Norwich Western Link

Environmental Statement

Chapter 4: Reasonable Alternatives Considered

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4 Reasonable Alternatives Considered

4.1 Introduction

4.1.1 This chapter of the Environmental Statement (ES) outlines the reasonable alternatives to the Proposed Scheme that have been considered by the Applicant, together with the main reasons for proceeding with the preferred scheme. This chapter covers the alternatives investigated during the development of the Norwich Western Link (the Proposed Scheme) as a whole.

4.2 Requirement for the Consideration of Alternatives

4.2.1 Regulation 18(3)(d) of the EIA Regulations 2017 **(Ref. 4.1)** states that an ES should include:

"a description of the reasonable alternatives studied by the developer, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment."

4.2.2 Schedule 4(2) of the EIA Regulations 2017 **(Ref. 4.1)** states that an ES should include:

"A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."

4.2.3 To accord with Regulation 18(3)(d) of the EIA Regulations 2017, the various interventions to the local road network, including public transport interventions and non-road schemes, as well as the route and design alternatives that have been considered by the Applicant for the Proposed Scheme are set out in this chapter.

4.3 Alternative Development

4.3.1 A number of studies have been undertaken in the development of the Proposed Scheme. These are outlined below including a summary of the key considerations that informed decisions on option selection and refinement.

4.4 A47-A1067 Western Link Road Scoping Study 2014

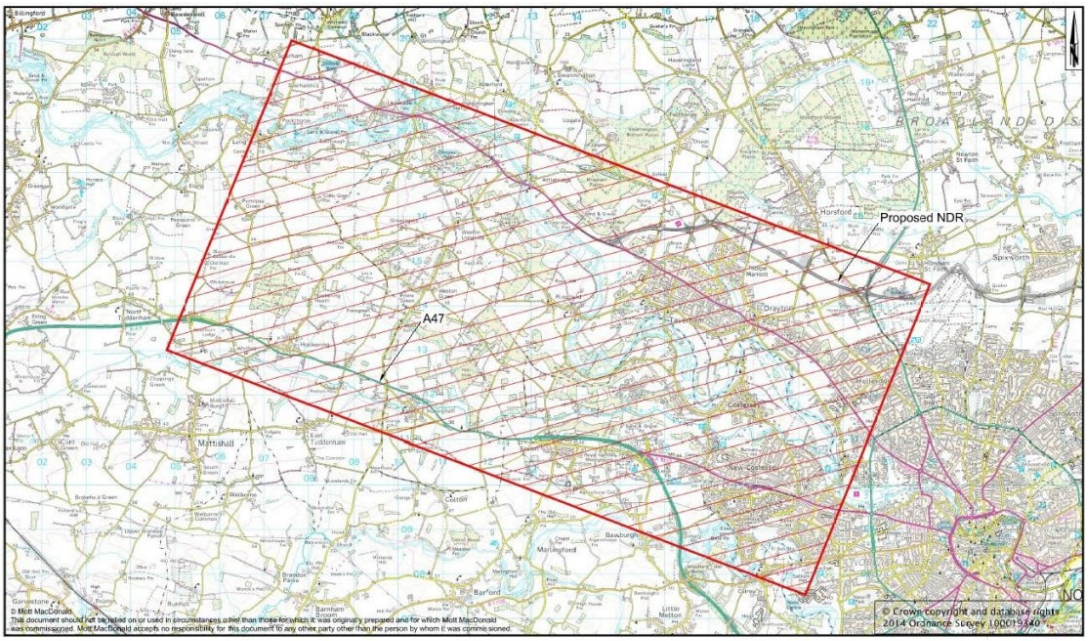
4.4.1 A significant amount of work was carried out on both the detail and justification of the original Northern Distributor Road (NDR) (now known as the A1270 Northland Broadway) scheme, which included separate route options for linking the A47 and A1067. Options available to Norfolk County Council (as the promoter of the NDR) included promoting a full NDR to include a western route option over the Wensum Valley, which would be the most effective in traffic terms, or promoting a separate scheme with a separate timescale to address further identifiable constraints between the A47 and the A1067.

4.4.2 From work undertaken at the time, a decision was made to seek consent to build only part of the originally planned NDR road scheme, meaning a separate scheme (linking the A47 and A1067) would be considered and developed at a later stage to allow more time to further consider the constraints and opportunities of this link.

4.4.3 The A47-A1067 Western Link Road Scoping Study was undertaken in 2014 to investigate potential route options for a Western Link Road.

4.4.4 The study area for this scoping study is shown in **Plate 4-1** below.

Plate 4-1 Study Area for the Scoping Study 2014 (source: Scoping Study 2014)



Source: Mott MacDonald

4.4.5 A set of sifting objectives were adapted from recommendations contained in the Department for Transport 'Early Assessment and Sifting Tool' (EAST). These included Specific Local Objectives that were agreed in discussion with the County Planning Authority, reflecting the concerns expressed by local stakeholders and County Planning Authority members. The objectives related to:

- Specific Local Objectives:
  - 1a. Improve strategic connectivity;
  - 1b. Reduce adverse impacts in Taverham/Costessey area caused by traffic routeing between the A47 and A1067;
  - 1c. Reduce adverse impacts in Ringland area caused by traffic routing between the A47 and A1067;
  - 1d. Reduce adverse impacts in Weston Longville/Hockering area caused by traffic routeing between the A47 and A1067;
  - 1e. Accessibility for Queens Hills;
- Wider Transport and Government Objectives (Sustainable travel opportunities – public transport, cycling and walking);

- Economic;
- Carbon;
- Socio-distributional Impacts;
- Local Environment;
- Well Being;
- Managerial;
- Financial; and
- Commercial.

4.4.6 A set of criteria was developed for each objective to help differentiate the performance of alternative route options against sifting objectives. These were developed in RAG (Red/Amber/Green) format and were outlined in Table 3.2 of the Scoping Study 2014.

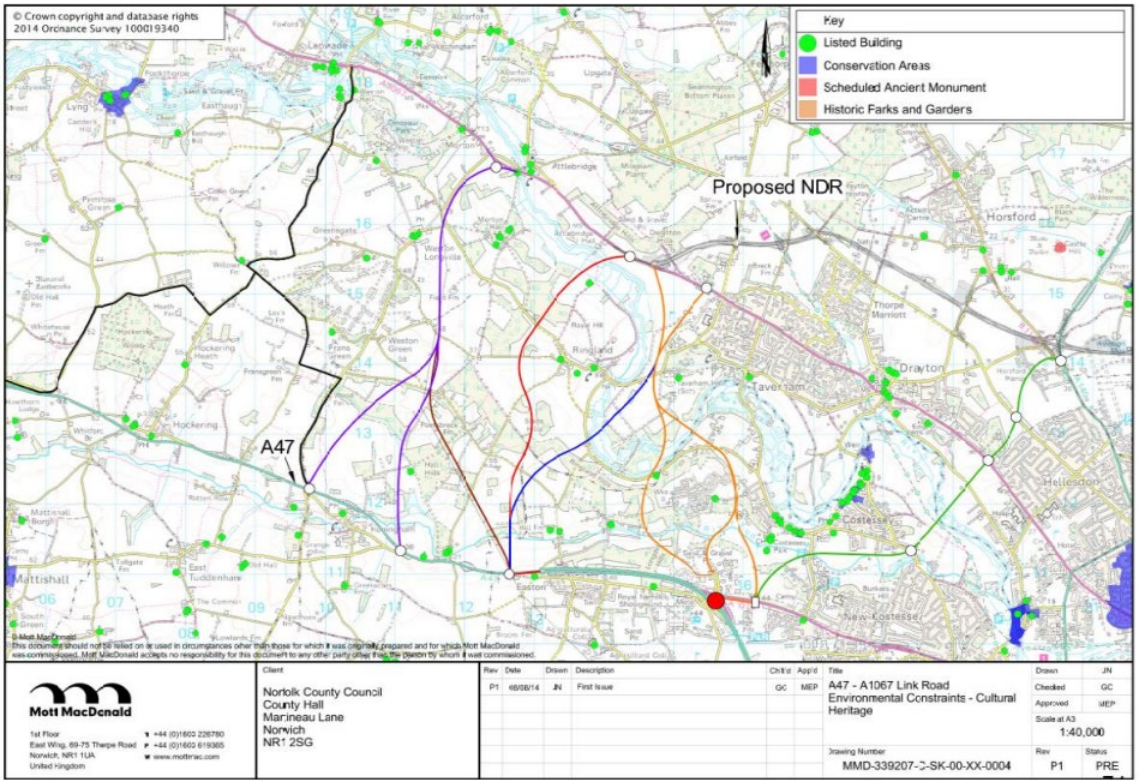
4.4.7 The options considered were:

- **Public Transport Only** – This Option looked to extend a bus route based on the existing Konectbus service 10 (operating between Thorpe Marriott and Norfolk and Norwich University Hospital (NNUH) via Taverham and Costessey). Alternatively, subject to the provision of the access through Queens Hills being available, a residential area south of Ringland Lane, Konectbus service 10 could also serve Queens Hills and the Longwater Retail Park;
- **Purple / Brown Routes** – These routes looked to provide a direct connection between the A47 and A1067, but not the NDR;
- **Red Route** - This route looked to provide a direct connection between the A47 and NDR/A1067 terminal at Deighton Hills;

- **Blue Routes** - These routes looked to provide direct connections onto the A47 and in the case of the Blue 2 route, also the A1067/NDR terminal at Deighton Hills;
- **Orange Routes** - The Orange 2 and Orange 4 routes provide a direct connection between the A47 at Longwater Interchange and the NDR/A1067 terminal at Deighton Hills, whilst the other Orange routes provide some indirect connections using the A1067 and A1074; and
- **Green Route** - This route would provide a direct connection to the NDR and Norwich Airport, however, its connection to the A47 is indirect and via a new signalised junction on the A1074.

4.4.8 These routes are illustrated on **Plate 4-2** below.

Plate 4-2 A1067 to A47 route options (source: Scoping Study 2014)



4.4.9 To inform the sifting process, a desk-based study was carried out to map environmental constraints. The impact of alternative routes on traffic patterns, and in particular existing local roads between the A47 and A1067, was examined using the Norwich Area Transport Strategy (NATS) transport model, against a baseline of growth assumptions and measures contained in the Joint Core Strategy, which included the NDR. High level estimates of capital cost (at 2014 prices) for each route alignment were developed, which included an allowance for 'optimism bias', in accordance with Department for Transport (DfT) guidance.

4.4.10 Consideration was given to recommended economic flow ranges for single and dual carriageway standards, as set out in DfT guidance. No stakeholder consultations were carried out as part of this study.

4.4.11 The output from the Study is presented in the form of a sifting matrix, which has been replicated in **Appendix 4-1** of this Chapter. The Scoping Study concluded:

"The Orange and Green routes provide the greatest benefits in terms of Specific Local Objectives i.e. to remove through traffic from local roads between the A47 and A1067, enable a second access to be formed for Queen's Hills and contribute to improved strategic connectivity. The Red and Blue routes are less effective in meeting these Objectives;

The Purple and Brown routes are the least effective in terms of Specific Local Objectives and do not provide significant relief to local roads in the Taverham/Costessey and Ringland areas, or the conditions under which a second access could be formed for Queen's Hills. Whilst not examined formally as part of this study, this conclusion also applies to further offline improvement of the Lenwade-Hockering route;

A comparison of traffic model forecasts with opening year flow ranges set out in DfT standard TA46/97 indicates that the Purple and Brown routes are only likely to be economically viable at a single carriageway S2 standard. For the Red, Blue, Orange and Green routes this comparison suggests that

a dual 2-lane carriageway D2AP standard would be the starting point for economic assessment, although single carriageway standards may require consideration;

The Red, Blue, Orange and Green routes would have to provide new crossings of the River Wensum SAC [Special Area of Conservation]/*SSSI* [Site of Special Scientific Interest]*. The level and feasibility of engineering mitigation of adverse impacts during both construction and operation have not yet been raised with statutory environmental stakeholders, placing significant risks and uncertainty over capital costs and hence deliverability of these options; and*

The Orange 5, Orange 6 and Green routes require significant remediation works to the Costessey landfill site, placing further risks and uncertainty over their cost and deliverability."

4.4.12 The Public Transport Only Option was an option that looked to improve connections to the NNUH and Norwich Research Park (NRP) from the Costessey, Taverham and Thorpe Marriott areas. The service could slightly reduce traffic in the Costessey and Taverham areas, though would have no impact on villages further west such as Weston Longville, Hockering and Ringland. The report suggested that this option could facilitate the opening of a bus-only second access into Queen's Hills, but could not reduce traffic to a level where the access could be opened up for all vehicles.

4.4.13 The Study suggests that the Public Transport Only Option could offer significant journey time savings for public transport trips to the NNUH and NRP, from the north-western suburbs of Norwich, though could not facilitate the delivery of any forthcoming housing allocations that were being considered at the time. An increase in public transport options would be likely to improve accessibility for vulnerable users. The use of existing highway networks, and the theoretical slight drop in traffic volumes in some locations, would mean that there could be positive or neutral impacts on the River Wensum Special Area of Conservation (SAC)/Site of Special

Scientific Interest (SSSI), other designated sites, heritage and landscape, and in terms of air quality and noise.

4.4.14 In general, bus only options have a relatively limited catchment of users within 400m walking distance of stops, so would be unable to fully tackle an area-wide traffic issue in a predominantly rural area with dispersed settlement patterns. They are also less likely to cater for longer distance trips for leisure purposes (for example tourism trips to the North Norfolk coast from origins west of Norwich). Buses and public transport options would not be capable of reducing HGV and LGV movement from the study area and, without additional highway capacity, buses would potentially experience delays on existing corridors.

4.4.15 According to the Study, a busway or segregated bus route involving new infrastructure would also have been likely to require a new or upgraded crossing of the River Wensum SAC, which would be likely to encounter similar environmental challenges, though may have offered benefit to a more limited catchment than a highway option. With existing bus mode shares (UK Census 2011) in the local area of less than 7%, it was considered that public transport measures could help to complement a new highway link option, but would only offer a partial solution and would not be sufficient to tackle many of the objectives identified in the early stages of the project. In particular, bus-based options would be unlikely to cater for longer distance trips.

