A12 Chelmsford to A120 widening scheme

TR010060

7.3 Combined Modelling and Appraisal Report

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7.3 COMBINED MODELLING AND APPRAISAL REPORT

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1 Executive summary

1.1.1 This Combined Modelling and Appraisal Report details the modelling and appraisal work undertaken for the A12 Chelmsford to A120 widening scheme (the proposed scheme).

1.1.2 The application is seeking powers to widen the existing A12 to three lanes between Boreham Interchange (junction 19) and Marks Tey Interchange (junction 25). These works extend for a total of 15 miles (24km) and comprise two new three-lane bypasses, between the existing junctions 22 and 23; and between the existing junctions 24 and 25 respectively, to be known as the A12. A detailed description of the proposed scheme can be found in Chapter 2 of the Environmental Statement [TR010060/APP/6.1].

1.1.3 The Combined Modelling and Appraisal Report describes the model development, forecasting and economic appraisal carried out for the proposed scheme.

1.1.4 The current level of traffic on the A12 between junction 19 and junction 25 is extremely high for a two-lane dual carriageway and is close to capacity. As the A12 comes closer to its capacity, queues and delays become more regular and severe, and are expected to continue to increase in the future. Road users experience increased journey times, as well as journey times which are difficult to predict from day to day.

1.1.5 A strategic traffic model has been developed for the A12 scheme, using industry-standard SATURN (Simulation and Assignment of Traffic to Urban Road Networks) and DIADEM (Dynamic Integrated Assignment and Demand Modelling) software. This A12 model is based on National Highways' South East Regional Traffic Model (SERTM), but refined in the proposed scheme's area of influence. This refinement was done by modelling the roads around the scheme in more detail and using local traffic count and journey time survey information.

1.1.6 The outputs from the strategic traffic model have been used to assess the traffic impacts of the proposed scheme and to provide inputs into economic and environmental appraisals, as well as informing the buildability (construction traffic management) of the proposed scheme and operation and design of its junctions.

1.1.7 The base year of the strategic traffic model is 2019. The model represents typical weekday traffic conditions for the morning peak hour (AM), evening peak hour (PM), and an inter-peak (IP) average hour in the middle of the day. The models were calibrated and validated in line with Department for Transport (DfT) traffic modelling guidance.

1.1.8 Future year traffic models were developed from the base year model, by taking into account planned local land use and transport infrastructure changes alongside national projections of population and economic changes. To demonstrate the long-term impacts of the proposed scheme, three forecast years have been modelled: 2027 (current programmed Opening Year), 2042 (fifteen years after opening) and 2051 (final year for which traffic growth forecasts are available).

1.1.9 We have produced traffic models to predict traffic conditions for two different scenarios: a future scenario where the proposed scheme is not built (known as the Do Minimum scenario), and a future scenario where the proposed scheme is built (known as the Do Something scenario).

1.1.10 Differences between the model predictions of flows, journey times and travelled distances from these two scenarios are obtained from the models and used in the economic appraisal. Flows from both scenarios also form the basis of several of the environmental assessments described in the Environmental Statement [TR010060/APP/6.1].

1.1.11 Predicted future journey times between the Do Minimum and Do Something scenarios have been compared. There is a decrease in journey time along the A12 due to the proposed scheme. This is due to the increase in capacity along the A12 which reduces delay. Northbound journeys in the PM and southbound journeys in the AM have the biggest journey time savings, as these are where the largest delays are predicted in the Do Minimum scenario. The largest journey time savings are of almost ten minutes between junctions 19 and 25 in the 2042 PM peak.

1.1.12 In terms of traffic flow, the scheme is predicted to significantly reduce traffic on the two sections of the existing A12 that are bypassed as part of the proposed scheme (Rivenhall End and between junctions 24 and 25).

1.1.13 Traffic would increase on all sections of the A12 between junctions 19 and 25 as the capacity is increased, and also increase slightly on sections of the A12 on either side of the proposed scheme. Because the A12 would see such an improvement in journey times and reliability, traffic would re-route onto the A12 away from other less suitable routes.

1.1.14 On the Local Road Network (i.e. the majority of roads in the surrounding area excluding the A12 itself), traffic is generally expected to reduce, with some increases in traffic on roads leading into the A12 junctions, such as the B1023 north of Tiptree, the B1408 at Copford and the B1137 in Boreham.

1.1.15 As well as the strategic traffic modelling, operational modelling of key junctions has also been undertaken. This includes junctions constructed or improved as part of the proposed scheme, as well as other junctions identified as being affected by changes in traffic flows.

1.1.16 Economic appraisal has taken place to understand the impact of the proposed scheme, to help determine whether the scheme is likely to be value for money. The economic appraisal is generally based on information extracted from the traffic models.

1.1.17 The impacts of the proposed scheme have been monetised wherever practicable over a 60-year appraisal period. The impacts assessed in the monetised assessment include journey time savings, changes in road user delay during construction and maintenance, changes in indirect taxes, safety benefits, noise, air quality and greenhouse gas impacts. In addition to this initial assessment of benefits, benefits are also calculated for journey time reliability impacts and for wider economic impacts arising from increased productivity.

1.1.18 The initial monetised benefits of the scheme (excluding journey time reliability and wider economic impacts) amount to a Present Value of Benefits (PVB) of £341 million. When compared to the estimated cost to the public sector of £452 million this produces an initial Benefit to Cost Ratio (BCR) of 0.8. With journey time reliability and wider economic impacts included, the PVB increases to £775 million producing an adjusted BCR of 1.7.

1.1.19 Some of the scheme's economic impacts cannot be monetised. The assessment of these impacts is summarised in the Appraisal Summary Table and Worksheets provided in Appendix E.

2 Introduction

2.1 Introduction

2.1.1 National Highways (the “Applicant”) has submitted an application under section 37 of the Planning Act 2008 (the “2008 Act”) to the Secretary of State via the Planning Inspectorate (the Inspectorate) for an order to grant development consent (DCO) for the A12 Chelmsford to A120 widening scheme (the “proposed scheme”)

2.1.2 This Combined Modelling and Appraisal report (ComMA) describes the model development, forecasting, traffic modelling results and economic assessment of the proposed scheme.

2.2 The proposed scheme

2.2.1 The A12 Chelmsford to A120 widening scheme (the “proposed scheme”) comprises improvements to the A12 between junction 19 (Boreham interchange) and junction 25 (Marks Tey interchange), a distance of approximately 24km, or 15 miles. The scheme involves widening the A12 to three lanes throughout (where it is not already three lanes) with a bypass between junctions 22 and 23 and a second bypass between junctions 24 and 25. It also includes safety improvements, including closing off existing private and local direct accesses onto the main carriageway, and providing alternative provision for walkers, cyclists and horse riders (WCH) to existing routes along the A12, which would be removed.

2.2.2 A detailed description of the proposed scheme can be found in Chapter 2 of the Environmental Statement [TR010060/APP/6.1].

2.3 The Applicant

2.3.1 The Applicant is appointed and licensed by the Secretary of State for Transport as the strategic highways company for England. It is responsible for operating, maintaining and improving the strategic road network in England on behalf of the Secretary of State for Transport. The network is made up of England's motorways and all-purpose trunk roads (the major "A" roads) and the existing A12 is part of the trunk road network for which the Applicant is responsible. Following construction of the proposed scheme, parts of the existing A12 will be de-trunked and placed in the responsibility of the local authority, with the Applicant being responsible for operating, maintaining, and improving (under its general statutory powers in respect of the latter) the new route of the proposed scheme.

2.4 Previous analysis

2.4.1 National Highways have developed the proposed scheme through their Project Control Framework (PCF) process. An Options Assessment

Report (Highways England, 2016) identified problems on the route and described potential options to address these.

2.4.2 The options selection process continued through PCF Stages 1 and 2, including traffic modelling and economic assessments of value for money for each option. This led to the selection of a preferred route for the proposed scheme.

2.5 Purpose of report

2.5.1 The ComMA describes the model development, forecasting, traffic modelling results and economic assessment of the proposed scheme.

2.5.2 The ComMA links to, and summarises, the following packages detailing the technical transport modelling and appraisal work undertaken as part of this project and which are standalone appendices to this document:

- Transport Data Package Report, Appendix A to the ComMA
- Transport Model Package Report, Appendix B to the ComMA
- Transport Forecasting Package Report, Appendix C to the ComMA
- Economic Appraisal Package Report, Appendix D to the ComMA
- Economic Appraisal Package – Appraisal Summary Table and Worksheets, Appendix E to the ComMA
- Economic Appraisal Package – Distributional Impacts Report, Appendix F to the ComMA

2.6 Structure of report

2.6.1 Following the introduction, the structure of this report is as follows:

- Chapter 3 – Local transport situation
- Chapter 4 – Summary
- Chapter 5 – Use of data
- Chapter 6 – Model development
- Chapter 7 – Model calibration and validation
- Chapter 8 – Forecast assumptions
- Chapter 9 – Forecast results
- Chapter 10 – Economic appraisal approach
- Chapter 11 – Economic appraisal results
- Chapter 12 – Sensitivity tests

- Chapter 13 – Data annex

3 Local transport situation

3.1 Overview

3.1.1 The location of the A12 from junction 19 to junction 25 is shown in Plate 3-1. The A12 is a major A-road in the east of England, providing the main south-west/north-east road connection through Essex, Suffolk, and Norfolk. It connects Lowestoft in the north-east to London and the M25, intersecting with the A47, A14 and A120 which provide strategic connections to the ports of Felixstowe and Harwich, Peterborough, Cambridge and the M11. The A12 road also acts as a link via the A120 to Stansted airport.

3.1.2 The A12 performs essential functions at the strategic, regional, and local levels, as summarised in Table 3-1. The current public transport provisions are outlined in detail in the Transport Assessment report [TR010060/APP/7.2].

Plate 3-1 Regional context – main south-west and north-east connection through Essex, Suffolk and Norfolk

