A12 Chelmsford to A120 widening

Scheme Assessment Report

Highways England

2017

PLEASE NOTE

This report was part of the suite of products prepared to support Stage Gate Assessment Review 2 (SGAR 2) in 2017 and informed the recommendation of the preferred route selection.

Since then, a SAR Addendum has been produced and published which provides an updated overview of the scheme development and supports the announcement of the preferred route.

The sections which are now superseded by the SAR addendum are listed below:

- Chapter 5 – Traffic Forecasts, Economics and Costs
- Chapter 6 – Operational Assessment
- Chapter 7 – Maintenance Assessment
- Chapter 8 – Environment Assessment and Environmental Design
- Chapter 10 – Appraisal Summary Tables
- Chapter 11 – Detailed Cost Estimates

In addition to the above, all appendices, bar the Report on Public Consultation, are now superseded by the SAR Addendum and as such have been removed from this document.

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1. Existing Conditions

1.1 Statement of the problem

1.1.1 The A12 is an important economic link in Essex and across the East of England. It provides the main south-west/north-east route through Essex and Suffolk, connecting Great Yarmouth and Ipswich in the north-east to the M25 and London in the south-west. The section between Chelmsford and Colchester (Junction 19, Boreham interchange to Junction 25, Marks Tey interchange) currently experiences congestion at peak times, with reduced speeds and increased vehicular delays and journey times. The existing traffic volume along the A12, between Boreham (J19) to Witham (J21), is approximately 82,000 vehicles per day two-way. In the East of England, the A12 is amongst the most heavily trafficked.

1.1.2 At Witham bypass, the existing traffic volume is approximately 63,000 vehicles per day two-way, and the A12 at Rivenhall End the existing traffic volume is approximately 68,000 vehicles per day two-way. Between junction 24 to J25, the existing traffic volume is 65,000 vehicles per day two-way.

1.1.3 Heavy Goods Vehicles account for between 8% and 12% of the traffic on the route, confirming that the A12 provides an important freight connection for the ports of Felixstowe and Harwich. There are commuting desire lines between Chelmsford and Colchester and between Braintree and Maldon. Due to the variability in the standard of the corridor and limited suitable diversion routes, it is vulnerable to incidents which can cause significant disruption over a wide area.

1.1.4 A large proportion of route sections experience high or very high delays on a regular basis. The worst of these are focused mostly on the A12 from Junction 20a to Junction 25. While safety and congestion are often expressed by users and stakeholders (refer to Report on Public Consultation – Appendix A) as a significant concern along this section of the route, the collision rates tend to be below the average for rural A-roads. The severities of collisions on this section are generally similar to the national level for this type of route, whilst the number of killed and seriously injured casualties is slightly higher. However, clear-up times after incidents significantly affect journey times, with a major factor in this being the lack of alternative routes and variability in the standard of the road.

1.1.5 The busiest link on this section of the A12 is between Junctions 20b and 21, with Annual Average Daily Traffic (AADT) flows of approximately 40,900 northbound and 41,300 southbound. This may indicate that this particular section is used by traffic “crossing” across the A12 and it is linked with the commuting desire line between Braintree and Maldon and to a lesser extent the desire line between Chelmsford and Braintree.

1.1.6 The key scheme objectives are to support economic growth, provide a safe and serviceable network, provide more free flowing network, an improved environment, and more accessible and integrated network. The existing conditions are described in Section 1.2 below.

1.1.7 The East of England Route Strategy (March 2017) contains the current investment plans and growth potential for the road network including the A12. The Strategy highlights that there are capacity and safety issues for the road users at Junctions 20b (Hatfield Peverel), 22 (Witham) to 23 (Kelvedon) amongst other challenges for the Road Investment Strategy (RIS) 2015 to 2020.

1.1.8 The Essex County Council Local Transport Plan (LTP) 2011 notes the problems with the A12 and the economic impact of the lack of reliability of the strategic road in the County. One of the main actions in the LTP was to lobby Government for the delivery of necessary enhancement measures on the A12 corridor.

1.1.9 There have been a number of studies into the problems of the A12. These include:

- A12 Route Management Strategy (June 2001);
- London to Ipswich Multi-Modal Study (LOIS) (2002);
- A12 Commission Inquiry (2008);
- Substantial Transport Options for the Growing A12/GEML corridor towns (May 2010);
- London to Haven Ports Study (September 2010).

1.2 Existing Conditions

1.2.1 The existing A12 route forms a strategic link between London and the east coast 'Haven Ports' of Felixstowe and Harwich. The A12 intersections with the A47, A14 and A120 provide strategic connections to Peterborough, Cambridge and the M11, respectively. The A12 is paralleled for much of its length by the Great Eastern Main Line (GEML) railway, which runs from London Liverpool Street to Ipswich and Norwich, connecting all the major settlements along the corridor. The A12 route has been split into three studies and this one lies between Junctions 19 (Boreham) and 25 (Marks Tey) as shown in Figure 1.1.

1.2.2 The A12 is the only strategic road route between the major settlements of Brentwood, Chelmsford, Colchester and Ipswich. It is therefore used extensively for commuting, business and freight trips between these towns and the wider region. Tourism is a key driver of economic growth in eastern England, which also places seasonal traffic pressure on the A12 outside of typical peak times.

1.2.3 The major destinations are outside of this section, but the key locations are Chelmsford, Witham and Kelvedon, which are bypassed by the A12. Also, of note is Tiptree, which lies to the south-east of Kelvedon and is reputed to be the largest village in England. Access to the A12 for residents of Tiptree is either via Kelvedon or Rivenhall.

1.2.4 The mainline A12 varies in cross-section, based on the Design Manual for Roads and Bridges (DMRB) standards, between Junctions 19 (Boreham) and 25 (Marks Tey). The carriageway varies between dual two-lane and dual three-lane carriageways. The A12 from Junction 19 to 25 is approximately 24.5km in length, and it is predominantly a dual two-lane carriageway with a limited length of dual three-lane carriageway running southbound between Junctions 19 and 20a.

1.2.5 The main junctions along this section of the A12 are all grade separated, with the exception of J20a/b westbound. At locations, if existing A12 direct accesses to adjacent properties are to be retained, the A12 would contain a number of design elements which do not meet current TD22/06 Layout of Grade Separated Junctions, or TD41/95 Vehicular Access to All Purpose Roads, DMRB design standards. These direct accesses will be removed and re-connected to the existing or new local access roads. There are also several local roads, footways and rights of way which cross above or below the A12. The Great Eastern Main Line (GEML) runs in close proximity to the western carriageway between Junctions 19 and 20a and passes to the west of Witham where it branches off to Braintree.

1.2.6 The existing pavement construction is a mixture of concrete and bituminous pavements. The existing concrete pavement is between 40 and 50 years old and has a number of significant defects which are a maintenance concern.

1.2.7 There are currently 17 bus routes and 3 coach routes operating on and/or around the A12 between Junctions 19 and 25, some of which extend along the entire route of the proposed widening scheme. These regional bus and national coach services provide links between the major settlements along the A12 corridor. The services vary in terms of journey time and frequency, which reduce in the evenings as well as at weekends.

1.2.8 Congestion is experienced routinely on links along the length of the A12, particularly between Hatfield Peverel Junction (Junction 20a) and Marks Tey Interchange (Junction 25). Local authorities and the business community perceive that there is a serious lack of investment in the A12 and believe this is seriously constraining growth in the corridor. There are substantial growth aspirations along the corridor which are likely to be constrained by what is perceived as poor overall performance of this section of the route.

1.2.9 There are approximately 15 kilometres of cycle ways and footpaths between Junctions 19 and 25. However, many routes are discontinuous and the traffic on the A12 acts as a further disincentive to their use. There are instances of historic severance of public rights of way. The scheme provides opportunities to improve linkages and correct historic severance. This will be discussed further in the Walking, Cycling and Horse Riding Assessment, in preparation. NCR 16 crosses the A12 at Junction 22, and Regional Route 50 crosses at Terling Hall Road.

1.2.10 There are four registered parks and gardens within 1 km of the study area including Boreham House (Grade II), which lies 100m east of Junction 19. The A12 follows the route of the historic Roman road.

1.2.11 Marks Tey Brickpit Site, which is of Special Scientific Interest, is located approximately 150m north-west of Junction 25 and is an important site for Pleistocene sediment vegetation records. Brockwell Meadows Local Nature Reserve is directly adjacent to the A12 at Witham. The study area includes a number of Biodiversity Action Plan (BAP) Priority Habitats, including ancient & semi-natural woodland, ancient replanted woodland, deciduous woodland, broadleaved woodland, woodpasture and parkland, coastal and floodplain grazing marsh.

1.2.12 The Centenary Circle footpath crosses the A12 south of Junction 19. In addition, there are a number of other footpaths and bridleways in the study area which cross, or lie adjacent to, the A12. There are a number of national cycle routes which cross the A12 in the study area.

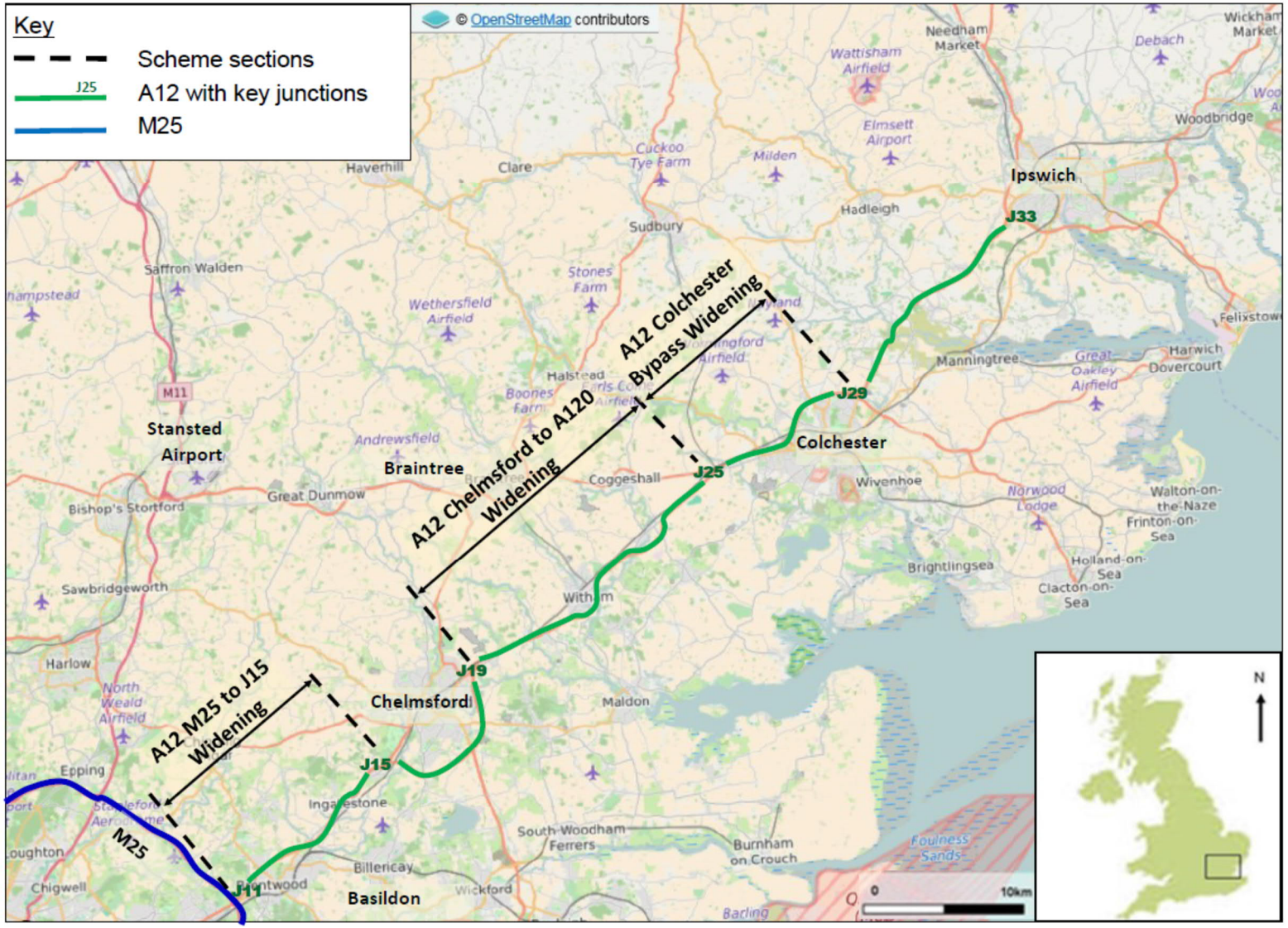

Figure 1.1 : A12 Mainline Study Area

1.3 Infrastructure Constraints

1.3.1 The A12 scheme will aim to upgrade the full length of the section (Junction 19 to Junction 25) to the same consistent standard, and remove all direct at-grade accesses to residential, commercial and agricultural properties where located along the A12.

1.3.2 The A12 has many existing structural assets along its corridor between Junctions 19 and 25, including a number of bridges and culverts, gantries, retaining walls, average speed cameras and masts. Some of these assets have been in place for many years and are subject to ongoing maintenance. A number of structures may require widening or replacement and several new structures are likely to be required on new off-line sections of the scheme.

1.3.3 The significant considerations specific to the A12 Junctions 19 to 25 scheme are, but not limited to, as follows:

- Existing A12 highways boundary;
- Existing Statutory Undertaker's apparatus in the vicinity of the scheme;
- Affected properties and businesses in vicinity of the scheme.

1.3.4 Significant adjacent potential schemes along the route include:

- A12 Colchester Bypass scheme;
- A12 M25 to Chelmsford scheme;
- A120 Braintree to A12 scheme;

1.4 Garden Communities

1.4.1 In the last two years, proposals have emerged for three garden communities in North Essex, of which the Garden Community at the Colchester Braintree Borders, sometimes also known as Marks Tey, has a direct effect on the A12 scheme. Policy reference can be found in the Colchester and Braintree Council draft local plan policy SP9.

1.4.2 The proposed Garden Community on the border of Braintree District and Colchester Borough is the vicinity of Marks Tey. Indicative locations are shown in the emerging local plans for both Councils, which are running to the same timetable which were submitted for consultation and examination in November 2017. These plans show that the eventual number of dwellings proposed could be as many as 24,000, of which 2500 are to be built by 2033. The Garden Communities were the subject of examination hearings in January 2018.

1.4.3 The emerging garden communities' proposals are inconsistent with the original proposals for the A12. Therefore, it will be necessary to go back and redesign the road and junctions between J24 and J25. It is not known who will fund this longer route, but it is noted that there is a related bid for Housing Infrastructure Fund monies.

1.4.4 As and when these garden communities gain further status the impacts will be assessed in relation to the A12 proposals.

2. Planning Factors

2.1 Existing Routes

2.1.1 The existing A12 is a strategic road connecting London with Essex, Suffolk and the Haven Ports. The route has been split into four studies, one of which being where the A12 (Junctions 19 to 25) runs between Chelmsford and the A120, which runs, to the west, towards Braintree and Stansted Airport.

2.1.2 The major destinations of Chelmsford and Colchester are just outside of this section of the A12, but the key locations within this section of the A12 are Witham and Kelvedon, both of which are bypassed. Also, of note is Tiptree, which lies to the south-east of Kelvedon and is reputed to be the largest village in England. Tiptree is located 10 miles south-west of Kelvedon (Junction 24). Access to the A12 for residents of Tiptree is either via Kelvedon or at Rivenhall.

2.2 Solutions Investigated

2.2.1 Nine options were assessed in Highways England Project Control Framework (PCF) Stage 1 and a summary of the A12 Options in PCF Stage 1 are shown in Table 2.1.

Table 2.1 : A12 Options in PCF Stage 1

Option	Online/Offline	Description
Option 3a	Offline	• Online widening between Junctions 19 and 22 and Junctions 23 to 24. Offline bypass sections between Witham and Kelvedon (junctions 22 to 23), and Kelvedon and Marks Tey (Junctions 24 to 25). • Existing A12 will be de-trunked where the offline improvements are provided. • Full junction upgrades for Junctions 19 to 25.
Option 101	Offline	• Widening between Junctions 19 and 25, as Option 3a, with a local access road between Hatfield Peverel and Witham. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 20a to 24, except the removal of the existing Junction 20b. • Partial junction works at the existing Junction 25.
Option 102	Offline	• Widening between Junctions 19 and 25, as Option 3a, with a local access road between Hatfield Peverel and Witham. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 21, 22 and 24. • No new Junction 20a, 20b and 23. • Partial junction works at the existing Junction 25.