4.4.16 The Scoping Study 2014 includes a RAG (Red/Amber/Green) rating in Appendix E (of the Scoping Study 2014) relating to the Scheme Specific Objectives considered at the time. The Public Transport Option scored Red or Amber for all of the objectives. In particular, it would not have offered connections to the Strategic Road Network, would have little impact on strategic traffic on local routes and would not facilitate delivery of housing.

4.5 Norwich Western Link Technical Report 2016

4.5.1 The Norwich Western Link Technical Report, June 2016 (Ref 4.3) provides further information with respect to the previously considered options for a Western Link Road as per the A47-A1067 Western Link Road Scoping Study 2014.

4.5.2 The Norwich Western Link Technical Report 2016 provided a high level summary of the types of option that could be considered in a long list of options to consider in the later Option Appraisal Report (OAR) stage. Six categories were outlined:

- Highways and traffic management;
- Walking;
- Cycling;
- Public Transport;
- Green infrastructure; and
- Open space.

4.5.3 The report reviewed the routes from the Scoping Study 2014. The route options were considered to fall within three broad corridors defined as within western (Brown and Purple routes), central (Red and Blue routes) and eastern (Green and Orange routes) corridors, and concluded that a central option is likely to offer the preferred corridor because:

- It would provide the most direct link between the NDR and A47 and therefore deliver the greatest transport benefit for strategic traffic;
- The eastern options had become limited by the (subsequently constructed) Queen's Hills developments; and
- The western options did not appear to achieve the stated objectives.

4.5.4 The routes are illustrated on Plate 4-2.

4.5.5 In consideration of a public transport option (or options) as an alternative to road building, criteria were set for a bus service, including:

- Providing an alternative to the car between A1067 and A1174;
- Minimising overlap with existing services;
- Providing a more direct link to key trip attractors; and
- Being realistic in terms of service level relative to potential patronage.

4.5.6 A single option was derived, which required one additional bus route, to extend the existing park and ride service between the Costessey Park and Ride and the University Hospital area, such that it would also serve Costessey and Taverham and, potentially, the Queen's Hills/Longwater area. The 2016 Report noted that the Scoping Study 2014 concluded that this option would improve access within these areas but would not address traffic concerns in the villages further west, namely Weston Longville and Weston Green in the Wensum Valley. It was also likely to have a neutral or slightly positive impact on the environment.

4.5.7 Using the Scoping Study 2014 as a basis for discussion, meetings were held with both the Environment Agency and Natural England during summer 2016. The impact of the crossing of the River Wensum was the primary concern for both the Environment Agency and Natural England; the key points from these meetings were summarised as:

- A minimal number of piers in the floodplain;
- No piers within the water and no impact upon the bank;
- Loss of flood storage in the flood zone would require compensation;
- Surface water treatment will need to be to a high standard; and
- The development is not unacceptable in principle, but the right balance with sustainable development is required.

4.6 Norwich Western Link Technical Report 2017

4.6.1 The Norwich Western Link Technical Report 2017 focussed on the need for the scheme as part of a wider strategy, describing the outputs from initial traffic modelling to present the challenges and likely economic benefits associated with a Norwich Western Link (NWL) (in earlier technical reports referred to as a Western Link Road), and explored the potential engineering solutions to identify a number of possible options and wider considerations. The Report comprised the following:

- Strategic Context;
- Evidence Base;
- Potential Options;
- Initial Economic Appraisal;
- Summary;
- Recommendations; and
- Suggested Next Steps.

4.6.2 The Technical Report 2017 primarily considered the provision of a new link road from the A1067 to the A47 west of Norwich within a preferred 'central corridor' as suggested in the Technical Report 2016.

4.6.3 A notional route alignment, as shown in **Plate 4-3** below, was used to provide an indication of possible route length, type, and junction locations for the purposes of appraisal.

Plate 4-3 (source: Norwich Western Link Technical Report 2017)

4.6.4 The Technical Report 2017 identified 13 preliminary engineering solutions to carry a NWL across the River Wensum Valley, as follows:

- Steel Composite Box Girder;
- Composite Steel / Concrete Twin Plate Girder;
- Constant Depth Trapezoidal Concrete Box Girder - Constructed by Launching or Gantry;
- Green / Living Bridge;
- Tunnel;
- In situ Concrete Balanced Cantilever;
- Embankments with Bridge over river;
- Composite Steel / Concrete Multiple Girder;
- Half through Steel Plate Girder;

- Cable Stay;
- Tied Arch / truss bridge / bow string;
- Composite Pre-cast Concrete; and
- Constant Depth Concrete Box Girder.

4.6.5 These preliminary engineering solutions were then evaluated in relation to the aesthetic and environmental impacts that these structures may have on the area and were scored on constructability, aesthetics and environmental considerations within an option design matrix.

4.6.6 This review identified four potential options that could deliver the most appropriate solution for crossing the River Wensum and floodplain. These were:

- Steel Composite Box Girder Bridge;
- Composite Steel / Concrete Twin Plate Ladder Girder Bridge;
- Constant Depth Trapezoidal Concrete Box Girder Bridge; and
- Tunnel.

4.6.7 The bridge options presented were selected to allow relatively long span lengths to reduce the number of piers within the flood plain of the River Wensum. All bridge options incorporated a clear span over the river and its banks, although construction activity would have been required within the flood plain.

4.6.8 The four options were presented to Natural England and the Environment Agency in July 2017.

4.6.9 The following key points were specifically noted by both the Natural England and the Environment Agency as positive contributions to the design for the three bridge options:

- It was acknowledged that there was no construction upon the riverbanks which was a key concern from previous consultation;

- It was welcomed that the embankments and bankseats (abutments) are not within the floodplain; and
- A significant soffit height of the bridge above the watercourse would reduce the degree of shading beneath.

4.6.10 Natural England and the Environment Agency noted specific considerations for a bridge option. These are detailed in **Table 4-1**, along with how they were later considered and responded to by the Applicant during the scheme development.

Table 4-1 NWL Technical Note 2017 NE and EA comments

Natural England and Environment Agency Comment	Scheme Response to comments
Highway runoff is likely to require a high degree of treatment to both remove routine highway pollutants, but also to provide treatment/containment in case of a pollution event/spillage.	The treatment train has been considered as part of the Drainage Strategy (Document Reference 4.04.00) submitted as part of the Planning Application.
It was queried whether salt spray could result in an impact upon the River Wensum, and this would require additional assessment.	A salt spray assessment has been undertaken and reported in **Chapter 12: Road Drainage and Water Environment** (Document Reference 3.12.00).
Smaller, thinner piers were preferable from the perspective of flood water attenuation, and this should be considered as the design progresses.	The design refinement has looked to minimise the number of piers (and other infrastructure) in the flood plain and the flood risk assessment has identified suitable flood water attenuation included in the design. As outlined in the Design and Access Statement (paragraph 4.5.18 – 4.5.19) (Document Reference 1.02.00), the pier shape and size are governed by engineering requirements though visual impact of the structure in the landscape is a principle of the design.
Greater information on the construction process should be included in any future optioneering.	Construction processes continued to inform optioneering and design refinement.
A significant number of species surveys are likely to be required in order to provide sufficient information to inform the assessments.	A comprehensive suite of ecological surveys has been undertaken to inform the Environmental Statement.
Opportunities for environmental enhancement should be sought.	As part of the Environmental Statement opportunities for enhancement have been explored and included.

4.6.11 Both the Environment Agency and Natural England were supportive of the progress that had been made with the potential options since consultation in 2016, and continued liaison during the adoption of a preferred alignment was recommended.

4.6.12 The Report suggested that a tunnel option, once operational and all mitigation established, would be likely to have a minimal impact on the Wensum Valley environment above ground level as there would be no structure present. However, the Environment Agency and Natural England raised concerns about a tunnel structure interrupting the flow of groundwater to the River Wensum, which could compromise the Water Framework Directive objective for the groundwater body.

4.6.13 Modelling work was completed to provide an indicative assessment of a possible dual or single carriageway NWL. This work was based on an assumed alignment **Plate 4-3** (which was not taken to be a preferred solution). The economic appraisal of the options, that assumed an indicative dual carriageway over large bridge structures to cross the Wensum Valley, provided a high value for money (vfm) rating (using Department for Transport guidance). An indicative single carriageway bridged solution would deliver low value for money. For a tunnel option, the dual carriageway option would deliver low value for money, and the single carriageway option would deliver poor value for money. It was noted that these outputs were based on initial appraisal work to assist decision making as to whether or not to continue with a NWL project.

4.7 Norwich Western Link Option Assessment Report March 2019 (updated from November 2018)

4.7.1 The Norwich Western Link OAR was produced in line with DfT guidance and identified a long list of 82 options, these were sifted down to create a short list of four main options.

4.7.2 The OAR was originally published in November 2018 with an updated version published in March 2019. The March 2019 update included

requests for additional options following the Environment, Development and Transport (EDT) Service Committee November 2018 after the original OAR was published, in particular the sub-option Option D east and a separate cost had been developed for an Option B variant. For consistency with the details published for consultation, the OAR was updated, in accordance with the EDT Committee request, to provide further details of the alternative Option variants for Option B and D Tunnel Option.

4.7.3 The OAR considered three tunnel options. A cut-and-cover tunnel option was considered to be the simplest from an engineering perspective. However, this approach was reported to potentially sever or significantly impact on groundwater flows within the floodplain of the River Wensum and also risk severing other waterbodies in the floodplain.

4.7.4 A bored tunnel using a tunnel boring machine was also considered. The OAR noted that this approach would have a high mobilisation cost (typically £15-20 million per tunnel boring machine). A bored tunnel was reported to be required to be deeper and therefore require long approach ramps from the tunnel, extending the cutting to a significant length beyond the tunnel portals.

4.7.5 A mined tunnel (excavated without removing the overlaying rock or soil) was reported in the OAR, where there would be challenges in excavating below the water table and also challenging to work in soft granular material/chalk.

4.7.6 In terms of alignment and layout, it was noted that the tunnel option would require long ramps after the tunnel portals to reach ground level whilst meeting standards on carriageway gradient, likely resulting in large land take. For the north side of the River Wensum, it was reported that there would likely be challenges connecting to the A1067 and it was expected that it could involve additional major works to the A1067 to connect.

4.7.7 These additional engineering and layout constraints were noted to likely result in a worse value for money outcome than reported for a tunnel option in Technical Report 2017.

4.7.8 For these reasons, the tunnel options were discounted at this stage.

4.7.9 A wide range of non-tunnel options were generated, covering a range of travel modes, approaches and scales as a potential means of addressing the specific objectives to be considered and appraised using the DfT's EAST tool, to identify a shortlist of options to take forward for further appraisal.

4.7.10 The option generation process led to an initial long list of 82 options, which encompassed a wide range of possibilities that spanned scale, transport modes and geography. The 82 options do not include tunnelling options which were discounted in the OAR 2017 report, with majority of reasons being cost and water resource impacts. The long list included both infrastructure and non-infrastructure interventions and improvements. These options are illustrated in the **Appendix D** of the OAR. A number of categories were created, within which each intervention was placed, as shown in **Table 4-2**.

Table 4-2 Long List categories and number of interventions

Category	Number of interventions
New link highways options	44
Network improvement schemes	8
Demand management	3
Active travel	8
Information	3
Freight	3
Public transport options	12

Category	Number of interventions
Do nothing	1
Total	**82**

4.7.11 The 82 options were subjected to the EAST process, as is good practice when preparing a Transport Business Case. EAST, the DfT's decision support tool, was adopted as the primary mechanism for evaluating options against a number of assessment criteria relevant to the decision-making process. It is intended as a means to summarise and present evidence in a consistent format on how options perform and compare.

4.7.12 The EAST is designed to assess and compare all types of transport-related options, packages, strategies and plans, across all modes and geographies. Its flexibility allows options to be considered at the early stages of development. Questions are arranged to be consistent with the DfT's Transport Business Case principles, based around the best practice five-case model approach. These five assessment topics were:

- Strategic;
- Economic;
- Managerial;
- Financial; and
- Commercial.

4.7.13 Due to the sensitive nature of the study area, in terms of environmental considerations, an additional sixth assessment topic covering 'environmental' was added to support the EAST assessment. The options appraisal was expanded to consider a total of seven environmental areas which was consistent with later stages of the business case process and broadly compatible with the topic areas within Volume 11 of the Design

Manual for Roads and Bridges (DMRB). The additional environmental areas were:

- Air quality;
- Noise;
- Greenhouse gases;
- Landscape/townscape;
- Biodiversity;
- Cultural heritage; and
- Water environment.

4.7.14 The full appraisal of the 82 options can be found in the Norwich Western Link OAR (**Ref: 4.5**).

Option Sifting

4.7.15 The 82 options were scored against the six assessment topics (strategic, economic, managerial, financial, commercial, and environmental assessment topics) and a two-stage sifting process was undertaken. The first stage involved the removal of options which failed to perform at least as well as the “Do Nothing” option when compared against all assessment topics. The Do Nothing option included no new infrastructure.

4.7.16 Performance scoring was derived from the EAST, where individual scores were given against each of the criteria within the assessment areas for each option. These scores were combined and unweighted, giving equal regard to each of the assessment areas, allowing an indication of option performance. A decimal score of between a minimum of 0 and a maximum of 1 was calculated for each of the assessment topics with a combined overall maximum score of 6 available. The environmental area combined all environmental sub-topics (noise AQ etc.) into a single score (maximum of 1). Those options that performed worse than the “Do Nothing” option were discounted.

4.7.17 After the Round 1 sift, a total of 34 options remained, including 22 new link highway options, 5 network improvement schemes,3 active travel options, 3 public transport options and a freight option.

