changes in hydrology will be effectively managed through appropriate construction methods and appropriate environmental design measures to comply with relevant legislation.
- 9.9.261 The potential cumulative effects of light disturbance are expected to be mitigated through sensitive lighting designs that avoid light spillage on important otter and bat habitat.
- 9.9.262 The potential cumulative effects of collision mortality on otter are expected to be mitigated through good practice bridge design and the use of mammal ledges.
- 9.9.263 The risk of collision mortality on bats would be expected to be effectively mitigated through appropriate environmental design and landscaping.
- 9.9.264 Mitigation measures that would help offset cumulative landscape and visual impact would include, for example; retaining vegetation wherever possible, implementing elements into early design to help offset the landscape and visual

impacts and developing a landscape strategy that is responsive to the local landscape character through retention and enhancement of key landscape features.

Comparative assessment

Options 1 and 2

- 9.9.265 Options 1 and 2 are likely to have in-combination effects on Grade II* Listed Buildings and on Winthorpe Conservation Area by impacting the heritage resource and through changes to the landscape.
- 9.9.266 The Sustainable Urban Extension (SUE) to the south of Newark-on-Trent will take around 70 ha of BMV agricultural land. The SUE, combined with the loss of BMV land in Option 1, would bring the cumulative loss to well over Natural England's 20 ha significance threshold for both Options 1 and 2.
- 9.9.267 There is the potential for both options and the SUE to have landscape or visual cumulative effects. During construction, plant/traffic noise and movements will have an effect. The loss of trees, hedgerows and farmland will result in cumulative effects on landscape pattern and scale and on land-use.
- 9.9.268 During operation, built form of an urban nature, infrastructure and traffic will be present across largely rural areas. This will result in cumulative effects on character and visual amenity due to urbanisation for both options. Taking into consideration mitigation and enhancement measures, the overall effects would be judged to be of moderate significance.
- 9.9.269 Changes in hydrology from construction or operation of the scheme in combination with identified committed developments could occur. This is likely to have significant effects on designated nature conservation sites, priority habitats and watercourses.
- 9.9.270 Intra-scheme effects associated with both options include combined effects from climate change projections of:
- Heavy rain and wetter winters.
 - Drier summers and hotter summers.
 - Warmer winters and reduced snow.
- 9.9.271 Overall, the in-combination and cumulative effects are very similar for Options 1 and 2 and should not influence option selection.

Option 2 Modified and 1-2 Hybrid Option

- 9.9.272 The in-combination and cumulative effects of Option 2 Modified are generally the same as Option 2. However, for Option 2 Modified, with a proposed route further to the southeast, the combined effect of the loss of open space within the conservation area in heritage and landscape terms is likely to be less than for Option 2.
- 9.9.273 For in-combination effects, 1-2 Hybrid Option is no worse or better than Option 1 and is preferred to Option 2 as its route is further to the southeast. Therefore, the combined effect of the loss of open space within the conservation area in heritage and landscape terms is likely to be less than for Option 2.

9.9.274 For cumulative effects, 1-2 Hybrid option is no worse or better than any of the other options.

Vulnerability to Major Disasters

Summary of approach

9.9.275 The following potential effects of major accidents and disasters have been considered in the PCF 2 Stage 2 EIA for Options 1 and 2:

- Major accidents and disasters have the potential to release emissions of air pollutants over the short term. Given that any release would be of relatively short duration and temporary, it is considered that there would not be a material effect on annual mean concentrations.
- Whilst the historic environment is at risk in general to major accidents and disasters, it is not anticipated that the scheme would change the baseline vulnerability of the heritage assets compared to the scheme not being constructed.
- Major accident events largely include, but are not restricted to, major road traffic accidents. Other man-made risk may include chemical spills, which could directly affect tree planting, cuttings and embankments and leaving soils unable to develop vegetative cover, opening the surrounding landscape to views of the road corridor. Disaster events, such as major flooding events, high winds, storm events or extreme drought have the potential to cause harm to the landscape and visual amenity of the surrounding area, as these could contribute to the partial loss or removal of blocks of tree planting, which may cause disruption of views within the landscape and lead to the road corridor being an incongruous element for a period of time.
- Major accidents and disasters could potentially directly damage habitats, and injure or kill individual animals or populations supported by those habitats. It is considered that the further surveys and assessments that will be undertaken following the preferred route announcement and during preliminary design will provide the information required to design out the risks that major accidents and disasters present.
- Major disasters could damage the road surface and/or ancillary items such as barriers, requiring repair or rebuilding. The severity of the disaster would determine how many layers of the road need to be replaced and over what distance, which would account for the quantity of materials needed and waste generated and the effect on the receptors. There may be an indirect effect on roads that are used as alternatives while the damaged road is repaired, as the alternative roads would experience heavier traffic and may require increased repair or earlier rebuild. However, it should be noted that any effect would be temporary and considered unlikely to significantly affect regional material and waste receptors.
- Man-made or natural incidents requiring the closure of roads within the proposed scheme area has the potential to increase noise levels from alternate routes during free-flow conditions or cause congestion, leading to lower noise levels.

- Government Lockdowns, such as during the Covid-19 pandemic, have been found to severely reduce the number of vehicles on the road, and as a result the noise levels decrease.
- Noise mitigation measures that have been damaged can adversely affect the acoustic performance. Resurfacing the affected section of road and/or repairing the noise barrier would reverse the damage.
- Weather conditions can affect sound propagation and it is possible that extreme conditions or temperature inversions could have an impact on noise.
- Despite the limited nature of natural risks the UK is exposed to, the potential of natural circumstances such as extreme rainfall or major droughts impacting on groundwater for example, are considered to have the potential to have a direct, reductive effect on the future effectiveness of the drainage system of the scheme and subsequent effects on the water environment.
- In terms of man-made risks, the most pertinent for water would be events which could affect traffic in the area such as major road traffic accidents or plane/rail crashes and events such as major chemical/pollutant spills that could affect the scheme and pass through to the wider water environment.
- As well as causing gradual changes to average conditions, climate change may also alter the frequency and severity of extreme weather events, such as heavy rainfall, storms and heatwaves. These weather events could be associated with major disasters affecting the scheme.