Option 103	Offline	• Widening between Junctions 19 and 25, as Option 3a, with a local access road between Hatfield Peverel and Witham. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 21 and 23. • No new Junction 20a, 20b, 22 and 24. • Partial junction works at the existing Junction 25.
Option 104	Online	• Widening online between Junctions 19 and 25 with a local access road for the stretch from Kelvedon to Marks Tey. • The existing A12 northbound carriageway will be re-used as a local access road between Junctions 22 and 23 and between Junctions 24 and 25. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 21 to 24. • Removal of Junctions 20a and 20b, to be replaced with a new Junction 20. • Partial junction works at the existing Junction 25.
Option 105	Online	• Widening online between Junctions 19 and 25 with a local access road for the stretch from Kelvedon to Marks Tey, as Option 104. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 21 to 24. • Removal of the existing Junctions 20a and 20b. • Partial junction works at the existing Junction 25.
Option 106	Offline	• Online widening between Junctions 19 and 22, as Option 3a. • New offline alignment north over the Great Eastern Railway from Junction 22, to tie back into A12 before Junction 25, south of Marks Tey. • The existing A12 would be de-trunked where the offline improvements are provided. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 20, 21, 22 and 24. • Removal of the existing Junctions 20a and 20b. • Existing Junction 23 to be retained on the existing A12. • Partial junction works at the existing Junction 25.
Option 107	Offline	• Online widening between Junctions 19 and 24, as Option 3a, with an offline bypass sections between Witham and Kelvedon (Junctions 22 to 23). • Online widening from Junctions 24 to 25, as Option 104. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 20 to 24. • Removal of the existing Junctions 20a and/or 20b. • Partial junction works at the existing Junction 25.

Option 108	Offline	• Widening between Junctions 19 and 24, as Option 104. • Offline bypass between Kelvedon North (Junction 24) and Marks Tey/A120 (Junction 25), as Option 3a. • Partial improvement to Junction 19. • Full junction upgrades for Junctions 20 to 24. • Removal of the existing Junctions 20a and/or 20b. • Partial junction works at the existing Junction 25.

2.3 Additional Options

2.3.1 A Stage 2 route review and value management workshop was held on 6th July 2017 to assess if any new routes could be identified. During the workshop, a total of 15 routes were reviewed and assessed against the Do Minimum option, including the PCF Stage 1 options listed above. The results were recorded in the value management workshop report. No further new viable routes were identified from the workshop.

2.4 Solutions Developed

2.4.1 An options sifting exercise was undertaken in December 2016 and March 2017, to assess the performance of each option against the RIS 1 Scheme objectives. As a result, Options 101-103, 105 and 106 were discounted due to insufficient economic or transportation benefits being accrued, deliverability or viability issues, or unacceptable environmental impacts being anticipated.

2.4.2 During PCF Stage 2, the four proposed options that were taken forward to the public consultation in January - March 2017 were renamed as follows:

- **Option 1:** Formally Option 104 - Online widening and full junction strategy.
- **Option 2:** Formally Option 3a - Online widening, with two new offline bypasses at Rivenhall and Marks Tey, respectively and a full junction strategy.
- **Option 3:** Formally Option 107 - Online widening, with a new offline bypass at Rivenhall and a full junction strategy.
- **Option 4:** Formally Option 108 - Online widening, with a new offline bypass at Marks Tey and a full junction strategy.

2.4.3 The naming convention Options 1-4 shall be used throughout the remainder of this report.

2.4.4 These options are described in more detail in Section 4 of this report, where the preferred route is defined.

3. Do-Nothing Consequences

3.1 Traffic Queues and Delays

3.1.1 To help understand future problems at the A12 mainline, traffic models were developed to provide evidence about the Do-Nothing situation. Congestion can reduce economic growth, impact productivity and is frustrating for customers.

3.1.2 Logistics and freight companies would have longer transport times and commuters would have to factor delays into their daily travel. Increased congestion would also bring dis-benefits to the local residents and businesses that rely on the A12 route. Figure 3.1 and Figure 3.2 show the existing (2015) and predicted (2038) flow to capacity ratio in the AM and PM peak hours, in the AM and PM peak hours respectively. It can be seen that the road is predicted to be operating close to or above capacity by 2038 across more of the route, significantly increasing congestion above the current levels.

3.2 Barrier to Economic Growth

3.2.1 Connectivity enables economic growth. By reducing congestion related delay, improving journey time reliability, increasing the overall capacity of the A12 and improving traffic flow across the highway network, this scheme will help support local growth plans. Improved journey times and reliability brings people and businesses closer together, creates job opportunities and long term sustainable growth. Increasing road capacity now will also help to meet predicted demand in the future.

3.2.2 Without intervention, the A12 would act to constrain economic growth as increased traffic volumes and congestion levels would impede the efficient movement of goods. The increase in delays, low journey speeds and unpredictable journey times experienced on these routes could result in loss in productivity for businesses.

3.3 Safety Performance

3.3.1 Existing safety performance would be likely to deteriorate in a Do-Nothing scenario, as congestion and delays increase. The safety performance of the A12 between Junctions 19 and 25 is in accordance with expected performance for a Strategic Road Network (SRN) dual carriageway route. However, some links perform better than others. Based on accident data for the years 2011-2015, Junctions 21 to 22 and Junctions 24 to 25 have higher Killed or Seriously Injured (KSI) casualty rates than the SRN norm. There are clusters of collisions at some locations, including approaches to junction diverges and merges.

3.3.2 A Do-Nothing scenario would result in an increased exposure to risk for road workers, as operation of the route would become more difficult owing to the level of interventions required for maintenance. These include ongoing repairs associated with existing concrete pavements and dealing with incidents, the volume of which may increase as traffic flows increase, resulting in further increasing congestion.

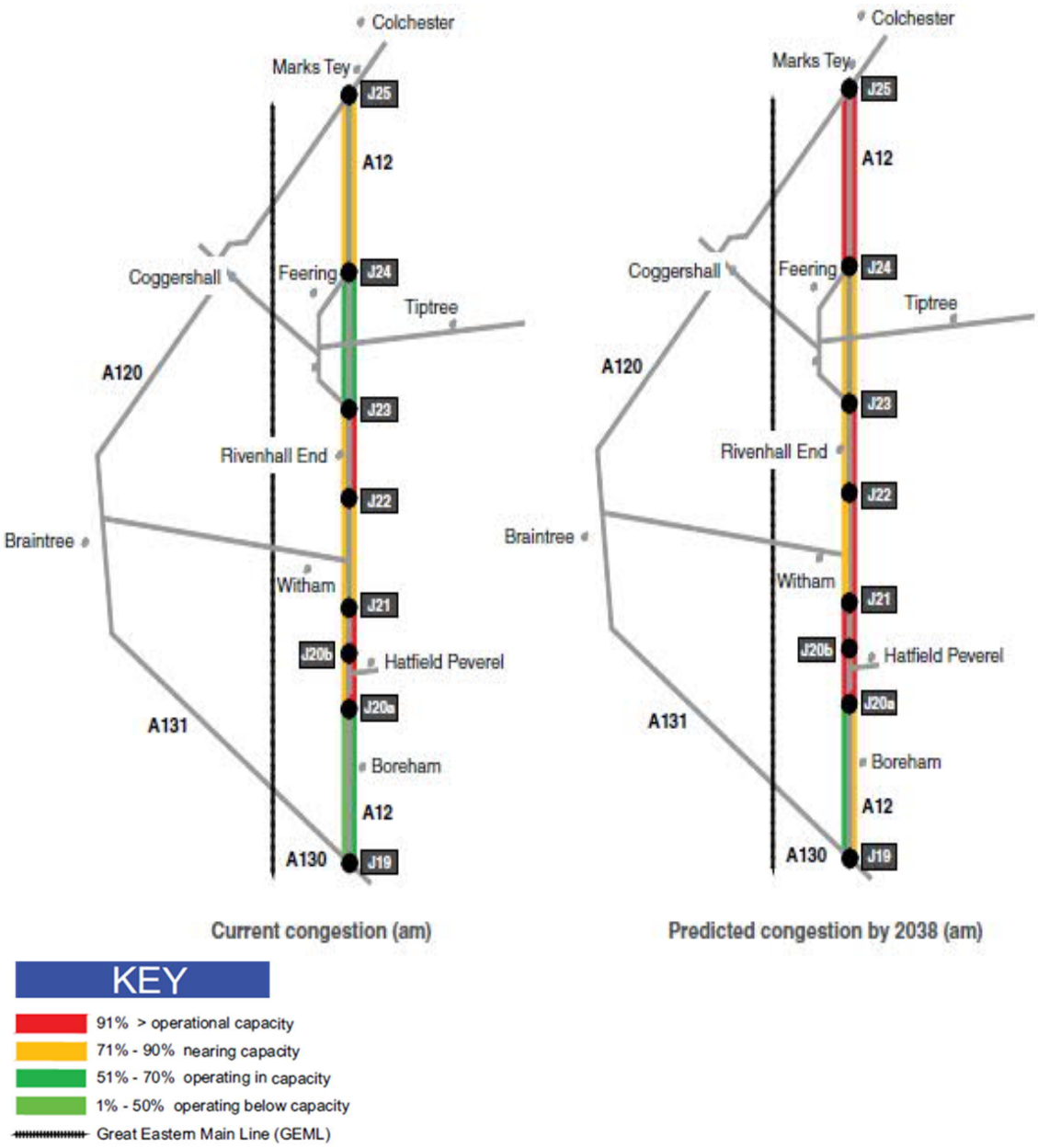

Figure 3.1 : Existing (2015) and Predicted (2038) Flow to Capacity Ratio (AM)

Figure 3.2 : Existing (2015) and Predicted (2038) Flow to Capacity Ratio (PM)

4. Summary of Consulted Schemes

4.1 General

4.1.1 Nine highways options were eliminated at PCF Stage 0, as described in the Options Assessment Report including:

- A new parallel offline route from Junctions 19 to 25, including bypasses of all major settlements
- A parallel motorway M12 scheme.
- Improving the existing carriageway and central reservation barriers
- Improving lay-bys and the existing road.

4.1.2 A number of studies and consultations have taken place on the A12. These all recognised the need to improve the A12 noting the following issues:

- congestion;
- safety;
- resilience;
- reliability;
- sub-standard junctions;
- detrimental impact on economic growth; and
- lack of provision for WCH users.

4.1.3 New options were assessed against the objectives and the PCF Stage 1 sifting process identified 4 options, as shown in Table 4.1.

4.1.4 Further junction strategy reviews were carried out during Stage 2, to assess the removal of Junctions 20a and 20b at Hatfield Peverel and to provide access from a new Junction 21. The junction assessment was carried using the traffic model and an economic assessment (refer Section 5 of this report).

4.1.5 The walking, cycling and horse riding assessment process has commenced and is feeding into the design process in accordance with DMRB, TD42/17.

4.1.6 A preliminary road safety audit has not been carried out at this stage – however a detailed operational safety review has been carried out, and a PCF Safety Plan developed which deals with road user and road worker safety. Safety is dealt with at every stage of design development by road safety audit trained staff embedded in the design team.

4.1.7 A Departures from Standards Checklist was produced which outlines the Departures from Standards at PCF Stage 2. There have been several Safety Control Review Group (SCRG) meetings held at Stage 2 and discussions on potential Departures will be further discussed in more detailed at the next PCF Stage 3.

4.1.8 Each of the Stage 2 Options 1, 2, 3 and 4 propose similar improvement proposals consistent with each other, these are outlined below and in Table 4.1. The improvement proposals are as follows for the options:

- The introduction of roundabout road markings at Junction 19 and increasing lane widths to improve operational efficiencies and safety;
- Closure of all private accesses on to the A12 mainline;
- Widening of the roundabouts at Junction 19 to introduce additional lanes to enhance the operational efficiency;
- New traffic signing including gantries to ensure improved driver comprehension of the junction layout;
- Improvements will be made to the layout of Walking, Cycling & Horse-Riding (WCH) routes along the A12 mainline and the construction of a new WCH footbridge to assist pedestrians, cyclists, and equestrian use;
- Improvements will be made to the layout of WCH routes which cross the A12 mainline including the construction of new WCH bridges to provide for pedestrian, cyclist, and equestrian routes and desire lines. Additionally, suitable alternative routes are proposed, where required, to supplement existing provision and to avoid the need for WCH users to use the main carriageway and slip roads of the A12 between Junctions 19 and 25.

Table 4.1 : Summary of Options in Consultation

PCF Stage 2 - Option	PCF Stage 1 - Option Equivalent
Option 1 This option widens the A12 between Junction s 19 and 25 (Boreham to Marks Tey/A120) by using the existing highway boundary or adjacent land.	Option 104 Online widening.
Option 2 This option would widen the road along the existing A12 except where widening could have a high local impact. Two new bypasses would take traffic off the A12 and onto a newly created A12 between Junctions 22 and 23 (Colemans to Kelvedon South Interchange) and Junctions 24 and 25 (Kelvedon North to Marks Tey/A120 Interchange). The bypasses would provide additional road network and potentially, additional resilience to deal with local incidents as the existing A12 would be de-trunked to a local road and retained.	Option 3a Online widening with two new bypasses at Rivenhall End and Marks Tey.
Option 3 This option is the same as Option 2, but with one new bypass between Junctions 22 and 23 (Colemans to Kelvedon South). The bypass would provide additional road network and potentially, additional resilience to deal with local incidents, as the existing A12 would be de-trunked to a local road and retained.	Option 107 Option 101 (online widening) with a new bypass at Rivenhall End.
Option 4 This option is the same as Option 2, but with one new bypass between Junctions 24 to 25 (Kelvedon North to Marks Tey/A120 Interchange). The bypass would provide additional road network and potentially, additional resilience to deal with local incidents as the existing A12 would be de-trunked to a local road and would be retained.	Option 108 Option 104 (online widening) with a new bypass at Marks Tey.

4.1.9 All Options 1 to 4 would be built in construction phases, to optimise the junction constructability and works on the A12 carriageway widening. The following initial construction phases have been identified in a Construction Methodology and Phasing Report These are not to be considered final, and are summarised below:

- **Phase 1:** Junctions 19 to 21 – Approx. Ch. 29,600m to Ch. 39,200m
- **Phase 2:** Junctions 21 to 22 – Approx. Ch. 39,200m to Ch. 41,500m
- **Phase 3:** Junctions 22 to 23 – Approx. Ch. 41,500m to Ch. 46,000m
- **Phase 4:** Junctions 23 to 24 – Approx. Ch. 46,000m to Ch. 48,000m
- **Phase 5:** Junctions 24 to 25 – Approx. Ch. 48,000m to Ch. 54,500m

4.1.10 All options would include additional interface with the A120 Braintree to A12 scheme (currently being recommended for inclusion in RIS2 by Essex County Council on behalf of the Department for Transport and Highways England). Current proposals suggest this would introduce a new or combined junction at Junction 23 or north of Junction 24.

4.2 Option 1

4.2.1 Online Option (Widening the Existing A12)

- Option 1 would widen the existing A12 corridor to three lanes in each direction between Junctions 19 and 25, see Figure 4.3 below.

- This option would increase capacity on the road network and will meet predicted demand for design year 2038.

- Network resilience would increase slightly with the widening of the A12 from 2 lanes to 3 lanes between Junctions 20a and 25, in both directions. The section between Junctions 21 and 24 would be upgraded to allow for all traffic movements to/from the A12 to connect to existing local roads to access Witham, Rivenhall and Kelvedon, which would provide improved connectivity.

- The option would require land within the existing highway boundary. It may also require land immediately next to it, particularly between Junctions 22 and 23 and between 24 and 25. This option would remove all direct private accesses onto the new A12. Therefore, alternative access arrangements would need to be provided to those affected. Details would be developed after further studies and in collaboration with the affected residents and landowners.

- The construction duration for this option, accounting for the phased delivery, has been estimated at 6 to 10 years.