4.7.18 At this stage, it was also decided that new single carriageway highway link options would be omitted from the study. The Option Selection Report 2019 (See Section 4.8 below) went on to consider further and appraise single carriageway and dual carriageway options. All but Option A were shown to require the additional capacity offered by dualling in the 2040 forecast year. These options were discounted on the basis that dual carriageway options will produce the most robust assessment in consideration of potential land take, costing and environmental concerns. It should also be noted that dual carriageway options, in general, provide more benefit in terms of increased capacity and therefore network resilience, improved journey time and associated economic benefit and safer design. In terms of the issues with HGV movements the increased speed limit for HGVs on dual carriageways (60mph) as opposed to single carriageways (50mph) would significantly improve chances to attract HGVs to reassign away from local rat-running routes.

4.7.19 Discounting the single carriageway options removed a further eight options, resulting in a total of 26 options after Round 1. The remaining options were subsequently re-categorised into “Non-Highway Options”, “New Link Highway Options” and “Existing Link Upgrade Options”.

4.7.20 The 26 options and their respective performance scores against all the assessment topics are provided in **Table 4-3**. The “Do Nothing” option scored 3.61.

Table 4-3 Options (after Round 1 sift) with respective performance scores

Category	Option	Score
Do Nothing	Do Nothing Benchmark	3.61

Category	Option	Score
Non-Highway Options	Option 39: Improvements to existing junctions	3.36
Non-Highway Options	Option 40: Signing and lining improvements	3.91
Non-Highway Options	Option 41: Signal improvements	3.69
Non-Highway Options	Option 44: New / improved crossing points	3.71
Non-Highway Options	Option 49: Improvements to existing bus services (28, 29 and X29)	3.66
Non-Highway Options	Option 50: Improvements to existing bus services (23, 23A and 24)	3.66
Non-Highway Options	Option 55: Promote cycling schemes	3.74
Non-Highway Options	Option 58: Mobility as a service scheme	3.62
Non-Highway Options	Option 68: Lorry management strategy	3.74
Non-Highway Options	Option 74: New bus route connecting Dereham, Hellesdon and Norwich Airport	3.85
New Highway Link Options	Option 2: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (1A), dual	3.73

Category	Option	Score
New Highway Link Options	Option 4: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (2A), dual	3.73
New Highway Link Options	Option 6: A1067 Attlebridge to A47 west of Easton, 2014 Brown, dual	3.78
New Highway Link Options	Option 8: A1067 (west of A1067 / A1270 junction) to A47 west of Easton, 2014 Red, dual	3.77
New Highway Link Options	Option 10: A1067 (east of A1067 / A1270 junction) to A47 west of Easton, 2014 Blue (1), dual	3.67
New Highway Link Options	Option 12: A1067 / A1270 junction to A47 west of Easton, Blue (2), dual	3.67
New Highway Link Options	Option 16: A1067 / A1270 junction to A47 /A1047 Longwater Interchange, 2014 Orange (2), dual	3.62
New Highway Link Options	Option 20: A1067 / A1270 junction to A47 /A1047 Longwater Interchange, 2014 Orange (4), dual	3.62
New Highway Link Options	Option 28: North Tuddenham via Attlebridge, 2018 Road Alignment (1), dual	3.68
New Highway Link Options	Option 30: A47 Honingham to Attlebridge (1), 2018 Road Alignment (2), dual	3.73
New Highway Link Options	Option 32: A47 Honingham to Attlebridge (2), 2018 Road Alignment (3), dual	3.67

Category	Option	Score
New Highway Link Options	Option 70: Purple Line (2018 public consultation), dual	3.78
New Highway Link Options	Option 72: Blue Line (2018 public consultation), dual	3.73
New Highway Link Options	Option 80: Pink Line (2018), dual	3.82
Existing Link Upgrade Options	Option 75: Black Line (2018 public consultation) existing route – single carriageway upgrade	3.81
Existing Link Upgrade Options	Option 76: Black Line (2018 public consultation) existing route – dual carriageway upgrade	3.92

Comparison against specific objectives - 2019

4.7.21 In order to understand how the remaining 26 options performed with regard to the specific objectives, and their subsequent use in tackling the identified issues and need for intervention, performance scores were calculated for each of the remaining options. The 12 specific objectives were:

- S1 Reduce congestion and delay, and improve journey time reliability, on routes through the study area;
- S2 Improve network resilience and efficiency of the strategic and local transport network;
- S3 Reduce the number of HGVs using minor roads;
- S4 Make the transport network safer for all users (including Non-Motorised Users);
- S5 Encourage modal shift to more sustainable modes of transport;

- S6 Provide traffic relief (and reduce noise & emissions) within residential areas;
- S7 Enable improved accessibility to existing and new housing and employment sites;
- S8 Improve emergency response times;
- S9 Improve access to green space;
- S10 Not affect the ecological integrity of the River Wensum SAC;
- S11 Contribute to the improved health and well-being of local residents; and
- S12 Improve connectivity and accessibility to Norwich International Airport, NRP and NNUH.

4.7.22 For each of the 12 specific objectives, the likelihood of each option addressing the objective was scored on a scale of 1 (unlikely to address the scheme objective) to 5 (fully addresses the scheme objective). These scores were thereafter added together, and an overall percentage produced.

4.7.23 The 26 options, and their respective scores in addressing the specific objectives, are provided in **Table 4-4**. The "Do Nothing" option scored 27%.

Table 4-4 Options (after Round 1 sift) with respective performance scores

Category	Option	Score
Do Nothing	Do Nothing benchmark	27%
Non-Highway Options	Option 39: Improvements to existing junctions	68%
Non-Highway Options	Option 40: Signing and lining improvements	62%

Category	Option	Score
Non-Highway Options	Option 41: Signal improvements	45%
Non-Highway Options	Option 44: New / improved crossing points	52%
Non-Highway Options	Option 49: Improvements to existing bus services (28, 29 and X29)	60%
Non-Highway Options	Option 50: Improvements to existing bus services (23, 23A and 24)	60%
Non-Highway Options	Option 55: Promote cycling schemes	48%
Non-Highway Options	Option 58: Mobility as a service scheme	57%
Non-Highway Options	Option 68: Lorry management strategy	62%
Non-Highway Options	Option 74: New bus route connecting Dereham, Hellesdon and Norwich Airport	68%
New Highway Link Options	Option 2: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (1A), dual	83%
New Highway Link Options	Option 4: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (2A), dual	82%
New Highway Link Options	Option 6: A1067 Attlebridge to A47 west of Easton, 2014 Brown, dual	80%

Category	Option	Score
New Highway Link Options	Option 8: A1067 (west of A1067 / A1270 junction) to A47 west of Easton, 2014 Red, dual	85%
New Highway Link Options	Option 10: A1067 (east of A1067 / A1270 junction) to A47 west of Easton, 2014 Blue (1), dual	83%
New Highway Link Options	Option 12: A1067 / A1270 junction to A47 west of Easton, Blue (2), dual	85%
New Highway Link Options	Option 16: A1067 / A1270 junction to A47 /A1047 Longwater Interchange, 2014 Orange (2), dual	85%
New Highway Link Options	Option 20: A1067 / A1270 junction to A47 /A1047 Longwater Interchange, 2014 Orange (4), dual	85%
New Highway Link Options	Option 28: North Tuddenham via Attlebridge, 2018 Road Alignment (1), dual	75%
New Highway Link Options	Option 30: A47 Honingham to Attlebridge (1), 2018 Road Alignment (2), dual	78%
New Highway Link Options	Option 32: A47 Honingham to Attlebridge (2), 2018 Road Alignment (3), dual	78%
New Highway Link Options	Option 70: Purple Line (2018 public consultation), dual	80%
New Highway Link Options	Option 72: Blue Line (2018 public consultation), dual	80%
New Highway Link Options	Option 80: Pink Line (2018), dual	80%

Category	Option	Score
Existing Link Upgrade Options	Option 75: Black Line (2018 public consultation) existing route – single carriageway upgrade	63%
Existing Link Upgrade Options	Option 76: Black Line (2018 public consultation) existing route – dual carriageway upgrade	70%

4.7.24 A second round of sifting was undertaken. The lower score achieved by the non-highway options, in most cases, indicates that individually they would be less likely to achieve the specific objectives. For this reason, it was decided that the remaining non-highway link options would be set aside at this point, but would be assessed individually at a later stage.

4.7.25 The new highway link options were taken forward because they perform significantly better against the specific objectives. However, a further sifting exercise was required to further refine the remaining 16 options (The 14 'New Highway Link Options' and 2 'Existing Link Upgrade Options' in **Table 4-4** above) down to a shortlist of the best performing options.

4.7.26 A review of the new highway link options was undertaken looking at those which were competing geographically (on broadly similar alignments) to remove options that performed less well than directly competing alignments.

4.7.27 For example, Option 4 did not perform as well as Option 2, which had a similar alignment. Compared with Option 2, Option 4 crossed the strategic gas main and had a significant impact on a County Wildlife Site (CWS), intersecting it on two separate occasions. In addition, Option 4 connected to the A47 at Honingham, which did not align with the proposed National Highways' A47 Road Investment Strategy scheme at that time. For these reasons Option 4 was discounted.

4.7.28 The review of Option 6 found that it did not perform as well as the other options, and it was subsequently discounted. This was due to the

alignment running adjacent to the extra high voltage (EHV) pylons for the longest distance. This would impact the feasibility and cost of implementation of this option, due to building within close proximity of the EHV pylons and the associated risks. In addition, Option 6 also had the biggest impact on CWSs, severing a large CWS in two.

4.7.29 Option 10 and Option 12 were discounted due to the cost of the proposed crossing of the River Wensum for these options which would also be significant due to challenging levels. Furthermore, these options run adjacent to the River Wensum for a significant distance, resulting in a greater potential to pollute the watercourse and increased risk. Furthermore, both options were likely to have significant commercial impact affecting the overall scheme cost.

4.7.30 Option 16 and Option 20 would have similar issues to Option 10 and Option 12 with regard to the River Wensum crossing and the alignment being adjacent to the water course for a significant length, introducing a greater risk of pollution during construction. The topography along these routes would also be more challenging due to the steeper valley sides and substantial level differences. These options also connected to the A47 at the Longwater interchange and would drive significant traffic through the Longwater junction, potentially exacerbating existing congestion issues. In addition, through the Longwater Business Park and due to recent development, there may have been feasibility issues with respect to providing a dual carriageway. Option 16 was also noted as potentially impacting upon ancient woodland. As such, both Option 16 and Option 20 were discounted.

4.7.31 Option 28 had the longest alignment of the retained options, and intersected the A47 west of Hockering, which did not align with the National Highways' A47 scheme. It was considered likely to attract fewer trips than options located further east, as demonstrated by traffic modelling. Consequently, this option would be less likely to support the specific

objectives and was considered less likely to deliver an acceptable Benefit Cost Ratio (BCR) and gain wider public support, thus it was discounted.

4.7.32 Option 30 was discounted as it was likely to affect more properties than the other similar options, as it passes close to settlements and within proximity to many farm buildings. This option also ran directly underneath the EHV pylons, which may impact the feasibility and cost of implementation, due to the pylons being immovable. There were also potential issues with the proposed alignment of Option 30. The proximity to Wood Lane near to the junction with The Broadway was likely to result in severance of the road network and directly impact upon farms and the connectivity between dwellings and land.

4.7.33 Option 32 would have crossed the strategic gas main on two separate occasions, increasing overall scheme cost and risk. As a result, this option was discounted.

4.7.34 Option 70 was discounted due to the alignment crossing the strategic gas main and Orsted cable route at their intersection, which would likely result in significant cost and risk to the project. In addition, the alignment of this option is reliant on an existing stretch of Taverham Road between residential properties and near to listed buildings.

4.7.35 Option 72 compared closely with Option 8 due to the similar alignment of the routes. When comparing the two options, it was noted that Option 72 ran adjacent to the Orsted cable route for a significant length which would increase associated risk of impact. The alignment of Option 72 is also longer in length by approximately 600m leading to higher associated construction costs and potentially less journey time benefits. In terms of topography, the alignment of Option 8 was also noted as having a slightly less significant height variation over the entire length of the route. While its alignment was similar to Option 8, Option 72 performed worse in relation to engineering constraints and was therefore discounted.

4.7.36 During the sifting exercise, a total of 56 options were discounted following Round 1, and a further 12 options were discounted following Round 2. **Appendix 4-2** provides the outcome of the sifting exercise, confirming which options were discounted and the main reasoning for being discounted at the OAR stage.

4.7.37 The non-highways options in general scored lower against the specific objectives compared with highways options, indicating that individually they would be less likely to achieve the specific objectives. For this reason, it was decided that the remaining non-highway link options would be carried through as potential additions to the Proposed Scheme which could be used as supplementary measures in association with the shortlisted highways options.

4.7.38 The existing link upgrade options comprised either single carriageway (Option 75) or dual carriageway (Option 76) with upgrades to the B1535 from the A47 east of Hockering to the A1067 at Lenwade, and the A1067 to the A1270 junction. Traffic modelling indicated that a link broadly following the existing B1535 alignment would attract lower volumes of traffic compared to new links further east, but the baseline study highlighted that this route could potentially benefit from geometrical upgrades. The early round of public consultation also highlighted a significant voice in favour of upgrading existing routes with about one third of respondents supporting this concept.

4.7.39 Option 75 was therefore retained, as it would adequately facilitate the forecast flows associated with a single carriageway link further to the west and would take advantage of the existing single carriageway while offering continuity of network conditions with some sections of new alignment. The lower costs associated with the single carriageway option would provide a greater BCR than the dual carriageway option on the same alignment (Option 76), with lower future maintenance costs, but also less additional capacity. The single carriageway option had the benefit that it used the existing bridge at Attlebridge rather than requiring a new viaduct structure

crossing the River Wensum. A dual carriageway variant of this option would require a new and more elevated bridge on the A1067 at Attlebridge which would increase costs. The dual carriageway variant (Option 76) was therefore discounted. However, due to the significantly longer route from A47 to A1270 offered by Option 75, journey time savings were expected to be lower than for other more direct offline route options. A single carriageway would also have a lower speed limit and an online solution would be more disruptive during construction.