Comparative assessment

9.9.276 All potential effects of potential major accidents and disasters are considered to be temporary and not to be significant prior to mitigation measures for all areas of Options 1 and 2, Option 2 Modified and 1-2 Hybrid Option as the scheme is unlikely to increase major accidents and disaster events.

Summary of Environmental Assessment

9.9.277 Table 9-14 summarises the differences between the options and identifies the more favourable option where possible in terms of the environmental assessment for each environmental topic.

Table 9-14: Environmental Assessment Summary

Environmental Topic	Summary Description
Air Quality	All four options are not expected to result in significant adverse effects on human health or designated ecological sites. Therefore, no option is considered to be environmentally better or worse than the other, and there is no preferred option with regards to air quality.
Cultural Heritage	Although all four options would generate significant adverse effects, Option 2 Modified would lessen the impacts on the Winthorpe Conservation Area; it would likely require less extensive mitigation and offsetting measures compared to Option 1, Option 2 and the 1-2 Hybrid Option, to potentially lessen the effects to not significant. Therefore, Option 2 Modified is the preferred option with regards to cultural heritage.

Environmental Topic	Summary Description
Landscape and Visual	<p>All options have the potential to result in significant adverse landscape and visual effects. However, Option 2 Modified would have a less significant effect on views and on the landscape character due to the comparatively smaller footprint and utilisation of the existing A46 to the south of Winthorpe. This would result in fewer adversely affected landscape and visual resources and greater opportunity to mitigate potential impacts compared to Option 1, Option 2 and the 1-2 Hybrid Option.</p>
Biodiversity	<p>Following appropriate mitigation, e.g. environmentally sensitive designs of landscaping, watercourse crossings, drainage and lighting, and the security of compensation for habitat loss, it is expected that for all options the potential residual environmental effects would be reduced to neutral. In comparison, the effects of habitat loss and fragmentation on important biodiversity resources are greatest for Option 1 and least for Option 2 Modified. Option 1 would require greater mitigation to address impacts to LWSs and priority habitats. The loss of lowland mixed deciduous woodland and open channel habitat along Winthorpe Beck would also be greater for the 1-2 Hybrid Option compared to Option 2 Modified. Less mitigation is required as a result. Therefore, Option 2 Modified is the preferred option with regards to biodiversity.</p>
Geology and Soils	<p>For all four options, limited land contamination effects are expected that would not be significant. As such, there is little to distinguish between the options with respect to land contamination. However, the 1-2 Hybrid Option would take less agricultural soils compared to Option 1, Option 2 and Option 2 Modified and less BMV land than Option 1. Therefore, although all options would result in a large adverse effect, which is significant, in terms of loss of agricultural soils and BMV land the 1-2 Hybrid Option is the most favourable of the four options.</p>
Materials and Waste	<p>Option 1 would have a slightly larger impact on the capacity of waste facilities compared to Option 2. Based on a qualitative assessment of the volume of material assets required and the waste generated during construction, the 1-2 Hybrid Option is similar to Option 1 but worse than Option 2. In comparison, Option 2 Modified is better than both Option 1 and the 1-2 Hybrid Option, and similar to Option 2. This means that the impact on landfill capacity and waste infrastructure is small for Option 2 Modified. Overall, none of the options would have a significant effect on material assets or waste. However, Option 2 Modified is slightly environmentally better than Option 2 and is, therefore, the preferred option with regards to materials and waste.</p>
Noise and Vibration	<p>Considering scheme-wide effects and the potential levels of mitigation required, the 1-2 Hybrid Option and Option 2 Modified would be environmentally better than Option 1 and Option 2 but still have the potential to cause significant adverse effects, like all other options. However, a preferred option cannot be determined between the two.</p>
Population and Human Health	<p>With respect to private property and housing, and a physical health perspective, Option 2 is environmentally worse than the other three options and could result in significant adverse effects. However, Option 2 is environmentally better in terms of development land and businesses.</p> <p>In terms of community land and assets, all options would have a significant adverse effect, although Option 1 is environmentally worse than the other three options.</p> <p>The 1-2 Hybrid Option is the least damaging to agricultural land holdings, however the potential effects of all options are assessed as significant.</p>

Environmental Topic	Summary Description
	<p>All four options are considered equal with regards to increasing ease of movement when accessing open space/recreational facilities, employment sites and the wider transport network.</p> <p>Overall, whilst all options of the potential to have significant adverse effects, Option 2 Modified is environmentally better from a Population and Human Health perspective and the preferred option in this regard.</p>
Road Drainage and the Water Environment	<p>All options have a similar potential to impact on water quality and increase flood risk resulting in large adverse effects on the water environment during construction and operation, which are significant. Overall, from a water environment perspective Option 2 Modified would have the least adverse effect, followed by Option 2, Option 1 and then the 1-2 Hybrid Option. This is because Option 2 Modified would require less mitigation, compensation and offsetting to ensure all adverse effects are not significant. Therefore, Option 2 Modified is the preferred option with respect to the water environment.</p>
Climate	<p>All four options are not expected to result in significant adverse effects and would not be environmentally worse or better in comparison. Therefore, there is no preferred option with regards to climate.</p>
Cumulative Effects	<p>All options have the potential to have significant adverse effects. For in-combination effects, the 1-2 Hybrid Option is no worse or better than Option 1, followed by Option 2 Modified and then Option 2. For cumulative effects, no option is environmentally worse or better than the other. Therefore, either the 1-2 Hybrid Option or Option 1 would be the preferred option.</p>
Vulnerability to major disasters	<p>All four options are not expected to result in significant adverse effects and would not be environmentally worse or better in comparison. Therefore, there is no preferred option with regards to vulnerability to major disasters.</p>

9.10 Social Impacts Assessment

9.10.1 This section details the findings of a Social Impact Assessment undertaken for the A46 Newark Northern Bypass Improvement scheme PCF Stage 2.

Approach

9.10.2 Social impacts cover the human experience of the transport system and its impact on social factors, not considered as part of economic or environmental impacts. Each social impact is required to be assessed as part of the appraisal and an assessment entered into the AST. The analysis is undertaken here in accordance with TAG guidance Unit A4.1, with the results of the assessment forming part of the AST. Both beneficial and / or adverse social impacts of transport interventions are considered, along with the identification of social groups likely to be affected.