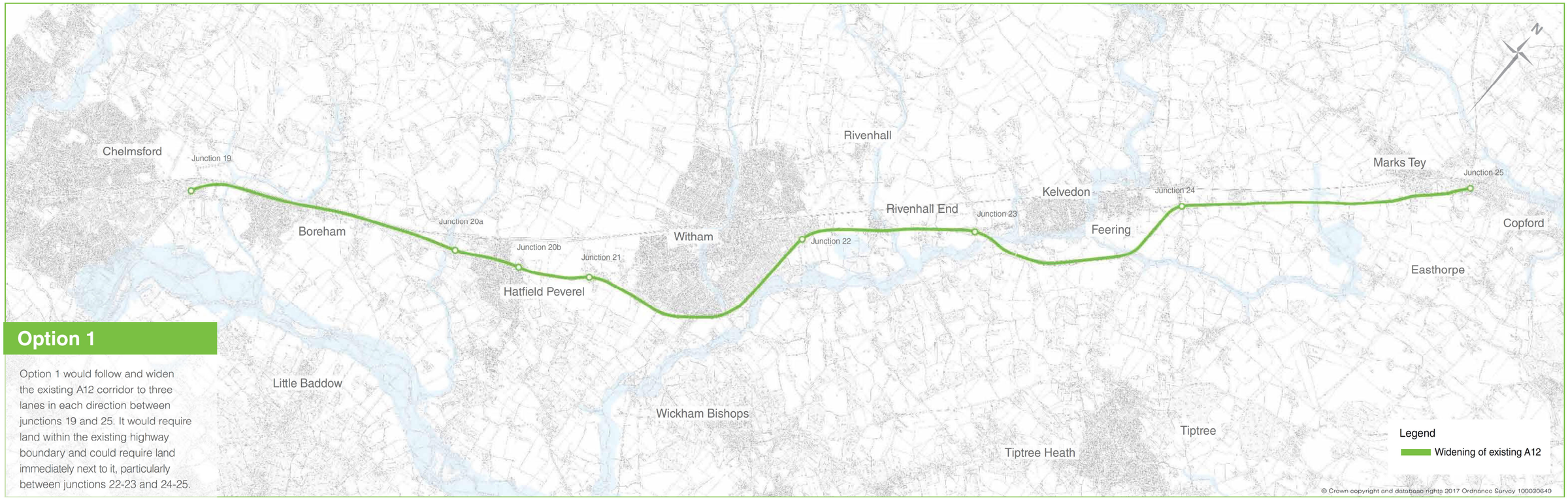

Figure 4.3 : Option 1

4.3 Option 2

4.3.1 Option 2 – Widening with New Rivenhall and Marks Tey Bypasses

- Option 2 would widen the existing A12 to three lanes in each direction between Junctions 19 and 22, as Option 1. At Junction 22, it would leave the existing A12 and creates a new 3-lane bypass in each direction to the south, running parallel to the existing A12 (Rivenhall bypass). At around Junction 23, it would re-join the existing A12. The existing A12 would be widened to 3 lanes in each direction between Junctions 23 and 24. At Junction 24, the new A12 would leave the existing A12 and create a second 3-lane bypass in each direction to the south, running in parallel with the existing A12 (Marks Tey bypass), re-joining the existing at Junction 25, see Figure 4.4 below.

- The existing A12 along the bypass sections (Rivenhall and Marks Tey) would be de-trunked and would require further design development and agreement with Essex County Council and collaboration with the local authorities and stakeholders. These would be returned to local roads upon agreement.

- This option is likely to provide the most capacity of all the options and will meet predicted for design year 2038.

- Network resilience would increase in relation to localised incidents, with the existing A12 being widened from 2 lanes to 3 lanes between Junctions 20a and 25 in both directions. In addition, the benefit of the 2 new bypasses and the de-trunking of the A12 would also provide further localised network resilience for any incidents or maintenance on these A12 sections. The existing Junctions 21 to 24 would be upgraded to allow for all traffic movements to/from the A12 to connect to existing local roads to access Witham, Rivenhall and Kelvedon, which will provide improved network connectivity.

- This option would require land within the existing highway boundary. It may also require land immediately next to it. It would also require significant land in the locations of the two proposed bypasses. As with Option 1, where the route widens the existing A12, any existing direct private accesses onto the A12 are likely to be removed, with alternative access arrangements provided.

- The construction duration for this option, accounting for the phased delivery, has been estimated at 5 years to 10 years.

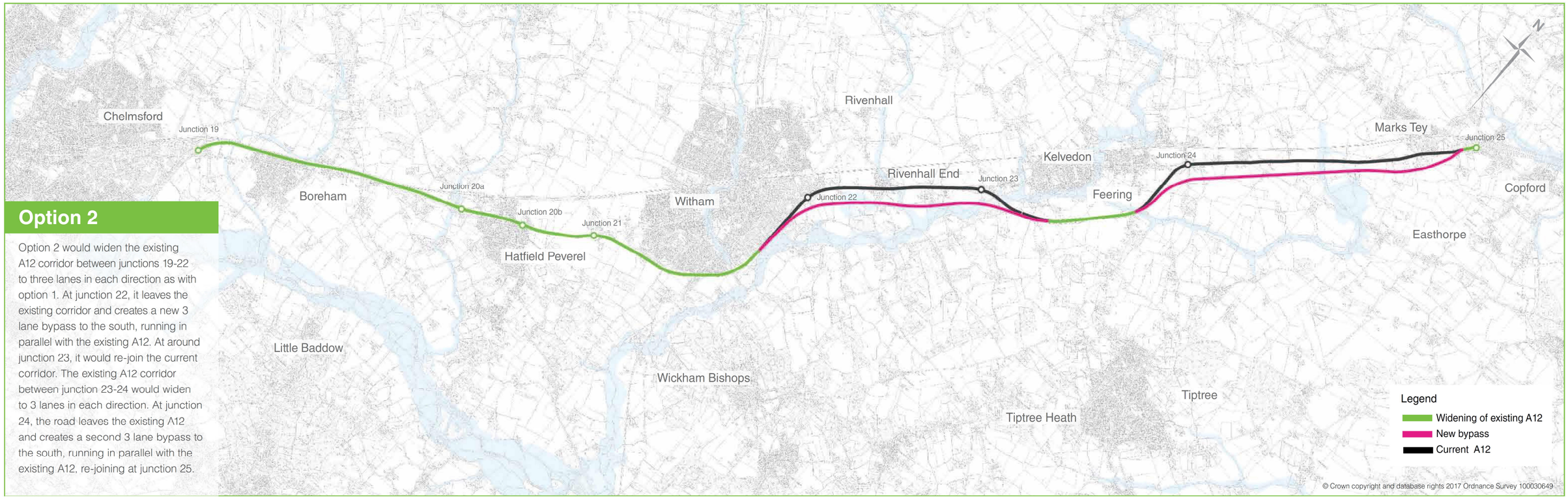

Figure 4.4 : Option 2

4.4 Option 3

4.4.1 Option 3 - Widening with New Rivenhall Bypass

- Option 3 would widen the existing A12 to three lanes in each direction between Junctions 19 and 22, as Option. At Junction 22, it leaves the existing A12 and creates a new 3-lane bypass in each direction to the south, running parallel to the existing A12 until Junction 23, where it would re-join the existing A12. It then follows the existing A12 between Junctions 23 and 25, which would be widened to three lanes in each direction, see Figure 4.5 below.

- The existing section of the A12 parallel to the bypass (Rivenhall) would be de-trunked and would require further design development and agreement with Essex County Council and collaboration with the local authorities and stakeholders.

- This option is likely to provide more capacity on the road network than Option 1 but less than Option 2. It will provide similar capacity to Option 4 and will meet predicted demand for design year 2038.

- Network resilience would increase with the existing A12 being widened from 2 lanes to 3 lanes between Junctions 20a and 25, in both directions. In addition, the new bypass and the de-trunked A12 would provide further network resilience for any operational incidents or maintenance on this A12 section of the A12. The existing Junctions 21 to 24 would be upgraded to allow for all traffic movements to/from the A12 to connect to existing local roads to access Witham, Rivenhall and Kelvedon, which will provide improved network connectivity.

- This option would require land within the existing highway boundary. It may also require land immediately next to it. It would also require land in the location of the proposed bypass. Where the route follows the existing corridor, any existing direct private accesses onto the A12 are likely to be removed, with alternative access arrangements provided.

- The construction duration for this option, accounting for the phased delivery, has been estimated at 5½ to 10 years.

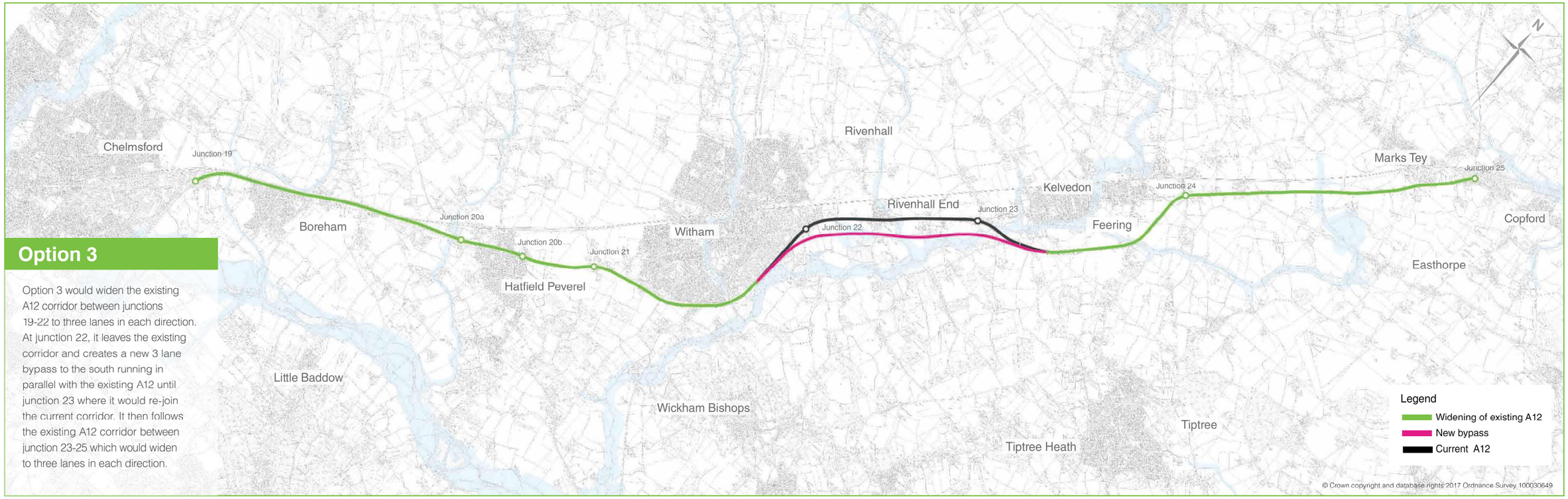

Figure 4.5 : Option 3

4.5 Option 4

4.5.1 Option 4 - Marks Tey Bypass

- Option 4 would widen the existing A12 to three lanes in each direction between Junctions 19 and 24, as Option 1. At Junction 24, it would leave the existing A12 and create a new 3-lane bypass in each direction to the south, running parallel to the existing A12 until Junction 25, where it would re-join the existing A12, see Figure 4.6 below.

- The existing section of the A12 parallel to the bypass (Marks Tey) would be de-trunked and would require further design development and agreement with Essex County Council and collaboration with the local authorities and stakeholders.

- This option is likely to provide more capacity on the road network than Option 1 but less than Option 2. It provides similar capacity to Option 3 and will meet predicted demand for design year 2038.

- Network resilience would increase with the existing A12 being widened from 2 lanes to 3 lanes between Junctions 20a and 25, in both directions. In addition, the new bypass and the de-trunked A12 would provide further network resilience for any operational incidents or maintenance on this section of the A12. The existing Junctions 21 to 24 would be upgraded to allow for all traffic movements to/from the A12 to connect to existing local roads to access Witham, Rivenhall and Kelvedon, which would provide improved network connectivity.

- This option would require land within the existing highway boundary. It may also require land immediately next to it. It would also require land in the location of the proposed bypass. Where the route follows the existing corridor, any existing direct private accesses onto the A12 are likely to be removed, with alternative access arrangements provided.

- The construction duration for this option, accounting for the phased delivery, has been estimated at 5½ to 10 years.

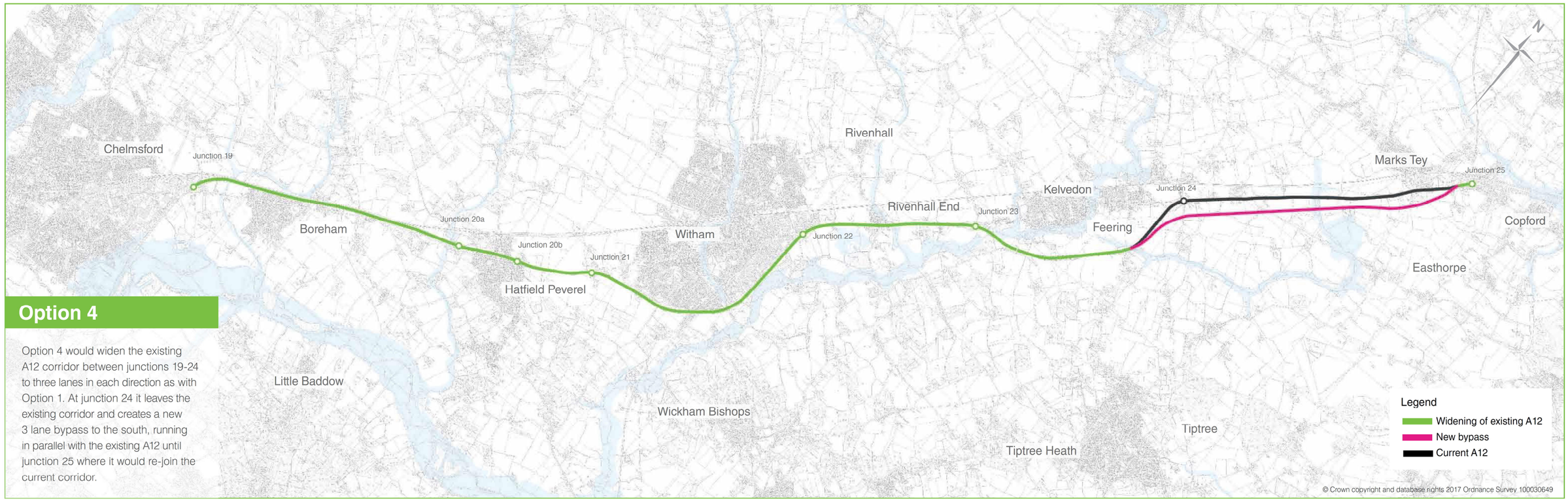

Figure 4.6 : Option 4

5. Traffic Forecasts, Economic and Costs

5.1 Traffic Modelling

5.1.1 In order to predict the impact of the scheme in the future, a series of transport models have been developed to produce forecasts of traffic flows on the A12 in future years based on detailed modelling of the existing traffic conditions.

5.1.2 The model used to represent existing conditions, is known as the Base Year Model. It was developed using SATURN modelling software and was approved by Highways England. The model can therefore be used with confidence to predict future traffic flows, as described below.

5.2 Traffic Forecasting

5.2.1 Traffic models were used to predict traffic conditions in order to quantify the benefits of the proposed A12 Junctions 19 to 25 Widening Scheme. Traffic forecasts were produced for the Opening Year (2023) and a Design Year, 15 years later (2038). For economic appraisal, it is advisable to forecast traffic flows as far into the future as possible, to the extent which standard forecasting datasets allow, which is currently 2051. Hence this year was also modelled. The models took into account surrounding highway schemes and housing and employment developments in the area, as well as background traffic growth expected in the future years.

5.2.2 The forecast models were developed based on the Base Year Model of existing conditions described above.

5.2.3 The following forecast scenarios were modelled:

- Do-Minimum — Where no improvements were made to the A12 between Junctions 19 and 25;
- Do-Something — Options 1-4 as outlined in Section 2.4 above.

5.2.4 The forecast models were run through a Variable Demand Modelling process in order to predict how overall traffic levels would respond to future traffic conditions.

5.2.5 Overall, the model forecasts that the increased capacity of the A12 draws traffic onto the strategic road network, resulting in some reductions in flow on local authority roads. There is some reduction in flow through urban areas, in part due to the provision in the scheme options of full movement junctions, replacement partial or limited junctions. The model also forecasts significant journey time reductions on the A12.

5.3 Summary of the Expected Effects of the Scheme Options

5.3.1 Analysis of the forecast results has highlighted that many of the broad impacts of Options 1 to 4 are similar in terms of changes of flow and journey time savings and are summarised below:

1. There is an increase in flow on the A12 (in both directions) for the extent of the scheme. This is expected, as the extra capacity and reduction in journey time attracts more vehicles.

2. There is minimal increase in flow on the A12 (in both directions) outside of the extents of the scheme. This is expected, as these sections of the A12 are already operating close to capacity in the Do-Minimum scenario, meaning that although there may be a marked increase in flow on the upgraded section of the A12, the existing capacity issues on the other sections of the A12 will still exist.

3. There is a decrease in flow at the southbound on-slip at Junction 19. The increase in flow on the mainline A12 southbound causes an increase in delay for traffic joining from

the southbound on-slip at Junction 19, so some traffic chooses to take an alternate route to avoid this delay. 'Select Link Analysis' (SLA) shows that this rerouting traffic is originating from Chelmsford town centre (Springfield area). These vehicles have reassigned to use Junction 17 to continue their journey.