Sifting Outcome

4.7.40 Following the sifting process, a shortlist of options consisting of three new highway link options, one existing link upgrade and 10 non-highway options were shortlisted.

Non-Highways Options:

- Option 39: Improvements to existing junctions;
- Option 40: Signing and lining improvements;
- Option 41: Signal improvements;
- Option 44: New / improved crossing points;
- Option 49: Improvements to existing bus services (28, 29 and X29);
- Option 50: Improvements to existing bus services (23, 23A and 24);
- Option 55: Promote cycling schemes;
- Option 58: Mobility as a service scheme;
- Option 68: Lorry management strategy; and
- Option 74: New bus route connecting Dereham, Hellesdon and Norwich Airport.

New Highway Link Options:

- Option 2: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (1A), dual carriageway;
- Option 8: A1067 (west of A1067 / A1270 junction) to A47 west of Easton, 2014 Red, dual carriageway; and
- Option 80: Pink Line (2018), dual carriageway.

Existing Link Upgrade Option:

- Option 75: Black Line (2018 public consultation) existing route – single carriageway upgrade.

4.7.41 A comparison of the shortlisted options against the specific objectives was undertaken and the result presented in **Table 4-5** below.

Table 4-5 Specific objective appraisal of shortlisted options (source: Norwich Western Link OAR 2019)

Objectives	Reduce congestion and delay and improve journey times reliability on routes through the study area	Improve network resilience and efficiency of the strategic and local transport network	Reduce the number of Heavy Goods Vehicles using minor roads	Make transport network safer for all users (including Non-Motorised Users)	Encourage modal shift to more sustainable modes of transport	Provide traffic relied (and reduce noise & emissions) within residential areas	Enable improved accessibility to existing and new housing and employment sites	Improve emergency response times	Improve access to green space	Not affect the ecological integrity of the River Wensum SAC	Contribute to the improved health and well-being of local residents	Improve connectivity and accessibility to Norwich International Airport, Norwich Research Park and Norfolk & Norwich University Hospital
New Highway Link Options Option 2	5	5	5	4	2	5	4	5	5	3	3	4
New Highway Link Options Option 8	5	5	5	4	2	5	5	5	5	3	3	4
New Highway Link Options Option 80	5	5	5	4	2	4	4	4	5	3	3	2
Non-Highways Options Option 39	3	3	5	4	2	3	3	4	3	5	3	3
Non-Highways Options Option 40	3	3	5	4	1	3	1	3	3	5	3	3
Non-Highways Options Option 41	4	4	1	4	1	2	1	4	1	3	1	1
Non-Highways Options Option 44	1	1	1	4	4	4	2	1	3	3	5	2
Non-Highways Options Option 49	3	2	1	3	5	4	2	1	3	5	4	3
Non-Highways Options Option 50	3	2	1	3	5	4	2	1	3	5	4	3
Non-Highways Options Option 55	1	2	1	2	5	2	1	1	3	5	5	1
Non-Highways Options Non-Highways Options Option 58	2	2	1	4	5	2	4	1	3	5	3	2

Objectives	Reduce congestion and delay and improve journey times reliability on routes through the study area	Improve network resilience and efficiency of the strategic and local transport network	Reduce the number of Heavy Goods Vehicles using minor roads	Make transport network safer for all users (including Non-Motorised Users)	Encourage modal shift to more sustainable modes of transport	Provide traffic relied (and reduce noise & emissions) within residential areas	Enable improved accessibility to existing and new housing and employment sites	Improve emergency response times	Improve access to green space	Not affect the ecological integrity of the River Wensum SAC	Contribute to the improved health and well-being of local residents	Improve connectivity and accessibility to Norwich International Airport, Norwich Research Park and Norfolk & Norwich University Hospital
Non-Highways Options Option 68	3	4	5	4	1	5	1	3	2	4	4	1
Non-Highways Options Option 74	3	3	3	3	5	3	4	1	3	5	3	5
Existing Link Upgrade Options Option 75	3	3	4	3	3	4	3	2	3	3	4	3

Table Key : **5** – Fully addressed the objective, **4** – significantly / largely addressed the objective, **3** – moderately / somewhat addressed the objective, **2** – slightly / partially addressed the objective

1 – unlikely to address the objective

4.7.42 Based on the analysis in **Table 4-5** above, options 2, 8, 75 and 80 along with the Do-Nothing option were carried through for further analysis. To simplify the further analysis, the options were renamed running from west to east using A to D.

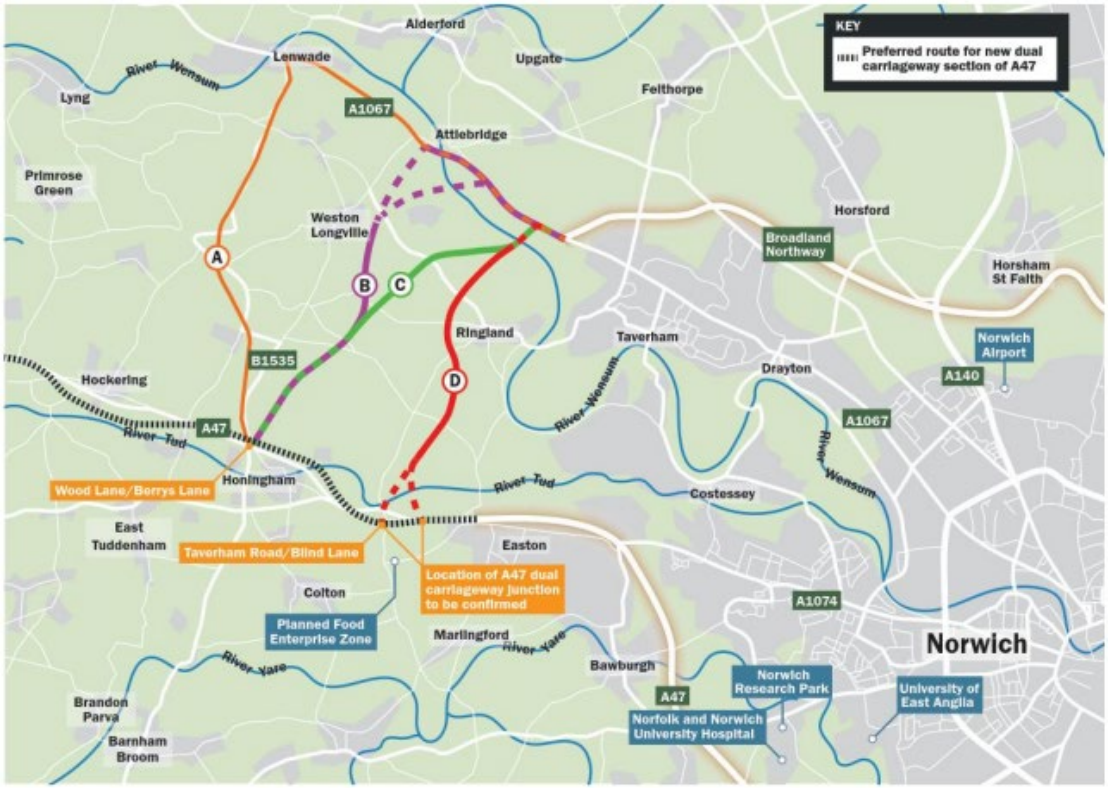
- Option A (orange) – previously Option 75 Black;
- Option B (purple) – previously Option 2. Two slight route alternatives at the northern end of the route were included to consider where the option could join the A1067. Option B East and Option B West;
- Option C (green) – previously Option 80 Pink; and
- Option D (red) – previously Option 8 Red. Two alternatives were added for how the option could join the A47. Option D East and Option D West.

4.7.43 Option B, previously route Option 2, which runs east of Weston Longville and links to the A47 at Wood Lane introduced two slight route alignment alternatives at the northern end of the route to consider potential options for where the route could join the A1067. Similarly, two alternatives are given for how Option D (previously Option 8) could join the A47; one at Taverham Road and one closer to Easton.

4.7.44 The option appraisal and sifting process used the scoring of the Do-Nothing option to facilitate sifting with only options scoring greater than the Do-Nothing (against EAST scoring and against strategic objectives) progressing through the sifting. The Do Nothing option was not progressed further on the basis that the remaining options scored higher than it. Later stages of the optioneering process used Do Nothing as a benchmark in order to provide a base from which to make comparisons.

4.7.45 The options which successfully progressed from the sifting process are shown on **Plate 4-4** below.

Plate 4-4 -Shortlist Highway Options (source: Norwich Western Link OAR 2019)



4.7.46 Key stakeholders were engaged through this process including Local Liaison Group workshops with Parish Council representatives and Member Working Group meetings. During 2017 and 2018 discussions were progressed with Natural England and the Environment Agency. This culminated in a meeting held in October 2018 where both were supportive of the progress that had been made with the proposals (of a viaduct over the River Wensum and floodplain) since consultation in 2016 and that a solution that does not materially impact the ecological integrity of the River Wensum SAC could potentially be achievable subject to appropriate assessment.

Comparison against specific objectives - 2021

4.7.47 As the Proposed Scheme progressed towards the Outline Business Case (OBC) stage, the original scheme objectives were reviewed within the Option Assessment Report (OAR) Addendum 2021, in accordance with WebTAG, to reduce the overall number of objectives to be more in-line with

those typically required at the OBC stage. It was determined that the original high-level objectives "Support sustainable growth" and "Support economic growth" were closely related and could be condensed into one high-level objective – "Support sustainable economic growth".

4.7.48 The Specific Objectives were also reviewed within the OAR Addendum, with the 12 original objectives condensed into six new Specific Objectives. The final High-Level and Specific Objectives were presented in Table 5-1 and Table 5-2 of the OAR Addendum, and are listed below:

- High-Level Objectives:
  - Support sustainable economic growth;
  - Improve the quality of life for local communities;
  - Promote an improved environment; and
  - Improve strategic connectivity with the national road network.
- Specific Objectives:
  - Improve connectivity and journey times on key routes within the Greater Norwich area;
  - Reduce the impacts of traffic on people and places within the Western area of Greater Norwich;
  - Encourage and support walking, cycling and public transport use in Greater Norwich;
  - Improve safety on and near the road network, especially for pedestrians and cyclists;
  - Protect the natural and built environment, including the integrity of the River Wensum SAC; and
  - Improve accessibility to key sites in Greater Norwich.

4.7.49 In line with the approach applied previously in the OAR, performance scoring was undertaken with the EAST matrix, where individual scores were given against each of the criteria within the assessment cases and environmental assessment for each option. These scores were combined and unweighted, giving equal regard to each of the cases, allowing an

indication of option performance. A decimal score of between a minimum of 0 and a maximum of 1 was calculated for each of the assessment cases with a combined overall maximum score of six available. Those options that performed worse than the "Do Nothing" option were discounted.

4.7.50 After the Round 1 sift, the same 34 options from the initial appraisal remained, including 22 new link highway options, five network improvement schemes, three active travel options, three public transport options and a freight option. The 34 options and their respective performance scores (from the original appraisal and the sensitivity test) against all the assessment cases are provided in Table 5-4 of the OAR and presented in **Table 4-6** below.

Table 4-6 Options (After Sift 1) with Respective Scoring - OAR Addendum

Type	Option	Previous Score	Sensitivity Test Score
Non-Highway Options	Option 39: Improvements to existing junctions	3.63	3.7
Non-Highway Options	Option 40: Signing and lining improvements	3.91	3.91
Non-Highway Options	Option 41: Signal improvements	3.69	3.76
Non-Highway Options	Option 44: New / improved crossing points	3.71	3.71
Non-Highway Options	Option 49: Improvements to existing bus services (28, 29 and X29)	3.66	3.72
Non-Highway Options	Option 50: Improvements to existing bus services (23, 23A and 24)	3.66	3.79

Type	Option	Previous Score	Sensitivity Test Score
Non-Highway Options	Option 55: Promote cycling schemes	3.74	3.81
Non-Highway Options	Option 58: Mobility as a service scheme	3.62	3.69
Non-Highway Options	Option 68: Lorry management strategy	3.74	3.67
Non-Highway Options	Option 74: New bus route connecting Dereham, Hellesdon and Norwich Airport	3.85	3.92
New Highway Link Options	Option 2: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (1A), dual	3.73	3.73
New Highway Link Options	Option 3: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (2A), single	3.66	3.66
New Highway Link Options	Option 4: A1067 Attlebridge to A47 west of Honingham, 2014 Purple (2A), dual	3.73	3.73
New Highway Link Options	Option 5: A1067 Attlebridge to A47 west of Easton, 2014 Brown, single	3.73	3.66
New Highway Link Options	Option 6: A1067 Attlebridge to A47 west of Easton, 2014 Brown, dual	3.78	3.78
New Highway Link Options	Option 7: A1067 (west of A1067 / A1270 junction) to A47 west of Easton; 2014 Red, single	3.73	3.73

Type	Option	Previous Score	Sensitivity Test Score
New Highway Link Options	Option 8: A1067 (west of A1067 / A1270 junction) to A47 west of Easton; 2014 Red, dual	3.77	3.84
New Highway Link Options	Option 9: A1067 (east of A1067 / A1270 junction) to A47 west of Easton; 2014 Blue (1), single	3.67	3.67
New Highway Link Options	Option 10: A1067 (east of A1067 / A1270 junction) to A47 west of Easton; 2014 Blue (1), dual	3.67	3.67
New Highway Link Options	Option 11: A1067 / A1270 junction to A47 west of Easton; 2014 Blue (2), single	3.62	3.62
New Highway Link Options	Option 12: A1067 / A1270 junction to A47 west of Easton; Blue (2), dual	3.67	3.67
New Highway Link Options	Option 16: A1067 / A1270 junction to A47 / A1047 Longwater Interchange; 2014 Orange (2), dual	3.62	3.62
New Highway Link Options	Option 20: A1067 / A1270 junction to A47 / A1047 Longwater Interchange; 2014 Orange (4), dual	3.62	3.62
New Highway Link Options	Option 28: North Tuddenham via Attlebridge (1), 2018 Road Alignment (1), dual	3.68	3.68

Type	Option	Previous Score	Sensitivity Test Score
New Highway Link Options	Option 30: A47 Honingham to Attlebridge (1), 2018 Road Alignment (2), dual	3.73	3.73
New Highway Link Options	Option 32: A47 Honingham to Attlebridge (2), 2018 Road Alignment (3), dual	3.67	3.67
New Highway Link Options	Option 69: Purple Line (2018 public consultation), single	3.78	3.71
New Highway Link Options	Option 70: Purple Line (2018 public consultation), dual	3.67	3.67
New Highway Link Options	Option 71: Blue Line (2018 public consultation), single	3.73	3.66
New Highway Link Options	Option 72: Blue Line (2018 public consultation), dual	3.73	3.73
New Highway Link Options	Option 79: Purple Line (2018), single	3.69	3.75
New Highway Link Options	Option 80: Purple Line (2018), dual	3.82	3.82
Existing Link Upgrade	Option 75: Black line (2018 public consultation), existing route, single	3.81	3.81
Existing Link Upgrade	Option 76: Black line (2018 public consultation), existing route, dual	3.92	3.86

Source: Table 5-4, Option Assessment Report Addendum, 2021

4.7.51 The result of the sifting carried out in the OAR Addendum demonstrated that the strategic case scoring altered slightly for a number of options as a result of consolidating the scheme objectives, and the outcome of the sifting process remained the same. Therefore, it was demonstrated that the sifting produced with the original objectives was still consistent with the preferred options selected.