9.10.3 The eight indicators considered within the social impact appraisal are:

- Collisions.
- Physical Activity.
- Security.
- Severance.

- Journey Quality Impacts.
- Option Values and Non-Use Values.
- Accessibility Impacts.
- Personal Affordability Impacts.

Collisions

Introduction

- 9.10.4 A transport intervention can influence the number of collisions and resulting casualties (slight, serious or fatal). It is important to examine these changes in collisions / casualty levels as there are significant costs associated with collisions for individuals, the government and private businesses. For example, casualty costs include the suffering of individuals and families, loss of economic output and medical costs. Costs of a collision include, damage to vehicles and infrastructure, police cost, legal and insurance costs and in certain cases losses due to extended journey times and road closures.
- 9.10.5 As the A46 Newark Northern Bypass improvement scheme aims to reduce the number of collisions occurring on the A46 and A1 around Newark-on-Trent, an assessment using the DfT's COBA-LT was undertaken. The assessment examines the costs associated with a collision and the resulting casualties. A comparison is made between the forecast collisions with the scheme and the forecast collisions without the scheme to show the resulting change in costs stemming from the scheme. Figure 9-6 shows the study area for this COBA-LT assessment.

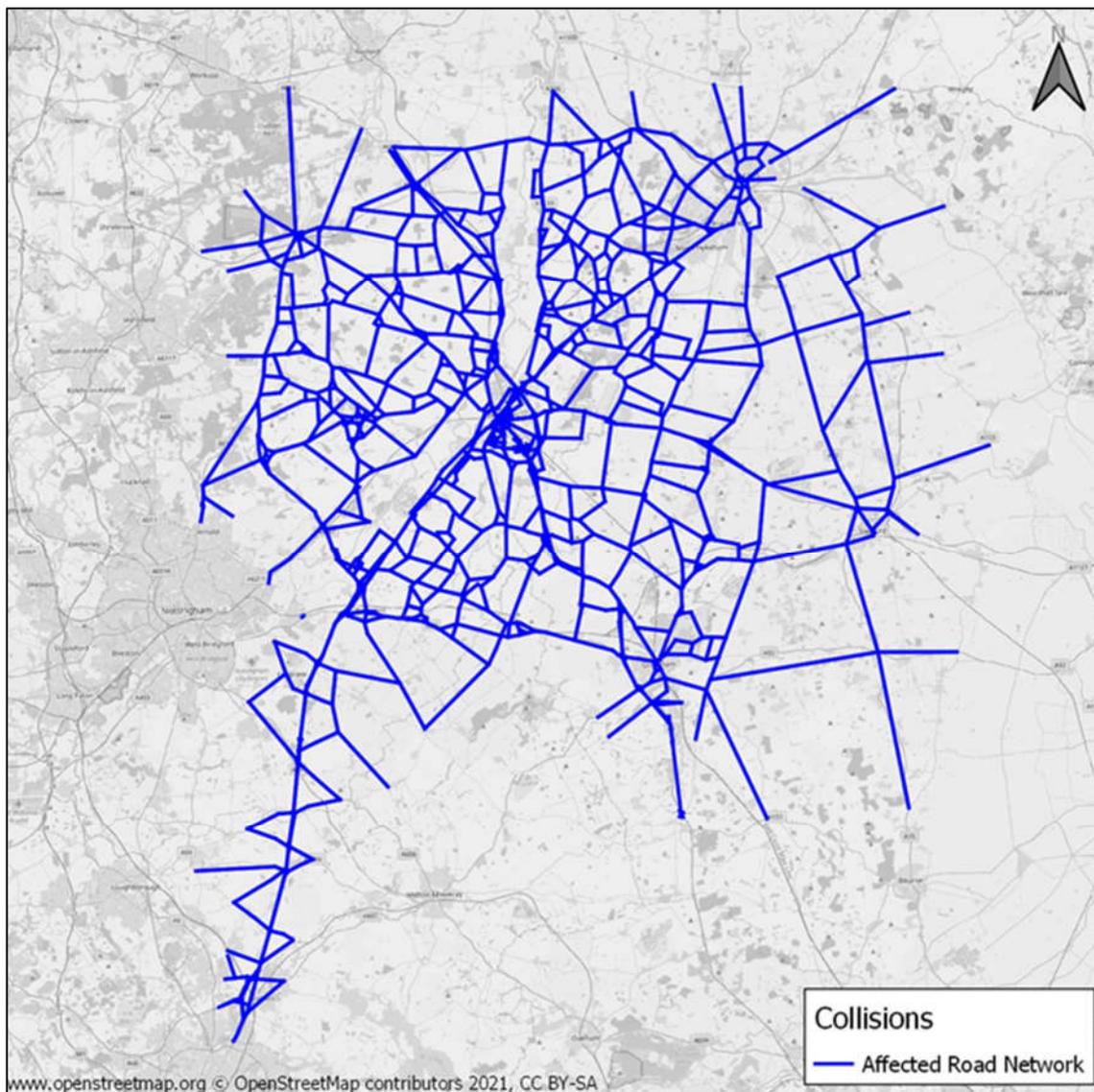


Figure 9-6: COBA-LT Assessment Area

Assessment

Option 1

9.10.6 A COBA-LT assessment was undertaken for each option for combined link and junction collision statistics within the assessment area. Table 9-15 summarises the changes in the number of casualties and the resulting changes in costs for Option 1.

Table 9-15: Option 1 COBA-LT Assessment Collision Summary

Group		Do Minimum	Do Something Option 1	Scheme Saving (DM-Option 1)
Casualty Summary	Fatal	781.5	787.5	-6.1
	Serious	7,441.3	7,446.9	-5.6
	Slight	62,470.4	62,612.1	-141.7
Collision cost (£m)		1,885.48	1,889.77	-4.29

- 9.10.7 The assessment predicts an overall cost disbenefit of £4.29 million (0.2% increase) as a result of Option 1. The increase in number of accidents and the associated cost are a small proportion of the overall accidents in the study area and, therefore, the social impact is expected to be slight.
- 9.10.8 The option is predicted to cause an increase in casualties of all severities, with an increase in fatal casualties of 6.1 (0.8%). The predicted impact to collisions is a result of the rerouting of traffic to the A46 using single carriageway roads that have higher accident rates than dual carriageways.
- 9.10.9 Therefore, the overall impact of Option 1 to collisions is considered slight adverse.