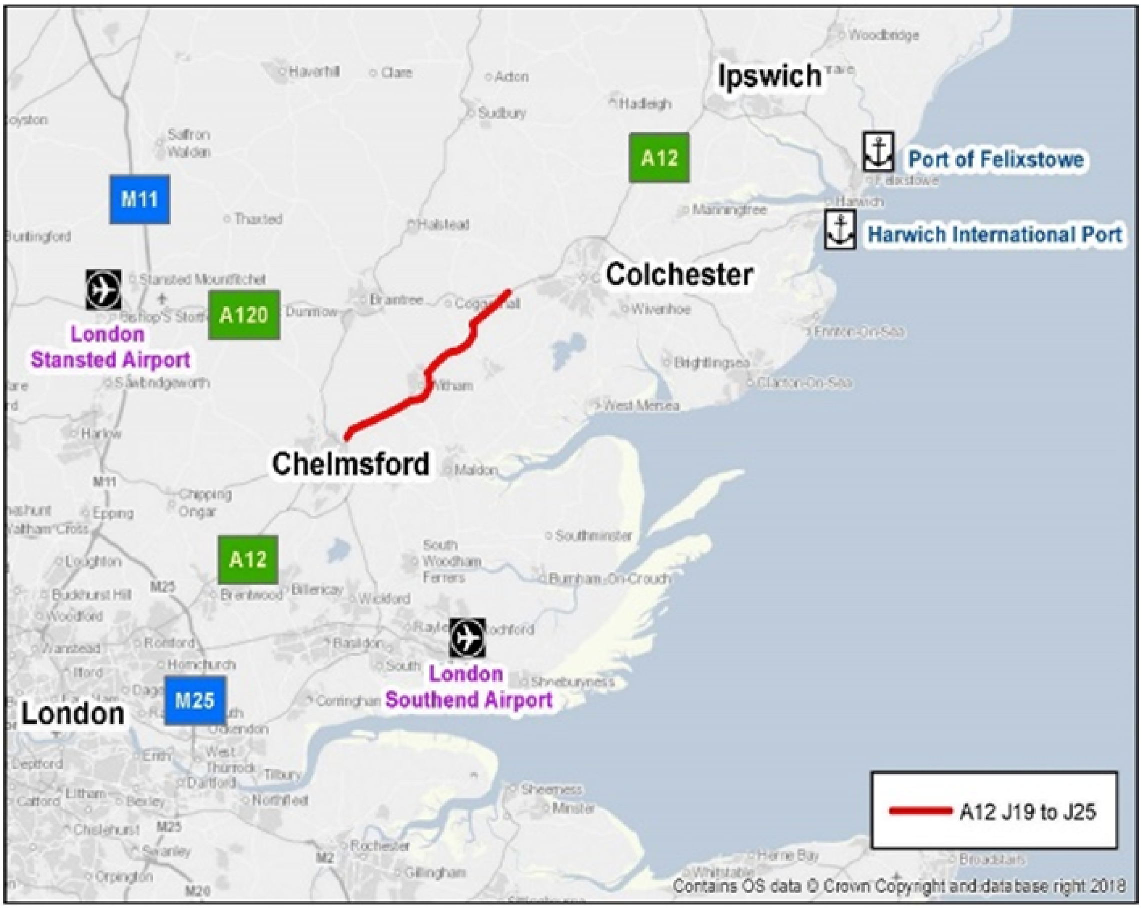


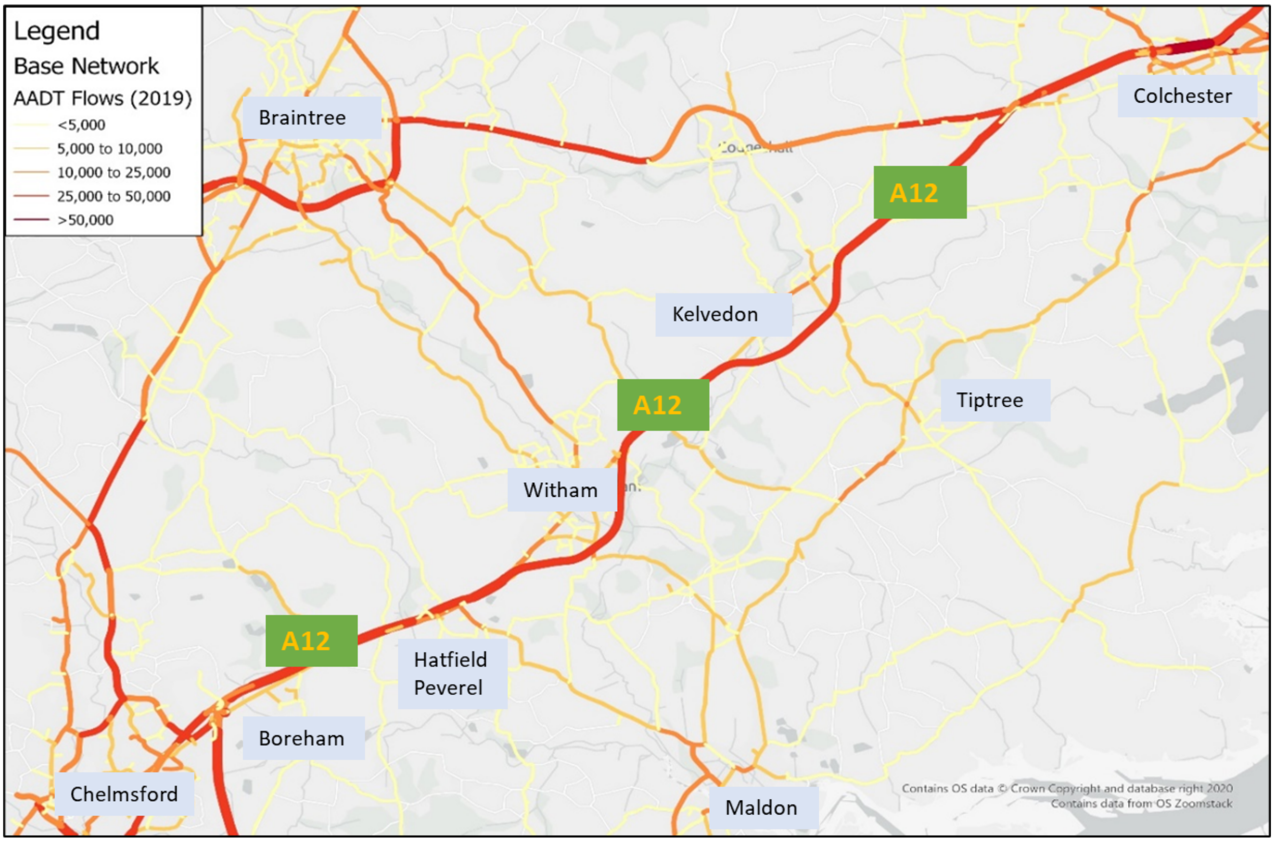
Table 3-1 Key functions of the A12

Functional level	Description
Strategic	• Forms part of the Trans-European Road Network (TERN) carrying national, European and international traffic • Provides a strategic connection to the ports of Felixstowe and Harwich for freight and passenger traffic, and to Stansted airport • Forms part of the National Highways SRN between London, the south-east and the east of England
Regional	• Provides for the distribution of goods and services • Links the major regional commercial centres along the route • Provides access to holiday destinations within the region
Local	• Forms a bypass of some of the towns along the route • Provides the only means of access to some communities along the route • Is used by commuters on a daily basis.

3.2 Current traffic flows

3.2.1 Plate 3-2 shows the current annual average daily traffic (AADT) flows as of 2019.

Plate 3-2 Current traffic flows – 2019 AADT



3.2.2 Flows are highest on the A12 itself. Local roads close to the A12 with high traffic flows include the A130, A131 and A120, as well as those within the communities of Hatfield Peverel, Witham and Kelvedon. Flows are also high on east-west B-road routes running parallel to the A12, and on B-roads leading out of settlements such as Maldon, Tiptree and Braintree towards the A12.

3.2.3 A summary of predicted future traffic flows on the A12 between junction 19 and junction 25 is provided in Chapter 4 of this report.

3.3 Current congestion

3.3.1 To put the above traffic flows into context, Plate 3-3 and Plate 3-4 show the levels of congestion for the AM and PM peak hours (as at 2019). This current level of traffic is extremely high for a two-lane dual carriageway. If a new road was being built today, the current level of traffic is either close to or exceeds the maximum recommended limit for what a two-lane road can support.

3.3.2 The plates show how close the current morning and evening rush hour traffic is to the theoretical capacity of the road. Much of the road is either close to or beyond this capacity in either the morning or evening rush hours. As the road comes closer to its capacity, queues and delays become more regular and severe, and are expected to continue to increase in the future. Road users experience increased journey times, as well as journey times which are difficult to predict from day to day.

Plate 3-3 Congestion on the A12 (2019 AM peak hour)

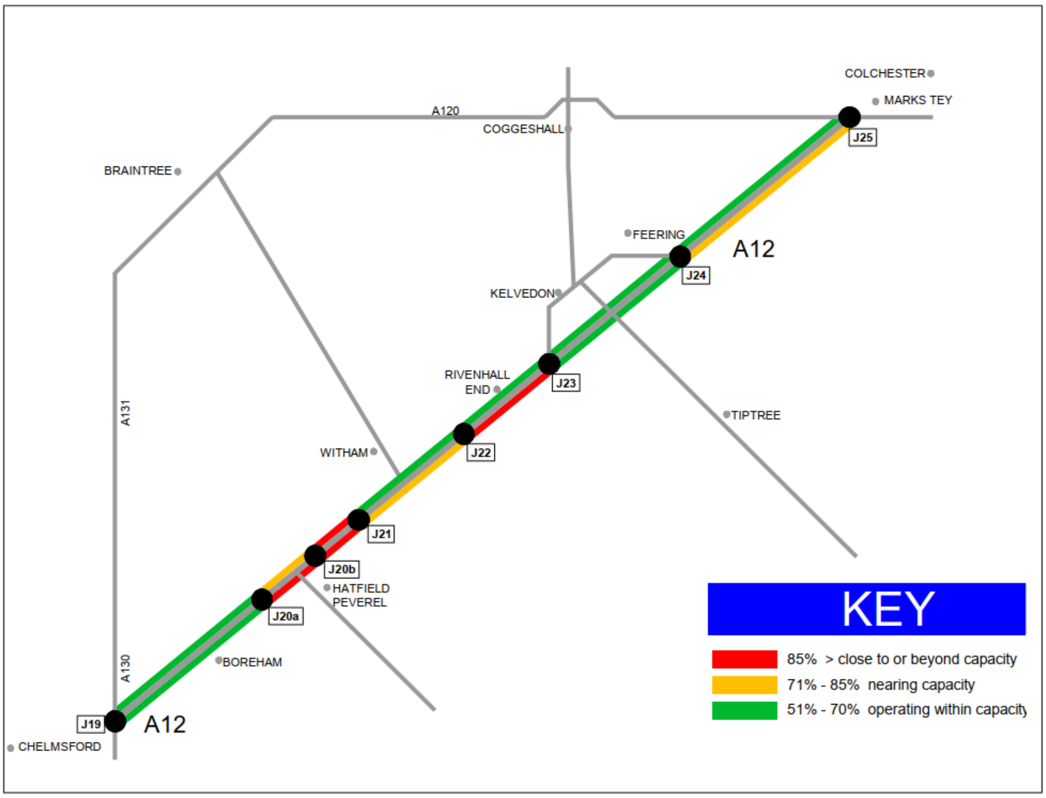
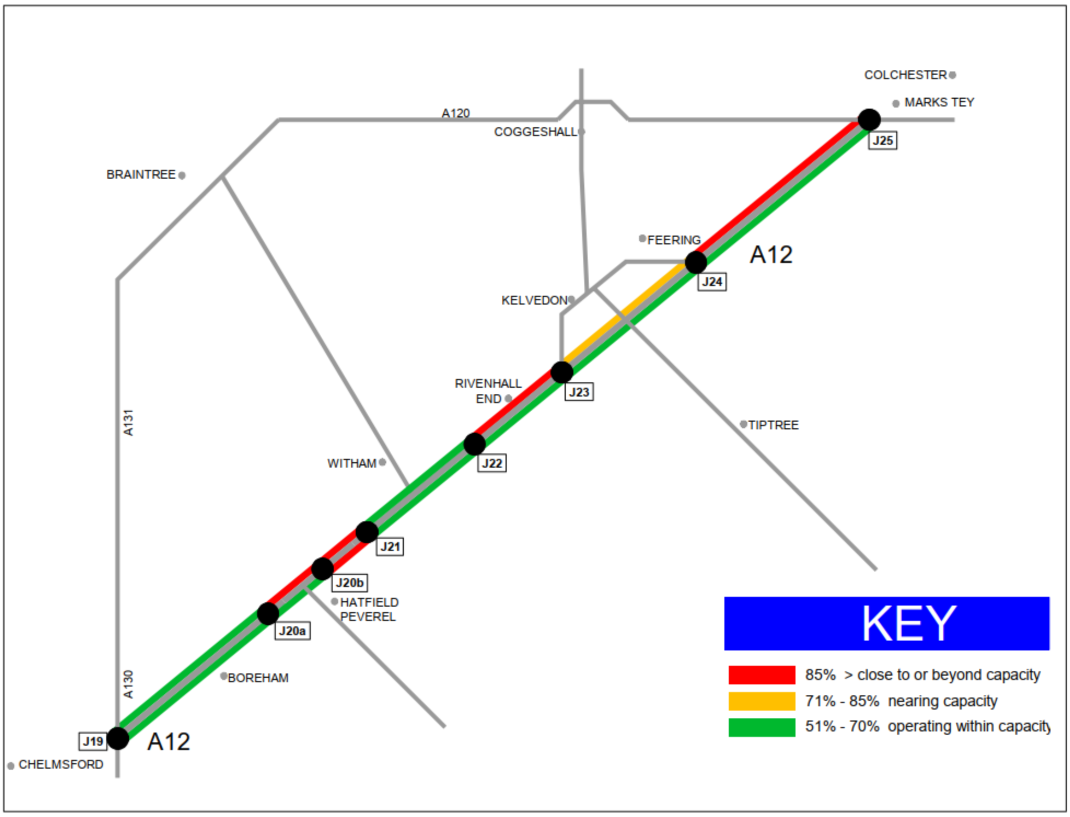


Plate 3-4 Congestion on the A12 (2019 PM peak hour)

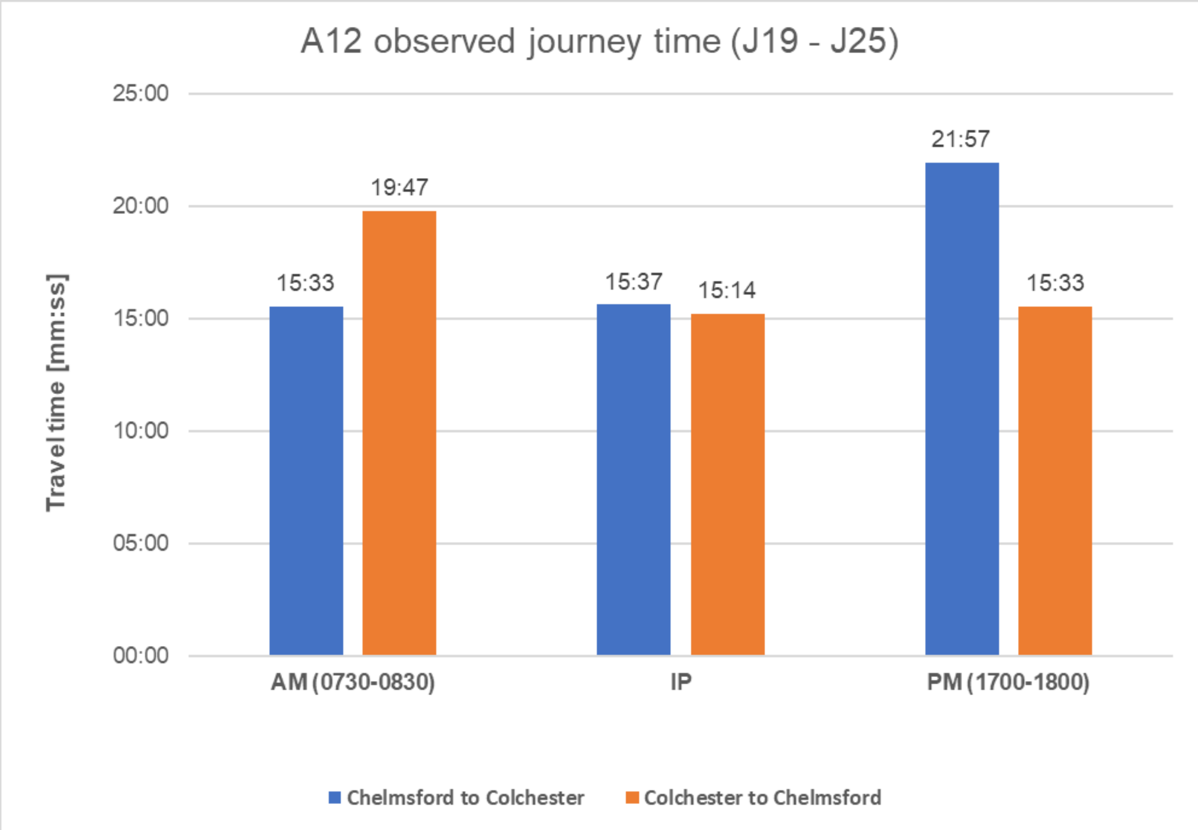


3.4 Current journey times and reliability

3.4.1 Due to the high level of traffic for a two-lane dual carriageway, all sections of the A12 between junction 19 and junction 25 are in the worst performing 10% of links on National Highways' network in the East of England (Highways Agency, 2014) in terms of Vehicle Hours Delay.