4.8 Option Selection Report 2019

4.8.1 The further decision making on a Preferred Option was informed by both the Option Selection Report 2019 (OSR) and the accompanying Committee Report for the scheme, which considered the following shortlisted route options:

- **Route Option A**: Runs from the A47 at its junction with Wood Lane and Berrys Lane to the A1067 Fakenham Road, at its junction with Porters Lane and the B1535 to the south
- **Route Option B East**: Runs from the A47 at its junction with Wood Lane and Berrys Lane to the A1067 connecting to a new junction to the east of the existing junction connecting the A1067 to A1270
- **Route Option B West**: Runs from the A47 at its junction with Wood Lane and Berrys Lane to the A1067 connecting to a new junction near Attlebridge
- **Route Option C**: Runs from the A47 at its junction with Wood Lane and Berrys Lane to the A1067 Fakenham Road to the west of its junction with the A1270
- **Route Option D East**: Runs from the A47 to the east of its junction with Taverham Road to the A1067 Fakenham Road, at its junction with Porters Lane and the B1535 to the south

- **Route Option D West:** Runs from the A47 at its junction with Taverham Road to the A1067 Fakenham Road to the west of its junction with the A1270

4.8.2 The shortlisted options for consideration at OSR stage are presented in **Plate 4-4** above.

4.8.3 Within the OSR, each option was assessed against the strategic and local objectives using the following criteria:

- **Engineering:** An assessment of each shortlisted option in respect of land constraints, utilities interface, topography, tie in with the A47, departures from DMRB standards, drainage design and structural requirements.
- **Cost:** A total project cost was estimated for each option combining an estimate for base construction cost and a quantitative risk value for each option (due to the full scope of mitigations being unknown).
- **Traffic And Economic Assessment:** Traffic modelling was undertaken using the 2015 NATS model to assess the impact of proposed infrastructure associated with each of the shortlisted options. At the time of the OSR stage, the modelling was considered to be suitable for relative comparison of options, to inform the selection of a preferred option. DfT WebTAG methodology was used to inform an economic appraisal with an adjusted BCR calculated for each shortlisted option to determine the respective value for money. The traffic modelling was also used to inform the environmental appraisal for noise, air quality and greenhouse gases.
- **Environment (including Biodiversity):** An assessment of the noise, greenhouse gas, historic environment, water environment, geology & soils, landscape, air quality and biodiversity impacts of each option. The OSR assessment was carried out in accordance with TAG Unit A3 (December 2015) and was a desk-based appraisal

supported by some site survey. Known statutory designated environmental constraints at the time of the OSR had also been taken into account in the route development process.

- **Feedback from public consultation on shortlisted options:** Two rounds of consultation were undertaken presenting the shortlisted options to members of the public, affected landowners and key stakeholders. An analysis of questionnaire responses and more detailed narrative on responses from stakeholders was completed to determine the level of support for each of the shortlisted options.

4.8.4 A summary of the performance of the route options at OSR stage (July 2019) against these criteria is set out below.

Preferred route selection

4.8.5 **Engineering:** In order to understand the engineering requirements, preliminary design of each option was undertaken, which followed the design guidance in the DMRB applicable to roads of this nature. This involved an assessment of the schemes against nine separate criteria:

- Horizontal alignment, land use and constraints - how far each route avoids impact.
- Junctions and links – requirement and challenge of these.
- Topography and profile – challenge of terrain / requirement for large embankment and cuttings.
- Structures / bridges – complexity and number required.
- Drainage – drainage strategy requirements.
- Public utilities interaction – impacts on utilities with consideration of complexity and challenge of these.
- Junctions with A47 dualling scheme – ease of accommodation within current known Highways England proposals.

- Departures from standards – how physical constraints may affect design acceptability.
- Buildability – complexity of construction including online / offline works, with each option being ranked for performance.
- Route Option C ranked as the best performing option in six of the nine criteria, and the second best performing in a further two. It was ranked as the best performing route option from an engineering perspective. The second ranked scheme was Option B East, which did not perform as well under the assessment due to a poorer fit with existing topography (potential increase in volume of earthworks), the need to dual a greater length of the A1067 carriageway and possible departures from DMRB standards in respect of the design of the scheme.
- Option A performed poorly in respect of impact on existing land use, interface with utilities, buildability, and the need for the introduction of new or amendment of existing junctions. Option B West performed poorly due to the number of new structures/amendments to existing structures required, possible departures from standard and impact on land use.
- Both variants of Option D ranked lowest for engineering criteria due to complexity of the junction tie in requirements with the A47, a poor fit with existing topography (potential increase in volume of earthworks), the greatest number of new/amendment to existing structures and being the most complex to construct (with the inclusion of an additional viaduct over the River Tud).
- **Cost:** Option C was estimated as the third most expensive scheme**.** Option A was the least expensive option due to the utilisation of an existing highway link and a single carriageway solution. Option B West was the second least expensive option with no requirement to construct a new viaduct across the River Wensum. Option B East

was estimated to be slightly more expensive than Option C due to the requirement to upgrade a greater length of the A1067 from single to dual carriageway. Both variants of Option D were the most expensive, linked to the overall complexity of construction and tie in with the A47, the number of new structures and earthworks requirements.

- **Biodiversity:** The impact of each of the shortlisted options on biodiversity was presented in the OSR using the table presented in **Table 4-7** (Table 5.3.3 in the OSR). The biodiversity assessment considered the likely impact on the River Wensum (SAC), barbastelle bats, other statutory designations, non-statutory designations, habitats, and other protected / notable species. A constraints plan was used to inform the option selection process that included available baseline information for these features. Whilst the table items were not scored or weighted, likely impacts upon the SAC were given a more negative rating in the decision-making process given the legal protection afforded to this internationally designated site.

4.8.6 As per Table 8.2 of the OSR, Options C and both variants of Option D were assessed to be the better performing, being identified as having a 'large adverse' impact on biodiversity and ecological features, compared to Option B and Option A, which were assessed to have a 'very large adverse' impact on biodiversity and ecological features.

4.8.7 This conclusion was informed by the information displayed in **Table 4-7**, and recognised that Options C and Options D had lesser impacts upon the River Wensum SAC/SSSI and barbastelle bats using the information available. It was recognised however, that Route D would likely cause the greatest amount of habitat severance and fragmentation and Route C would cause habitat severance, notably affecting The Broadway.

4.8.8 **Environment:** Option A was considered likely to result in the lowest number of adverse noise impacts. Option C and Option B East were considered to offer the best balance in terms of adverse noise impacts and scheme benefits. Option B West and Option D were likely to provide the least desirable balance.

4.8.9 Option B East, Option C and Option D (both variants) were assessed to have a moderate adverse impact on the historic environment. Options B West and A were assessed as having a large adverse impact on the historic environment.

4.8.10 Option A was assessed to have a minor benefit on local air quality (compared to the do nothing). Option B (both variants) and Option C were considered to have a negative impact on local air quality in the long-term. Option D (both variants) resulted in the worst negative local air quality impact.

4.8.11 The assessment of greenhouse gas emissions for each option showed that Option A led to a net benefit in terms of emissions of greenhouse gases. The other options led to a dis-benefit of various levels. Option B West has the smallest dis-benefit. Option B East and Option C performed similarly (Option B East performed slightly worse than Option C). The variants of Option D led to the greatest emission of CO2 emissions. This was undertaken in line with TAG Unit A3.4 (31 May 2019) methodology which assesses the impact of the options as a result of traffic emissions using the road. The assessment does not include consideration of the embedded carbon from construction.

4.8.12 Options A and B West were assessed as having a minor adverse impact on the water environment. Option B East, Option C and Option D (both variants) were assessed to have a moderate adverse impact on the water environment.

Table 4-7 OSR Table 5.33 July 2019 Version. Containing assessment of impacts upon biodiversity features

Coding for Table 4-7

Key	Likely Impacts
R	Major
A	Moderate
B	Minor
G	Not applicable

Ecological Feature	A	B (Western variant)	B (Eastern variant)	C	D (Both variants)	Route with biggest impact
River Wensum SAC	B	R	A	A	A	Option B (Western variant)
Barbastelle bats	R	R	R	A	A	Option A and Option B
River Wensum Site of Special Scientific Interest (SSSI)	B	R	A	A	A	Option B (Western variant)
Ancient woodland – direct and indirect – approx. within 200m	B	G	G	B	A	Option D
Habitat of Principal Importance (HPI)	B	A	A	R	R	Option C and Option D
Woodland	B	A	A	R	R	Option C and Option D
County Wildlife Sites	B	B	A	A	R	Option D
Watercourses (excluding the River Wensum)	A	B	A	A	R	Option D
Habitat fragmentation	B	A	A	A	R	Option D
Pond loss	R	A	A	G	G	Option A
Reduction in HPI quality	B	A	A	A	R	Option D
Number of hedgerows dissected	A	A	A	A	A	Option B (Western variant)

4.8.13 **Traffic And Economic Assessment:** As part of the OSR, predicted traffic flow, journey time, and accident changes were analysed, and generally, all routes generated journey time savings for local roads nearest to them. Page 3 of the OSR confirms that Route Option C was modelled to attract around 31,700 vehicles per day so would benefit more traffic than Options B or D, which were predicted to attract 30,000 - 30,800 journeys per day. Option A would attract the least traffic of the four main options considered at this stage, with only about 9,800 vehicles expected to be attracted to benefit this option.

4.8.14 The economic assessment showed that Options C, B East and B West represented high value for money schemes, with Option C having the highest BCR. Both variants of Option D represented medium value for money and Option A offered low value for money.

4.8.15 **Public Consultation:** Two rounds of public consultation involving a range of stakeholders were undertaken as part of the option selection process and recorded in the OSR. The first round of consultation established that there was public support for a 'western link' in principle, with the majority of respondents indicating that they thought a highway solution would best solve the traffic issues in the study area, supported with complementary non-highway measures to improve options for sustainable local travel. **Figure 7.7** of the OSR details the level of support for each of the shortlisted options from the second round of public consultation. Option D was the most supported option and Option C was the second most supported option. Options B and A received significantly less support compared to Options C and D.

Conclusion of the Preferred Route Selection process

4.8.16 The conclusion of the Option Selection Process was that Route Option C was chosen. From a connectivity perspective, the Option C horizontal alignment was well supported by members of the public as it offered good connectivity between A47 and A1270 and would encourage strategic traffic to avoid the villages in the west of Norwich with a more direct route from

Wood Lane to Broadland Northway, avoiding Ringland and Weston Longville. This route links well with the A47 North Tuddenham to Easton Improvement Scheme and a connection to Wood Lane was considered preferable to Taverham Road where there are residential properties (including listed buildings) close to the existing A47 junction. Option C was also considered to be less challenging to construct in terms of vertical alignment as it avoids the steep topography through Ringland Hills and avoids crossing the River Tud on an additional viaduct which was also preferred by the Environment Agency.

4.8.17 Option C was therefore considered to offer the optimum solution and it was also assessed as being the route that was most acceptable to local stakeholders in the vicinity of the scheme. This is because Option C was positioned broadly equidistant between the nearest villages of Ringland and Weston Longville, whereas Option D is close to Ringland and Option B is close to Weston Longville. Option C was considered to offer a more equitable solution for the local communities.

4.8.18 In considering the project objectives, it was noted that Option C:

- Has received significant public support;
- Provides 'high' value for money (as defined in DfT guidance);
- Balances the significant environmental issues (with no direct impact to the River Wensum Special Area of Conservation designation);
- Limits environmental impacts (with provision of appropriate mitigation);
- Promotes cycling and walking on the existing local roads due to the reduction in vehicular traffic;
- Provides significant journey and transport benefits and improved network resilience;

- Supports the delivery of future growth by providing appropriate infrastructure;
- Minimises property and community impacts;
- Provides a high quality strategic and direct connection between the A47 strategic road network and A1270 major road network (also linking to Norwich Airport); and
- Improves access to NNUH, particularly for north and west Norfolk, and reduces emergency response times.

4.8.19 The report to Norfolk County Council Cabinet July 2019 concluded (at Paragraph 4.4.7) that: '*it is recommended that Option C is taken forward as the Preferred Route as this offers a solution which offers good value for money, is publicly acceptable, limits environmental impacts and is the least challenging option to deliver from an engineering and risk perspective.'*

4.8.20 The report recommended Route Option C be adopted as the preferred route option, as presented in **Plate 4-5** below and was the route taken forward for assessment in the development of the Application.