4. There is a decrease in flow on the B1137 through Hatfield Peverel. Following the closure of Junctions 20a and 20b and the introduction of a new all-movements junction at J21, traffic from the south and south-east of this area can access the A12 via J21, rather than via Hatfield Peverel and J20a/b.

5. There is a decrease in flow (in both directions) on Witham High Street. This is partially due to increased accessibility to/from the A12 from local areas in the town. i.e. traffic originating from east of Kelvedon and wanting to join the A12 southbound can use Junction 24 instead of travelling through the town centre. Previously, there were limited movements at Junctions 23 and 24.

6. There is an increase in flow on Easthorpe Road, especially NB. This is due to traffic originating from south of the A12 near Junction 25 in the Colchester area. The approach to Junction 25 from the south is congested, causing traffic to re-route onto Easthorpe Road and join the A12 SB at Junction 24. Some of these vehicles also travel through Kelvedon towards Coggeshall. Some of this traffic has reassigned from the A120 WB.

7. Flows on the B1022 and B1026 have decreased. This is due to traffic reassigning onto the A12 – flow increases can be seen on links perpendicular to the A12 (south of A12).

8. Flows around the Maldon area (the B1018 and the A414) have decreased. This is due to traffic reassigning onto the A12 – flow increases can be seen on links perpendicular to the A12 (south of A12).

5.3.2 Overall, the provision of the improvements has a net benefit in the future years. The benefits for each scheme are discussed in the sections below.

5.4 Journey Times

5.4.1

5.4.2 Table **5.1** shows the journey times on the A12 route between Junctions 19 and 25, for the Do-Minimum and the Do-Something scenarios in 2038. By 2038, there are journey time savings of 1½ to 8 minutes between Junctions 19 and 25. The largest time savings are towards Chelmsford (i.e. westbound) in the AM peak and towards Colchester (i.e. eastbound) in the PM peak. Journey time savings are forecast for all options, which demonstrate that each of the schemes would relieve congestion and lead to improved journey times and reliability. Journey time savings are similar for all options, with Option 2 demonstrating the best journey time savings overall due to the provision of two new offline sections while still retaining access to the 'old' A12 road.

5.5 Economic Appraisal

5.5.1 A summary of the monetised costs and benefits for the four options is provided in Table 5.2. The table includes a Benefit to Cost Ratio (BCR). This is a key metric used to indicate the comparative value for money of different options, and is simply the scheme's benefits divided by its costs.

Table 5.1: Journey Time Comparison in 2038 for the Core Growth Scenario (mm:ss) for the A12 between Junctions 19 and 25

							Comparison to Do-Minimum			
Time Period	**Direction**	**Do-Minimum**	**Option 1**	**Option 2**	**Option 3**	**Option 4**	**Option 1**	**Option 2**	**Option 3**	**Option 4**
AM Peak	Eastbound	21:05	15:40	15:20	15:22	15:37	-5:25	-5:45	-5:43	-5:28
	Westbound	25:53	18:00	17:47	17:58	17:48	-7:53	-8:06	-7:55	-8:05
Inter-Peak	Eastbound	16:56	14:46	14:27	14:30	14:43	-2:10	-2:29	-2:26	-2:13
	Westbound	16:17	14:43	14:19	14:26	14:36	-1:34	-1:58	-1:51	-1:41
PM Peak	Eastbound	23:09	16:13	15:51	16:08	16:17	-6:56	-7:18	-7:01	-6:52
	Westbound	19:11	15:27	14:57	15:05	15:16	-3:44	-4:14	-4:06	-3:55

Table 5.2 : Summary of Monetised Costs and Benefits

		Option 1	Option 2	Option 3	Option 4
Benefits	Travel Time and Vehicle Operating Cost	£483.4m	£541.3m	£533.2m	£509.8m
	Maintenance Delay	£40.5m	£56.8m	£45.2m	£52.4m
	Delays During Construction	-£120.5m	-£77.4m	-£104.5m	-£93.4m
	Accident	-£18.0m	-£23.7m	-£16.6m	-£24.8m
	Indirect Tax Revenues	£108.2m	£113.5m	£113.9m	£107.4m
	Total PVB	*£493.6m*	*£610.5m*	*£571.2m*	*£551.4m*
Costs	Investment Costs	£522.0m	£541.0m	£581.4m	£576.1m
	Operating Costs (Capital Costs of Maintenance)	-£15.4m	-£10.5m	-£13.7m	-£12.1m
	Total PVC	*£506.6m*	*£530.5m*	*£567.7m*	*£563.9m*
Initial Benefit to Cost Ratio (BCR)		**1.0**	**1.2**	**1.0**	**1.0**
Additional Benefits	Journey Time Reliability	£182.0m	£180.7m	£176.8m	£187.9m
	Wider Impacts	£6.8m	£7.7m	£7.5m	£7.1m
	Total Adjusted PVB	£682.4m	£798.9m	£755.5m	£746.4m
Adjusted BCR *(including Additional Benefits)*		**1.3**	**1.5**	**1.3**	**1.3**

All monetary values are in 2010 prices, discounted to 2010.

5.5.2 The economic results show:

- The scheme provides large journey time savings, which are similar across options. It will also result in an increase in vehicle operating costs through increased fuel consumption and vehicle wear-and-tear. The increased fuel consumption would also provide a benefit in terms of increased government tax revenues.
- The scheme is predicted to provide benefits to road users in terms of reduced delays during maintenance.
- There are significant economic disbenefits from delays to road users during the construction of the scheme. These disbenefits are largest for Option 1, which is entirely online. The disbenefits are smallest for Option 2, as it has the longest offline section. These construction delay disbenefits are likely to be refined as more detailed construction plans become available during the scheme's development.
- The total benefits of each scheme are between £494m and £610m. The largest benefits are for Option 2, due its lower construction delays compared to other options.
- Additional benefits have also been derived due to an increase in journey time reliability with the scheme in place, and from wider economic impacts. These effects provide additional benefits of around £184m to £195m. In line with DfT guidance, these impacts have not been included within the core BCR (referred to as Initial BCR by DfT) of the scheme. However, they can be considered within an 'adjusted BCR' and used to inform the overall value for money assessment of the scheme.
- The scheme costs provided for each option were re-standardised, using standard economic adjustments, to provide a 'Present Value of Costs' (PVC) for each option. This includes an allowance for the reduced long-term maintenance liability with the scheme in place. The PVCs range from £507m to £568m, with Option 1 being the cheapest option and Option 3 the most expensive option.
- A COBA-LT assessment was used to estimate the scheme's impact on accident numbers, based on national default assumptions on the severity of accidents. This shows, in all options, a slight disbenefit on A12 with an improvement on local roads, resulting from transfer of traffic from the local road network to the A12 (widened to D3AP). However, a more detailed collision and casualty analysis was carried out on A12 Junctions 19 to 25. They have also been used in the derivation of safety baselines and safety objectives in the PCF Safety Plan. These indicated that while the performance (casualty rate) of the existing route is in accordance with an SRN dual carriageway, some individual existing links perform worse for Killed and Seriously Injured (KSI) casualties. The current COBA-LT accident assessment does not take into account this higher than average proportion of KSIs on these sections of the existing A12, meaning that the true accident benefits of the scheme are underestimated in the economic assessment.
- In addition, it is proposed to provide triple pack technology (CCTV, variable message signs and incident detection) on the route, which will improve ability to deal with incidents, improve safety and provide mitigation for departures from standards at some junction merges and diverges. This would provide a further saving of 13% accidents compared with standard D3AP, further increasing the scheme's safety benefits. The COBA-LT accident assessment will be updated to reflect these impacts during later stages of scheme development.

5.5.3 To understand the likely value for money of each scheme, the benefits can be compared to the costs to provide a Benefit to Cost Ratio (BCR). The BCRs (without benefits from journey time reliability and wider economic impacts) are shown below:

- Option 2 provides a BCR of **1.2**.
- Options 1, 3 and 4 provide a BCR of **1.0**.

5.5.4 The Adjusted BCRs (i.e. including benefits from journey time reliability and wider economic impacts) are shown below:

- Option 2 provides a BCR of **1.5**, which is likely to represent a **low to medium** value for money (VfM) rating
- Options 1, 3 and 4 provide BCRs of **1.3**, which is likely to represent a **low** value for money (VfM) rating

5.6 Conclusion

5.6.1 Each option provides significant economic benefits, which outweigh the cost of implementing the scheme.

5.6.2 Option 2 provides the highest adjusted Benefit to Cost Ratio (BCR), with a BCR of 1.5 including benefits from journey time reliability and wider economic impacts. This is likely to represent **low to medium** value for money.

5.6.3 Options 1, 3 and 4 provide lower levels of benefits, with adjusted BCRs of 1.3. This is likely to represent **low** value for money.

5.6.4 The differential in benefits between the four options is generally due to the higher level of delay to road users during the construction of online sections of road, which partially offsets the scheme benefits. Option 2 has the largest proportion of offline construction, resulting in the lowest level of user delay disbenefits.

6. Operational Assessment

6.1 General

6.1.1 The operating regime proposed for the scheme is D3AP with triple pack technology, providing additional safety and operational benefits, and allowing mitigation of departures from standards at junction merges and diverges.

6.1.2 Currently average speed cameras are present between Junctions 22 and 24. A revised enforcement strategy will be required for the scheme.

6.1.3 Operational assessment has not been finalised as this stage due to the fluctuation in the actual scheme scope and older results could be misleading. This will be undertaken at the during PCF Stage 3.

6.2 Conclusion

6.2.1 Detailed operational assessment has not been finalised at this Stage 2, due to the ongoing scheme design development and Garden Communities emerging local development plan (November 2017) and Draft Local Plan Policy SP9, in Colchester and Braintree District Council. Full operational assessment will be undertaken at the next PCF Stage 3.

7. Maintenance Assessment

7.1 Impact of Operational Regime

7.1.1 The proposed scheme would be working towards a D3AP standard for the A12 route with technology upgrades. The operational regime would include a number of elements designed to facilitate future maintenance, and the provision of concrete barriers would reduce maintenance interventions required, thus improving road worker safety in accordance with the overall safety objectives for the project. There would also be a five-year maintenance free period after completion.

7.2 Civils Infrastructure

7.2.1 Concrete barrier – this would virtually eliminate repair resulting from collisions, reducing exposure to risk for workers and road users, and increasing network availability.

7.2.2 Geometric Standards – the use of high standard geometry would facilitate safer operation of routine maintenance and temporary traffic management.

7.2.3 Structures – new structures would be provided at all junctions and at the intersection with the A12. New grade separated junction replacements of existing junctions (west of existing Junction 19, west of existing Junction 21, east of existing Junction 22 and west of existing Junction 23, west of existing Junction 24) are required, in addition to the River Brain, the River Blackwater (viaduct), the Braintree Branch Line of the GEML, side road bridges, minor structures for WCH crossings, and various culverts. Safe access will be designed to facilitate maintenance of this infrastructure. Additional grade separated junctions required to be further assessed in detailed.

7.2.4 Pavement – pavement would be maintained using standard methods, and would require lane closures.

7.2.5 Drainage – safe access would be provided to enable required maintenance of drainage facilities including channels, gullies, attenuation and pollution control measures.

7.2.6 Soft estate and fencing - safe access would be provided to enable required maintenance of aspects these elements.

7.2.7 The Maintenance and Repair Strategy report will be prepared for design Stage 3 for the preferred route to develop the above items.

7.3 Technology - Maintenance and Repair Strategy for Road Side Technology

7.3.1 Maintenance Access – provision of emergency bays combined with maintenance access bays and technology cabinets, and variable message signs would facilitate safer maintenance of assets.

7.3.2 MIDAS Detectors – Above ground detection would reduce maintenance requirements on the carriageway, minimising loop detector repair, traffic management interventions and exposure to risk.

7.3.3 Temporary Traffic Management – Rotating Temporary Traffic Management Signs (ROTTMS) would be provided based on designed fixed taper points to facilitate placing of Traffic Management (TM) signing without the need for road workers to work from or within the carriageway to place the signs. The signs could be turned on and would provide further protection to road workers engaged in placing cones and lamps from vehicles.

7.3.4 Variable Message Signs – these can be used to further enhance advance warning of road works and implementation of temporary speed limits.

7.4 Specific maintenance challenges

7.4.1 The assumption is that the existing concrete pavement will be replaced where required, with overlays provided where there are noise concerns. There will be pavement surveys undertaken during the next PCF Stage 3 to identify these areas.

7.4.2 Options 1 is an on-line option. This will require local access roads (LAR) to facilitate access to premises along the route, for bus stops and for WCH users in the sections between Junctions 22 and 23, and Junctions 24 and 25. This may introduce requirements for additional fencing between the routes, and complications for maintenance of equipment in any adjacent sections. It will be essential, if the LAR is adjacent to the main carriageway, to provide sufficient width between the routes to facilitate safe locations for the siting of equipment and subsequent maintenance.

7.5 Safety

7.5.1 Road user safety on the proposed route would be improved by the design year in all options. Current proposals involve widening to D3AP with additional safety improvement provided by triple package technology. However, at this stage, benefit calculations have been based on widening to D3AP standard only and would be updated at a later stage of the project. The route currently operates with the performance generally expected of a Strategic dual carriageway road, but with some links performing better than others. On-line Options 1 and 3 require a parallel single carriageway local access road (LAR) in the Rivenhall End area to provide access to properties, public transport facilities and local junctions. The safety performance of the LAR results in less safety benefits than other options.

7.5.2 A COBA LT analysis has identified overall safety benefits, but that most of the benefits occurs on the local road network (traffic transferring to the SRN).

7.5.3 Road worker safety on the proposed route would be improved significantly over the existing route by the provision of a range of measures, including concrete barrier, fixed taper points and combined emergency/maintenance bays, which would reduce maintenance interventions and exposure to risk, or ensure they are designed to maximise safety of road workers and road users. However, in the on-line options, the complexities created by a parallel LAR in options 1 and 3 at Rivenhall End have resulted in a lower score of these options.

7.6 Walkers, Cyclists and Horse Riders

7.6.1 All options provide overall benefits for walkers, cyclists and horse riders by providing opportunities for improved local links between communities, leisure and employment opportunities, correcting historic severances and providing improved segregated links at junctions. The scheme would exclude walkers, cyclists and horse riders from the improved section of the A12, and require a suitable alternative route (generally based on the local roads and facilities through Boreham, Witham and Kelvedon, with improvements to facilities for these users where required).

7.7 Conclusion

7.7.1 In comparative terms all four options perform well against the objectives set. Options 1 to 4 all provide a balance between the ambition to release economic and housing growth in the area, provide additional road capacity, reduce congestion on the strategic network, improve resilience on this strategic route linking Felixstowe to the Thames Gateway ports and the wider national network, while improving road safety, reducing congestion and reducing the environmental impact of the road. In overall economic terms, Options 2 and 4 provide the best safety benefits.

8. Environmental Assessment and Environmental Design

8.1 Overview

8.1.1 The A12 Chelmsford to A120 PCF Stage 2 Environmental Assessment Report (EAR) contains a detailed description of the baseline environment for each environmental topic area. The PCF Stage 2 EAR includes an Options Appraisal Matrix (OAM) which summarises the different effects likely for each of the four options under consideration.

8.2 Air Quality & Greenhouse Gases

8.2.1 Braintree District Council currently monitors nitrogen dioxide (NO_2) at various locations across the district, using passive diffusion tubes. There are two monitoring sites located along the A12. A monitoring site at A12 Hatfield Peverel is located 90m to the north of the A12 carriageway. The 2014 NO_2 annual mean concentration at this location was 47.7µg/m³, exceeding the relevant air quality objective (AQO) of 40µg/m³. A monitoring site at A12 Rivenhall is located at the eastbound of the A12 carriageway (London Road). The 2014 NO_2 annual mean concentration at this location was 52.1µg/m³, also exceeding the relevant AQO.

8.2.2 The nearest air quality management area (AQMA) is located in Stanway (Lucy Lane North), approximate 2.3km to the east of Junction 25, declared for annual mean NO_2 by Colchester Borough Council. The AQMA is adjacent to Junction 26 of the A12. The initial traffic modelling indicates that Junction 26 could fall within the 'affected road network' of the scheme, with the potential to affect the AQMA. Air quality modelling would be required to test whether this has an impact on the AQMA, and whether mitigation measures would be required, for example, speed restrictions. Further analysis of the traffic data would inform the level of risk associated for all options.