3.4.2 In 2019, average journey times towards Chelmsford in the morning peak were almost four minutes slower than in the middle of the day. Journey times towards Colchester in the evening peak were over six minutes slower. Plate 3-5 shows these journey times visually.

Plate 3-5 Route journey time by time period



3.5 Safety

3.5.1 The route is currently of variable standard, with non-standard junctions, short slip roads and direct accesses onto the national speed limit dual carriageway.

3.5.2 Based on current population and employment growth forecasts, traffic levels and congestion are expected to worsen, which will increase existing safety problems.

3.5.3 The proposed scheme would apply a consistent standard of design along the route with three lane all-purpose road throughout, removing direct accesses onto the road, and reducing risks to road users, road workers and residents.

3.6 Impact of COVID-19

3.6.1 The traffic modelling presented in this report is based on Department for Transport (DfT) traffic growth predictions which pre-date the COVID-19 pandemic. However, sensitivity tests have been undertaken to understand the impact that higher or lower future traffic growth could have on the proposed scheme.

4 Summary

4.1 Overview

4.1.1 This chapter provides a summary of the key quantified impacts of the proposed scheme, including its costs and economic benefits.

4.1.2 Further information on the appraisal and the proposed scheme's impacts are provided throughout the rest of this report. Table 4-1 provides a summary of where that information can be found.

Table 4-1 Location of further modelling and appraisal information

Information	Location
Data used to inform the appraisal	Chapter 5
Traffic model development	Chapters 6 to 8
Summary of traffic model outputs	Chapter 9 and Chapter 13 (Data annex)
Economic assessment methodology and results	Chapters 10 to 12 and Chapter 13 (Data annex)

4.2 High level benefits and costs

4.2.1 Table 4-2 presents an overview of the high-level benefits and costs for the proposed scheme.

Table 4-2 High level benefits and costs (£m)

Benefits and costs	Value
Present value of benefits (initial)	£340.8m
Present value of benefits (adjusted)	£775.4m
Present value of costs	£452.1m
Initial benefit to cost ratio	0.8
Adjusted benefit to cost ratio	1.7

4.3 Sources of costs

4.3.1 The proposed scheme construction costs were developed by National Highways commercial division. Although labelled as construction costs, they include costs for construction, land/property, preparation/administration and supervision. The costs exclude all VAT and exclude any historic costs.

4.3.2 Expenditure profiles were developed to derive the construction costs in each financial year. Inflation was then added for each year using National Highways projected construction-related inflation. Finally, the costs were rebased to 2010 prices for economic calculations, using the Gross Domestic Product (GDP) deflator series as published in the DfT's Transport Appraisal Guidance (TAG) Databook. This gave a construction cost of £655m.

4.3.3 In addition to the direct costs of developing and building the proposed scheme, the impact on road maintenance costs has also been considered. Road maintenance costs are incurred with and without the proposed scheme in place. These costs were calculated for the full appraisal period of the proposed scheme (60 years from the year of opening). The 'with scheme' maintenance costs were compared against the 'without scheme' maintenance costs, to derive a net maintenance cost impact of the proposed scheme.

4.3.4 Both the construction and maintenance costs were then discounted to 2010, which gave a Present Value of Costs (PVC) of £452.1 million in 2010 market prices. This comprised construction-related investment costs of around £463.1 million and a reduction in maintenance costs of −£11.0 million.

4.4 Sources of benefits

4.4.1 The proposed scheme is expected to provide significant economic benefits. Economic analysis has been undertaken to quantify these benefits. Where practicable, benefits have been monetised.

4.4.2 One of the main objectives of the proposed scheme is to address the problem of congestion, which causes slow and unreliable journeys. The largest predicted source of monetised scheme benefits is due to travel time savings, as the proposed scheme relieves congestion which would otherwise worsen if the scheme is not built. These time savings would benefit a wide range of road users: commuters, leisure trips, freight and other business trips.

4.4.3 The proposed scheme would also provide benefits by improving safety, making journey times more reliable and reducing roadwork delay during future maintenance.

4.4.4 In addition to these direct benefits, it would also lead to wider impacts on the economy by increasing business productivity as connectivity improves, increasing the number of people in work and increasing business output.

4.4.5 Economic disbenefits would arise from increases in noise, air quality and greenhouse gas emissions.

4.4.6 A summary of the monetised and quantified benefits is provided in Section 4.6 and Section 4.7 of this report. Further details on these benefits, as well as non-monetised benefits, are provided in Chapter 11 of this report.

4.5 Traffic flows

Demand growth along the route (Do Minimum)

4.5.1 Table 4-3 presents the forecast growth in AADT for the situation without the scheme (the 'Do Minimum' scenario). This is presented for the opening year (2027), and a design year 15 years later (2042). It also shows the growth in traffic between those years. The traffic flows shown are one-way flows, for the northbound (NB) and southbound (SB) direction.

Table 4-3 Demand growth along the route (Do Minimum)

Link	AADT (opening year)	AADT (design year)	AADT change (%)
A12 J19–20a NB	48,500	51,700	7%
A12 J19–20a SB	50,400	56,400	12%
A12 J20a–20b NB	43,000	45,700	6%
A12 J20a–20b SB	43,100	48,500	13%
A12 J20b–21 NB	49,500	53,200	8%
A12 J20b–21 SB	50,000	56,600	13%
A12 J21–22 NB	39,600	43,400	9%
A12 J21–22 SB	38,500	44,100	15%
A12 J22–23 NB*	44,100	47,700	8%
A12 J22–23 SB*	42,300	47,800	13%
A12 J23–24 NB	36,700	40,800	11%
A12 J23–24 SB	34,800	39,600	14%
A12 J24–25 NB	42,500	47,200	11%
A12 J24–25 SB	41,300	47,100	14%
Distance-weighted average NB	42,100	46,000	9%
Distance-weighted average SB	41,400	46,900	13%

** South of Rivenhall End*

Demand growth along the route (Do Something)

4.5.2 Table 4-4 presents the forecast growth in AADT for the situation with the scheme in place (the 'Do Something' scenario). This is presented for the opening year (2027), and a design year 15 years later (2042). It also shows the growth in traffic between those years. The traffic flows shown are one-way flows, for the NB and SB direction.

Table 4-4 Demand growth along the route (Do Something)

Link	AADT (opening year)	AADT (design year)	AADT change (%)
A12 J19–21 NB	55,400	62,400	13%
A12 J19–21 SB	51,100	59,400	16%
A12 J21–22 NB	48,700	57,200	18%
A12 J21–22 SB	44,200	53,200	20%
A12 J22–24 NB	46,600	54,800	18%
A12 J22–24 SB	42,700	51,600	21%
A12 J24–25 NB	46,600	54,300	16%
A12 J24–25 SB	42,600	51,200	20%
Distance-weighted average NB	49,400	57,200	16%
Distance-weighted average SB	45,200	53,900	19%

Demand changes along the route due to the scheme (Do Minimum vs Do Something)

4.5.3 Table 4-5 compares flows on the A12 between Do Minimum and Do Something. Where a section is bypassed as part of the proposed scheme, the Do Something traffic flows shown are for the new mainline A12 section, not the bypassed section of road.

Table 4-5 Demand along the route (Do Minimum (DM) vs Do Something (DS))

Link	2027			2042		
	AADT (DM)	AADT (DS)	AADT DM vs DS % Change	AADT (DM)	AADT (DS)	AADT DM vs DS % Change
A12 J19–20a NB	48,500	55,400	14%	51,700	62,400	21%
A12 J19–20a SB	50,400	51,100	1%	56,400	59,400	5%
A12 J20a–20b NB	43,000	55,400	29%	45,700	62,400	37%
A12 J20a–20b SB	43,100	51,100	19%	48,500	59,400	22%
A12 J20b–21 NB	49,500	55,400	12%	53,200	62,400	17%
A12 J20b–21 SB	50,000	51,100	2%	56,600	59,400	5%
A12 J21–22 NB	39,600	48,700	23%	43,400	57,200	32%
A12 J21–22 SB	38,500	44,200	15%	44,100	53,200	21%
A12 J22–23 NB*	44,100	46,600	6%	47,700	54,800	15%
A12 J22–23 SB*	42,300	42,700	1%	47,800	51,600	8%
A12 J23–24 NB	36,700	46,600	27%	40,800	54,800	34%
A12 J23–24 SB	34,800	42,700	23%	39,600	51,600	30%
A12 J24–25 NB	42,500	46,600	10%	47,200	54,300	15%
A12 J24–25 SB	41,300	42,600	3%	47,100	51,200	9%
Distance-weighted average NB	42,100	49,400	17%	46,000	57,200	24%
Distance-weighted average SB	41,400	45,200	9%	46,900	53,900	15%

** South of Rivenhall End Do Minimum*

4.6 Key monetised benefits and costs

4.6.1 Table 4-6 presents a summary of the key monetised benefits and costs of the proposed scheme.

Table 4-6 Key monetised benefits and costs

Category	Benefits and costs in £'000 (2010 prices discounted to 2010)
Business users	
Journey time savings	£238,828
Vehicle operating costs	£10,360
Non-business users	
Journey time savings	£284,842
Vehicle operating costs	−£68,299
Reliability	
Business reliability	£78,929
Non-business reliability	£101,818
Safety	
Safety	£13,090
Environmental impacts	
Noise	−£6,550
Local air quality	−£16,325
Greenhouse gases	−£113,418
Wider economic impacts	
Agglomeration	£216,222
Market competition	£31,438
Labour supply	£6,257
Customer impact	
Traffic delays due to construction	−£60,857
Traffic impacts due to maintenance	£29,962
Other impacts	
Indirect tax revenues	£29,140
[Other – please specify]	
Costs	
Cost to broad transport budget	£452,122

4.7 Key quantified benefits and costs

4.7.1 Table 4-7 presents a summary of the key quantified benefits and costs of the proposed scheme.

Table 4-7 Key quantified benefits and costs

<table>
<tr><th>Category</th><th>Quantified impacts</th><th>Units</th></tr>
<tr><td>Journey times</td><td></td><td></td></tr>
<tr><td>Journey time savings</td><td>
<table>
<tr><th>NB</th><th>2027</th><th>2042</th></tr>
<tr><td>AM</td><td>3:53</td><td>5:41</td></tr>
<tr><td>Inter-peak (IP)</td><td>2:28</td><td>3:36</td></tr>
<tr><td>PM</td><td>8:02</td><td>9:37</td></tr>
</table>
<table>
<tr><th>SB</th><th>2027</th><th>2042</th></tr>
<tr><td>AM</td><td>5:16</td><td>6:46</td></tr>
<tr><td>IP</td><td>2:31</td><td>4:04</td></tr>
<tr><td>PM</td><td>3:13</td><td>5:08</td></tr>
</table>
</td><td>(average saving per journey on <u>scheme sections</u> in minutes)</td></tr>
<tr><td>Safety</td><td></td><td></td></tr>
<tr><td>Accidents</td><td>262 (increase)</td><td>(total number saved)</td></tr>
<tr><td>Fatalities</td><td>2</td><td>(total number saved)</td></tr>
<tr><td>Seriously injured</td><td>200</td><td>(total number saved)</td></tr>
<tr><td>Slightly injured</td><td>496 (increase)</td><td>(total number saved)</td></tr>
<tr><td>Environmental impacts</td><td></td><td></td></tr>
<tr><td>Number of noise important areas affected</td><td>20
Increase = 2
Decrease = 13
No change = 4
Increase & decrease=1</td><td>(number)</td></tr>
<tr><td>Names of Air Quality Management Areas (AQMAs)</td><td>Lucy Lane North AQMA</td><td>(names)</td></tr>
<tr><td>Change in NOx emissions</td><td>2,599</td><td>(tonnes - over 60y appraisal)</td></tr>
<tr><td>Change in PM10 emissions</td><td>318</td><td>(tonnes - over 60y appraisal)</td></tr>
<tr><td>Change in greenhouse gas emissions</td><td>1,535,559</td><td>(tonnes CO2e – over 60y appraisal)</td></tr>
</table>

Category	Quantified impacts			Units
Customer impact: totals				
Traffic delays due to Construction	See below			
Traffic impacts due to Maintenance	See below			
Customer impact: per journey				
		NB	SB	
Traffic delays due to Construction *Phase 1: J20A to J24 (narrow lanes and reduced speed limit)*	AM	04:23	04:31	*(JT increase mm:ss by time period)*
	IP	04:26	04:36	
	PM	04:04	04:47	
		NB	SB	
Traffic delays due to Construction *Phase 2: J19 to J25 (narrow lanes and reduced speed limit)*	AM	05:33	05:49	*(JT increase mm:ss by time period)*
	IP	06:24	06:16	
	PM	04:58	06:27	
		NB	SB	
Traffic delays due to Construction *Phase 3: J20A to J25 (narrow lanes and reduced speed limit)*	AM	04:10	04:32	*(JT increase mm:ss by time period)*
	IP	04:34	04:44	
	PM	04:00	04:50	
Traffic impacts due to Maintenance	Monetised assessment shows an overall benefit from reduced maintenance delays with the scheme in place. Direct comparison of maintenance delays in minutes with and without the scheme is not available.			