Plate 4-5 Plan of NWL Preferred Route (Option C)

4.9 Alignment Refinement Appraisal Report 2022

4.9.1 An Alignment Refinement Appraisal Report 2022 was prepared in 2022 to respond to data from the ecology survey programme and the discovery of a barbastelle bat maternity roost along the alignment. The conclusion of this appraisal is outlined below.

NWL scheme progress since preferred option selection: Ecological Surveys

4.9.2 After the selection of the preferred route, the development of the design progressed and, to inform this, a series of ecological surveys were undertaken as set out in Table 10-5 and Table 11-15 of the report. This included surveys for bats between 2019-2021.

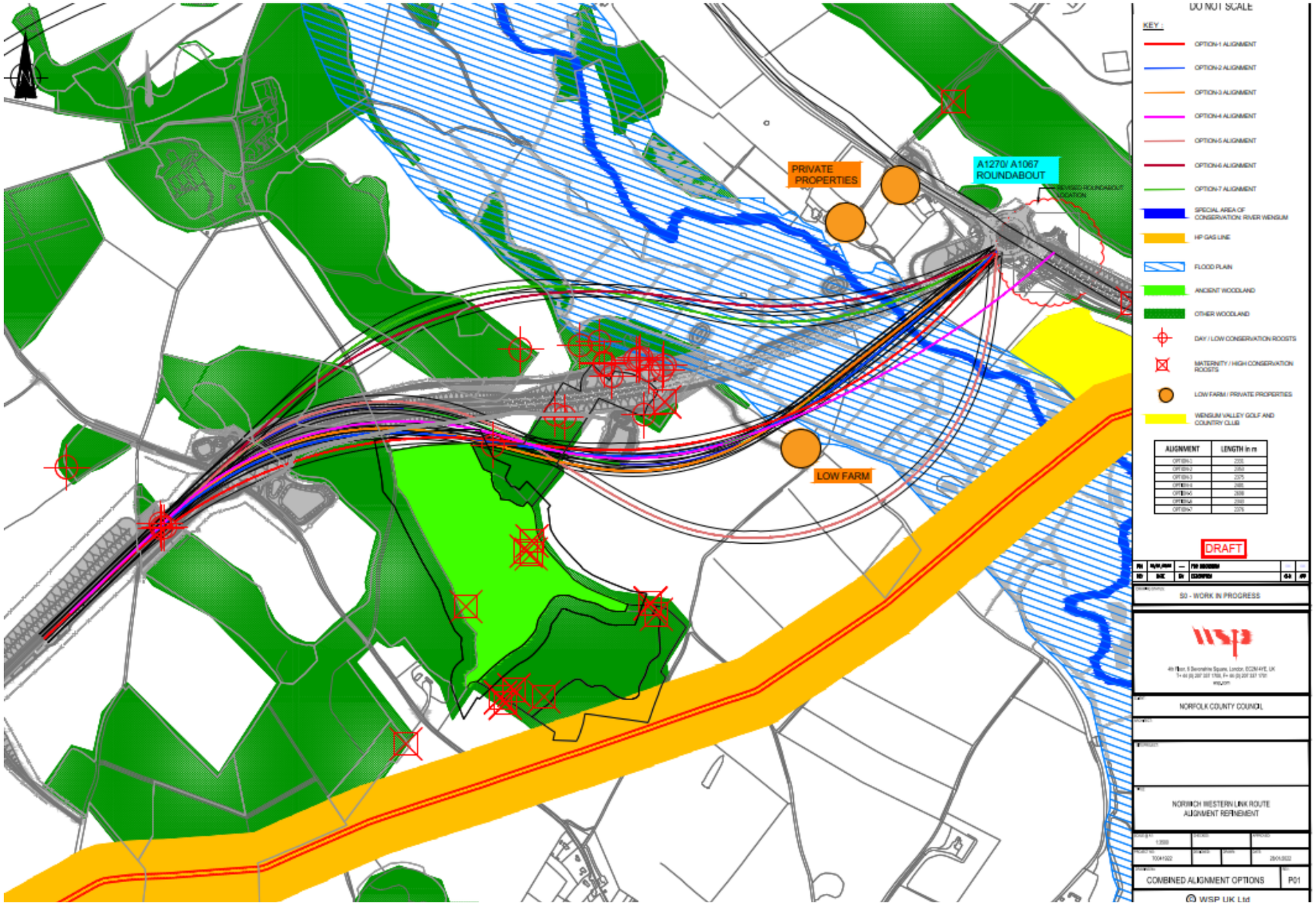
4.9.3 Building on previous years' surveys, in 2021, 22 barbastelles were tagged and tracked in May, June, and August to establish day roost locations, core and peripheral foraging areas and flight lines between roosts and foraging areas. A total of 28 barbastelle roosts were identified through these surveys. This included a barbastelle bat maternity roost associated with the Primrose Grove colony located within the site boundary (at the time) of the Preferred Route at Rose Carr.

4.9.4 Bats and their roosts are afforded strict legal protection, pursuant to the Habitats Directive and the Conservation of Habitats and Species Regulations 2017 and so in this context, refinements to the route were considered to avoid impacts to this maternity roost.

Alignment Refinement Exercise

4.9.5 An alignment refinement exercise was undertaken where seven alignment refinement options were created as outlined in **Plate 4-6** below and subject to an appraisal in line with the criteria applied in the OSR 2019.

Plate 4-6 Alignment Refinement Options



4.9.6 Further assessment on the refinement options was undertaken as follows:

- A further assessment of environmental impacts following methods used in the 2019 OSR, taking into account further baseline data gathered since selection of the preferred route;
- An assessment of the change in total project cost of the refinement options; and
- As assessment of the engineering viability of the refinement options.

4.9.7 The results of the above assessments were used to determine the most suitable alignment refinement of the Preferred Route.

4.9.8 All refinement options assessed achieved the outcome of avoiding direct impact on the barbastelle bat maternity roost within Rose Carr and were considered feasible in terms of incorporating mitigation to maintain habitat connectivity. Refinement Options 4 and 5 were considered favourable as they were assessed to result in the lower loss of woodland resource for barbastelle.

4.9.9 Refinement Option 4 was assessed to have a lesser impact on the River Wensum SAC and other ecological habitats. Option 5 was considered to have a greater impact on the River Wensum SAC and floodplain habitat as a result of the wider, longer, curved viaduct needed to span the River Wensum and floodplain, including a greater potential for shading impacts on the river. Options 6 and 7 were also assessed to have a greater impact on the River Wensum SAC and associated habitats in comparison to Option 4.

4.9.10 Options 1 to 3 were shown to directly impact the Primrose Grove ancient woodland, with a need to remove trees to construct the highway. Options 4 and 5 maintain a buffer distance from the ancient woodland, whilst Options 6 and 7 avoid impacts and were furthest away from the ancient woodland. However, whilst Options 6 and 7 avoid the impact on ancient woodland

they were shown to perform worst for most other ecological and environment criteria.

4.9.11 The requirement for a wider, longer viaduct structure for Option 5 means that it was assessed to have the greatest negative impact on the landscape and on visual receptors. Options 1 to 4 were assessed to have a more adverse impact on cultural heritage; namely, the Grade II listed Barn 50m north west of Low Farm House compared to the other options. Options 1 to 4 would also likely require the purchase of a residential property that would not be returned to residential use.

4.9.12 From the engineering and cost assessments of the refinement options, Option 4 was assessed to be more buildable and less expensive than Option 5. Again, this was mainly a consequence of the viaduct size for Option 5. Whilst Options 1 to 3 were considered more buildable and less expensive than Options 4 and 5, they were not favourable from the ecological and environment perspective. Options 6 and 7 were assessed to be the least buildable and the most expensive refinement options.

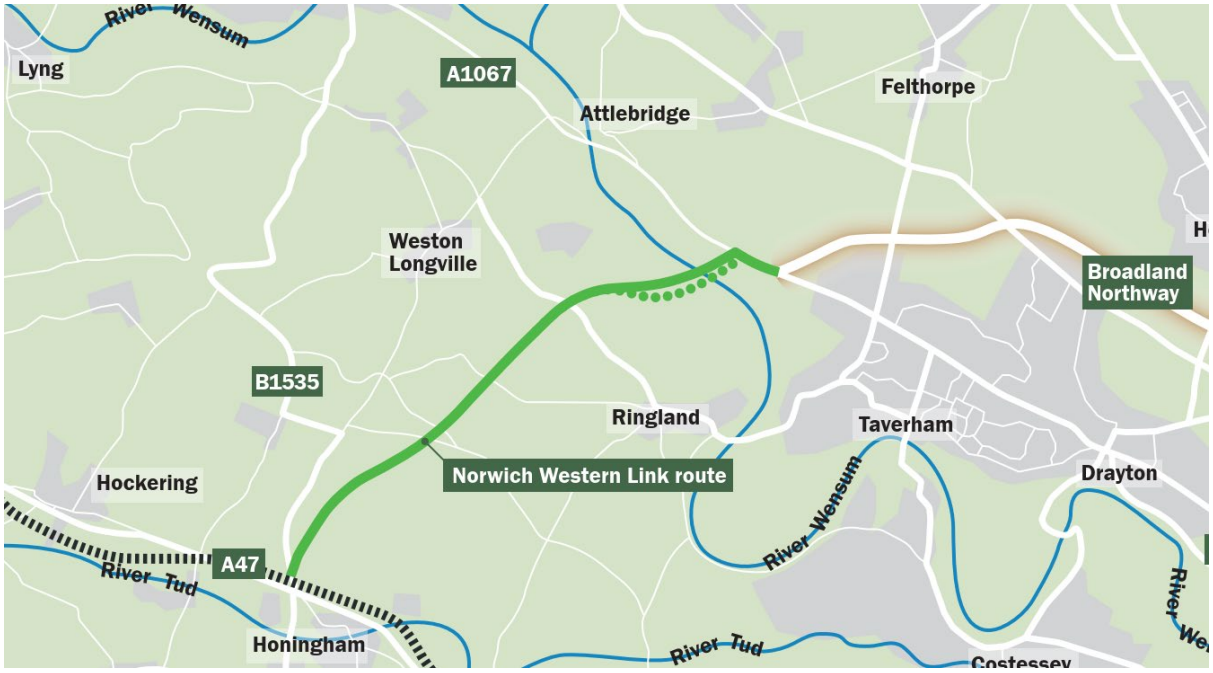
4.9.13 From the information assessed throughout the report, the additional adverse environment impacts, greater expense, and more challenging buildability of Option 5 were considered to amount to a clear and convincing reason for preferring Option 4 as the most suitable refinement of the previous preferred route.

4.9.14 The Option 4 realignment of the preferred route was also considered to continue to meet the high level and specific objectives of the NWL scheme. It was noted that it would need to be demonstrated as part of the EIA for the planning process that the choice of Option 4 was adequately justified having regard to its potential adverse effects, in the light of all relevant matters, including both its performance across a range of environmental, engineering, and cost factors, and potentially revisiting discarded options that remained feasible.

Appraisal Conclusion

4.9.15 On balance, refinement Option 4 was selected as the most suitable alignment refinement of the Preferred Route. This is presented by the dotted green line on **Plate 4-7** below. The considerations noted in paragraph 4.9.14 were taken forward in the appraisal exercise noted in section 4.10 below.

Plate 4-7: Chosen refinement of previous preferred route (refinement represented by dotted green line) (source: Alignment Refinement Appraisal Report 2022)



4.9.16 The refined alignment at the northern end of the scheme was approved by Cabinet on 4th July 2022.

4.10 Review of OSR Conclusions in Light of 2022 Alignment Refinement

4.10.1 In light of the refinement of Option C as set out above, a reassessment of the options considered in 2019 was undertaken to establish if the 2019 conclusions remain the same in light of the refinements undertaken to Option C, and changes in knowledge of the baseline.

4.10.2 This exercise is described in **Appendix 4.3**: Review of OSR Conclusions in Light of 2022 Alignment Refinement (Document Reference 3.04.03) and a summary is set out below.

4.10.3 The reassessment exercise involved a proportional appraisal of the refined route of Option C (the Option 4 refinement of Option C is now referred to as 'Option C Refined') against Option C from the OSR in 2019 to determine how the alignment refinement and work to inform the ES has impacted how this route option scored. The scoring was undertaken to a similar level as the OSR 2019 to allow an appropriate level of comparison.

4.10.4 This exercise demonstrated that Option C Refined and Option C in the OSR 2019 score similarly in most topics with the exception of bats, ancient woodland, Habitats of Principal Importance and the historic environment. In summary:

- The score for Option C was upgraded to major adverse since the OSR as the surveys identified the barbastelle maternity roost at Rose Carr (the driver for the alignment refinement). The Option C Refined route avoided this roost resulting in a better score of moderate adverse.
- As a result of further assessment in the ES, Option C Refined scored a major adverse impact on ancient woodland as a result of air quality impacts. This was due to the alignment refinement bringing the route close to the ancient woodland. Option C being set further away, would result in a lower air quality impact on the ancient woodland.

- With the Option C Refined avoiding Rose Carr woodland, Option C Refined was reported as having a lower impact on Habitats of Principal Importance compared to Option C.
- For the Historic Environment, Option C Refined potentially reduces the overall impact to designated heritage assets at the Morton Hall Estate. However, Option C Refined brings the alignment and viaduct closer (approximately 45m away) to the Grade II listed Barn 50m north west of Low Farm House. However, this did not result in a change to the overall moderate adverse impact previously reported for Option C.

4.10.5 After this exercise the conclusions in respect of the other OSR Options (Option A, Option B (both variants) and Option D (both variants) were revisited in light of the appraisal of Option C Refined to see if Option C Refined remained the best performing option.

4.10.6 As outlined in **Appendix 4.3**, on reconsideration of Option A this option remained discounted due to its impacts on bats and the historic environment. Option B West remained discounted due to the impacts on the historic environment and engineering. Option D (both variants) remained discounted with reasons including its impacts on engineering, biodiversity air quality, noise and greenhouse gasses.