8.2.3 Options that move traffic away from local receptors (e.g. through the proposed bypass options) would result in air quality improvements at these locations. However, the areas where the proposed bypass is located would potentially experience a deterioration in air quality. The nature of the impact would be determined through air quality modelling at the next stage of the EIA.

8.2.4 There are likely to be temporary construction effects on air quality associated with dust and emissions during construction. However, these would be managed to acceptable levels through general good construction site practices.

8.2.5 All options are likely to impact on carbon dioxide in two ways; firstly, carbon is generated during the construction phase as a result of extracting raw materials, processing materials for use in construction and the movement of vehicles during the construction phase (construction carbon); and secondly, carbon is generated from vehicles during the operation phase as a result driving along the new route corridor (operation carbon).

8.2.6 Operation carbon would be quantified as part of the business case over summer 2018 using the Highways England carbon tool (August 2015 as amended February 2016) and based on the traffic modelling outputs. The direct energy associated with the operation of the road, such as energy from the use of lighting would not be considered in line with IAN 153/11 (Highways Agency, 2011b).

8.3 Noise

8.3.1 There are 18 noise important areas (NIA) along the A12 between Junctions 19 and 25. A further four are located on the A130 adjacent to Junction 19; eight on the A120 adjacent to Junction 25; and one at Junction 26. There are six railway NIA in the study area. Options with offline bypasses may lead to improvements to NIA along sections of the existing A12 where the route is taken offline.

8.3.2 The existing noise climate in the vicinity of the scheme is dominated by road traffic noise, predominantly from the A12 and associated junctions. The noise patterns would change following the implementation of the scheme with some areas experiencing increased noise and some decreased noise, which would vary for the different options. Receptors along offline routes could be more sensitive to the changes in noise levels, whereas receptors along the existing A12 may be less sensitive to noise increases for the online routes due to existing ambient noise levels.

8.3.3 A detailed noise model would need to be developed to assess the effects of the scheme and whichever option is taken forward. Noise barriers are likely to be required to reduce the impact to receptors along offline sections of the route. Thin surfacing (or low noise road surfacing) would also be considered as a mitigation measure for all options, though the impact of this would be to increase whole life maintenance costs due to the low life span of such surfacing which requires more regular replacement.

8.4 Landscape Impacts

8.4.1 The study area is described as low lying with a distinctive network of ditches and streams, waterbodies and rivers (including the River Blackwater, River Ter and Domsey Brook). These features provide a strong sense of place within the landscape. Existing vegetation forms an integral part of the landscape fabric and also provides visual screening in views towards the existing A12 and associated traffic, other major roads and the railway line.

8.4.2 All options would exacerbate the prominence of major highway infrastructure within the landscape. This is because extensive established vegetation that helps to integrate the existing A12 into the landscape may be removed along the online sections. The scale of the infrastructure, including major new and improved junctions, and the elevated position of some elements would be at odds with the scale and character of the surrounding landscape. Options with offline bypasses and major junctions are likely to have particularly adverse effects on landscape character and quality, with a loss of vegetation, disruption to field pattern and reduced tranquillity.

8.4.3 There would be visual effects of significance for a high number of visual receptors for all options. This is particularly the case for residents within properties on the peripheries of surrounding nearby settlements, where proposed lane widening on the existing A12 could in places result in the loss of mature vegetation that currently screens views to the road. Other visual receptors which would likely experience effects are users of rights of way and public open space in the vicinity of the A12.

8.4.4 Landscape mitigation would be developed for the option that is taken forward. This would likely include measures such as:

- Sensitive design of screen mounding, drainage features, embankments, and signage

- Utilisation of sensitive lighting design
- Dense native tree and shrub planting on and adjacent to highway earthworks to create woodlands, copses and shelterbelts in order to break up the scale of the road
- Retention of views to local landmarks through breaks in the planting to help create a sense of place.

8.5 Historic Environment

8.5.1 There are 358 cultural heritage assets within 1km of the A12, of which 64 are designated sites. All options are likely to impact the setting of a scheduled monument to the south of Rivenhall, listed buildings, conservation areas at Boreham, and Boreham House and Braxted Park registered parks and gardens. Online options may have less of an effect on historic setting as development would occur within the existing highways corridor and the online sections are generally further away from the designated features.

8.5.2 The registered park and garden at Boreham House is located within 100m of the A12. All options could result in significant effects to this asset, as the proposed improvements at Junction 19 physically impact the site. The nearest scheduled monument to the A12 is Rivenhall Long Mortuary Enclosure. Options 2 and 3 would likely result in significant effects to the setting of the Rivenhall Long Mortuary Enclosure Scheduled Monument, as they would be located within 50m of this asset.

8.5.3 The high number of designated and non-designated sites within the study area shows the high potential for buried archaeology. Options 2 and 3 would involve the construction of a new offline route south of Rivenhall, which is an area of high archaeological potential, and assets that form part of an historic landscape. Historic England noted the importance of this historic landscape and the associated Palaeolithic deposits in this area during a stakeholder meeting in June 2017. They noted that there is likely to be the need for significant investigation and evaluation of features in this section which should be factored into the programme and the mitigation and risk budgets, particularly for the offline options.

8.5.4 Other sites which may be impacted, and are areas integral to the East of England Regional Research Framework, include the Kelvedon Roman Cemetery, a roman road, and areas of complex cropmarks near Colemans Farm and Appleford Farm. Option 1 would have a more limited effect on known and unknown archaeology due to the limited land take alongside the existing A12, which is likely to have been partially disturbed during construction of the existing road.

8.5.5 Archaeological remains and other heritage assets are non-renewable resources and their removal could lead to substantial harm to or loss of significance. The presence and value of any heritage assets would be determined through a staged assessment of desk based study, geophysical survey and trial trenching. This would allow a mitigation strategy to be developed which would seek to avoid heritage assets in the first instance. Where this is not possible a scheme of works in advance of, or during, construction may be required. This would allow assets to be recorded and advance the understanding of the significance of any cultural heritage asset to be lost (wholly or in part) and to disseminate the results.

8.6 Biodiversity

8.6.1 There are no Ramsar or European designated sites within 5km of the A12. There are three Ramsar and European sites within 20km of the A12 that could be hydrologically linked to the A12 due to being in the same river catchments. These are Blackwater Estuary Ramsar/Special Protection Area (SPA), Colne Estuary Ramsar/SPA and Essex Estuaries Special Area of Conservation (SAC). A further eight European sites are located within 20km of the A12 that are designated for birds (potentially mobile species).

8.6.2 There are two local nature reserves (LNR) and seven local wildlife sites (LWS) within 500m of the A12. Whetmead LNR (also designated as an LWS) is located immediately adjacent to the existing A12 between Junction 21 and Junction 22. All options have the potential to significantly affect this site through both direct effects (through loss of habitat) and indirect effects (through noise, air quality and disturbance).

8.6.3 The study area supports a number of Biodiversity Action Plan (BAP) priority habitats including deciduous woodland, wood pasture and parkland, traditional orchards, ponds, hedgerows, and rivers and streams. In addition, protected species that have been recorded within the study area include badgers, bats, birds, dormouse, fish, great crested newt, invertebrates, reptiles, otter, water vole, and white-clawed crayfish. Impacts to protected species could arise from direct mortality, habitat loss/fragmentation, and disturbance. These impacts would be greatest for Option 2, as the offline bypasses would result in the greatest habitat loss, severance and fragmentation; and least for Option 1, which is entirely online, where the least amount of habitats are likely to be disturbed.

8.6.4 Specific ecological mitigation would need to be identified through the more detailed phase 2 surveys to minimise the effects on habitats and species once the preferred option has been selected. Protected species licences and compensatory habitats are likely to be required for all options.

8.7 Water Environment

8.7.1 Areas of flood zone 2 and 3 are associated with the main rivers in the study area. The A12 crosses five main rivers between Junctions 19 and 25, these are: Boreham tributary, at Boreham; River Ter at Junction 20a; River Brain, south east of Witham; River Blackwater, east of Junction 23; and Domsey Brook, east of Kelvedon.

8.7.2 All options could have a significant effect on the environment through loss of floodplain storage, increase in impermeable area and changes to flow paths, resulting in increased flood risk elsewhere. This is particularly the case for the offline options along the Blackwater corridor between Junctions 22 and 23. Mitigation would therefore be required to offset impacts on flood risk and a Flood Risk Assessment completed as part of the environmental assessment to demonstrate the design would adequately protect the water environment.

8.7.3 There are seven Water Framework Directive (WFD) water bodies crossed or discharged to by the A12 which form part of the Anglian River Basin. These include the main rivers crossed by the A12 mentioned above, as well as the Chelmer (d/s confluence with Can), south of Junction 19, and Roman River, north east of Junction 25, which the A12 discharges to. All options have the potential to significantly affect WFD water bodies, with potential impacts on the hydromorphological, biological and physico-chemical elements of the water bodies. Mitigation would likely be required and would be informed through river corridor surveys and WFD assessment.

8.8 Physical Activity

8.8.1 There a number of existing Public Right of Ways (PRoWs) / bridleway and cycleways in the vicinity of the A12 scheme between Junctions 19 to 25. Regional Cycle Route 50 crosses the A12 at Hatfield Peverel, Essex County Council cycle route 1 crosses the A12 between Junctions 21 and 22 and NCR 16 crosses the A12 at Junction 22.

8.8.2 Options have been assessed to identify whether they create severance for WCHs, whether the severance is mitigatable and whether the option provides opportunities to reduce existing severance issues within the route, and possibly existing WCH safety issues.

8.8.3 Initial consideration has been given to proposed development adjoining the route, and initial workshops with road user groups and WCH groups, and discussions with the Local Highway Authorities have been held to inform the development of the options.

8.9 Journey Quality

8.9.1 Journey quality is expected to improve under all of the options, as congestion would reduce and the journey times would become more reliable. Safety improvements and new planting would also improve the experience of the route to drivers.

8.10 Other DMRB Environmental Topics Not Required by TAG

Geology and Soils

8.10.1 The study area is underlain by a bedrock geology consisting of London Clay, part of the Thames Group (clay with some silts and sands), with the Lambeth Group and Thanet Sands Formation (both consisting of silts, sands and gravel) underlying the London Clay. The superficial geology comprises Head deposits (clay, silt and sand), glaciofluvial deposits (sand and gravel), Lowestoft Formation (formed of Diamicton), Brickearth and localised Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel). There are also localised deposits of glaciolacustrine materials (sand and gravel) and Kesgrave Catchment Subgroup (sand and gravel).

8.10.2 The majority of land is classed as ALC grade 2 (very good) with the remaining areas generally grade 3 (good and moderate). This high grade land should be considered a high sensitivity receptor. Options 2, 3, and 4 would result in the loss of the best and most versatile agricultural land through construction of new offline bypasses. The designs would need to keep the loss to a minimum by retaining existing field boundaries where possible and retaining parcels of land that are large enough to retain viability for farming.

8.10.3 In general, the whole study area is underlain by minerals deposits and all options would need to assess whether there is a significant effect relating to the sterilisation of mineral resources. Mitigation may include extracting the mineral supplies prior to construction of the road.

8.10.4 There are mineral consultation areas located near Junctions 19, 22, 24, and 25. This includes a quarry near to Junction 22 at Coleman's Farm which had planning approval granted in June 2016. The site has permission to extract an estimated 2.5 million tonnes of sand and gravel over a 17-year period. Options 2 and 3 cross the known minerals site at Coleman's Farm and surrounding minerals areas. There would be a permanent footprint within the minerals areas and quarry boundary, which has the risk of sterilising minerals reserves in these areas. This could be a significant effect based on the scale and importance of the mineral reserves in the area. It is likely that there would be expectation to extract minerals prior to construction, with significant impacts on the programme and costs of Options 2 and 3. Either a viaduct or additional fill may be required to span the extracted areas, which have not currently been factored into the costs for Option 2 or 3.

8.10.5 Coleman's Quarry also has a proposed restoration plan to create habitats at the site as part of the restoration proposals after mineral extraction. Options 2 and 3 would significantly affect the restoration and are likely to require additional offsite compensatory habitat to offset the quarry impacts both in terms of loss of habitat and also impacts on habitat quality due to noise and air quality impacts associated with the new bypass being located through the restored site habitats.

8.10.6 There is the potential for contaminated land within the study area and further investigation and assessment is required to understand this risk. This would include building on the existing baseline and following this up with a programme of ground investigations. At this stage, the risk is expected to be similar for all options. It is likely that bespoke mitigation would be required to minimise the risk of contaminated land pathways opening up to both environmental (rivers and soil) and human (local residents, construction workers, road maintenance crews) receptors.

Materials

8.10.7 All options are likely to require large quantities of materials to construct, which has the potential to generate a significant effect on the environment. The main materials are likely to be in the form of the aggregates required to provide fill for the scheme but also include topsoil, pavement, concrete, steel and timber.

8.10.8 At this stage the cut-fill balance for the four options is not known in detail. It is likely that Option 2 will require the greatest amount of materials to construct, and Option 1 the least amount. Option 2 may therefore result in the largest impact on the environment, as there could be increased quarry for raw materials (borrow or steal pits) and increased numbers of construction vehicles transporting materials to the site, causing negative air quality, noise, and community effects.

8.10.9 Significant amounts of additional material would be required if there was a need to infill the quarry after minerals extraction for Options 2 and 3 if this was a requirement from Essex County Council to avoid minerals sterilisation. This has not currently been factored into the cut fill balance, costs or programme.

8.10.10 The key wastes generated during construction would be in the form of aggregates/soil from cuttings, vegetation associated with site clearance, and potential concrete/pavement from any breaking up of the existing carriageway. It is assumed that there will be no aggregate/soil based waste taken off site and that this would be accommodated within the scheme footprint and designs. There is not enough information available at this stage to provide waste quantities for specific options.

People and Communities

8.10.11 The overall scheme would likely have significant benefits to traffic and transport within the area, as capacity is improved and congestion reduced. This would benefit road users as journey times potentially decrease, and driver stress is improved. There would be short term effects during construction, as traffic management would be required. Option 1 is likely to involve the most traffic management and is likely to affect road users for a longer construction period due to less efficient working alongside the live road network. Option 2 would involve the least traffic management and disruption, as the offline sections could be constructed with minimal disruption to live traffic.

8.10.12 All options would likely support economic growth and development within the region and are likely to have beneficial effects in terms of socio-economics. Some businesses along the existing A12 could suffer from a loss of passing trade where the bypass routes are proposed. These issues would need investigating in more detail during PCF Stage 3 in discussion with the relevant businesses and other interested parties.

8.10.13 The offline bypasses associated with Options 2, 3, and 4 have the potential to result in benefits to residential property along the existing A12 as traffic is moved onto the new strategic route. This would reduce traffic along the de-trunked A12, improving access and amenity in the local community. However, offline sections of road would result in some properties being sandwiched between two dual carriageways, which may increase severance and disconnect with the local communities. In these cases, the detrunked dual carriageway would though carry significantly less traffic, and the current private accesses to the detrunked road could be retained.

8.10.14 Online widening associated with Option 1 is likely to require more building demolition than the offline sections. The online options would also require local access roads to be constructed to provide access for existing properties along the A12, where the accesses are removed from the main carriageway.

8.10.15 Options 2, 3, and 4 have the potential to impact public rights of way (PRoW) where offline routes sever them. However, it is expected that PRoW would be maintained, with grade separated crossings provided where they would be severed. The overall scheme is also looking at improving rights of way through the study area by connecting current PRoW routes and improving historic severance. All options would include improvements to rights of way and potential reconnections of routes severed by the existing A12.

Potential of Options Considered to Affect the Environment in Comparison to the Preferred Route

8.10.16 The OAM summarises the effects of each of the different options in relation to the various environmental topics.

8.10.17 The OAM shows that Option 1 is environmentally preferred option. This is because the option would be constructed online within the existing A12 corridor rather than creating a new infrastructure feature within the landscape. This would have less ecological, landscape and setting effects than Options 2, 3 and 4. However, Option 1 is likely to require the demolition of a greater number of residential properties and businesses. It will also require the construction of new local access roads, all of which could result in significant effects to the community.

8.10.18 The offline options at Rivenhall (Option 2 and Option 3) extend over an area of known minerals deposits, some of which have licence to extract, and other areas that do not currently have permission for extraction. There is a risk that the offline options could sterilise minerals. Mitigation may include extracting the minerals prior to construction. This could have implications for the programme and budget if extraction is required prior to construction.

8.10.19 The offline options at Rivenhall would also involve offline development in the Blackwater Valley, with the potential to significantly affect the sensitive landscape character, as well as archaeological and ecological assets within this area. The options also lie close to the Rivenhall Long Mortuary Scheduled Monument and could affect the setting of this site. Historic England has also noted the important historic landscape around the scheduled monument which would be significantly affected by Options 2 and 3. The Options, would sever the landscape with limited opportunities to mitigate.