Option 2

- 9.10.10 The change in the number of casualties, by severity, and resulting changes in collision costs are shown in Table 9-16 for Option 2.

Table 9-16: Option 2 COBA-LT Assessment Collision Summary

Group		Do Minimum	Do Something Option 2	Scheme Saving (DM-Option 2)
Casualty Summary	Fatal	781.5	787.2	-5.7
	Serious	7,441.3	7,429.0	12.3
	Slight	62,470.4	62,366.7	103.7
Collision cost (£m)		1,885.48	1,884.17	1.31

- 9.10.11 For Option 2 the assessment predicts a total collision cost saving of £1.31 million (0.1% decrease). Hence, Option 2 decreases collision costs, although this change is relatively small.
- 9.10.12 Option 2 shows an expected decrease in the number of serious and slight casualties, but an expected increase in the number of fatal casualties of 5.7 (0.7%). Since there is an expected increase in fatal casualties, any impact to collisions as a result of Option 2 is not considered beneficial.
- 9.10.13 Since there is a small benefit to the cost of collisions, but a small increase in the number of fatalities, the overall impact to collisions has been ranked as neutral for Option 2.

Option 2 Modified

- 9.10.14 Table 9-17 summarises the changes in the number of casualties and the resulting impact to the cost of collisions for Option 2 Modified.

Table 9-17: Option 2 Modified COBA-LT Assessment Collision Summary

Group		Do Minimum	Do Something Option 2 Modified	Scheme Saving (DM-Option 2 Modified)
Casualty Summary	Fatal	781.5	787.2	-5.7
	Serious	7,441.3	7,429.3	12.0
	Slight	62,470.4	62,364.9	105.5

Group	Do Minimum	Do Something Option 2 Modified	Scheme Saving (DM-Option 2 Modified)
Collision cost (£m)	1,885.48	1,884.60	0.88

9.10.15 For Option 2 Modified the assessment predicts a total collision cost saving of £0.88 million (0.05% decrease). While there is a decrease in the expected cost of collisions across the impact area, this change is relatively small.

9.10.16 As with Option 2, Option 2 Modified predicts an expected decrease in serious and slight casualties, but an increase in fatal casualties of 5.7 (0.7%). Therefore, the impact to collisions resulting from Option 2 Modified is not considered beneficial, due to there being an expected increase in fatalities.

9.10.17 Overall, since there is a slight increase in fatal casualties but a slight decrease in the total number of casualties and associated collision costs, the impact of Option 2 Modified to collisions is considered neutral.

1-2 Hybrid Option

Table 9-18: 1-2 Hybrid Option COBA-LT Assessment Collision Summary

Group		Do Minimum	Do Something 1-2 Hybrid Option	Scheme Saving (DM-1-2 Hybrid Option)
Casualty Summary	Fatal	781.5	787.7	-6.2
	Serious	7,441.3	7,432.3	9
	Slight	62,470.4	62,388.4	82
Collision cost (£m)		1,885.48	1,885.14	0.34

9.10.18 For the 1-2 Hybrid Option the assessment predicts a total collision cost saving of £0.34 million. While there is a decrease in the expected cost of collisions across the impact area, this change is relatively small.

9.10.19 As with Option 2 and Option 2 Modified, this option predicts an expected decrease in serious and slight casualties, but an increase in fatal casualties of 6.2. Therefore, the impact to collisions resulting from the 1-2 Hybrid is not considered beneficial, due to there being an expected increase in fatalities.

9.10.20 Overall, since there is a slight increase in fatal casualties but a slight decrease in the total number of casualties and associated collision costs, the impact of the 1-2 Hybrid Option to collisions is considered neutral.

Assessment Summary

9.10.21 The overall social impact to collisions for each option and the impact to the cost of collisions is shown in Table 9-19.

Table 9-19: Collision Social Impact Assessment Summary

Option	Impact	Benefit Change (£m)
Option 1	Slight Adverse	-4.29
Option 2	Neutral	1.31

Option	Impact	Benefit Change (£m)
Option 2 Modified	Neutral	0.88
1-2 Hybrid Option	Neutral	0.34

Physical Activity

Introduction

- 9.10.22 DfT guidance notes that transport and the physical environment of urban areas both play a major role in the amount of physical activity that people are engaged in on a day-to-day basis. There is a longstanding recognition of the interrelationship between transport, the environment and health. A 2012 meta-analysis estimated that physical inactivity was responsible for 5.3 million deaths worldwide, similar to smoking and obesity.

Assessment

- 9.10.23 TAG Guidance Unit 4-1 requires consideration of the impacts of any travel scheme on physical activity. This is the case even if an intervention is unlikely to significantly affect active modes of travel directly, as it could cause modal shift away from active travel. It is recommended by TAG Unit 4.1 that physical activity is assessed quantitatively by estimating the change in the number of walking and cycling users as result of the scheme. As the A46 Newark Northern Bypass is primarily a strategic highway scheme, changes to active travel are likely to be small. Consequently, to maintain a proportionate assessment, physical activity changes have been assessed qualitatively. The assessment of this is covered under the Walking Cycling and Horse-riding Assessment and Review (Section 9.3) and Population and Human Health (Section 9.9) sections of this report.
- 9.10.24 There is the possibility that increasing the capacity and efficiency of the A46 will encourage people to use cars for local journeys when they currently travel by walking and cycling. However, this is only likely to account for a small number of journeys, if any.
- 9.10.25 The strategic nature of the road means the majority of journeys are longer distance. There is a possibility that faster road journey time may cause some modal shift away from public transport, particularly rail. Rail journeys would generally include a greater amount of active travel before or after the rail journey than travelling by car.
- 9.10.26 Overall Option 1 will not significantly improve Cattle Market junction for pedestrians and hence therefore have little impact on active travel. Therefore, the impact of Option 1 on physical activity is likely to be neutral.
- 9.10.27 Overall, with the improvements for pedestrians at Cattle Market junction, it is likely that Option 2, Option 2 Modified and the 1-2 Hybrid Option would have a slight beneficial effect on physical activity.