4.10.7 Option B East impacts (moderate adverse) a greater number of heritage assets than Option C Refined including some with a higher Grade I and Grade II* listing, with Option B East impacting 6 assets compared to 1 for Option C Refined. In terms of Biodiversity, Option B East would have a lower impact on ancient woodland (as a result of air quality impacts) than Option C Refined given the greater distance between Option B East and the ancient woodland. Option B East and Option C Refined both lie in proximity to confirmed barbastelle roosts and bisect foraging and commuting habitat. Whilst Option B East would likely require less woodland loss than Option C Refined (approximately 8ha compared to 16ha), both options impact the roost resource either known or likely to be used by bat

species including barbastelle. Although the extent of habitat types of value to bats impacted by the respective options differs, in both cases mitigation to reduce impacts associated with habitat fragmentation would be required. Option B East would require an increased length of the Fakenham Road to be dualled compared to Option C Refined. The greater length of dualled road would likely require mitigation to reduce effects of north-south habitat fragmentation. This would require substantial engineering consideration given the topography and increase overall land take for the scheme. For Option C Refined, this includes mitigation to retain habitat connectivity, specifically at The Nursery. As set out in Appendix 4.3, further bat survey was completed for Option B East during the winter period 2021-22 to enable an objective comparison with Option C Refined. In summary, whilst there is greater certainty of the impacts Option C Refined will have upon barbastelle and other bat species, the data collected does not indicate that this will necessarily be greater or lesser than the impact of Option B East.

4.10.8 Option C Refined provides a more efficient route than Option B East in traffic and transport terms. Option C Refined offers greater separation of traffic from the villages of Ringland and Weston Longville in comparison with Option B East. The Option B variants received lower consultation support in 2019 compared to Option C.

4.10.9 On balance, Option C Refined was still considered to present the better alignment option overall.

4.11 Consideration of a Package of Non-Highway Options

4.11.1 When the OAR was completed in 2019, it was decided that it would not be proportionate to the level of assessment to consider a package of the non-highway links as a reasonable alternative to the preferred option, given the lower aggregate scores that they achieved against the scheme specific objectives at that time. However, given that the preferred option has undergone significant detailed investigation, including the alignment refinement, a package of the non-highway options previously considered has been re-considered as to whether this presents a viable alternative to the latest preferred option.

4.11.2 Although not part of the Proposed Scheme, the Applicant is in parallel producing a package within the Sustainable Transport Strategy (STS) (Document Reference: 4.02.00) that includes Complementary Sustainable Transport Measures similar to some of the non-highway options considered at the OAR stage. Therefore, to an extent, a package of non-highway options has been provided in addition to the Proposed Scheme, which in no way replaces the need for the NWL, but endeavours to enhance the impact of the scheme to meet the objectives that are not as strongly met by the core scheme. The Proposed Scheme is also considered to be complementary to the Transport for Norwich (TfN) strategy which focusses on providing sustainable lower cost alternative mode options within Norwich city centre and on key radial corridors into Norwich, and also partially offers some of the elements, which were considered at the OAR stage of the project. In this context it would be duplicative to now include some of those same scheme components considered previously.

4.11.3 For clarity, detailed estimation of the capital and ongoing maintenance cost of the proposed non-highway link options has not been carried out. They have also not been designed and therefore accurate benefits have not been quantified. This means that a benefit-cost ratio for the non-highways package has not been produced. However, **Table 4-8** describes the

benefits of the non-highway options in relation to the preferred option with a qualitative assessment.

4.11.4 It is apparent that the non-highway package would minimise effects on the River Wensum SAC in comparison with the Proposed Scheme. However, doing nothing would also score well in this regard but would also not address the issues the Proposed Scheme is intended to resolve. Impacts to the River Wensum SAC are considered in more detail via the HRA and EIA processes for the Proposed Scheme.

4.11.5 Several non-highway link options have been discounted prior to packaging as they are being taken forward by other mechanisms, e.g. STS and TfN; the options discounted are:

- Option 44 – New / Improved Crossing Points – taken forward within the TfN Strategy and STS.
- Option 49 – Improvements to existing bus services (28, 29 and X29) – taken forward by existing bus operators.
- Option 50 – Improvements to existing bus services (23, 23A and 24) - taken forward by existing bus operators.
- Option 55 – Promote Cycling Schemes – taken forward within the STS and TfN.
- Option 68 – Lorry Management Strategy – taken forward within the TfN Strategy.

4.12 Summary

4.12.1 On review of the packaging of options it was identified that some of the OAR non-highway options are already being delivered via other mechanisms (e.g. STS and TfN) and therefore this reduces the number of elements which can logically form a package going forward. The remaining five items have been considered again to see what they contribute and it is considered that the level of influence of the individual ingredients is quite

limited in terms of area wide influence. The majority of multi modal options are not a realistic solution for the rural fringe due to sparse population patterns and longer travel distances, so the package of non-highway measures would not reduce traffic and congestion significantly and would only benefit a confined catchment of users. Even when packaged together the best performing OAR non-highway options would not offer a combined solution that is comparatively effective at meeting the scheme objectives and preventing traffic using the minor roads through the west of Norwich.

4.12.2 Additionally, it is clear that the package of non-highway measures could only create a localised effect within close proximity to the individual elements of works whilst the Proposed Scheme would have influence over a much wider area, so the magnitude of benefit would be more widespread and applicable to a much greater range of transport network users.

Table 4-8 Benefits of the Non-Highway Options in relation to the Preferred Option

Option	Non-highway option package
Option 39: Improvements to existing junctions	There were four junctions considered to have significant benefits in regard to maximising capacity, traffic flows and addressing safety issues: • A1074 Dereham Road / Marl Pit Lane / Larkham Lane • A140 Sweet Briar Road / A1074 Dereham Road / A140 Guardian Road • A140 Boundary Road / A1067 Drayton Road / A140 Sweet Briar Road/ A1067 Drayton High Road • A1067 Drayton High Road / Middletons Lane / Hospital Lane This option could reduce the number of HGVs using minor roads, however the improvements would only offer a minor increase in capacity in the urban periphery and attract more use of the outer ring road of Norwich, which is already very busy and would bring more traffic into the centre of Norwich and closer to residential receptors. This option received a low score for the objective that sought to encourage modal shift to more sustainable modes of transport, as junction improvements would not create new facilities for Non-Motorised Users (NMUs) and sustainable modes. It would not offer much extra network resilience as it relies on the same routes which currently exist. This option only applies to four localised junctions on the edge of the Outer ring Road, so would have a very localised impact and there is limited space available around the junctions to do improvement works and this is already a busy route, so would only accommodate limited growth.
Option 40: Signing and lining improvements	This option may help deter HGVs from using minor roads. However, it would only advise them of alternative routes that currently exist and would not actually offer any increased capacity or better routes for these journeys. It is anticipated that in the longer-term people will become more reliant on satellite navigation systems so increased signage may be ignored and is expected be ineffective at making a significant difference. There are already signs directing HGVs away from minor roads in the west of Norwich and strategic advisory signage for longer distance traffic but drivers still choose to take the shortest and most direct route available where possible. The option additionally received low scores for the objectives that considered improvements to modal shift and enhanced accessibility for new housing and employment sites. It is clear that whilst this is a lower cost solution it would not be capable of making a noticeable difference to user behaviour across the network.
Option 41: Signal improvements	This option would only be applicable to existing signalised junctions, however, the majority of existing junctions in the west of Norwich are priority junctions, with existing traffic signals only present at a small number of junctions on A1074 and A1067. Within the scope of the Transport Assessment, only two existing junctions are signalised out of a total of 31 total junctions considered in the western side of the city.

Option	Non-highway option package
Option 58: Mobility as a service scheme	Combining public and private transportation methods into a unified platform of service to manage trips is best employed in urban areas with good access to public transport. The study area west of Norwich is currently difficult to serve by bus due to sparse settlement patterns and therefore the benefits would be minor and applicable to central Norwich which is more remote from the rural settlements in the west of Norwich. Additionally, in rural areas, a MaaS scheme is likely to increase trips (for example taxi movements) on the network, in order to access transport facilities (e.g. bus stops / park and ride sites) to enable onward journeys, which would be counterproductive.
Option 74: New bus route connecting Dereham, Hellesdon and Norwich Airport	A new bus service would improve connectivity and accessibility to Norwich International airport, Norwich Research Park (NRP) and Norfolk and Norwich University Hospitals (NNUH). Whilst additional public transport services offer modal shift away from private vehicles, it is considered that the impact would only be minor and is not comparable to the scale of benefits offered by the preferred scheme. Part of this service is now covered by Konectbus 512 service which was introduced in 2022 and links Hellesdon to NNUH, NRP and University of East Anglia (UEA). This service was initiated in 2022 following consultation with bus operators as part of the development of the STS. There are also other existing rapid bus services operating from Dereham to Norwich along the A47 and A1074 corridor. Hence if the Option 74 service was introduced now it would only offer additional links from Dereham to Norwich airport which would serve a very limited number of users originating from Dereham travelling on a specific journey. Adding services in the evening and weekends would assist to an extent but this does not address issues at peak times when congestion is greatest.

4.13 Summary and Conclusion of Alignment Option Process

4.13.1 This chapter has demonstrated that extensive consideration has been given to potential reasonable alternatives to the Proposed Scheme prior to reaching a preferred option. The Proposed Scheme has been refined in response to known constraints and there is an evidence base of surveys and background data underpinning the option selection and refinement. Considerable effort has been made to assess the potential environmental effects of the scheme throughout the design process. Relevant surveys and data have been collected holistically to inform the detailing of the design and mitigation measures, so that the Proposed Scheme adequately meets the legislative requirements applicable to protected species and habitats that may be affected by the scheme. Due regard to applicable policy and environmental legislation has been taken into account so that a sustainable design in the context of the National Planning Policy Framework (NPPF) can be achieved. This is further discussed in the Planning Statement.

4.13.2 In the work carried out by the Applicant since 2004, when the concept of a Norwich Western Link was first identified through the NDR Public consultation, it is clear that a well-reasoned and clear process has been followed in reaching a preferred option. Separate studies have subsequently been undertaken in 2014 looking at a range of highway options and a public transport option. In 2017-2018 further work was undertaken to test the feasibility of a viaduct over the River Wensum SAC with Natural England.

4.13.3 During 2018-2019 a holistic Option Appraisal Report was prepared, considering a wide range of ideas across a range of modes covering a total of 82 options. A systematic sifting process aligned with DfT methodology and environmental criteria was used to filter out lower performing options, with those scoring less than the Do Minimum removed. Further sifting based on performance against scheme objectives was used to reach a short list of 4 main options (Options A to D), with two sub option variants.

Highway options were found to best meet the scheme objectives and likely to offer better value for money. However additional non-highway, active travel and public transport measures were identified and reserved for packaging with a preferred highways option. These measures individually would not be effective as a solution to the key issues identified within the study area, which tend to relate to longer distance strategic traffic routing through the minor rural roads in the west of Norwich whereas non-car options would predominantly cater for shorter distance trips and would be unable to accommodate mode shift for freight and HGV movement.

4.13.4 The existing minor road network in the west of Norwich is intrinsically difficult to serve efficiently with public transport. The population is distributed in isolated settlements with spaces between villages often beyond walking and cycling distance. There are limited catchments for bus services and the roads are geometrically constrained. Hence, previous rural bus services have been discontinued. There are already frequent bus services into central Norwich serving the A47 and A1067 corridors and Park and Ride sites available on the west side of Norwich at Thickthorn, Costessey and Norwich Airport offering opportunities for access to sustainable modes of travel. Orbital bus services around Norwich have been trialled in the past and these were shown to have poor uptake. Hence it is unlikely that a package of non-highway options, in the rural area to the west of Norwich would be able to deliver a step change in travel behaviour that is sufficient to solve the problems identified within the study area. However, as part of the Sustainable Transport Strategy, a package of Complementary Sustainable Transport Measures has been identified which could be put in place once the Proposed Scheme is in place to alleviate strategic traffic.

4.13.5 The option development and selection process was informed by extensive public consultation and stakeholder engagement, with a first round of NWL specific consultation in summer 2018, with the majority of respondents indicating that a highway option would best solve the transport issues identified in the study area, with additional non-highway options supporting. A second round of consultation regarding the shortlisted options, indicated a strong preference for Options D and C, with Options A and B afforded much less support, similar to the Do Nothing benchmark. Options C and D were seen to offer better connectivity of A47 and A1270 Broadland Northway and offer enhanced opportunities for orbital traffic movement around Norwich. Option C was considered a more equitable solution as it is equidistant between the communities of Ringland and Weston Longville.

4.13.6 The decision to take forward a preferred Route alignment was announced in July 2019 as Option C which on balance considering all aspects encompassing a wide range of environmental topics was the most suitable and well supported option which had less engineering challenges and offered high value for money in economic terms. A Local Access consultation was also carried out to help shape a sustainable transport strategy to accompany the scheme based on a complementary package of non-car travel options developed with input from relevant stakeholders.

4.13.7 Once further environmental surveys had been carried out, seven options were considered for the refinement of Route C in response to ecological constraints. A systematic process was applied to this, which identified an option, which balances the need for increased separation from a maternity bat roost in the northern woodlands, with other planning and environmental considerations across all of the topics considered within this ES. The refined option has been subject to further scrutiny by recognised industry experts on ecology and set out in public consultation in 2022. The detail of mitigation measures and design elements has also been informed by extensive surveys and collaboration with stakeholders. Therefore it can be concluded that a solution is proposed that meets the needs and objectives

of the scheme, and balances this with adequate mitigation across all environmental topics considered within the ES.

4.13.8 Finally, a review in 2023 of the refined option against the OSR options reconfirmed the preferred route as the best performing option in overall terms having regard to the scheme objectives.

4.14 Scheme Design and Construction Alternatives

4.14.1 During the design development of the Proposed Scheme, there has been close working between the design and environmental teams. The environmental constraints and opportunities have influenced the design development of the Proposed Scheme and considered alongside other factors such as engineering and operational/maintenance requirements.

4.14.2 The design and construction alternatives that were considered for certain elements of the Proposed Scheme are outlined below.