Potential of Options Considered to Achieve the Scheme's Environmental Objectives in Comparison to the Preferred Route

8.10.20 Options 2, 3, and 4 would improve the environmental impact of transport on communities along the existing A12 corridor where offline bypasses are proposed. This is because the bypasses would reduce congestion and move traffic away from existing NIA. Option 1 may have fewer benefits than the other options; however, there would still be improvements to the community through installation of noise barriers and low noise road surfacing, and reduced congestion through increased capacity on the network.

8.10.21 The second environmental objective is about reducing the impact of new infrastructure on the natural environment. The environmental appraisal has influenced all options through the PCF Stage 1 and 2 design process. This has included changes to the Junction 19 improvements to reduce effects to the registered park and garden at Boreham House (all options); and moving the mainline alignment near Junction 23 more north to reduce impacts to the Rivenhall Long Mortuary Scheduled Monument and floodplain associated with the River Blackwater (Options 2 and 3).

8.10.22 Option 1 is likely to have lower environmental effects on the natural and built environment compared to Options 2, 3 and 4, as it would be built within the existing A12 corridor. Option 2 would have the most significant environmental impacts, as the two offline bypasses would result in the greatest impact to landscape, biodiversity and soils through severance and land take. It would also have significant effects on the historic landscape at Rivenhall, which would be difficult to mitigate and on the potential Palaeolithic deposits. All options would include mitigation to reduce the impact on the environment. This mitigation would be further developed at the next stage of assessment.

8.10.23 The borrow areas are likely to have significant effects on the environment, particularly in terms of protected species and habitats. A construction traffic assessment is likely to be required to understand the impacts of the vehicle movements during construction on the existing road network.

8.11 Conclusion

8.11.1 Option 1 is the preferred option for the environment, as it is likely to have lower environmental effects on the natural and built environment compared to Options 2, 3 and 4, due to being built along the existing A12 corridor. Option 2 would have the most significant environmental impacts, as the offline bypasses would result in the greatest impact to landscape, biodiversity, heritage, and soils through severance and land take. Some of the impacts, such as to cultural heritage, will be difficult to mitigate.

9. Public Consultation

9.1 Summary of consultation

9.1.1 Between 23 January and 3 March 2017 Highways England consulted on the A12 Chelmsford to A120 scheme. The consultation included 7 public information events at various suitable locations along the scheme's length. Participants were given the opportunity to comment on all aspects of the scheme, and 907 responses were received during the consultation period.

9.1.2 The *Report on Public Consultation* (May 2017) provides a detailed analysis of questionnaire responses to the public consultation. This is supported by an independent *Summary Report* (April 2017) produced by Dialogue by Design (DbyD) and can be found on the Highways England A12 project website:

https://highwaysengland.co.uk/our-work/east/a12-chelmsford-to-a120-widening-scheme/

9.1.3 This section summarises the analysis of responses to questions relating to consultation options and junctions feedback, and the factors influencing these decisions.

9.2 Results of public consultation

9.2.1 The consultation received 907 responses, including responses from all key local authorities. 824 respondents expressed a preference for 1 of the 4 options, or supported none of the options. Consultation Option 2 received the most support from respondents with 402 of the 824 (49%) expressing it as their preferred route option. The second most popular consultation option was Option 1 with 227 of the 824 (28%) expressing it as their preferred route option. Option 3 was third most popular with 91 of 824 (11%) followed by Option 4 with 37 of the 824 (4%) expressing it as their preferred route option.

9.2.2 The consultation also asked for views on the need to improve junctions. The majority of respondents felt that improvements were needed at all junctions from 19 to 25. This was particularly clear at Junction 22 where 75% of respondents felt the junction was in need of improvements.

9.2.3 For Junctions 20a and 20b, we asked whether people would prefer to see these junctions to be retained and improved, whether they should be removed and a new Junction 20 be created, or whether they support neither of these options. Of the 757 who responded to the question on Junction 20a and 20b, 278 (37%) felt that the junctions should be retained and improved, 352 (46%) felt that the junctions should be removed and a new Junction 20 should be created and 127 (17%) did not support either option.

9.3 Comments on Option 2

9.3.1 The main reasons given for preference of Option 2 were:

- It would be the most future-proof
- It would cause the least disruption during construction
- It would be more resilient
- It will have the least impacts on local residents, particularly as it avoids Rivenhall End.

9.4 Additional Comments on Junctions

9.4.1 Consultation responses reflect that improvements are felt to be needed at all junctions. Key concerns raised were issues such as congestion, safety and short slip roads. Other issues raised were concern for visibility at junctions, signage and tight bends.

9.5 Comments on alternative designs

9.5.1 Respondents offered a number of alternative design suggestions. Whilst many of these alternatives have already been considered and ruled out, such as the creation of a Hatfield Peverel bypass, a northern bypass, extending the Marks Tey bypass or turning the A12 into a M12 Motorway, we have considered all comments raised with an open mind in recommending a preferred route selection.

9.5.2 The suggestions made by respondents relating to junctions are helping to inform the junction strategy. Responses offered suggestions such as merging Junctions 20b and 21, or merging Junctions 20a, 20b and 21 between Hatfield Peverel and Witham.

9.6 Stakeholder Consultation Views

9.6.1 The majority of respondents agreed that something needs to be done to improve the A12 between Junctions 19 to 25. 92% of respondents expressed a preference for Option 1, Option 2, Option 3 or Option 4, with only 8% of those who responded to question 1 expressing no preference.

9.7 Conclusion

9.7.1 The most popular preference throughout this consultation was Option 2, with 49% of respondents expressing this as their preferred route option. Respondents cited reasons such as future-proofing, resilience and minimised disruption during construction for their choice.

9.7.2 Respondents also felt that improvements were necessary for all junctions along the A12 Junction 19 to 25, but in particular at Junction 22, where 75% of respondents felt improvements were required. Junction 23 received the least support but still a slight majority of 51% felt improvements were necessary. Key issues raised across all junctions included visibility at junctions, signage and tight bends.

9.7.3 This is the first of a number of opportunities that stakeholders will have to formally feed into the scheme. We have concluded that the feedback we received from this consultation is sufficient for this stage, and as such we have now moved into the next stage of the scheme.

10. Appraisal Summary Table

10.1.1 Appraisal Summary Tables have been developed for each option and are presented on the following pages.

10.1 Option 1

Appraisal Summary Table — **Date produced:** 1 2 2018

Contact:	
Name	TBC
Organisation	Highways England
Role	Promoter/Official

Name of scheme:	A12 - Junction 19 at Chelmsford (Boreham Interchange) to Junction 25 at Marks Tey (A120) Improvement
Description of scheme:	Improvement of A12 to expressway standard between J19 and J25. Four scheme options are being considered: • **Option 1) A12 online widening to three lanes throughout. Local access roads to provide alternative access to existing at grade junctions.** • Option 2) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall) and offline bypass between J24 and J25 (Marks Tey). • Option 3) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall). • Option 4) A12 online widening to three lanes with offline bypass between J24 and J25 (Marks Tey). This AST relates to Option 1.

Impacts		Summary of key impacts	Assessment: Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£50m). It will also provide a decrease in road user delays (£9m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£): £269,572,000 Net journey time changes (£): 0 to 2min: £59,738,000; 2 to 5min: £117,792,000; > 5min: £92,042,000	N/A	£207,259,000	
	Reliability impact on Business users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to business users, due to a decrease in travel time variability (£48.5m) and a decrease in delay caused by incidents (£31.0m)	N/A	N/A	£79,529,000	
	Regeneration	Not assessed at this stage.	N/A	N/A	N/A	
	Wider Impacts	An assessment of 'Output Change in Imperfectly Competitive Markets' has been undertaken. This captures the profit that firms make on additional outputs generated as a result of reduced transport costs.	N/A	N/A	£6,792,000	
Environmental	Noise	This option may reduce noise due to reduced congestion along the A12. It may also increase noise due to more traffic, and this could affect Noise Important Areas (NIA) near Rivenhall End and Kelvedon. Without modelling, it is assumed that the noise levels are likely to be worse than existing overall. However, mitigation could include noise fencing and low noise surfacing.	Not quantified at this stage.	Slight adverse	WebTAG noise analysis not carried out at this stage.	
	Air Quality	Existing receptors along the A12 are likely to experience slight worsening effects of air quality due to increased traffic flow, which would give rise to pollutant emissions. However, this may be reduced in some areas due to a reduction in congestion.	Not quantified at this stage.	Slight adverse	WebTAG air quality analysis not carried out at this stage.	
	Greenhouse Gases	Not assessed at this stage.	Change in non-traded carbon over 60y (CO2e): Not quantified Change in traded carbon over 60y (CO2e): Not quantified	Unknown	WebTAG greenhouse gas analysis not carried out at this stage	
	Landscape	This option follows the existing corridor, where the A12 already forms a dominant feature within the landscape. There would be landscape effects to the corridor, for example impacts on the setting of registered parks and gardens, particularly Boreham House and New Hall Boreham. Online widening would result in loss of established highway planting and/or introduce signs and other engineered features, opening up views of the road and changing the character of the highway landscape. Major junctions and local access roads could cause significant landscape and visual effects. There might be views of the option from areas of public and private open space, place of work, educational establishments and from vehicle travellers on surrounding roads where they cross or run within close proximity to the option.	N/A	Moderate adverse	N/A	
	Townscape	N/A	N/A	N/A	N/A	
	Historic Environment	This option is located within 300m of the registered parks of Boreham House and New Hall, and the Chelmer and Blackwater Navigation and Boreham Road conservation areas, with potential effects to their setting. The option could further impact the setting of listed buildings and other designated and non-designated assets along its route. This option would have a more limited effect on known and unknown archaeology due to the limited land take alongside the existing A12, which is more likely to have been disturbed previously. However, junction improvements would extend beyond the highways boundary and could physically impact archaeological remains.	N/A	Moderate adverse	N/A	
	Biodiversity	This option would require widening of the A12 to the east between J21-J22, impacting the western boundary of the Whetmead local nature reserve (LNR) and local wildlife site (LWS), which includes rough meadow, young woodland and scrub. As the option remains online throughout, it would reduce the loss of habitat along the corridor and result in less habitat fragmentation. Online widening would also avoid new watercourse crossings in the area, including the River Blackwater and Domsey Brook, reducing impacts to priority habitats and species these watercourses may support. Potential impacts to protected species including badgers, bats, birds, dormouse, fish, great crested newt (GCN), invertebrates, reptiles, otter, water vole, white-clawed crayfish, and other priority species listed in Section 41 of the NERC Act 2006 and/or listed on the Essex or Highways Biodiversity Action Plan (BAP). Impacts could arise from direct mortality, habitat loss/fragmentation, and disturbance, however these effects would, be reduced as the option is online.	N/A	Slight adverse	N/A	
	Water Environment	The option would require extensions of the carriageway and culverts over a number of existing river/watercourse crossings. It will also require some new/modified crossings and associated drainage in the vicinity of new or improved junctions. Physical modifications to rivers / watercourse could alter the channel characteristics and water quality, and could lead to a change or deterioration in the Water Framework Directive (WFD) status. The option is likely to require works in flood zone 3, which could alter existing flood flows and would potentially require flood compensation and flood defence consent.	N/A	Slight adverse	N/A	
Social	Commuting and Other users	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£70m). It will also provide a decrease in road user delays (£31m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£): £296,298,000 Net journey time changes (£): 0 to 2min: £48,079,000; 2 to 5min: £111,205,000; > 5min: £136,925,000	N/A	£196,184,000	Moderate Beneficial impacts (✓✓) across all income quintiles
	Reliability impact on Commuting and Other users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to commuting and other users, due to a decrease in travel time variability (£59.9m) and a decrease in delay caused by incidents (£42.6m)	N/A	N/A	£102,492,000	
	Physical activity	Improving the A12 is unlikely to lead to increased numbers of walkers and cyclists nor is it likely to lead to longer trips for those that do. The Scheme is therefore expected to have minimal impact on physical activity. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	
	Journey quality	The Scheme is likely to reduce congestion and improve journey times leading to reduced traveller stress alongside making travel along the A12 less confusing for unfamiliar travellers through having fewer at grade junctions. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	
	Accidents	There is predicted to be an increase in the number of accidents with the scheme in place.	Change in Personal Injury Accidents: +340 Change in Casualties: Fatal +11, Serious +27, Slight +526	N/A	-£18,039,000	Neutral for all vulnerable groups
	Security	No assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Access to services	No assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Affordability	No assessment has been undertaken, as the scheme is not expected to result in changes to public transport fares. A distributional impact assessment has been undertaken based on the changes in Vehicle Operating Costs to highway users.	N/A	N/A	N/A	Moderate Adverse impacts (××) across the three most deprived quintiles. Large Adverse impacts (×××) to the 4th most deprived quintile. Moderate Adverse impacts (××) to the least deprived quintile.
	Severance	The Scheme proposes to provide for existing NMU routes through the provision of infrastructure to avoid further severance. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Option and non-use values	Not assessed - the Scheme in itself does not substantially change the availability of transport services within the study area.	N/A	N/A	N/A	
Public Account	Cost to Broad Transport Budget	Scheme cost estimates based on information provided by Highways England commerical team. Impact on future maintenance costs over 60 year period also incorporated.	N/A	N/A	-£506,602,000	
	Indirect Tax Revenues	The scheme will generate an increase in indirect tax revenue from an increase in fuel consumption.	N/A	N/A	£108,180,000	

10.2 Option 2

Appraisal Summary Table — **Date produced:** 1 2 2018

Contact:	
Name	TBC
Organisation	Highways England
Role	Promoter/Official

Name of scheme:	A12 - Junction 19 at Chelmsford (Boreham Interchange) to Junction 25 at Marks Tey (A120) Improvement
Description of scheme:	Improvement of A12 to expressway standard between J19 and J25. Four scheme options are being considered: • Option 1) A12 online widening to three lanes throughout. Local access roads to provide alternative access to existing at grade junctions. • **Option 2) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall) and offline bypass between J24 and J25 (Marks Tey).** • Option 3) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall). • Option 4) A12 online widening to three lanes with offline bypass between J24 and J25 (Marks Tey). This AST relates to Option 2.