Security Impacts

Introduction

- 9.10.28 TAG unit A4-1 states that security concerns are greater on roads where motorists are required to slow or stop their vehicle. This includes traffic lights or congested areas. Vehicles are also vulnerable when left unattended such as in car parks or at service stations.
- 9.10.29 As the A46 is to become a dual carriageway, security concerns are likely to be low. This is because dual carriageways are generally hard to access, and the high speeds associated help users avoid being a victim of crime. There are, however, still potential security issues on a dual carriageway, with high speeds potentially exacerbating these issues.
- 9.10.30 Other security issues exist with regards to a number of underpasses that currently exist to allow pedestrians and cyclists to cross the A46. The current intention is to extend the length of these underpasses due to the increased width of the carriageway resulting from dualling. Consequently, this could exacerbate both real and perceived security concerns for cyclists and pedestrians.
- 9.10.31 Due to the early stage of the scheme development, fully assessing security impacts is not possible. A qualitative comment has been included in this assessment for each security indicator explaining information available that will affect these indicators.

Assessment

- 9.10.32 Site perimeters will change due to the increased width of carriageways and junctions under all options. It is assumed that these will be adequately secured and that sufficient exits / entrances will be provided to access the road. More detailed analysis will be undertaken at a later stage when the scheme has reached the Detailed Design stage.
- 9.10.33 Informal surveillance on the road itself is likely to be improved due to the increased number of vehicles using the A46 as a result of the scheme. Hence, any potential security issues are likely to be detected more quickly. Option 2 and its variants are forecast to increase the number of vehicles using the A46 significantly due to improved journey times resulting from grade separation and therefore, informal surveillance should be increased. Option 1 is also forecast to increase the number of vehicles using the A46 due to dualling although lack of a grade separated junction at Cattle Market roundabout will limit this increase.
- 9.10.34 The A46 carriageway in the vicinity of any proposed junction is likely to require illumination. The actual arrangements of lighting will be assessed at a later stage, but it is assumed that lighting will be improved.
- 9.10.35 Currently detailed landscaping proposals are not available at this stage. As options are developed, landscaping will be taken into consideration to mitigate any potential security issues.
- 9.10.36 The use of technology such as CCTV and Emergency Roadside Telephones (ERTs) will be designed into the scheme at a later stage. It is likely the scheme would benefit from these being implemented.

- 9.10.37 With regards to active travel, security is likely to be reduced by the extension to underpasses due to the increased land take of the A46. The reduced security could be mitigated by improved lighting and visibility and implementing CCTV. The design will seek to minimise personal security issues but due to the early stage of the project, exact improvements to formal surveillance and lighting within underpasses is unknown.
- 9.10.38 According to data collected for the PCF Stage 1 Walking, Cycling and Horse-Riding Assessment, around 200 people a day use both Farndon and Winthorpe underpasses. While the number of users is relatively low, the fact that pedestrians from Farndon and Winthorpe can only travel to Newark-on-Trent via the underpasses means that any reduction in security in this area is likely to have a significant impact on users.

Table 9-20 – Security Assessment

Group	English National Average	Option 1	Option 2	Option 2 Modified	1-2 Hybrid Option
Site perimeters, entrances, exits	High	N/A	N/A	N/A	N/A
Formal surveillance	High	N/A	N/A	N/A	N/A
Informal surveillance	Low	Slight Beneficial	Slight Beneficial	Slight Beneficial	Slight Beneficial
Landscaping	Medium	N/A	N/A	N/A	N/A
Lighting and visibility	High	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
Emergency Call	Medium	N/A	N/A	N/A	N/A

- 9.10.39 Overall, the effect on security is difficult to fully and accurately assess at this stage of scheme development for both highways and active modes of transport. A more detailed assessment will be undertaken at a later stage of project development when exact details on security mitigation have been decided. Due to the reduced visibility as a result of the large extension to Winthorpe underpass, the impact of Option 1, Option 2, the 1-2 Hybrid Option and Option 2 Modified on security is moderate adverse.

Severance Impacts

Introduction

- 9.10.40 Community severance is defined in TAG unit A4.1 as the separation of residents from facilities and services they use within their community caused by substantial changes in transport infrastructure, or by changes in traffic flows. All options for the A46 Newark Northern Bypass scheme include significant changes to the road network and changes in traffic flows.
- 9.10.41 The A46 Newark Northern Bypass includes significant changes to the current road network with dualling and a new grade separated junction / bypass north of the A1/A46 Interchange included in all options and grade separation of Cattle

Market roundabout included in Option 2, Option 2 Modified and the 1-2 Hybrid Option. Most pedestrian / cycling crossings of the A46 around Newark-on-Trent are grade separated underpasses. The exception to this is the at-grade signalised crossing at Cattle Market roundabout and two public footpaths.

Assessment

- 9.10.42 Under all options, the footpath located to the west of Cattle Market roundabout is severed. This footpath links Kelham Road to the south of the A46 to Kelham Road north of the A46. The crossing is identified as having little usage in the Walking Cycling and Horse-Riding Assessment due to the need to travel through fields with no formal footpath. The crossing itself is unmarked and difficult to use due to the high speed of vehicles in this area. Accessing the crossing, also requires climbing low quality steps.
- 9.10.43 It is likely there would be few users inconvenienced due to the closure of this footpath as an alternative route via Cattle Market roundabout exists. This route would be signposted.
- 9.10.44 Under Option 1 pedestrians will have to cross the dualled A46 mainline and the two-lane slip road either side. Consequently, users will have to cross 8 lanes compared to the current 4. Although these lanes will be controlled by signals, there is likely to be a delay associated with waiting at these signals. Hence, it is likely that the perception of severance will be increased.
- 9.10.45 With Option 2, Option 2 Modified and the 1-2 Hybrid Option, users crossing Cattle Market junction would not need to cross the A46 mainline due to grade separation. The slip roads will be signalised allowing pedestrians and cyclists to cross easily. Consequently, despite the footpath closure, grade separation is likely to reduce the perception of severance in this area.
- 9.10.46 A second public footpath is planned to be closed. It is located between the A1/A46 junction and Winthorpe roundabout. The footpath links Newark-on-Trent Showground in the south to Winthorpe in the north. As all options propose bypassing the current A1/A46 Interchange to the north, the footpath between the A46 and Winthorpe, will be severed. The current footpath is in poor condition, usage has been identified as being very low and crossing the A46 is blocked by a safety barrier. Taking into account the identified poor condition and low usage, closure of this footpath is unlikely to have a significant effect on severance.
- 9.10.47 TAG Unit 4.1 states that severance will only be an issue where vehicle flows are significant enough to impede pedestrian movements. Consequently, flows were examined in two ways. The first was a significant change which was defined as flow that changed by 30% or greater. The second was a flow that changed by at least 10% but had an AADT of at least 10,000 vehicles. This type of road link was examined as the sheer volume of traffic would make the road very difficult to cross, so any reduction in traffic would have a significant effect on severance.
- 9.10.48 When the changes in the two factors were examined, it was found that the majority of changes in traffic levels occur outside the Newark-on-Trent urban area. Hence the effect of all options induced traffic flow changes on perception of severance is likely to be neutral.
- 9.10.49 Overall Option 1 will likely have a slight adverse effect on severance due to the increased number of lanes needed to be crossed at Cattle Market junction.