4.14.3 This section should be read in conjunction with Appendix 4.5 Design Evolution Report (Design Evolution Report 3.04.05). This Appendix sets out the design evolution of the Proposed Scheme from the point at which the route selection was determined. It describes how the design has developed in response to key factors including: policy, stakeholder engagement, and findings from environmental surveys / assessments.

4.14.4 The alternatives and option development for the measures in the Sustainable Transport Strategy are outlined in the Sustainable Transport Strategy (Document Reference 4.02.00) including Appendix 2: Wider Complementary Measures Shortlisting (Document Reference 4.02.02).

4.14.5 The Local Access Consultation reported in the Statement of Community Involvement (Document Reference 1.03.00) and the Transport Assessment Appendix 2 - Local Access 2020 Consultation Brochure (Document Reference 4.01.02) outlines the options considered in relation to side road access. A summary of this is also included within the Sustainable Transport Strategy (Document Reference 4.02.00).

The placement of the NWL/A1067 roundabout

4.14.6 The location of the NWL/A1067 roundabout sought to avoid the tree grouping nearby. The dualled section was designed north of the current A1067 footprint to avoid impact on the land to the south which includes the Fakenham Road Roadside Nature Reserve (RNR). The alignment also avoids the Wensum Valley Golf Course which would be unable to operate commercially as a full 18 hole course if the Proposed Scheme connected directly to the A1270.

4.14.7 The roundabout was moved following alignment refinement in 2022 moving the roundabout further east. This resulted in a reduced length of dualling required of the A1067 as part of the Proposed Scheme.

Viaduct

4.14.8 The option for the approaches to the north and south of the viaduct to have featured earth retaining walls as an alternative to the earthwork slopes used in the design was considered. Whilst earthwork slopes incurred a larger overall footprint than the retaining wall alternative, earth slopes were preferred in terms of visual impact and aesthetics providing a more natural solution with landscape planting.

4.14.9 An earlier outline design for the viaduct included two separate decks with a 2.5 m airgap, 13 spans and 4 sets of columns per pier location. The deck was comprised of 4 steel box girders acting compositely with a concrete deck. The later adopted design has been able to eliminate the air gap and reduce overall carriageway and verge widths, reducing the number of columns for each pier to 3. This reduced materials, improving cost and reduced the potential for shading to the SSSI and SAC in the Wensum valley beneath. The superstructure type was changed from 4 box girders to 3 steel girders and cross-beams to form a ladder beam deck with composite action with a concrete deck. The number of columns was reduced from 4 to 3 at each pier location, saving 12 column/piles and 14 bearings. The total material saving was some 12,600 tonnes of steelwork, concrete and rebar leading to a 10,367 CO2e (carbon dioxide equivalent) saving and a significant cost saving. The alignment refinement in 2022 reported above also resulted in a shorter viaduct as the floodplain was narrower at the location of the refinement compared to the original alignment.

4.14.10 Regarding the construction method both an incrementally launched deck and a lifted deck from temporary works platform were considered. A lifted deck approach was selected. It was noted that there would be disruption to the Wensum valley with access for piling rigs for either option, and together with the fact that the steelwork required was larger for the launched option (with the associated increase in carbon footprint), the cost was higher for the launched option, the requirements for more labour intensive works on top of the partially constructed deck (welding and more in situ concrete works), the associated environmental risks with larger in situ concrete pours and the longer construction programme associated to the launching sequence; erection by crane from a temporary works platform was the favoured option.

4.14.11 The earlier outline design included an environmental barrier on the viaduct that was 3m in height as a precautionary height at the early stage of design

development. Through assessment and further design of the barrier and its effectiveness the Proposed Scheme includes a viaduct environmental barrier that is 1.2m in height. The selection of barrier height considered the effectiveness of the barrier height in providing noise mitigation, cost of the high barrier and visual consideration of a higher barrier.

Nursey Woodland bat crossing feature

4.14.12 From bat flightline survey data the requirement for a bat crossing feature across the Proposed Scheme at the Nursery Woodland was identified. The options considered and proposed approach are set out in Chapter 11 Bats - Appendix 11.6 Outline Bat Mitigation Strategy. In summary, a landscape treatment option was considered as a mitigation option at the Northern Woodlands (Chainage 900 – 950), with the road in cutting. This design option aimed to retain as much of the surrounding woodland as possible to promote continued bat movement along the woodland ride at safe heights above the carriageways. A combination of canopy retention and planting would obstruct lower flight and provide shelter / minimise crossing width above the road.

4.14.13 Further arboricultural assessments and identification of poor sandy soil, confirmed that tree retention would not be possible for the majority of trees in the immediate vicinity of the alignment, as taking this approach once works commenced there would be an increased risk of wind throw/blow, resulting in a health and safety risk and lack of connectivity required for bats. A green bridge solution was therefore selected.

4.14.14 Two green bridge approaches were considered, including a concrete arch solution (c.8m in height) and a pre-cast beam solution (c.6m in height). These designs would result in either a 4-6m or 2-4m increase in barbastelle flight heights, respectively from the baseline. The two design options would also result in differing footprints and clearance extents. Overall, the arch structure and pre-cast beam structure were similar in multiple regards.

4.14.15 The pre-cast beam can be considered preferable in relation to feasibility and minimising impacts to bats and reasons included but not limited to:

- lower construction footprint (2,638m^2 equating to a 20% difference between options);
- lower permanent works footprint (2,451m^2 equating to a 22% difference between options);
- reduced number of trees to be removed (40 equating to a 15% difference between options); and
- more closely matching existing barbastelle vertical flight lines (2m difference).

Primrose Grove

4.14.16 As part of the alignment refinement exercise the route alignment moved closer to Primrose Grove ancient woodland at this location. Options were explored to maximise the distance to the woodland edge. An earthwork option was explored but even with a steep slope (to reduce footprint) resulted in encroachment into a 15m buffer from the edge of the ancient woodland (the 15m buffer was to protect root protection area of trees). Given the other constraints considered as part of the alignment refinement report, there was no opportunity to move the refined option alignment further from the ancient woodland edge. As such a retaining wall option was adopted. The retaining wall allowed for the realigned carriageway to be designed without encroaching on the ancient woodland 15m buffer.

Ringland Lane

4.14.17 Ringland Lane was identified as a site access route during the construction phase. Alongside Ringland Lane were areas of woodland and trees in sections.

4.14.18 On review of the construction access requirements for Ringland Lane it was identified that tree clearance may be required to allow sufficient width for access by construction vehicles and deliveries. To avoid the

requirement for this clearance the haul road was moved to the edge of the adjacent field to allow vegetation to be retained.

4.15 Foxburrow Plantation Green Bridge

4.15.1 Given that the Proposed Scheme cuts through a woodland at the Foxburrow Plantation (Chainage 4350 - 4400) location landscape treatments were considered as an alternative to a green bridge for bat connectivity. The options considered and proposed approach are set out in Chapter 11 Bats - Appendix 11.6 Outline Bat Mitigation Strategy.

4.15.2 The mitigation option for bat connectivity utilising a green bridge structures would require a larger construction footprint and associated habitat removal, in this case woodland clearance. For this reason, alternative options, including landscape treatments, were considered which may have a reduced construction footprint.

4.15.3 In the Foxburrow Plantation, due to the existing topography, there is already a requirement for woodland clearance beyond the final alignment to achieve the required level changes through this area. This means the option to create a relatively narrow road corridor through otherwise largely, physically unaffected woodland is not possible. It is also not possible to separate the carriageways as this would require significantly more earthworks, increasing the construction footprint and associated woodland loss. Whilst landscape treatment could be applied following construction, this would take a substantial period to establish and function as bat foraging habitat, encouraging crossing at height above the new road during operation. In addition, the requirement to incorporate an access route for landowners would remain and need to be satisfied via other means.

4.15.4 As such a green bridge solution was chosen.

Ancient and Veteran Trees

4.15.5 Several ancient and veteran trees were located along the NWL alignment. Whilst 7 would require removal which cannot be avoided (See

Arboricultural Impact Assessment **Appendix 10-35** of the Environmental Statement (Document Reference 3.10.35) for tree locations of the referenced trees) the design development has identified options that have been adopted to retain others. These are outlined below:

- Tree Reference - T34 – The tree was in conflict with the ditch next to pond number 5 and the earthworks would impact its Root Protection Area (RPA). Pond number 5 was reshaped to retain the tree.
- Tree Reference - T45 – The tree was in conflict with the creation of an earth bund and would have been impacted by the earthworks ditch. Earthworks were redesigned to allow retention.
- Tree Reference – T99 – Located east of the alignment next to the earth bund to be built. It would be impacted by the excavation of the ditch for the drainage pre-works. As such the earth bund design was reshaped to avoid the RPA and ditch next to it.
- Tree Reference – T113 – RPA slightly overlapped with an earth bund. As such the earth bund design was reshaped to avoid the RPA.
- Tree Reference – T309 – The tree was within an area earmarked for a construction compound. The construction compound boundary was moved so the RPA was outside the area.
- Other ancient or veteran trees (T33, T47, T72, T105, T112, W318) were reviewed at the very edge of the Proposed Scheme boundary and it was confirmed these could be retained without design changes. During construction, suitable tree protection measures would be included if works are carried out in proximity to the RPA boundary.
- Through the alignment refinement of the preferred route around Rose Carr, several veteran trees were protected from risk of removal.

4.15.6 Seven ancient and veteran trees are located along the Proposed Scheme alignment where they have been identified for removal. An optioneering report (**Appendix 4.4: Ancient and Veteran Trees Avoidance Alignment Optioneering Report** (Document Reference 3.04.04)) which assessed the scheme impacts of retaining the seven trees has been produced. The report highlights how revising the alignment to avoid these trees will be detrimental to other environmental aspects, including additional tree clearance and/or impact to bat habitats, and that therefore their retention is not possible.

4.15.7 A summary of the main conclusions is below. For more details refer to Appendix 4.4:

- T20 and T49 – To save these trees, at least another Veteran or Ancient tree in addition to other Category A trees and areas of woodland would be removed. The Broadway Green Bridge (GB1) would also need to be realigned that would impact the alignment to the existing bat flight path, which would likely reduce its effectiveness.
- T77 and T82 – To save these trees, the Broadway Green Bridge would have to be amended. The change could impact the alignment to the existing bat flight path, which would likely reduce its effectiveness. Alignment shift will also result in removal of other ancient and veteran trees as a result of the new design footprint.
- LG138 and LG141– Change in alignment would increase and/or skew the spans of both Morton and Broadway green bridges. It would also result in clearance of other veteran trees and hedgerow.
- T220 – cannot be saved without shifting the alignment north or south that would result in clearance of ancient woodland, other ancient / veteran trees and other woodland.

Essential Environmental Mitigation

4.15.8 Areas for Essential Environmental Mitigation have been identified through a refinement process and the areas are illustrated on the Essential Environmental Mitigation Plan (included in **Appendix 3-2** Plans (Document Reference 3.03.02).

4.15.9 The process to identify these areas has included identifying the mitigation/enhancement requirements and a programme of landowner discussions to select the most appropriate sites that meet the requirements. From the early assessment work and understanding from the survey work to support the ES, the likely type of mitigation and enhancement (including BNG) that would be required was identified. This identified the need to create and enhance areas of woodland, scrub, hedgerow, grassland, water features/ditches and river Water Framework Directive mitigation improvements.

4.15.10 The Applicant, alongside the technical teams, identified areas of land in proximity to the Proposed Scheme alignment that had the potential to provide the required mitigation/enhancement. Preliminary discussions with landowners also informed this process. A number of candidate sites were identified and a programme of landowner discussions were held to understand the preferences of landowners to host these measures, the preferred areas for use and the suitability of the sites for these measures. To inform these discussions the Environmental Mitigation and Enhancement Measures brochure was sent to landowners (Appendix 4.6 Document Reference 3.04.06) in 2021.

4.15.11 Through these discussions areas of land that were not suitable were discounted and the process strived to meet the requirements and views of the landowner, were practicable. This iterative process resulted in the areas identified on the Essential Environmental Mitigation Plan.. This iterative process resulted in the areas identified on the Essential Environmental Mitigation Plan.

Areas for temporary use during construction

4.15.12 Areas for temporary use during construction have been identified through a refinement process and the areas are illustrated on the **General Arrangement Plans** (included in Document Reference 2.03.00).

4.15.13 The process to identify these areas has included an initial identification of potential required areas completed by the Applicant during early stages of the design development and a further refinement associated with a more developed understanding of the construction requirements and programme constraints associated with ecological, geotechnical and logistical matters.

4.15.14 The Applicant, alongside the technical teams, identified areas of land in proximity to the Proposed Scheme alignment that had the potential to provide the required areas for compounds, temporary storage of construction material, temporary stockpiling of stripped topsoil, transport and logistic zones, temporary storage of as dug material, temporary drainage works to ensure adequate water run off treatment; all of them in areas that optimise the haulage distances in order to minimise the amount of intermediate handling and reducing in this way the number of Heavy Goods Vehicles and muck away trucks movements.

4.15.15 Through these discussions areas of land that were not suitable, did not meet the requirements or where landowners concerns could be accommodated, were discounted. This iterative process resulted in the areas identified on the General Arrangement Plans.

4.16 References

- Reference 4.1: Town and Country Planning (Environmental Impact Assessment) Regulations 2017. Statutory Instrument 2017 No. 571.
- Reference 4.2: A47-A1067 Western Link Road Scoping Study. (2014). Mott MacDonald.
- Reference 4.3: Norwich Western Link Technical Report, (2016). Mouchel.

- Reference 4.4: The Norwich Western Link Technical Report, (2017). WSP.
- Reference 4.5: The Norwich Western Link Option Assessment Report (OAR), (2019). WSP.
- Reference 4.6: Natural England (2016). Agricultural Land Classification (ALC) Grades – Pre 1988. Available at: Gov.uk website
- Reference 4.7: Norfolk Minerals and Waste Development Framework interactive map of Mineral Safeguarding Areas [Available online at: Norfolk mapping]