4.8 Strategic objectives

4.8.1 Table 4-8 summarises how results from the traffic and economic work support National Highways' strategic objectives.

Table 4-8 Summary of how appraisal outcomes support strategic objectives

Strategic outcome	KPI	Scheme contribution – qualitative	Scheme contribution – quantitative
Making the network safer	The number of KSIs on the SRN	**Road users:** Closure of direct accesses and lengthening of sub-standard slip roads. Improved route clarity and advanced information of incidents using technology – reduced driver/rider stress and early response to an incident reduces likely secondary incidents. **Road worker safety improvements due to technology:** Ability to close lanes, reduce speed and inform drivers reduces worker risk of injury.	From COBA-LT analysis: Total casualties saved due to scheme over 60-year appraisal period (across entire study network): Fatal 2, Serious 200, Slight −496. Monetised benefit: £13.1m.
Delivery of better environmental outcomes	Noise: number of Noise Important Areas mitigated Biodiversity: delivery of improved biodiversity, as set out in the National Highways Biodiversity Action Plan	**Biodiversity:** Despite the impacts to ancient woodland and veteran trees, the proposed scheme would provide a benefit to biodiversity due to the net gain of habitats (net gain of 25% for area-based habitats, 36% for hedgerow units, 165% for river units). Impacts to Perry's Woodland AW would be offset through woodland creation, and albeit this site is assessed as being of National value in line with DMRB guidance, the condition of the woodland is suboptimal. Similarly impacts to veteran trees are assessed as 'very large adverse' and albeit the diversity of nitrogen sensitive lichens they support could be reduced, the actual trees would be largely unaffected.	**Noise:** Impact on 20 Noise Important Areas: noise increase in 2, decrease in 13, no change in 4, a mix of increases and decreases in 1. **Air quality:** The scheme would result in a total increase in emissions in the opening year of: NO_x: +48.8 tonnes/yr, PM_{10}: +4.1 tonnes/yr. Air quality within Lucy Lane North AQMA was adversely affected at a receptor by the scheme. Overall the number of receptors exceeding AQOs with or without the scheme in place are below the guideline number of properties that would constitute a likely significant effect according to the significance criteria in DMRB LA 105.
Helping cyclists/walkers and other vulnerable users	The number of new and upgraded crossings	Improved connectivity encourages walking and cycling for leisure and utility journeys. This has health benefits for users and benefits to wider population (i.e. reduces driven journeys, reduces noise, vibration, particulates, NOx, CO_2 etc.). Active travel journeys (walk, cycle) also have better journey time reliability, resulting in better wellbeing for users. Proposed new crossings address both historic severance, and that caused by the scheme, thereby integrating with the existing network. It also creates opportunities for local highway authorities to extend and connect networks in future for additional benefits.	To provide safe crossings over the proposed A12 we are providing a total of six new walking, cycling and/or horse riding bridges across the scheme. In addition to this we are providing walking and/or cycling infrastructure across a total of ten road bridges and one accommodation bridge. In total this is 17 proposed, safe grade-separated A12 crossings across the scheme extents.

5 Use of data

5.1 Overview

5.1.1 To inform the traffic model development and economic appraisal, a number of sources of data were utilised. Full details of the available data, and the data which was selected for use before being processed and checked, can be found in the Transport Data Package in Appendix A. This section of the ComMA provides a summary of that report.

5.2 Traffic count data

5.2.1 Existing traffic count data was available from several sources. A summary of the counts taken forward for potential use in the A12 model development is presented in Table 5-1 and Plate 5-1. Each count site may represent more than one direction of traffic data. The following count types were used:

- Automatic traffic counts (ATCs). These are generally done via loops on the road which count the vehicles that pass over them.
- Manual classified link counts (MCCs). These are link counts which are manually split down into vehicle type (e.g. cars, Light Goods Vehicles (LGVs), Heavy Goods Vehicles (HGVs)).
- Manual classified turning counts (MCTCs). These are junction turning counts which are manually split down into vehicle type.

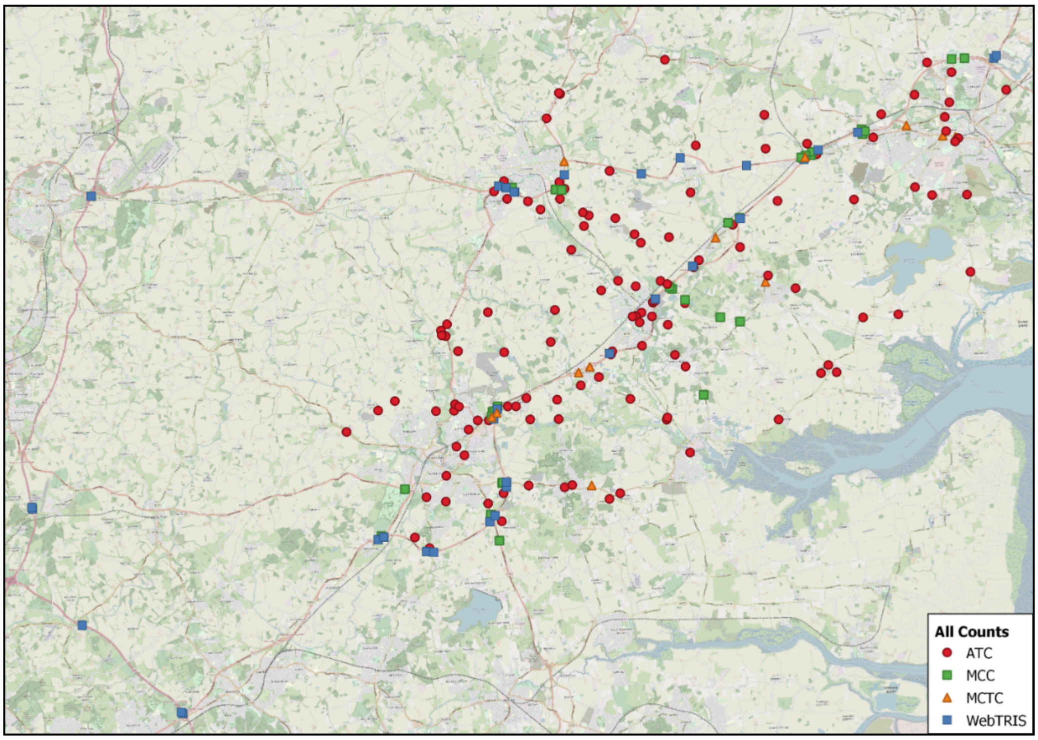
5.2.2 Traffic counts were extracted for weekday modelled hours (Monday–Thursday) and factored to 2019.

Table 5-1 Summary of volumetric dataset

Count source	Count type	No. of surveys by collection year				Total no. of counts
		2016	2017	2018	2019	
Data collected to develop the A120 Braintree to A12 traffic model	ATC	18	0	0	0	18
	MCC	11	0	0	0	11
	MCTC	0	0	0	0	0
Data collected to develop the PCF Stage 2 A12 Model	ATC	11	0	0	0	11
	MCC	2	0	0	0	2
	MCTC	5	0	0	0	5
Essex Count Database	ATC	9	8	21	56	94
	MCC	4	0	0	14	18

Count source	Count type	No. of surveys by collection year				Total no. of counts
		2016	2017	2018	2019	
	MCTC	1	1	1	4	7
WebTRIS (National Highways count database)	ATC	3	0	1	55	59
Total number of counts		64	9	23	129	225

Plate 5-1 Location plan of volumetric dataset



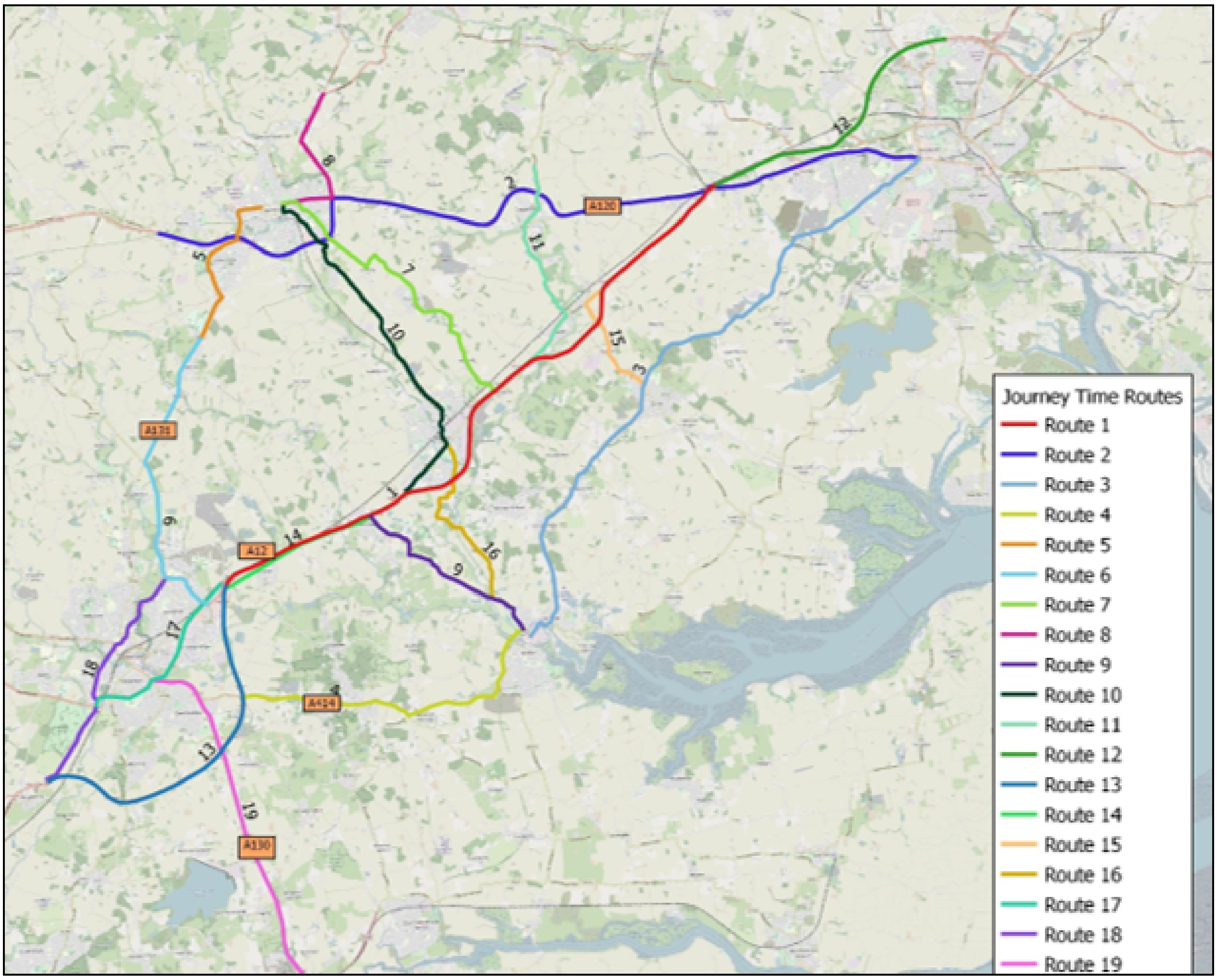
5.3 Journey time data

5.3.1 Journey time data was analysed as part of establishing baseline conditions to inform the traffic model development. The journey time data was used to check and compare the delays and travel times calculated by the model with observed data as part of the model validation process.

5.3.2 Journey time data along selected routes was obtained from Teletrac Navman. Teletrac Navman is a journey time dataset based on data gathered using satellite navigation devices installed in cars and other vehicles.

5.3.3 Journey time data was obtained and processed for 19 key routes as shown in Plate 5-2. The routes cover main routes through the A12 traffic model's area of detailed modelling.

Plate 5-2 Journey time routes for model validation



5.3.4 Journey time data was obtained for weekdays (Monday–Thursday), excluding school and bank holidays, in neutral months in 2019. Journey time data was processed for the following modelled time periods:

- AM peak (07:30–8:30)
- IP (average hour between 10:00–16:00)
- PM peak 17:00–18:00

5.3.5 Each journey time route was also split into several route sub-sections. This shows the places along each route where traffic moves more slowly, highlighting for example higher delays on the approaches to busy junctions. This allowed each route's journey time to be sense-checked in more detail than using a full route journey time alone. Table 5-2 details the journey times for the A12 between junctions 19 and 25. All other journey time data is presented in the Transport Data Package which can be found in Appendix A.

Table 5-2 A12 junction 19–25 observed journey times

Direction	Length (km)	Observed journey times (mm:ss)			Speed (km/h)		
		AM	IP	PM	AM	IP	PM
NB	25.3	15:33	15:37	21:57	98	97	69
SB	25.3	19:47	15:14	15:33	77	100	98

5.4 Matrix data used

5.4.1 The A12 traffic model uses origin-destination demand data based on National Highways' South East Regional Transport Model (SERTM) 2015 data. Section 6.6 describes how this data was then manipulated for use as the input matrices for the Development Consent Order (DCO) base model.

5.5 Accident data

5.5.1 To enable accident analysis to take place using the COst and Benefit to Accidents – Light Touch (COBA-LT) software, observed Personal Injury Accident (PIA) data was obtained for the five-year period 2015–2019.

6 Model development

6.1 Overview

6.1.1 A traffic model was developed to help inform the design and appraisal of the proposed scheme. The first step in this is to develop a 'base year model' to reflect current conditions. This chapter describes how we developed our base year model, which represents 2019 traffic conditions.