- 9.10.50 Overall Option 2, Option 2 Modified and the 1-2 Hybrid Option are likely to have a slight beneficial impact on severance due to the improved crossing facilities and separation of crossing from the A46 mainline at Cattle Market junction.

Journey Quality Impacts

Introduction

- 9.10.51 TAG Unit A4-1 states that in most cases travel is derived demand and hence, users are trying to access other services and therefore, a poor journey experience is easily noticed. Travel on the A46 is likely to be almost exclusively a derived demand due to the lack of utility the journey will provide compared to a scenic drive or rail journey for example. It is therefore, important that journeys on this section of road are made as simple and easy as possible to prevent boredom and associated psychological issues.
- 9.10.52 With increasing research into travel behaviour, there is increasing evidence that users are willing to pay to improve the quality of a journey. Consequently, it is important to measure changes in journey quality as a result of a scheme.

Assessment

- 9.10.53 TAG Unit A4-1 states that there is limited evidence on monetary valuations of quality in relation to highway projects. Therefore, a qualitative approach is recommended.

Traveller Care

- 9.10.54 Assessing the first category, traveller care, most of the sub factors are only relevant to public transport projects. Facilities has some relevance to a highways scheme as it assesses the presence of service stations and facilities for motorists.
- 9.10.55 Option 1, the 1-2 Hybrid Option and Option 2 Modified would be built on the current location of a service area. This will require the demolition of a restaurant and fuel station. Although this will reduce choice, other services are available within the vicinity of the demolished facilities. This includes another fuel station, two restaurants and two fast food restaurants. Consequently, though adverse the effects on facilities should be minimised but will still represent a mild inconvenience for users.
- 9.10.56 Option 2 does not include any provision for service improvement.

Traveller Views

- 9.10.57 Option 1 mainly follows the current route of the A46. The exception is the small diversion around the A1/A46 junction and small number of cuttings around this area. It is unlikely that road travellers' views will be significantly affected. Hence, the impact is neutral.
- 9.10.58 For Option 2, the 1-2 Hybrid Option and Option 2 Modified the main route of the A46 may experience slight better views as the road will be on raised embankments to allow grade separation at junctions. However, this is unlikely to be significant and therefore, the impact is neutral for travellers' views for motorists.

9.10.59 Due to the dualling of the A46 mainline for all options, current underpasses are extended, and new underpasses are created. The increased length of these underpasses will increase the length of time pedestrians and cyclists are subjected to poor views.

Traveller Stress

- 9.10.60 The A46 Newark Northern Bypass scheme will have the greatest impact on the final factor, traveller stress. The largest effects will be a reduction in traveller frustration, as the one of the main objectives of the scheme is to reduce congestion. Driver stress is currently exacerbated by the overall inability to move freely at peak times.
- 9.10.61 Option 1 is likely to increase speeds and reduce congestion, and Option 2 and its variants are likely to increase speeds and reduce congestion significantly. Increased speeds will occur due to the dual carriageway allowing maximum speeds of 70 mph (although speed restrictions lower than this will be in place at points where road curvature does not allow higher speeds).
- 9.10.62 For all options, journey times will be improved due to the diversion of the A46 mainline around the congested A1/A46 junction. The road will also have greater capacity with improved junction layouts and extra lanes, which is expected to help prevent queuing. The scheme is also likely to reduce frustration for vehicles not using the A46. This is because congestion will be reduced at the A1/A46 junction due to A46 traffic being diverted on to a new route.
- 9.10.63 The additional grade separation of Cattle Market junction in Option 2 and its variants will allow the vehicles on the main line to travel around the A46 stopping at fewer junctions, hence, improving journey times and reducing frustration. Additionally, traffic travelling north to south at Cattle Market junction will no longer have to cross the A46 mainline and hence, are likely to experience reduced wait time at the junction. Following TAG Unit A4.1 guidance, the effects of these options are large beneficial as a high level of traffic uses the A46.
- 9.10.64 While improvements are made to Cattle Market junction in Option 1 by converting it to a 'hamburger' junction, delays associated with queuing at the junction may remain. As a result, frustration is likely to remain particularly if dualling attracts more vehicles to use the A46. Consequently, while driver frustration is likely to be reduced by increased free flow traffic and reduced journey times, the impacts are likely to be small compared with grade separating junctions. Hence, Option 1 has a slight beneficial effect on driver frustration.
- 9.10.65 In all options, Farndon and Winthorpe junctions will remain at-grade so will not improve capacity significantly.
- 9.10.66 The effect of the scheme on fear of potential accidents is likely to have multiple facets. This is because dualling scheme will improve flow and increase speeds which would increase the fear of accidents. However, improvements in the design of roads are likely to improve safety and reduce fear of accidents.
- 9.10.67 The introduction of traffic lights at the Cattle Market and Winthorpe junctions in Option 1 is likely to improve user's perception of safety over a traditional roundabout. As the improvements to the road are likely to attract additional vehicles, these two junctions may feel less safe. Overall, the fear of accidents is likely to be slightly reduced in Option 1, mainly due to junction improvements.