Impacts		Summary of key impacts	Assessment: Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£32m). It will also provide a decrease in road user delays (£13m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£): £282,462,000 Net journey time changes (£): 0 to 2min: £53,639,000; 2 to 5min: £135,507,000; > 5min: £93,316,000	N/A	£278,644,000	
	Reliability impact on Business users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to business users, due to a decrease in travel time variability (£48.4m) and a decrease in delay caused by incidents (£30.5m)	N/A	N/A	£78,905,000	
	Regeneration	Not assessed at this stage.	N/A	N/A	N/A	
	Wider Impacts	An assessment of 'Output Change in Imperfectly Competitive Markets' has been undertaken. This captures the profit that firms make on additional outputs generated as a result of reduced transport costs.	N/A	N/A	£7,738,000	
Environmental	Noise	This option is unlikely to result in significant noise changes along the online sections of the route. There could be noise decreases for properties along sections of existing A12 adjacent to the new offline sections (e.g. in northwest of Witham and Rivenhall End). There is likely to be increases in noise for properties in the vicinity of new offline sections (e.g. at Pott's Green, The Rivenhall Hotel, Easthorpe Green Farm). Noise fencing and low noise surfacing could be employed to help mitigate some of the effects.	Not quantified at this stage.	Slight adverse	WebTAG noise analysis not carried out at this stage.	
	Air Quality	Receptors along the existing A12 are likely to experience slight worsening effects of air quality with the online sections between J19-J22 and J23-J24 due to increased traffic flows that would give rise to pollutant emissions. However, sensitive receptors along the existing A12 would slightly benefit from the offline sections between J22-J23 and J24-J25 due to traffic being moved away from the receptors.	Not quantified at this stage.	Slight adverse	WebTAG air quality analysis not carried out at this stage.	
	Greenhouse Gases	Not assessed at this stage.	Change in non-traded carbon over 60y (CO2e): Not quantified Change in traded carbon over 60y (CO2e): Not quantified	Unknown	WebTAG greenhouse gas analysis not carried out at this stage	
	Landscape	This option would introduce two new offline bypasses to a greenfield setting. This would result in significant effects on sensitive landscapes including the Blackwater Valley. Field severance and vegetation loss would significantly affect the landscape pattern, land use and therefore character. Online widening would result in loss of established highway planting and/or introduce signs and other engineered features, opening up views of the road and changing the character of the highway landscape. There are likely to be views and impacts on the setting of registered parks and gardens, particularly Boreham House and New Hall Boreham, and Prested Hall and Marks Tey Hall listed buildings. There might be views of the option from areas of public and private open space, place of work, educational establishments and from vehicle travellers on surrounding roads where they cross or run within close proximity to the option.	N/A	Large adverse	N/A	
	Townscape	N/A	N/A	N/A	N/A	
	Historic Environment	This option is located within 300m of the registered parks of Boreham House and New Hall, and the Chelmer and Blackwater Navigation and Boreham Road conservation areas, with potential effects to their setting. The option could further impact the setting of listed buildings and other designated and non-designated assets along its route. It is likely that there would be significant effects on the setting of Rivenhall long mortuary enclosure Scheduled Monument, because the option lies within 50m of the site. Offline sections of this option have the potential to adversely impact a range of archaeological remains identified within the proposed footprint. This includes significant prehistoric remains to the south of the existing A12 between Witham and Kelvedon. Historic England have highlighted the importance of archaeology in this area, and question the benefit of the option compared to the loss or deterioration of these resources. There are also archaeological remains between Kelvedon and Marks Tey, including cropmarks and a World War I landing field.	N/A	Large adverse	N/A	
	Biodiversity	This option would require widening of the A12 to the east between J21-J22, impacting the western boundary of the Whetmead LNR/Local Wildlife Site, which includes rough meadow, young woodland and scrub. Offline sections of this option have the potential to impact priority habitats, including important hedgerows, as well as road verges (which are recognised as an Essex Biodiversity Action Plan (BAP) habitat) through habitat loss and/or fragmentation. Potential impacts to protected species including badgers, bats, birds, dormouse, fish, great crested newt (GCN), invertebrates, reptiles, otter, water vole, white-clawed crayfish, and other priority species listed in Section 41 of the NERC Act 2006 and/or listed on the Essex or Highways BAP. Impacts could arise from direct mortality, habitat loss/fragmentation, and disturbance. The offline bypass between J21-22 would sever Colemans Quarry and impact the site's post extraction restoration plan. As a result Proposed Scheme would need to develop a restoration plan which factors in the new A12. This would potentially require offsite mitigation or compensation, which in turn would require additional land take. The site would also require long term management and maintenance, which could add considerable cost to the scheme.	N/A	Moderate adverse	N/A	
	Water Environment	This option would require extensions of the carriageway and culverts over a number of existing river/watercourse crossings. It will also require several new crossings and associated drainage in the vicinity of new or improved junctions and the offline sections. Physical modifications to rivers / watercourse could alter the channel characteristics and water quality, and could lead to a change or deterioration in the Water Framework Directive (WFD) status. The option is likely to require works in flood zone 3, which could alter existing flood flows and would potentially require flood compensation and flood defence consent. A new offline Junction 23 would potentially have a large footprint within the floodplain of the River Blackwater. This may require a viaduct to mitigate effects, would add significant cost and complexity to the scheme.	N/A	Moderate adverse	N/A	
Social	Commuting and Other users	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£46m). It will also provide a decrease in road user delays (£44m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£): £300,004,000 Net journey time changes (£): 0 to 2min: £39,240,000; 2 to 5min: £122,092,000; > 5min: £138,672,000	N/A	£241,882,000	Moderate Beneficial impacts (✓✓) across all income quintiles
	Reliability impact on Commuting and Other users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to commuting and other users, due to a decrease in travel time variability (£59.9m) and a decrease in delay caused by incidents (£41.9m)	N/A	N/A	£101,839,000	
	Physical activity	Improving the A12 is unlikely to lead to increased numbers of walkers and cyclists nor is it likely to lead to longer trips for those that do. The Scheme is therefore expected to have minimal impact on physical activity. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	
	Journey quality	The Scheme is likely to reduce congestion and improve journey times leading to reduced traveller stress alongside making travel along the A12 less confusing for unfamiliar travellers through having fewer at grade junctions. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	
	Accidents	There is predicted to be an increase in the number of accidents with the scheme in place.	Change in Personal Injury Accidents: +503 Change in Casualties: Fatal +10, Serious +46, Slight +697	N/A	-£24,061,000	Neutral for all vulnerable groups
	Security	No assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Access to services	No assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Affordability	No assessment has been undertaken, as the scheme is not expected to result in changes to public transport fares. A distributional impact assessment has been undertaken based on the changes in Vehicle Operating Costs to highway users.	N/A	N/A	N/A	Moderate Adverse impacts (××) across the three most deprived quintiles. Large Adverse impacts (×××) to the 4th most deprived quintile. Moderate Adverse impacts (××) to the least deprived quintile.
	Severance	The Scheme proposes to provide for existing NMU routes through the provision of infrastructure to avoid further severance. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Option and non-use values	Not assessed - the Scheme in itself does not substantially change the availability of transport services within the study area.	N/A	N/A	N/A	
Public Account	Cost to Broad Transport Budget	Scheme cost estimates based on information provided by Highways England commerical team. Impact on future maintenance costs over 60 year period also incorporated.	N/A	N/A	-£530,458,000	
	Indirect Tax Revenues	The scheme will generate an increase in indirect tax revenue from an increase in fuel consumption.	N/A	N/A	£113,459,000	

10.3 Option 3

Appraisal Summary Table

Date produced:	1	2	2018

Contact:	
Name	TBC
Organisation	Highways England
Role	Promoter/Official

Name of scheme:	A12 - Junction 19 at Chelmsford (Boreham Interchange) to Junction 25 at Marks Tey (A120) Improvement
Description of scheme:	Improvement of A12 to expressway standard between J19 and J25. Four scheme options are being considered: • Option 1) A12 online widening to three lanes throughout. Local access roads to provide alternative access to existing at grade junctions. • Option 2) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall) and offline bypass between J24 and J25 (Marks Tey). • **Option 3) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall).** • Option 4) A12 online widening to three lanes with offline bypass between J24 and J25 (Marks Tey). This AST relates to Option 3.

Impacts		Summary of key impacts	Assessment: Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£43m). It will also provide a decrease in road user delays (£10m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£): £279,104,000 Net journey time changes (£): 0 to 2min: £56,502,000; 2 to 5min: £130,231,000; > 5min: £92,371,000	N/A	£256,067,000	
	Reliability impact on Business users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to business users, due to a decrease in travel time variability (£47.1m) and a decrease in delay caused by incidents (£30.2m)	N/A	N/A	£77,214,000	
	Regeneration	Not assessed at this stage.	N/A	N/A	N/A	
	Wider Impacts	An assessment of 'Output Change in Imperfectly Competitive Markets' has been undertaken. This captures the profit that firms make on additional outputs generated as a result of reduced transport costs.	N/A	N/A	£7,483,000	
Environmental	Noise	This option is unlikely to result in significant noise changes along the online sections of the route. There could be noise decreases for properties along sections of existing A12 adjacent to the new offline section. There is likely to be increases in noise for properties in the vicinity of new offline section (e.g. The Rivenhall Hotel). Noise fencing and low noise surfacing could be employed to help mitigate some of the effects.	Not quantified at this stage.	Slight adverse	WebTAG noise analysis not carried out at this stage.	
	Air Quality	Receptors along the existing A12 are likely to experience slight worsening effects of air quality with the online sections between J19-J22 and J23-J25 due to increased traffic flows that would give rise to pollutant emissions. However, sensitive receptors along the existing A12 would slightly benefit from the offline sections between J22-J23 due to traffic being moved away from the receptors.	Not quantified at this stage.	Slight adverse	WebTAG air quality analysis not carried out at this stage.	
	Greenhouse Gases	Not assessed at this stage.	Change in non-traded carbon over 60y (CO2e): Not quantified Change in traded carbon over 60y (CO2e): Not quantified	Unknown	WebTAG greenhouse gas analysis not carried out at this stage	
	Landscape	This option would introduce one new offline bypass within a greenfield setting. This would result in significant effects on sensitive landscapes including the Blackwater Valley. Field severance and vegetation loss would significantly affect the landscape pattern, land use and therefore character. The landscape effects between J24-J25 would be reduced as the option is online at this section. Online widening would result in loss of established highway planting and/or introduce signs and other engineered features, opening up views of the road and changing the character of the highway landscape. There are likely to be views and impacts on the setting of registered parks and gardens, particularly Boreham House and New Hall Boreham. There might be views of the option from areas of public and private open space, place of work, educational establishments and from vehicle travellers on surrounding roads where they cross or run within close proximity to the option.	N/A	Moderate adverse	N/A	
	Townscape	N/A	N/A	N/A	N/A	
	Historic Environment	This option is located within 300m of the registered parks of Boreham House and New Hall, and the Chelmer and Blackwater Navigation and Boreham Road conservation areas, with potential effects to their setting. The option could further impact the setting of listed buildings and other designated and non-designated assets along its route. It is likely that there would be significant effects on the setting of Rivenhall long mortuary enclosure Scheduled Monument, because the offline section of the option would be within 50m of the site. The offline section of the route between J22-J23 has the potential to adversely impact a range of archaeological remains identified within the proposed footprint, including significant prehistoric remains to the south of the existing A12 between Witham and Kelvedon. Historic England have highlighted the importance of archaeology in this area, and question the benefit of the option compared to the loss or deterioration of these resources. There would be reduced impacts to archaeology between J24-J25 where the route is online.	N/A	Large adverse	N/A	
	Biodiversity	This option would require widening of the A12 to the east between J21-J22, impacting the western boundary of the Whetmead local nature reserve (LNR) and local wildlife site (LWS), which includes rough meadow, young woodland and scrub. The option has the potential to impact priority habitats, including important hedgerows, particularly in areas of offline improvements, as well as road verges (which are recognised as an Essex BAP habitat) through habitat loss and/or fragmentation. Impacts would be reduced between J24-25 where the route is online. Potential impacts to protected species including badgers, bats, birds, dormouse, fish, great crested newt (GCN), invertebrates, reptiles, otter, water vole, white-clawed crayfish, and other priority species listed in Section 41 of the NERC Act 2006 and/or listed on the Essex or Highways Biodiversity Action Plan (BAP). Impacts could arise from direct mortality, habitat loss/fragmentation, and disturbance, which may be reduced with only one offline section (between J22 and J23). The offline bypass between J21-22 would sever Colemans Quarry and impact the site's post extraction restoration plan. As a result Proposed Scheme would need to develop a restoration plan which factors in the new A12. This would potentially require offsite mitigation or compensation, which in turn would require additional land take. The site would also require long term management and maintenance, which could add considerable cost to the scheme.	N/A	Moderate adverse	N/A	
	Water Environment	The option would require extensions of the carriageway and culverts over a number of existing river/watercourse crossings. It will also require several new crossings and associated drainage in the vicinity of new or improved junctions and the offline section. Physical modifications to rivers / watercourse could alter the channel characteristics and water quality, and could lead to a change or deterioration in the Water Framework Directive (WFD) status. The option is likely to require works in flood zone 3, which could alter existing flood flows and would potentially require flood compensation and flood defence consent. A new offline Junction 23 would potentially have a large footprint within the floodplain of the River Blackwater. This may require a viaduct to mitigate effects, would add significant cost and complexity to the scheme.	N/A	Moderate adverse	N/A	
Social	Commuting and Other users	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£61m). It will also provide a decrease in road user delays (£35m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£): £300,028,000 Net journey time changes (£): 0 to 2min: £44,819,000; 2 to 5min: £118,682,000; > 5min: £136,527,000	N/A	£217,823,000	Moderate Beneficial impacts (✓✓) across all income quintiles
	Reliability impact on Commuting and Other users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to commuting and other users, due to a decrease in travel time variability (£58.2m) and a decrease in delay caused by incidents (£41.4m)	N/A	N/A	£99,643,000	
	Physical activity	Improving the A12 is unlikely to lead to increased numbers of walkers and cyclists nor is it likely to lead to longer trips for those that do. The Scheme is therefore expected to have minimal impact on physical activity. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	
	Journey quality	The Scheme is likely to reduce congestion and improve journey times leading to reduced traveller stress alongside making travel along the A12 less confusing for unfamiliar travellers through having fewer at grade junctions. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	
	Accidents	There is predicted to be an increase in the number of accidents with the scheme in place.	Change in Personal Injury Accidents: +371 Change in Casualties: Fatal +8, Serious +27, Slight +530	N/A	-£17,358,000	Neutral for all vulnerable groups
	Security	No assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Access to services	No assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Affordability	No assessment has been undertaken, as the scheme is not expected to result in changes to public transport fares. A distributional impact assessment has been undertaken based on the changes in Vehicle Operating Costs to highway users.	N/A	N/A	N/A	Moderate Adverse impacts (✗✗) across the three most deprived quintiles. Large Adverse impacts (✗✗✗) to the 4th most deprived quintile. Moderate Adverse impacts (✗✗) to the least deprived quintile.
	Severance	The Scheme proposes to provide for existing NMU routes through the provision of infrastructure to avoid further severance. However, no formal assessment has yet been undertaken at this stage.	N/A	N/A	N/A	N/A
	Option and non-use values	Not assessed - the Scheme in itself does not substantially change the availability of transport services within the study area.	N/A	N/A	N/A	
Public Account	Cost to Broad Transport Budget	Scheme cost estimates based on information provided by Highways England commerical team. Impact on future maintenance costs over 60 year period also incorporated.	N/A	N/A	-£567,664,000	
	Indirect Tax Revenues	The scheme will generate an increase in indirect tax revenue from an increase in fuel consumption.	N/A	N/A	£113,851,000	

10.4 Option 4

Appraisal Summary Table

Date produced: 1 2 2018

Contact:	
Name	TBC
Organisation	Highways England
Role	Promoter/Official

Name of scheme:	A12 - Junction 19 at Chelmsford (Boreham Interchange) to Junction 25 at Marks Tey (A120) Improvement
Description of scheme:	Improvement of A12 to expressway standard between J19 and J25. Four scheme options are being considered: • Option 1) A12 online widening to three lanes throughout. Local access roads to provide alternative access to existing at grade junctions. • Option 2) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall) and offline bypass between J24 and J25 (Marks Tey). • Option 3) A12 online widening to three lanes with offline bypass between J22 and J23 (Rivenhall). • **Option 4) A12 online widening to three lanes with offline bypass between J24 and J25 (Marks Tey).** This AST relates to Option 4.