6.1.2 Chapter 7 describes in more detail how we calibrated the model to observed 2019 traffic conditions and shows how well the model meets standard DfT modelling requirements.

6.1.3 Chapters 8 and 9 describe how we developed models to predict future traffic conditions and summarises the outputs from those models.

6.1.4 Full details of the base model development process are provided in the Transport Model Package found in Appendix B.

6.2 Traffic modelling overview

6.2.1 Our base year model is a representation of traffic patterns as they were in 2019. It was developed using the industry-standard SATURN and DIADEM modelling platforms. The information on where people are travelling to and from has ultimately been based on analysis of the movement of a vast number of mobile phones in the UK. The mobile phone data is completely anonymous but provides details of the travel patterns of millions of mobile phones around the country. This information was scaled to match traffic counts in the area and then merged with other data sources to provide the travel patterns of cars, vans and HGVs across the country.

6.2.2 The traffic model is then used to predict on which routes vehicles will travel, considering:

- Where people want to travel to and where they are coming from
- People's preference between journey time and journey distance
- The actual speeds of vehicles on the road network

6.2.3 The amount of traffic predicted by the model using the road network is compared to actual counts of the number of vehicles on the road network, collected from traffic counters laid out on the road or specially commissioned video surveys. The times that journeys are predicted to take are compared with observations from in-vehicle satellite navigation devices which provide actual travel times, recorded during the modelled hours. This process is known as model calibration and validation and is summarised in Chapter 7.

6.2.4 The DfT has issued guidelines on how traffic models such as this should be built, and the extent to which the predictions of traffic flows and times made by the model compare with real life (TAG). These guidelines are used in the assessment of transport schemes across the country. Our traffic models have been developed based on this guidance.

6.3 Model area

6.3.1 The traffic model was created to represent the transport system in this area of Essex. The model covers the whole of the UK to capture the actual start and end of every trip, but is more detailed in the areas around Chelmsford, Braintree, Colchester, Maldon and the towns and villages in between.

6.3.2 The network is divided into two key parts, the Fully Modelled Area and the External Area. The extents of these areas are described below.

- Fully Modelled Area: this is based on the area where the proposed interventions are expected to have influence and is further subdivided as follows:
  - Detailed Simulation Area: this represents the main scheme area where the greatest impacts from the proposed scheme will occur, i.e. along the A12, Chelmsford, Colchester, Maldon, Witham and Braintree. It therefore has the greatest level of accuracy and detail in the model. With the exception of Chelmsford, Colchester and Maldon urban areas, almost all roads are included, with junctions explicitly modelled in detail.
  - Rest of Fully Modelled Area (Buffer Area): this is the area over which impacts of the proposed scheme are considered to be quite likely but relatively weak in magnitude. This area roughly corresponds to the rest of the county of Essex outside the simulation area as well as some key strategic links that provide access into or through Essex such as the A14 and M11.
- External area: in this area impacts of the proposed scheme would be so small as to be reasonably assumed to be negligible.

6.3.3 All main roads are included, as well as those secondary routes and local routes in residential areas (especially 'rat-runs') that are likely to carry traffic movements which could use the proposed scheme, and that are significant in relation to the capacity of the proposed scheme.

6.3.4 The simulation area, Rest of the Fully Modelled network (ROFMA) and external area are illustrated in Plate 6-1. A more detailed map showing the buffer and simulation areas is given in Plate 6-2.

Plate 6-1 Local model network by area type

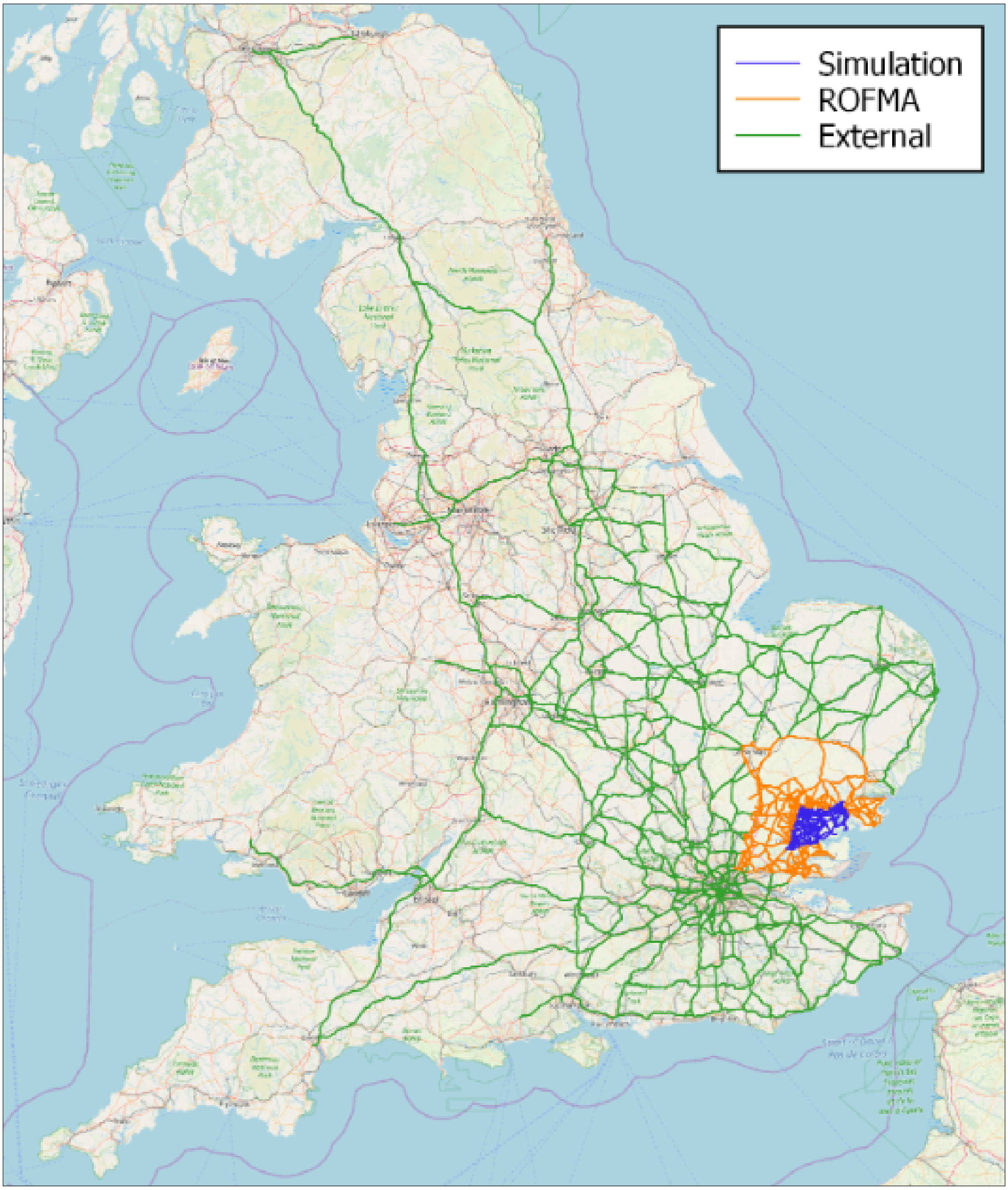
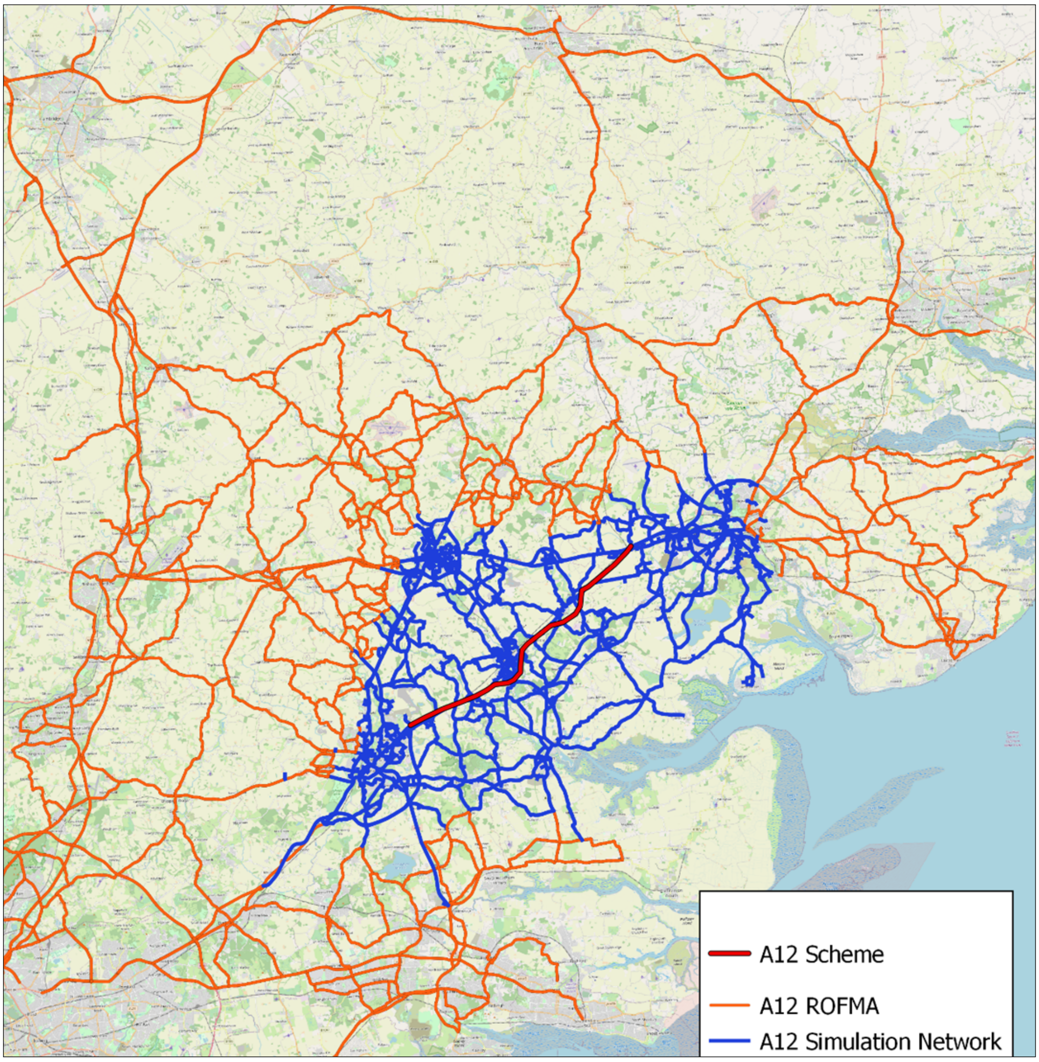


Plate 6-2 Local model network – buffer and simulation area



6.4 Time periods

6.4.1 The hours modelled in the traffic model are the morning and evening peak (confirmed by using traffic count data) and a typical hour in the middle of the day (the inter-peak). The specific hours modelled are:

- AM peak hour (07:30–08:30)
- Average weekday IP hour (10:00–16:00)
- PM peak hour (17:00–18:00)

6.5 User classes

6.5.1 The model segregates trips by vehicle type and trip purpose. A total of five user classes are represented:

- Car employer business
- Car commute

- Car other
- LGV
- HGV

6.6 Demand development

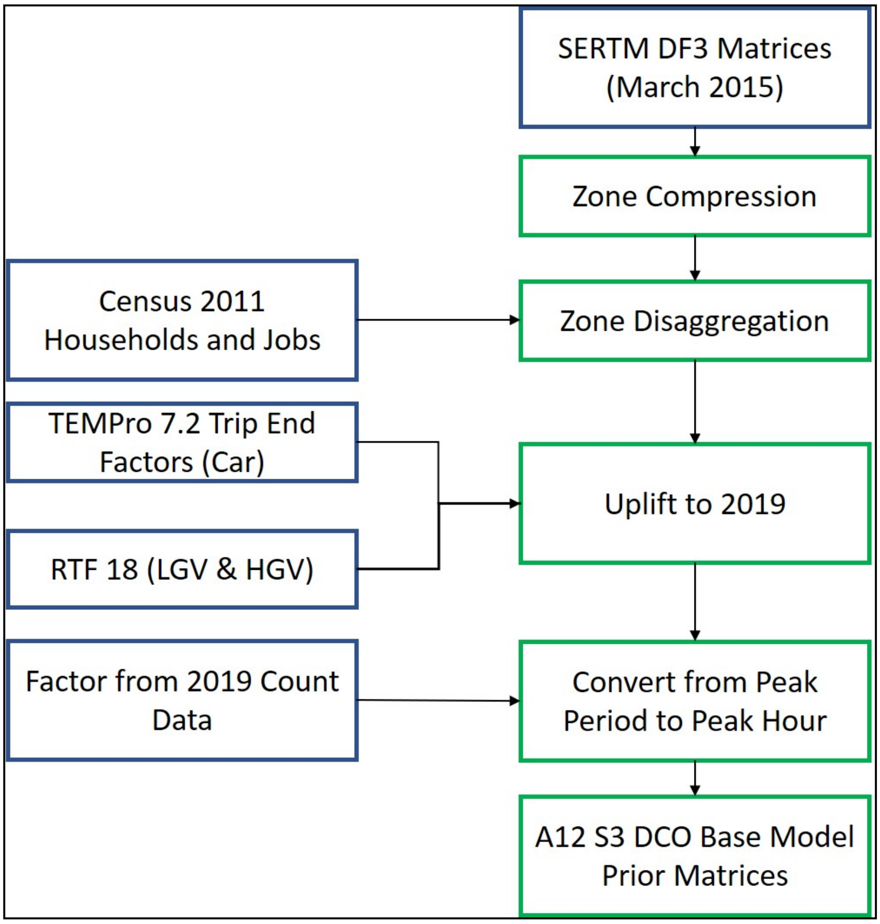
6.6.1 Information on where people are traveling to and from, known as traffic demand, was based on National Highways' existing SERTM. SERTM was originally developed using mobile phone data, representing traffic demand as it existed in 2015. The version of SERTM used was DF3.