- 9.10.68 For Option 2 and its variants grade separation of junctions or introduction of traffic lights is likely to make the junctions feel safer. Through-traffic will also be reduced at the A1/A46 junction, a junction that suffers a high number of accidents currently. Consequently, perception of safety is likely to increase in this location. Hence, the impact of these options on fear of accidents is moderate beneficial for motorists.
- 9.10.69 For pedestrians and cyclists, the fear of accidents is likely to be reduced around the A46. This is as a result of pedestrians no longer having to cross the A46 mainline west of Cattle Market junction. Additionally, the increased capacity of the A46 will encourage drivers to divert away from the Newark-on-Trent urban area, where pedestrians are present in greater numbers. Hence, the impact of all options on fear of accidents is slight beneficial for pedestrians and cyclists.
- 9.10.70 Route uncertainty may be increased by the complex road layout of the at-grade Cattle Market in Option 1, and the change from current roundabout layouts at Farndon and Winthorpe to more complex, potentially signalised layouts in all options. However, it is not deemed to result in a significant increase in driver stress, with the grade separated layout at Cattle Market junction in Option 2 and its variants becoming less complex for A46 traffic, which would no longer need to navigate the roundabout. The A46 mainline will also be diverted away from the complex A1/A46 junction, which is likely to make the route simpler to use when travelling east to west on the A46. Overall, the effect of Option 1 on route uncertainty is likely to be neutral, and is likely to be slightly beneficial for Options 2, Option 2 Modified and the 1-2 Hybrid Option.
- 9.10.71 Overall, Option 1 would have a slight beneficial impact on driver stress and Options 2, 2 Modified and the 1-2 Hybrid Option would have a large beneficial impact on driver stress.

Overall Effect

- 9.10.72 Overall, Option 1 is likely to have a neutral impact on journey quality. This is due to reduced frustration being somewhat tempered by reduction in service choice for some users.
- 9.10.73 Overall, and taking into account the impact on all users, Option 2, Option 2 Modified and the 1-2 Hybrid Option are likely to have a moderate beneficial impact on journey quality.

Options Values and Non-Use Values

Introduction

- 9.10.74 Option values and non-use values relate to the implementation or withdrawal of a public transport service. An option value is the benefit an individual receives from knowing a service exists should they need to use it. A non-use value stems from the knowledge that other people can use the service providing an altruistic benefit.

Assessment

- 9.10.75 As this scheme does not include public transportation changes, these indicators will not be assessed any further.

Accessibility

Introduction

- 9.10.76 Increasing car use has provided greater opportunity for people to travel and access the services they require. However, one in four households does not have access to a car for reasons including cost, disability and choice. These people rely on public transport, walking, cycling or lifts from friends, family or community organisations. The reliance on such 'networks', which are often limited, can lead to social exclusion. Hence, it is important to consider accessibility in the social impact assessment.
- 9.10.77 Accessibility can be affected in the following ways:
- The availability of a transportation service – e.g. bus service.
 - The cost of transportation – affects if and how far a person can travel.
 - Safety and Security – Poor security can dissuade people from travelling.
 - Trust and Reliability of transport – People may not use a service if the service is not reliable.
- 9.10.78 The main effects of the A46 Newark Northern Bypass scheme will be to the cost of personal transportation and safety and security for pedestrians.

Assessment

- 9.10.79 It is likely that the scheme will not have any significant impacts on the availability and affordability of public transport services. Whilst there are some slight increases in vehicle operating costs of vehicles, this will not significantly impact the affordability to access services. Any changes to underpasses or ProW are unlikely to significantly impact people's safety and security to change their perception of travelling to key services or by public transport.
- 9.10.80 Overall, the assessment of this is neutral for all options.

Personal Affordability

Introduction

- 9.10.81 Affordability of transportation is primarily a distributional issue as it can be a major barrier to the mobility of certain groups. The assessment presented in this section provides a 'light touch' consideration of affordability from a wider perspective. As this intervention only significantly affects road users, changes in affordability are only relevant if a household owns a car.

Assessment

- 9.10.82 It is assumed that public transport fares are not affected by the A46 Newark Northern Bypass scheme. Additionally, the scheme will not implement any road user charges and will not result in any changes to parking charges. Therefore, the only relevant change in personal affordability is changes in car fuel and non-fuel costs.
- 9.10.83 Car fuel costs and non-fuel costs are the only expected personal affordability changes. These changes are captured in TUBA outputs and processed as part

of the A46 Newark Northern Bypass Distributional Impact Assessment for internal trips within a 'Core Modelled Area' excluding any external or development zones.

- 9.10.84 The calculations of affordability impacts by income quintile in the appraisal tables are based on vehicle operating costs and other user charges for home-based 'commuting and other' trips (i.e. excluding business users). This is because impacts to business trips are experienced by businesses and not individuals and, hence, are not considered a social issue.
- 9.10.85 For all options there is an overall disbenefit to affordability for both low and medium / high income groups. This is likely caused by reduced congestion leading to increased traffic speeds. Higher vehicle speeds can increase fuel consumption and, hence, lead to increase vehicle operating costs. Both low and medium / high income groups experience disbenefits in terms of affordability.
- 9.10.86 Since there are increased fuel and non-fuel costs expected as a result of all options for both low and medium / high income groups, the overall affordability impact is considered moderate adverse.

Conclusion

- 9.10.87 The social impact assessment shows that Option 2 and Option 2 Modified present the same social impact across all indicators and, therefore, the social impact assessment does not present a preference between these two options. For the collision, physical activity, severance and journey quality indicators the social impacts of Option 2, Option 2 Modified and 1-2 Hybrid Option (assessed qualitatively against the other options) slightly outperformed Option 1. For the security, accessibility and personal affordability impacts all options returned the same social impacts.

10. Conclusions and Recommendation

- 10.1.1 The four options considered within this report are broadly similar and, as such, several of the topic areas have assessed that there is little to differentiate between each of the options.
- 10.1.2 An option assessment matrix (which can be found in Appendix E) has been used to consolidate the assessment work undertaken within the Option Selection stage. This option assessment matrix aligns with elements of the business case, namely the:
- Strategic and Economics case: the Client Scheme Requirements, as outlined in Section 3.1.
 - Management case: public acceptability and buildability.
 - Financial case: BCR and forecast outturn costs.
- 10.1.3 As well as highlighting the clear distinction in assessment between Option 1 and the other options, this tool helps identify the more subtle differences in impact of Option 2 and its variants.
- 10.1.4 The assessment of the four options has highlighted two key areas where measurable differences between the options have been identified.