Impacts		Summary of key impacts	Assessment				
			Quantitative			Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£38m). It will also provide a decrease in road user delays (£12m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£) £278,940,000 Net journey time changes (£) 0 to 2min: £55,187,000 / 2 to 5min: £124,045,000 / > 5min: £99,709,000			N/A	£234,404,000	
	Reliability impact on Business users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to business users, due to a decrease in travel time variability (£50.0m) and a decrease in delay caused by incidents (£32.0m)	N/A			N/A	£82,010,000	
	Regeneration	Not assessed at this stage.	N/A			N/A	N/A	
	Wider Impacts	An assessment of 'Output Change in Imperfectly Competitive Markets' has been undertaken. This captures the profit that firms make on additional outputs generated as a result of reduced transport costs.	N/A			N/A	£7,145,000	
Environmental	Noise	This option is unlikely to result in significant noise changes along the online sections of the route. There could be noise decreases for properties along sections of existing A12 adjacent to the new offline section at J24-J25. There is likely to be increases in noise for properties in the vicinity of new offline sections (e.g. at Pott's Green, Easthorpe Green Farm). Noise fencing and low noise surfacing could be employed to help mitigate some of the effects.	Not quantified at this stage.			Slight adverse	WebTAG noise analysis not carried out at this stage.	
	Air Quality	Receptors along the existing A12 are likely to experience slight worsening effects of air quality with the online sections between J19-J24 due to increased traffic flows that would give rise to pollutant emissions. However, sensitive receptors along the existing A12 would slightly benefit from the offline sections between J24-J25 due to traffic being moved away from the receptors.	Not quantified at this stage.			Slight adverse	WebTAG air quality analysis not carried out at this stage.	
	Greenhouse Gases	Not assessed at this stage.	Change in non-traded carbon over 60y (CO_2e): Not quantified Change in traded carbon over 60y (CO_2e): Not quantified			Unknown	WebTAG greenhouse gas analysis not carried out at this stage	
	Landscape	This option would introduce one new offline bypass within a greenfield setting. Field severance and vegetation loss would significantly affect the landscape pattern, land use and therefore character. The landscape effects between J22-J23, which includes the sensitive Blackwater Valley, would be reduced as the option is online at this section. Online widening would result in loss of established highway planting and/or introduce signs and other engineered features, opening up views of the road and changing the character of the highway landscape. There are likely to be views and impacts on the setting of registered parks and gardens, particularly Boreham House and New Hall Boreham, and Prested Hall and Marks Tey Hall listed buildings. There might be views of the option from areas of public and private open space, place of work, educational establishments and from vehicle travellers on surrounding roads where they cross or run within close proximity to the option.	N/A			Moderate adverse	N/A	
	Townscape	N/A	N/A			N/A	N/A	
	Historic Environment	This option is located within 300m of the registered parks of Boreham House and New Hall, and the Chelmer and Blackwater Navigation and Boreham Road conservation areas, with potential effects to their setting. The option could further impact the setting of listed buildings and other designated and non-designated assets along its route. The offline section of the route between J24-J25 has the potential to adversely impact a range of archaeological remains identified within the proposed footprint, including cropmarks and a World War I landing field between Kelvedon and Marks Tey. There would be reduced impacts to archaeology between J22-J23 where the route is online.	N/A			Moderate adverse	N/A	
	Biodiversity	This option would require widening of the A12 to the east between J21-J22, impacting the western boundary of the Whetmead local nature reserve (LNR) and local wildlife site (LWS), which includes rough meadow, young woodland and scrub. The option has the potential to impact priority habitats, including important hedgerows, particularly in areas of offline improvements, as well as road verges (which are recognised as an Essex BAP habitat) through habitat loss and/or fragmentation. There would be reduced impact between J22-23 where the route is online. This option avoids offline construction in the Blackwater Valley, which is an important ecological landscape with sensitive river valley habitats. Potential impacts to protected species including badgers, bats, birds, dormouse, fish, great crested newt (GCN), invertebrates, reptiles, otter, water vole, white-clawed crayfish, and other priority species listed in Section 41 of the NERC Act 2006 and/or listed on the Essex or Highways BAP. Impacts could arise from direct mortality, habitat loss/fragmentation, and disturbance, which may be reduced with only one offline section (between J24 and J25).	N/A			Slight adverse	N/A	
	Water Environment	The option would require extensions of the carriageway and culverts over a number of existing river/watercourse crossings. It will also require several new crossings and associated drainage in the vicinity of new or improved junctions and the offline section. Physical modifications to rivers / watercourse could alter the channel characteristics and water quality, and could lead to a change or deterioration in the Water Framework Directive (WFD) status. The option is likely to require works in flood zone 3, which could alter existing flood flows and would potentially require flood compensation and flood defence consent.	N/A			Slight adverse	N/A	
Social	Commuting and Other users	The Scheme will generate benefits for business users through addressing issues with the capacity and capability of the existing network. In the future, these issues will be exacerbated by growth across the Region which will generate significant issues for transport users. The Scheme will improve journey times along the route and reduce queuing at major junctions. The scheme is expected to provide significant journey time savings, offset slightly by a small increase in vehicle operating costs. The scheme is expected to provide disbenefits to road users during construction (-£55m). It will also provide a decrease in road user delays (£40m) during future maintenance compared to the 'without scheme' scenario.	Value of journey time changes(£) £301,360,000 Net journey time changes (£) 0 to 2min: £44,968,000 / 2 to 5min: £116,710,000 / > 5min: £139,682,000			N/A	£234,464,000	Moderate Beneficial impacts (✓✓) across all income quintiles
	Reliability impact on Commuting and Other users	Journey time reliability has been highlighted as a key problem on the route. The increase in capacity due to the scheme will result in reliability benefits to commuting and other users, due to a decrease in travel time variability (£61.9m) and a decrease in delay caused by incidents (£44.1m)	N/A			N/A	£105,931,000	
	Physical activity	Improving the A12 is unlikely to lead to increased numbers of walkers and cyclists nor is it likely to lead to longer trips for those that do. The Scheme is therefore expected to have minimal impact on physical activity. However, no formal assessment has yet been undertaken at this stage.	N/A			N/A	N/A	
	Journey quality	The Scheme is likely to reduce congestion and improve journey times leading to reduced traveller stress alongside making travel along the A12 less confusing for unfamiliar travellers through having fewer at grade junctions. However, no formal assessment has yet been undertaken at this stage.	N/A			N/A	N/A	
	Accidents	There is predicted to be an increase in the number of accidents with the scheme in place.	Change in Personal Injury Accidents: +501 Change in Casualties: Fatal +12, Serious +50, Slight +694			N/A	-£25,105,000	Neutral for all vulnerable groups
	Security	No assessment has yet been undertaken at this stage.	N/A			N/A	N/A	N/A
	Access to services	No assessment has yet been undertaken at this stage.	N/A			N/A	N/A	N/A
	Affordability	No assessment has been undertaken, as the scheme is not expected to result in changes to public transport fares. A distributional impact assessment has been undertaken based on the changes in Vehicle Operating Costs to highway users.	N/A			N/A	N/A	Slight Beneficial impacts (✓) to the most deprived quintile. Moderate Adverse impacts (××) across the second and third most deprived quintiles. Large Adverse impacts (×××) to the 4th most deprived quintile. Moderate Adverse impacts (××) to the least deprived quintile.
	Severance	The Scheme proposes to provide for existing NMU routes through the provision of infrastructure to avoid further severance. However, no formal assessment has yet been undertaken at this stage.	N/A			N/A	N/A	N/A
	Option and non-use values	Not assessed - the Scheme in itself does not substantially change the availability of transport services within the study area.	N/A			N/A	N/A	
Public Account	Cost to Broad Transport Budget	Scheme cost estimates based on information provided by Highways England commerical team. Impact on future maintenance costs over 60 year period also incorporated.	N/A			N/A	-£564,022,000	
	Indirect Tax Revenues	The scheme will generate an increase in indirect tax revenue from an increase in fuel consumption.	N/A			N/A	£107,382,000	

11. Detailed Cost Estimates

11.1 Scheme Cost Estimate

11.1.1 The Commercial Estimate Form 300 costs have been prepared by Highways England on 12th September 2017 for Options 1 to 4 as described in Section 4. A summary of the cost estimate for each option is shown in Table 11.1 below.

Table 11.1 : Summary of Scheme Cost Estimates (2017, Q3)

Form 300 Scheme Cost Estimates				
Option	**1**	**2**	**3**	**4**
Scheme Cost (Form 300)	**£874,458,362**	**£918,616,612**	**£986,349,881**	**£973,453,247**
Scheme Min	£611,671,326	£608,550,228	£662,740,733	£657,542,408
Scheme Max	£1,263,344,711	£1,392,029,302	£1,485,202,296	£1,471,229,530

11.1.2 Key Cost Assumptions for the Form 300 Cost Estimate:

- The scheme had been estimated as a standalone output. Therefore, there are no specific considerations given to the economy or diseconomy of including this scheme within a regional programme.
- The cost estimate includes a most likely contractor fee percentage of 9%, within a minimum and maximum range of 6% and 12% respectively.
- The lands cost estimate has been provided and included costs calculations. The HAL addition has been included in the estimate. Land costs estimates are to be treated as estimates and to be updated at later stages of design.
- The project risk register provided by the project team was a quantitative assessment. The cost estimate has widened the range around the project teams most likely assessment and advised additional risk allowance. Any change to the risk register has been communicated and agreed upon by the project team.
- The cost estimate includes the development costs/ budget for Stages 1 to 7.

11.1.3 The cost estimates were based on the following PCF stage completion / programme dates:

- PCF Stage 1 (Option Identification) – December 2016
- PCF Stage 2 (Option Selection) – September/October 2017
- PCF Stage 3 (Preliminary Design) – July 2018
- PCF Stage 4 (Statutory Procedures and Powers) – September 2019
- PCF Stage 5 (Construction Preparation) – February 2020
- PCF Stage 6 (Construction, Commissioning and Handover) – October 2025

12. Conclusion

12.1 Option Evaluation

12.1.1 During the PCF Stage 2 the options were assessed against the different scheme objectives and a summary is provided in the following text.

Road Investment Strategy Objective: Supporting Economic Growth

12.1.2 All 4 options would help contribute to economic growth in the local area and would increase capacity on the network, providing £483.4m, £541.3m, £533.2, £509.8m in travel time benefits for Options 1 to 4 respectively. All options would support the expected creation of 20,000 jobs locally over the next 20 years.

12.1.3 All options would also help improve journey time reliability, and could result in journey time savings of up to 8 minutes along the route. Option 2, however, would provide the greatest improvement to capacity as local traffic could continue to use the current A12, which would be de-trunked to a local road, along the bypass sections. This would improve traffic flow across the highway network.

Road Investment Strategy objective: A safe and serviceable network

12.1.4 Option 2 is the best performing option against the project objective. Buses, cyclists, walkers, horse riders and local road users will be able to use the existing de-trunked A12 along the bypassed sections. For safety, this would perform better than building a new single carriageway running parallel to the A12 at the bypassed sections, which would be necessary under Options 1, 3 and 4, with Options 3 and 4 requiring one single parallel carriageway, and Option 1 requiring two lengths of single parallel carriageway.

12.1.5 During operation, a single carriageway parallel road as envisioned for Options 1, 3 or 4 for the bypass sections would not perform as well as utilising the existing A12 for road worker safety. The distance between the new single carriageway and the widened A12 would limit working space.

12.1.6 Option 2 has the safety benefit of creating an improved alignment along a greater length of the A12, with Options 3 and 4 each creating a shorter length of new alignment. This occurs by moving the A12 to the south between Junctions 22 and 23 and between Junctions 24 and 25. By doing this, the curves in the road at Junctions 22, 23 and 24 are smoothed which would result in improved safety performance due to improvements in the alignment design.

12.1.7 The overall COBA LT analysis suggests Options 2 and 4 produce the largest monetary safety benefits. However, much of this is related to the local road network, from which some traffic is predicted to divert to the SRN as a result of the scheme.

Road Investment Strategy objective: A More Free-Flowing network

12.1.7 All 4 route options would improve resilience as a result of implementing 3 lanes in each direction. This means that in the event of a lane being out of operation, the other 2 lanes could still be used by traffic. In addition, the new bypasses required for Options 2, 3 and 4, and the associated detrunking of the A12, will also provide further network resilience for any operational, incidents or maintenance on this A12 section.

12.1.8 All options would also link with other potential future Road Investment Strategy (RIS) schemes, contributing to improvements across the wider network, such as the A12 M25 to Chelmsford and Colchester Bypass schemes. In addition, none of the options would prevent a tie in to an improved A120 if that scheme is taken forward.

Road Investment Strategy objective: An improved environment

12.1.9 From an environmental perspective Option 1 is the best performing option as it would have the least significant environmental impact. Options 2, 3 and 4 all contain 1 or 2 bypasses, which would result in significant environmental effects to the environment, some of which will not be mitigatable e.g. impacts on the landscape and cultural heritage along the River Blackwater. This is due to the development of new infrastructure through a sensitive landscape.

12.1.10 All options would cause some disruption to several property owners. The bypass options would benefit some property owners who reside alongside the existing A12, whilst others would be adversely affected along the new bypass routes. All options are likely to bring air and noise improvements to people living along the existing A12 corridor due to reduced congestion and improved road surfacing.

Road Investment Strategy objective: A more accessible and integrated network

12.1.11 Option 1 would allow improvements for public transport users, particularly bus users, as bus stops would be provided on a purpose built single carriageway local road where on-line sections would be widened. Options 2, 3 and 4 would retain current bus stops along the existing sections of the A12 which are to be de-trunked, but existing severance and operational issues would be dealt with as part of the scheme. All bus stops along the retained A12 would be relocated to the local road network. The differences are marginal.

12.1.12 All 4 options aim to provide good access routes for Walkers, Cyclists and Horse riders (WCH), including providing good off route provision where desirable. Option 2 has the best overall provision for these groups, as existing severance issues on A12 would also be rectified, whilst reduced flow on the existing route would improve ambience of existing shared facilities alongside the bypassed sections of A12. Option 1 would have facilities adjacent to the widened A12, which would impact negatively on their ambience.

Road Investment Strategy objective: Customer satisfaction

12.1.13 All options met most of the scheme specific objectives under the overarching Road Investment Strategy objectives.

Other objectives

12.1.14 An additional crucial objective is the economic value for money of the scheme. All schemes are measured using a Benefit to Cost Ratio (BCR). All 4 route options produced a value of benefits ranging from £682 million to £799 million, while the comparative scheme costs range from £507m to £568m.

12.1.15 Option 2 provides the highest Benefit to Cost Ratio (BCR), with a BCR of 1.5. This is likely to represent a 'Low to Medium' level of value for money. Options 1, 3 and 4 each have BCRs of 1.3, which is likely to represent a 'Low' value for money rating. It should be noted that these are 'adjusted' BCRs, which include benefits from journey time reliability and wider impacts.

Deliverability

12.1.16 Option 2 has the better deliverability due to the offline construction of the bypasses, reducing the impact to existing A12 road users. However, the offline construction requires more plant/ construction traffic and more materials to be brought to site. Option 4 has the next best deliverability, then Option 3 and finally Option 1 due to the amount of online construction work.

12.1.17 Option 2 has the least customer impacts during the construction phase as a result of the greater lengths that can be constructed offline without impacting on traffic during construction, followed by Option 3 and 4. The worst impact is Option 1 due to the online construction work and increased traffic management.

12.1.18 During construction, Option 2 performs better than the other options. This is because building bypasses away from the A12 would be safer than workers working alongside live traffic.

12.2 Option Comparison Table

12.2.1 The Options comparison colour coding system (Table 12.1) provides a colour coding system to compare the major factors that have been considered while selecting a Preferred Route. The Options were assessed against the project objectives in a series of workshops during Stage 2.

12.2.2 During these workshops a colour coding system was used as detailed in Table 12.1, which highlights the options ranging from "significant beneficial impacts to significant adverse impacts". The classifications were used for the options comparison table (Table 12.2):

Table 12.1: Options Comparison Table Key

	Significant Impact – Significant beneficial impact
	Major Impact – Major beneficial impact
	Minor Impact – Minor beneficial impact
	Neutral - No Impact
	Minor Impact – Possible minor adverse impact – Not significant with mitigation
	Major Impact – Potential major adverse impact – Mitigation may be possible
	Significant Impact – Will have likely significant adverse impact – Not possible to mitigate

Table 12.2: Options Comparison Table

Criteria	Option 1	Option 2	Option 3	Option4
Economic Benefit: **Supporting Economic Growth** a) Proposed scheme supports the growth identified in Local Plans by reducing congestion related delay, improve journey time reliability and increase the overall transport capacity of the A12				
Supporting Economic Growth b) Proposed scheme promotes specific traffic flow across the highway network				
A Safe and Serviceable Network a) Proposed scheme improves road user safety				
A Safe and Serviceable Network c) Proposed scheme improves road worker safety				
A More Free-Flowing Network: a) Proposed scheme increases the resilience of the transport network to cope with incidents including collisions, breakdowns, maintenance and extreme weather				
A More Free-Flowing Network b) The proposed scheme fully understands the impacts of other schemes and recognises other RIS schemes				
An Improved Environment a) Improve the environmental impact of transport on communities along the existing A12 corridor				
An Improved Environment b) Reduce the impact of new infrastructure on the natural and built environment by design				
A More Accessible an Integrated Network a) Proposed scheme provides a safe WCH route between communities and seeks to address severance				
A More Accessible an Integrated Network b) Improve safe and effective access for public transport users				
Customer Satisfaction a) Improve customer satisfaction				
Customer Satisfaction b) Improve scheme profile				
Public Consultation Response Preferences	28%	49%	11%	4%
Scheme costs	£875m	£919m	£986m	£973m
Traffic & Economic Value for Money	low	Medium	low	low
Deliverability/ Construction (impact on traffic during construction)				

12.3 The Recommended Route

12.3.1 The final decision on the preferred route was reviewed with Highways England and was informed by a combination of many factors including consultation responses, value for money, health and safety, environmental impacts and meeting of the scheme objectives, as explained in detail above, which were all considered. Through assessment of all these factors, Option 2 was seen to be the best performing option overall. 49% of individual and organisation responses expressed a preference supporting Option 2 as their favoured route option. While Option 2 has been assessed to have the least favourable impact on the environment, it is seen to be the most resilient and will generate the greatest capacity across the SRN and LRN. It will also have the highest safety performance for road users, will provide the greatest lengths of segregated WCH provision away from the A12 mainline, and will be safest for road workers during both construction and operation. On balance, taking all of the above into account, Option 2 is recommended as the Preferred Route.

12.3.2 This Preferred Route would be announced by Highways England in 2018/2019.

13. Appendix

Please note, all appendices, bar the Report on Public Consultation, are Superseded by the SAR addendum.

Appendix A. Report on Public Consultation

The 2017 Report on Public Consultation can be found at the link below ca be found on the A12 Chelmsford to A120 project website:

https://highwaysengland.co.uk/our-work/east/a12-chelmsford-to-a120-widening-scheme/

A12 Chelmsford to A120 Widening. Scheme Assessment Report.

PR113/20