6.6.2 Several steps were taken to convert the SERTM demand into demand for the A12 base model. These include:

- Aggregating and disaggregating the SERTM demand to the A12 model zone system
- Uplifting the data from 2015 to a 2019 base year
- Converting peak period demand to peak hour demand

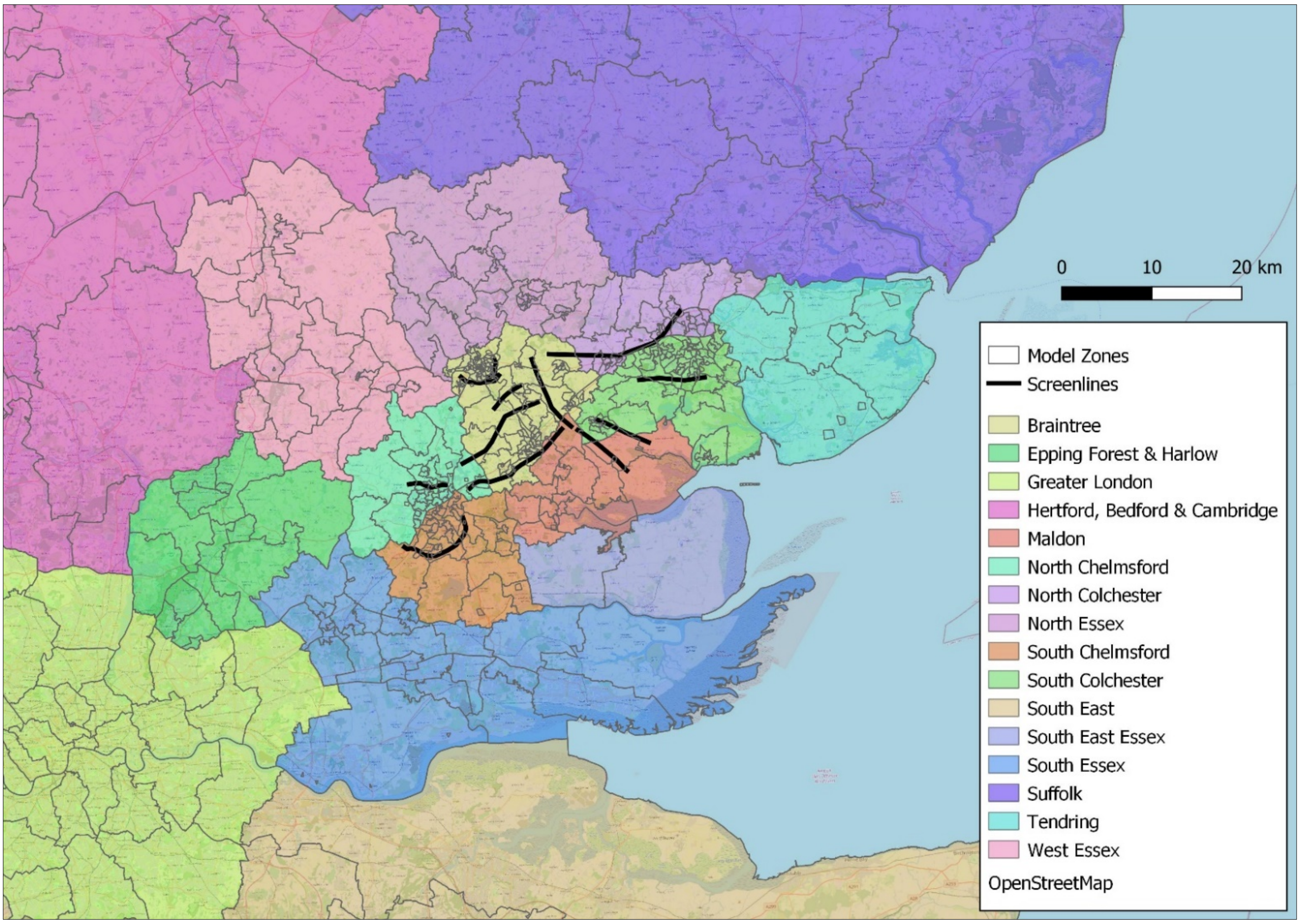
6.6.3 Plate 6-3 outlines the links in this process.

Plate 6-3 Base year demand methodology



6.6.4 The A12 model's zoning system is based on SERTM but disaggregated in the simulation area and its periphery to provide more detail in the geographic area of interest. Zones were disaggregated to Lower-Layer Super Output Area (LSOA) and, in some cases, Output Area (OA) level. In addition to this, some SERTM zones were aggregated where less detail was required for the A12 model. In total, the A12 zoning system consists of 579 zones. The zones have been grouped into 18 larger sectors, as shown in Plate 6-4.

Plate 6-4 A12 sector system – buffer and simulation areas



6.7 Network development

6.7.1 The model network was based largely on the traffic model developed by Essex County Council to assess the proposed A120 Braintree to A12 improvement scheme. This network was extended to add more detail where it was required to enable proper assessment of the proposed scheme.

6.7.2 Within the simulation area, each junction has been modelled in detail with the inclusion of saturation flows, correct turn availability and signal timings where required. Link lengths and classification were determined using the previous A120 model on which the A12 model is based, as well as mapping tools. Speeds were applied to the model network either as 'fixed speed' on a link, so speed does not vary by traffic volume, or by using Speed Flow Curves where the vehicle speed can be plotted depending on traffic volume between two defined points on the curve.

6.7.3 There are three key junction types which have been coded into the model:

- Signalised junctions
- Priority junctions
- Roundabouts

6.7.4 Depending on the classification, different saturation capacities and junction types have been coded into the model.

6.7.5 In total 38 bus routes and their frequencies have been coded into the A12 model. Bus timetable and routing information was extracted from the interactive Essex Public Transport map (CartoGold) developed by Essex County Council. Bus routes that start, terminate, or go through the simulation area have been included.

6.7.6 In order to prevent HGVs routing onto rural and restricted roads, a combination of time penalties and bans has been applied to links where appropriate. Bans were imposed on the network for links where there was a visible height or weight restriction for HGVs, e.g. weak or low bridge. Penalties were used generally where there was no legal restriction but for calibration purposes where needed to discourage HGVs from routing via clearly unsuitable narrow country lanes.

6.8 Variable demand modelling (VDM)

6.8.1 A variable demand model was developed as an incremental Origin-Destination based model using the DIADEM 7.0 software platform. The spatial coverage is the same as the highway model and they use the same zone system and generalised cost parameters.

6.8.2 For variable demand purposes, the model has been divided into two areas: the internal area and the external area. The internal area is the area where trip movements could potentially be impacted on by the proposed scheme. The external area is the area outside this. All external-to-external trips are fixed and therefore removed from the variable demand calculations.

6.8.3 Guidance recommends that LGV and HGV vehicle types are treated as fixed. Variable demand modelling is therefore only applied to car user classes.

6.8.4 Table 6-1 indicates the DIADEM responses which have been modelled for the proposed scheme.

Table 6-1 Scope of VDM for A12

Modelled	Not modelled
Trip frequency	Mode choice (active modes, bus)
Mode choice (car/rail)	Time of day choice
Trip distribution	Micro time choice
Cost damping	

6.8.5 For the public transport element of the variable demand model, the rail demand and cost matrices used were consistent with SERTM, based on data from the PLANET rail model. This demand and cost data was spatially adjusted to fit the A12 zone system.

7 Model calibration and validation

7.1 Overview

7.1.1 This chapter describes how we calibrated the model to observed 2019 traffic conditions and shows how well the model meets standard DfT modelling requirements.

7.1.2 Full details of the base model development process are provided in the Transport Model Package found in Appendix B.

7.2 Network and route choice checks

7.2.1 A series of checks were undertaken on the model, and these are summarised as follows:

- Network structure and connectivity – check of zone connectors to ensure they appropriately represent zone loading onto the local road network
- Check that the one-way links and restricted links were accurate
- Coded attributes for links and junctions – checking number of lanes, capacity, turn restrictions, junction type, along with reviewing SATURN warnings
- Check of link lengths using Geographic Information System (GIS) measurement and comparison against 'crow-fly' link lengths
- Check of bus routes against maps to ensure correct coding and frequency

7.2.2 As a result of the network checks undertaken for the base model, some improvements were made to the network. These improvements included modifications to the location of centroid connectors from certain zones to more accurately represent the road network.

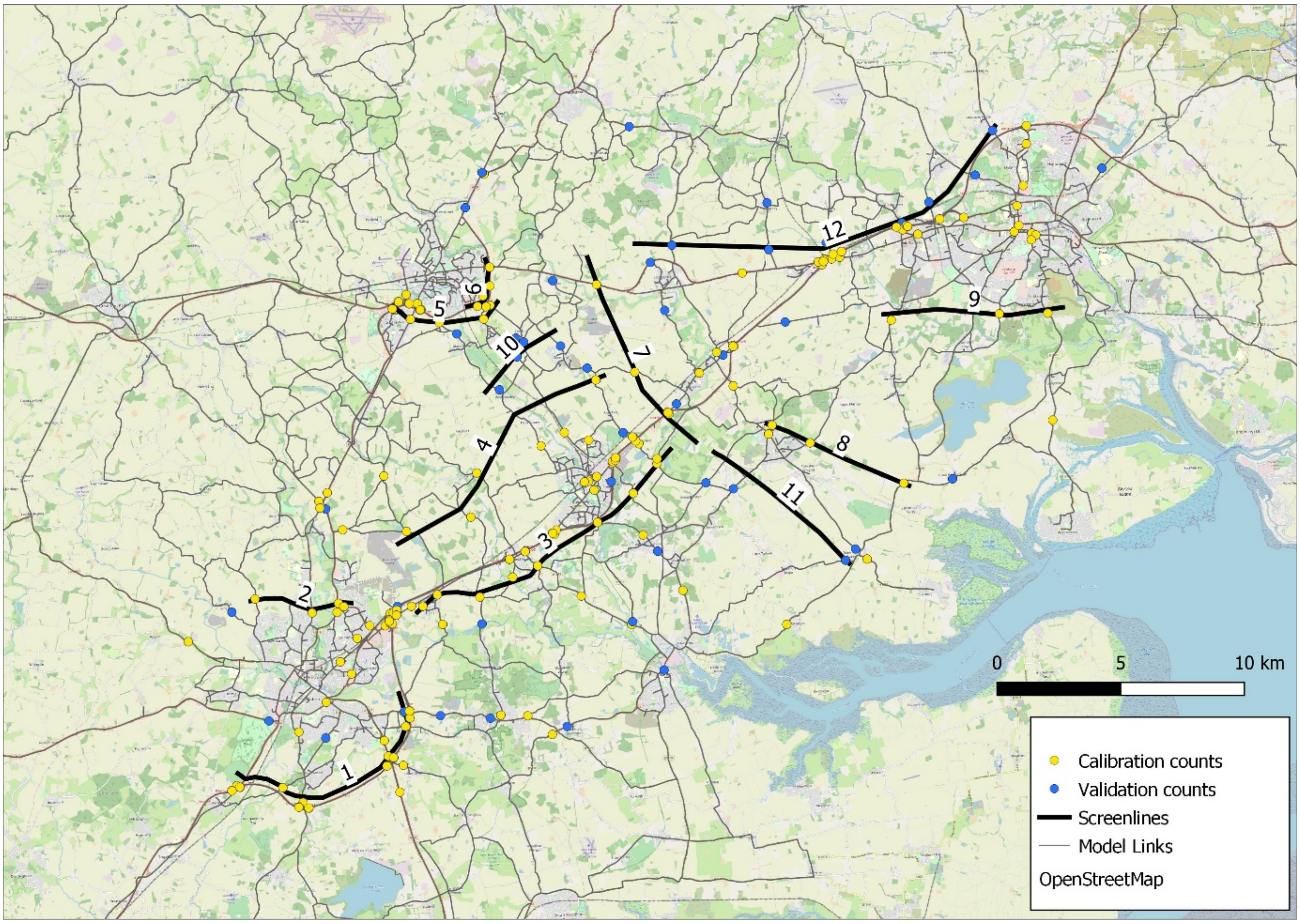
7.2.3 Checks were also done to ensure the route choices that traffic make within the model are realistic. Major urban areas covered by the network were identified, and routes between them checked against local knowledge, common sense and routes suggested by Google Maps. The model met the required criteria on how well these route choice validation checks should perform.

7.3 Prior matrices validation

7.3.1 The demand data described in Chapter 6 was loaded onto the traffic model network to perform the route choice validation described above. At this stage of the modelling process, that demand is known as the 'prior demand', i.e. before any further adjustments are made to it.

7.3.2 As described in Chapter 5, a large number of observed traffic counts were used in the development of the model. Some of these counts were combined into screenlines, and checks were done to show whether the model accurately reflects the level of traffic crossing each screenline. A map of all screenlines used within the model is shown in Plate 7-1.

Plate 7-1 Location of screenlines and counts



7.3.3 Checks were undertaken to show how well the prior demand model matched observed traffic counts. Overall, the model demand is slightly lower than the observed traffic counts. The checks showed that few of the screenlines met the validation criteria set out in TAG.