Cattle Market junction

- 10.1.5 The grade separation of Cattle Market junction and signalisation of Farndon roundabout in Option 2 will provide additional capacity on the A46 providing higher overall travel time savings than Option 1 leading to additional journey time benefits.
- 10.1.6 The separation of the largely strategic A46 traffic from the local traffic network is also considered to offer greater benefits in terms of safety, both to road users and walkers, cyclists and horse-riders. The result of this improvement to safety and journey time benefits is a scheme which delivers better value for money, as indicated in the comparative BCRs.
- 10.1.7 The results of the options consultation of Options 1 and 2 revealed greater overall support for Option 2 (64%) than for Option 1 (23%). The strong stakeholder support for Option 2 is largely due to the proposed grade separation at Cattle Market junction, which was preferred by 79% of respondents and which led to the inclusion of the Option 1-2 Hybrid in the selection process.

Route of the A46 in the vicinity of Winthorpe

- 10.1.8 Option 2 Modified was developed as a result of discussions and responses from stakeholders during the options consultation and was, therefore, not consulted on directly. It was developed based on the obvious preference for Option 2, with its grade separated junction at Cattle Market, but recognising the continued concerns over the proximity of the proposed route of the A46 to Winthorpe.

10.1.9 Moving the route of the A46 further away from Winthorpe, and partially back 'online' with the existing A46, is assessed to achieve environmental benefits over the other options in terms of:

- Landscape and Visual Effects.
- Noise and Vibration.
- Cultural Heritage.
- Biodiversity.
- Population and Human Health.

10.1.10 Full details of the assessment of the performance of the options against the scheme objectives are recorded in the options assessment matrix (Appendix E).

Recommendation

10.1.11 The significant safety and economic benefits of the grade separated Cattle Market junction together with the more marginal but still recognisable environmental benefits achieved through the route of the A46 in the vicinity of Winthorpe has led to the recommendation that Option 2 Modified be promoted as the preferred option for the A46 Newark Bypass scheme.

10.1.12 The preferred option, as shown in the General Arrangement drawing in Appendix F, shall incorporate a modification to the slip road from the A46 to Brownhills roundabout to maximise the space between the Nottingham to Lincoln railway line and the road.

11. Glossary

Table 11-1: Glossary

Term	Description
CO ₂ e	Carbon dioxide equivalent
ha	hectares
km	kilometres
m	metres
mm	millimetres
mph	miles per hour
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
PM ₁₀	Particulate matter 10 micrometres or less in diameter
Shared-use path	A facility used by more than one type of user – for example pedestrians and cyclists or pedestrians, cyclists and equestrians. This includes segregated or unsegregated facilities ⁴⁶ .
£k	Thousand pounds sterling
£m	Million pounds sterling

⁴⁶ DMRB, CD 143 Designing for walking, cycling and horse-riding, National Highways, March 2021.

12. Abbreviations

Table 12-1: Abbreviations

Term	Description
AADT	Annual Average Daily Traffic
AEP	Annual Exceedance Probability
ALC	Agricultural Land Classification
AMP	Archaeological Management Plan
AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
ARN	Affected Road Network
AST	Appraisal Summary Tables
BCR	Benefit Cost Ratio
BGS	British Geological Survey
BMV	Best and Most Versatile
BPM	Best Practicable Means
CCC	Climate Change Committee
CCTV	Closed-Circuit Television
CD&E	Construction Demolition and Excavation
CIEEM	Chartered Institute of Ecology and Environmental Management
COBA-LT	Cost and Benefit to Accidents - Light Touch
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DI	Distributional Impacts
DMRB	Design Manual for Roads and Bridges
DPD	Development Plan Document
EA	Environment Agency
EAR	Environmental Assessment Report
EDI	Equality, Diversity and Inclusion
EDIT	Equality, Diversity and Inclusion Tool
EIA	Environmental Impact Assessment
ERTs	Emergency Roadside Telephones
ES	Environmental Statement
FCA	Flood Compensation Area
GHG	Global Greenhouse Gas
GI	Ground Investigation
GPS	Global Positioning System
GWDTE	Groundwater Dependent Terrestrial Ecosystems

Term	Description
HADDMS	National Highways Drainage Data Management System
HER	Historic Environment Record
HGV	Heavy Goods Vehicle
IDB	Internal Drainage Board
IMD	Index of Multiple Deprivation
IoD	Indices of Deprivation
KSI	Killed or Seriously Injured
LCA	Landscape Character Assessment
LLFA	Lead Local Flood Authority
LGV	Light Goods Vehicle
LNR	Local Nature Reserve
LSOA	Lower Super Output Area
LTP3	Local Transport Plan
LWS	Local Wildlife Site
MMG	Mercia Mudstone Group
MRTM	Midlands Regional Traffic Model
MSA	Mineral Safeguarding Area
NCA	National Character Area
NERC	Natural Environment and Rural Communities
NIA	Noise Important Area
NPPF	National Planning Policy Framework
NPS NN	National Policy Statement for National Networks
NPV	Net Present Value
NSIP	Nationally Significant Infrastructure Project
NSLR	Newark Southern Link Road
PA	Planning Act
PCF	Project Control Framework
PCM	Pollution Climate Mapping
PFA	Pulverised Fuel Ash
PIP	Personal Independence Payment
PRoW	Public Rights of Way
PVB	Present Value of Benefits
RBD	River Basin District
RCP	Relative Concentration Pathway
RIS	Road Investment Strategy
ROC	Regional Operations Centre
SAC	Special Areas of Conservation
SCRG	Safety Control and Review Group

Term	Description
SOAEL	Significant Observed Adverse Effect Level
SOAR	Staged Overview of Assessment Report
SPA	Special Protection Areas
SRN	Strategic Road Network
SSSI	Site of Specific Scientific Interest
SUE	Sustainable Urban Extension
SUP	Shared-Use Path
TAG	Transport Analysis Guidance
TOS	Traffic Officer Service
TRA	Traffic Reliability Area
TUBA	Transport User Benefit Appraisal
WFD	Water Framework Directive
WSI	Written Scheme of Investigation
ZOI	Zone of Influence