7.3.4 At this stage, given the confidence in the network and route choice calibration, it was decided to use matrix estimation in order to further improve the fit between model demand and observed counts.

7.4 Trip matrix calibration

7.4.1 Following the prior demand assignment and refinement of the modelled network, the trip demand matrices underwent a process of 'matrix estimation' whereby trip matrices were adjusted such that the resulting assigned flows match the count data better.

7.4.2 A combination of short screenlines and standalone counts were used in matrix estimation; these were derived from count data and applied at the Car, LGV and HGV level.

7.4.3 It is important when running a matrix estimation process that the original prior (to estimation) trip matrices are not distorted in such a way that the underlying trip patterns are altered. To check that the effects of matrix estimation are minimised, guidelines are set out in TAG.

7.4.4 For most of the required checks, the matrix estimation changes either meet or very nearly meet the TAG criteria for all time periods. However, the changes do not meet the criteria in terms of sector-to-sector matrix changes. The TAG criteria specifies that at a sector level, trips should not change by more than 5% as a result of matrix estimation. In the A12 model, several sector pairs change by more than 5%.

7.4.5 This is to be expected given the use of SERTM matrices, which use 2015 origin-destination data even though some traffic patterns may have changed by 2019. Although matrix estimation results in some noticeable changes at sector level, the overall scale of variation from the prior is relatively minor and considered acceptable. The biggest sector changes are each justified and explained in the Transport Model Package found in Appendix B.

7.5 Assignment model calibration and validation

Model convergence

7.5.1 The traffic model assigns traffic to the network via an iterative process, with the aim of minimising travel costs on all routes. Convergence of the model was monitored to check the stability of the traffic model, i.e. whether traffic flows remain stable between successive iterations, providing a robust platform for further modelling. The results indicate that the model achieves a high level of convergence.

Calibration statistics

7.5.2 Checks are undertaken to show that the traffic model accurately reflects observed traffic conditions. The first such check is how modelled traffic flows compare to the observed counts that were used in the matrix estimation process. These are known as calibration counts, as they were used to calibrate the model.

7.5.3 TAG specifies criteria about how closely the model counts should compare to observed. Of the 313 calibration counts used in the model, over 85% meet the TAG criteria for all peaks.

7.5.4 For calibration counts that are arranged along screenlines, TAG has an additional criterion for total screenline flows. It requires that total modelled flows on all links crossing a screenline should be within 5% of the observed totals. The A12 model calibration screenlines are shown in Plate 7-1.

7.5.5 For the A12 model, most of the calibration screenlines meet the 5% difference criterion for all model peaks. There are only two screenlines which do not quite meet this criterion in the AM peak. However, those have a difference of less than 6% and the actual difference is less than 100 vehicles across the total screenline.

Validation statistics

7.5.6 In addition to the counts used in model calibration, some count sites are held back to use as independent validation counts. TAG specifies criteria about how closely the model counts should compare to observed and advises that 85% of validation count sites should meet those criteria. Of the 91 validation counts used in the model, over 85% meet the TAG criteria for all peaks.

7.5.7 For validation counts that are arranged along screenlines, TAG has an additional criterion for total screenline flows. It requires that total modelled flows on all links crossing a screenline should be within 5% of the observed totals. The A12 model screenlines are shown in Plate 7-1; the validation screenlines are screenlines 10, 11 and 12.

7.5.8 Although some of the validation screenlines do not pass the 5% criteria, there are a far greater number that pass or almost pass an alternative criterion of GEH of less than 4. The GEH statistic is often a better indicator when comparing lower flow levels as is the case here where these screenlines can be comprised of a small number of links and the links themselves can have low flows. Given the rural nature of the area, most of these validation screenlines have very low flow, often with less than 1,000 vehicles across the entire screenline. Full details of the validation screenline results, including discussion and justification of why the performance is considered acceptable, are provided in the Transport Model Package found in Appendix B.

Traffic flows on the A12 mainline

7.5.9 The validation of traffic flows on the A12 mainline itself are presented in Plate 7-2 and Plate 7-3. All A12 mainline flows meet the TAG link flow criteria, providing confidence that the modelled flows match the observed flows along the proposed scheme route.

Plate 7-2 A12 northbound mainline flows – all vehicles

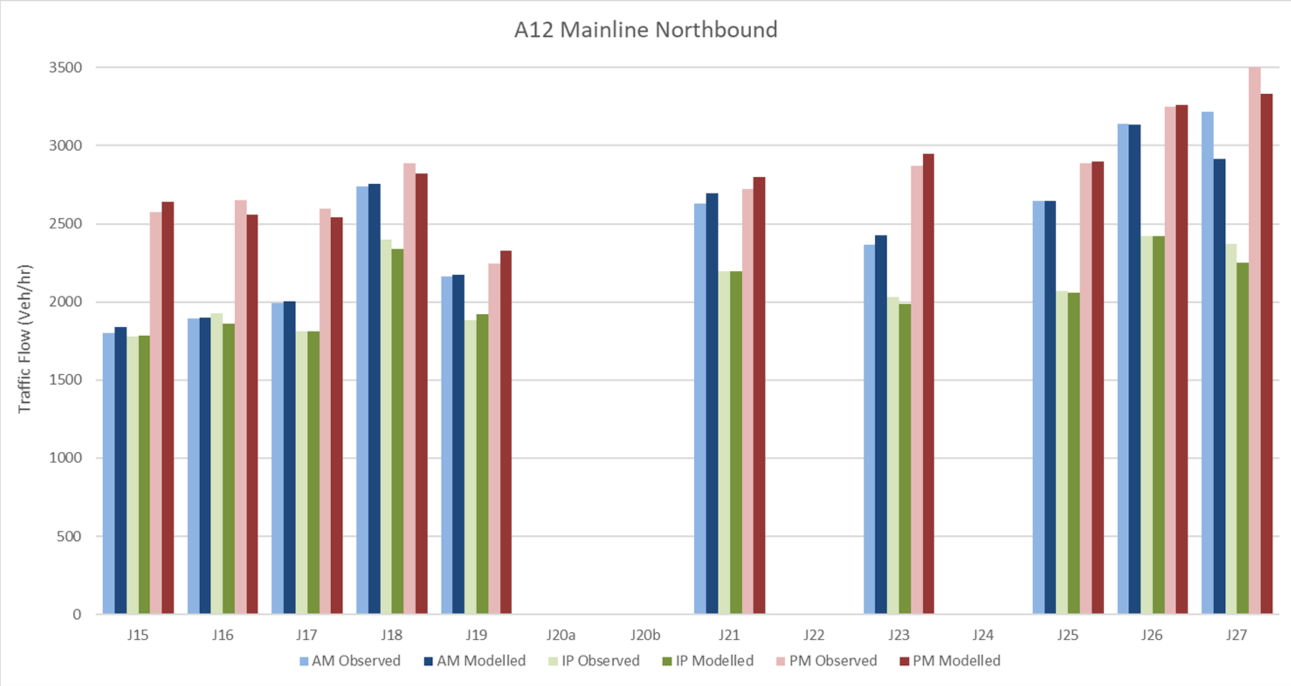
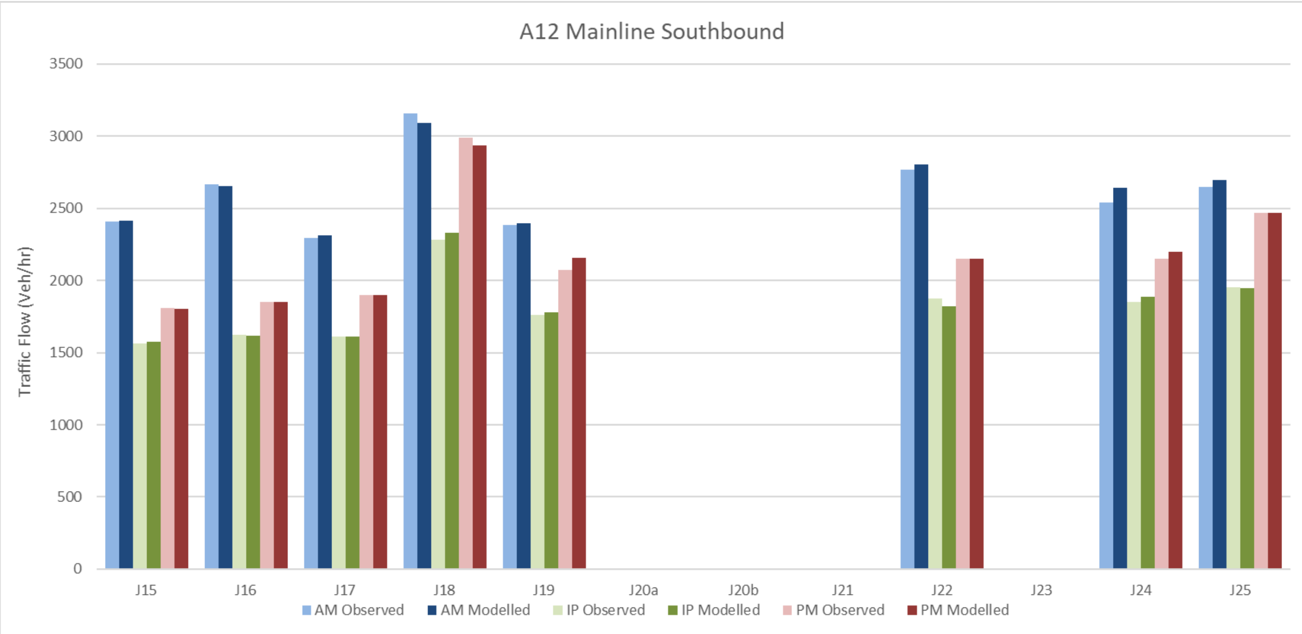


Plate 7-3 A12 southbound mainline flows – all vehicles



Journey time validation

7.5.10 Modelled journey time routes have been validated against observed journey times on specified routes. The location of these routes is provided in Plate 5-2.

7.5.11 TAG criteria specifies that modelled journey times should be within 15% of the mean observed journey time (or within 1 minute, if higher). The TAG acceptability guideline states that these criteria should be attained on more than 85% of routes. In the A12 model, 89% pass in the AM peak, 97% pass in the IP and 87% pass in the PM peak. Of particular importance for this study is the A12 route junction19 to junction 25 which validates to the observed journey time data for all time periods and in both directions.

7.6 VDM calibration

7.6.1 TAG guidance prescribes that where variable demand is assessed, realism tests should be carried out on the base year model to ensure that it behaves realistically to changes in travel costs and time, and the overall model response conforms to general guidelines.

7.6.2 Realism tests have been undertaken and demonstrate that the parameters used within the model are acceptable. The variable demand model was shown to be acceptable to be used as part of forecasting for the A12 model.

7.6.3 The DIADEM variable demand model is an iterative process, where highway demand matrices and travel costs are allowed to change at each iteration until convergence is reached. As with the highway assignment model, it must be shown that the model converged adequately. In assessing the outputs of the model runs, the main parameter of importance is the ‘relative gap’, which is the measure of convergence between demand and supply. TAG guidance recommends a relative gap of at least 0.2%. The base year realism testing models and the forecast models all converged to less than 0.2% within 10 iterations, which shows that the traffic model is stable and has converged to an acceptable standard.

8 Forecast assumptions

8.1 Overview

8.1.1 To understand the impact of the proposed scheme when it opens, we firstly need to understand how the background traffic conditions will change in the future. This chapter of the report describes how we use our traffic model to make these future traffic predictions.

8.1.2 Full details of the forecast model development process are provided in the Transport Forecasting Package found in Appendix C.

8.2 Modelled forecast years

8.2.1 Building on the previous Chapters 4, 5 and 6 which discuss modelling the traffic conditions as they were in 2019, we have also predicted future traffic conditions in the following three years:

- 2027, when the proposed scheme is expected to open
- 2042, which is fifteen years after opening
- 2051, which is the final year for which DfT has published traffic growth forecasts from its National Transport Model (NTM)

8.3 Predicting the growth in traffic

8.3.1 The overall level of growth in car trips from 2019 to the three future year scenarios is taken from the most recent DfT National Trip End Model (NTEM) forecasts, published in March 2017.

8.3.2 These forecasts are based on estimates from the Office for National Statistics (ONS) on the number of people living in each area. The number of car trips made per person varies according to factors such as age, employment status, car ownership and household size. This is then applied to the number of people forecast in the future for these categories. This produces a forecast of the future number of car trips.

8.3.3 The growth in the number of trips made by vans and HGVs is taken from DfT Road Traffic Forecasts, last published in 2018 (RTF18).

8.4 Local developments

8.4.1 Adjustments to the location of future car trips are also made by including certain planned housing developments, and other developments such as employment, retail and leisure sites. A list of these developments was produced through discussions with local planning authorities in Braintree, Chelmsford, Colchester, Maldon and Tendring.

8.4.2 For the main traffic forecasts used to inform the highway design and economic and environmental appraisals, known as the ‘core scenario’, only developments with planning permission (or for which planning applications have either been submitted or are expected to be submitted imminently) are specifically included in the traffic model. In addition, only developments over a certain size threshold are specifically included in the traffic model (because, for example, a development with 250 houses will have more of an impact on the road network than a single house extension or single storey development).

8.4.3 Any developments which are not specifically modelled are instead accounted for by general background traffic applied at a local authority level. In order to ensure that there is not too much traffic created on the network, the overall level of growth has been constrained to total local authority growth estimates from the NTEM.

8.5 Taking account of future changes in the road network

8.5.1 The road network in the transport model has also been updated to include road schemes that are likely to be built, regardless of whether the proposed scheme is built or not. This includes, for example, the Chelmsford North East Bypass which has not yet been built but has planning approval.

8.5.2 Road schemes which are considered not certain enough have been excluded. For example, the proposed A120 Braintree to A12 improvement scheme has not been included as it is not committed within a published government funding document. Road schemes which are considered too far away to affect the proposed scheme have also been excluded. For example, the proposed Lower Thames Crossing (LTC) has been excluded as the A12 is unlikely to carry significant volumes of the traffic that is expected to use the LTC.

8.6 Different model scenarios: with and without the scheme

8.6.1 We have produced traffic models to predict traffic conditions for two different scenarios:

- A future scenario where the proposed scheme is not built. This is referred to as the Do Minimum (DM) scenario.
- A future scenario where the proposed scheme is built. This is referred to as the Do Something (DS) scenario.

8.6.2 These models are used to predict changes in the time and cost of journeys if the proposed scheme is built, compared to the Do Minimum scenario. This includes traffic which does not use the A12 improvements itself but whose journey times are affected by changes in traffic patterns as a result of the proposed scheme. This could mean trips on minor roads having a faster journey time, due to less congestion from traffic that has now switched to the newly improved A12 road.

8.6.3 The model also predicts how people will react to these changes in the time and cost of their journeys. The possible changes include how often they make the same trip, a change in the time of day they travel, a switch to or from public transport, where they travel to and from or what route they choose to take.

8.6.4 The traffic model shows how many vehicles are expected to use each part of the road network, and the speeds they travel at. For some processes traffic data is required for time periods other than those represented directly by the traffic model. AADT flows are used for air quality assessment purposes, while noise assessment requires 18hr Annual Average Weekday Traffic (AAWT) flow and also evening and night-time volumes. Traffic flows for these purposes have been calculated by applying expansion factors to the traffic model flows. Full details are provided in the Transport Forecasting Package provided in Appendix C.

8.6.5 The traffic model is also used to measure the performance of the road network and to provide details on the location and level of congestion, the likelihood of accidents and changes in journey time reliability (not the length of journey time, but the consistency of the journey time remaining the same from day to day).

8.6.6 A summary of what the future year models predict is provided in Chapter 9.

9 Forecast results

9.1 Overview

9.1.1 The results of the future year models are described in this chapter. This includes the impacts of variable demand modelling, i.e. how people change their trip-making patterns in response to future congestion or to the A12 improvements themselves.

9.1.2 Full details of the forecast model results are provided in the Transport Forecasting Package found in Appendix C.

9.2 Flow changes due to the scheme

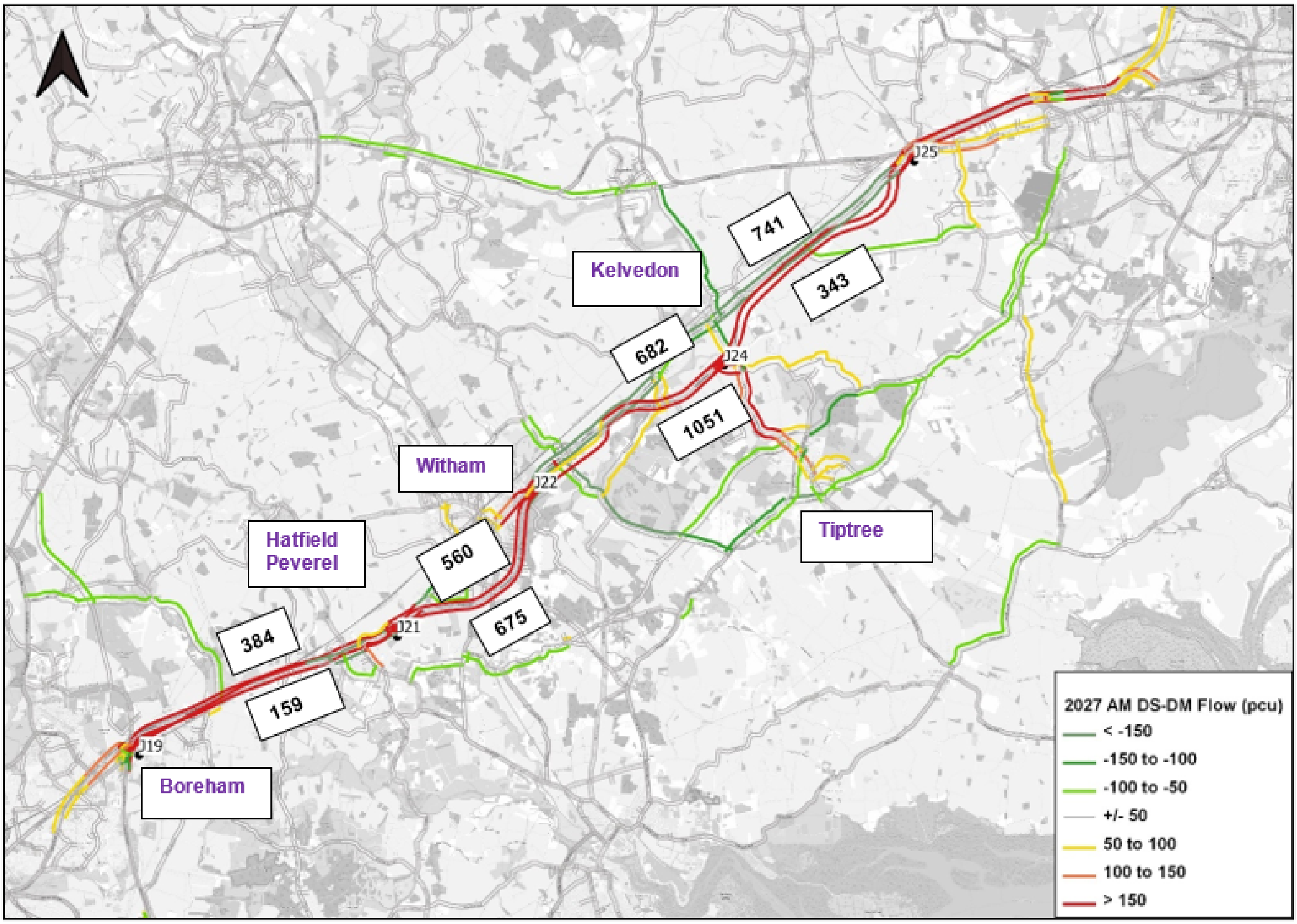
9.2.1 Between the base year and future years, traffic is predicted to increase (apart from places which are relieved by future planned schemes such as the Chelmsford North East Bypass). This would increase congestion and journey times throughout the study area in the DM (without scheme) scenario.

9.2.2 The proposed scheme would have the following impacts on the A12 itself when compared to the DM scenario:

- Traffic would reduce significantly on the two sections of the existing A12 that are bypassed as part of the proposed scheme (Rivenhall End and between junctions 24 and 25).
- Traffic levels would increase on the A12 between junctions 19 and 25, as well as on the sections of the A12 on either side of the proposed scheme. Because the A12 would see such an improvement in journey times and reliability, traffic would re-route onto the A12 away from other less suitable routes.

9.2.3 Table 4-5 provided a table of future A12 traffic flows, with and without the proposed scheme. A visual summary of the wider flow changes due to the proposed scheme in the 2027 AM peak hour is shown in Plate 9-1. The changes in flow are only shown on the links which are consistent between the DM and DS scenarios, therefore flow differences on the A12 itself where the proposed scheme changes from the DM are not always shown. Increases in traffic greater than 150 PCUs (Passenger Car Units – i.e. one car = 1 PCU, HGVS = 2.5 PCUs) per hour along the proposed scheme route are labelled.

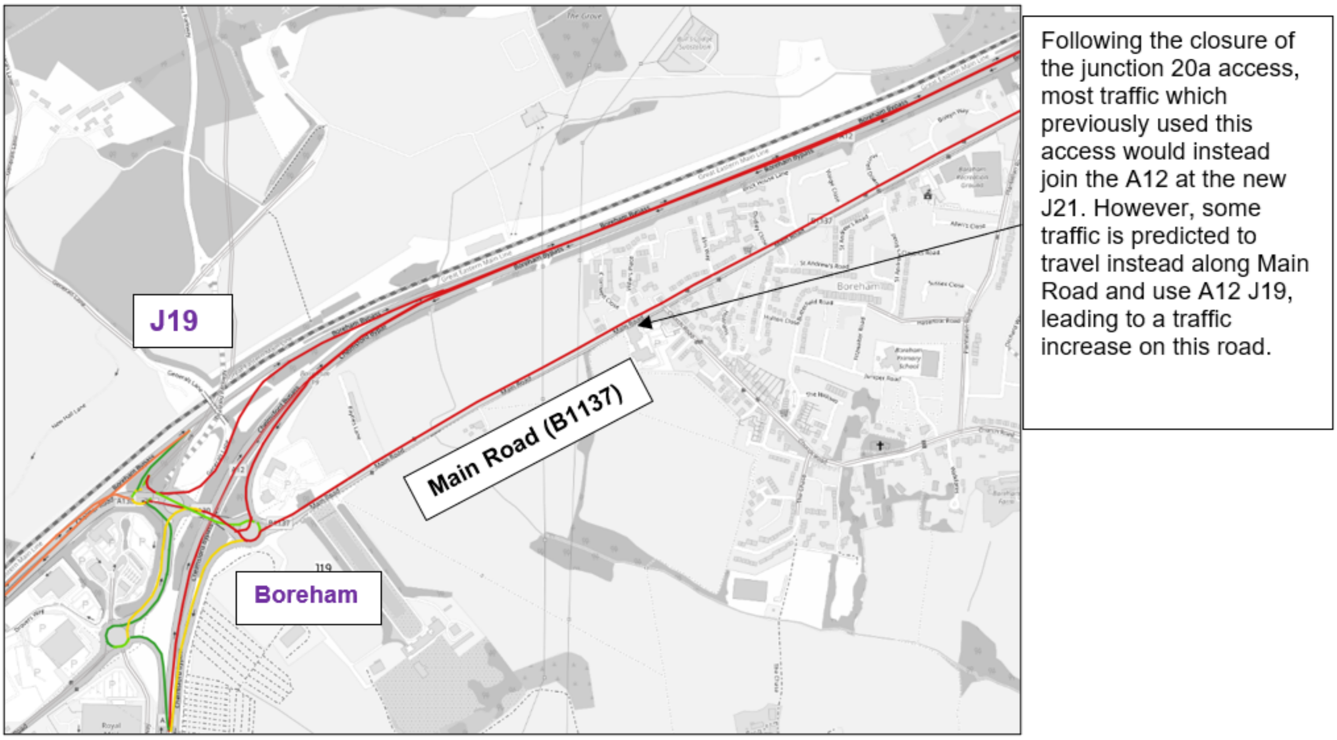
Plate 9-1 Traffic flow change Do Something vs Do Minimum (2027 AM)

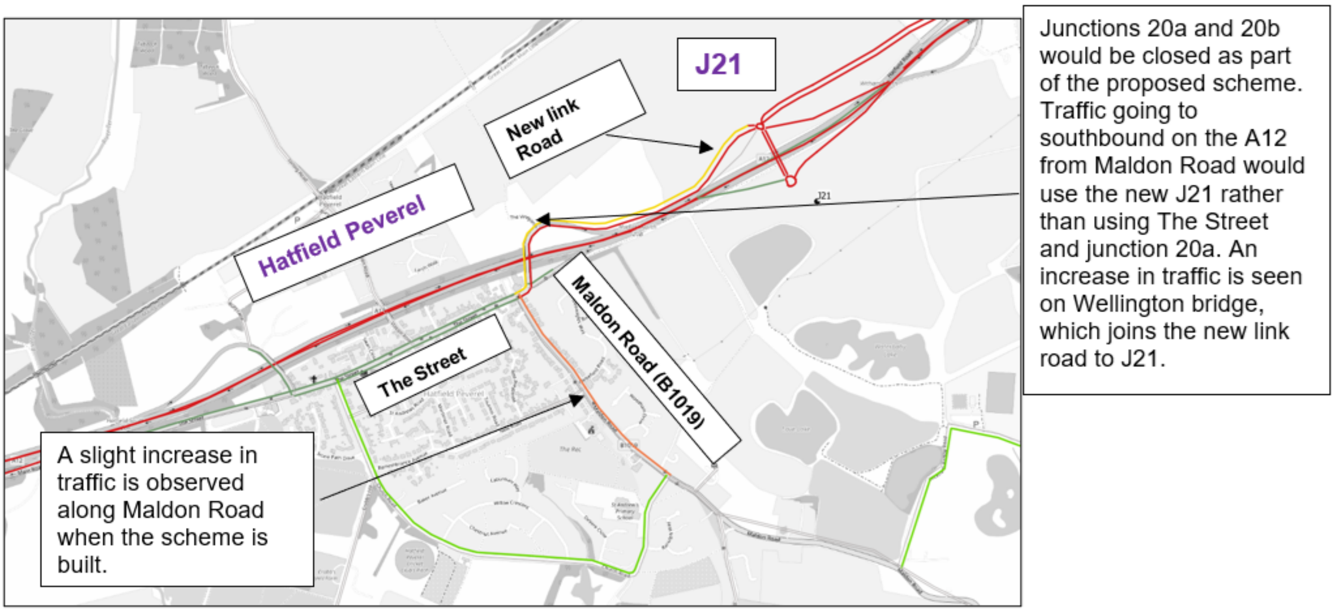


9.2.4 Plate 9-2 and Plate 9-3 show these local road flow changes in more detail.

9.2.5 Further information on the proposed scheme’s impact on the local road network is provided in the scheme’s Transport Assessment report [TR010060/APP/7.2].

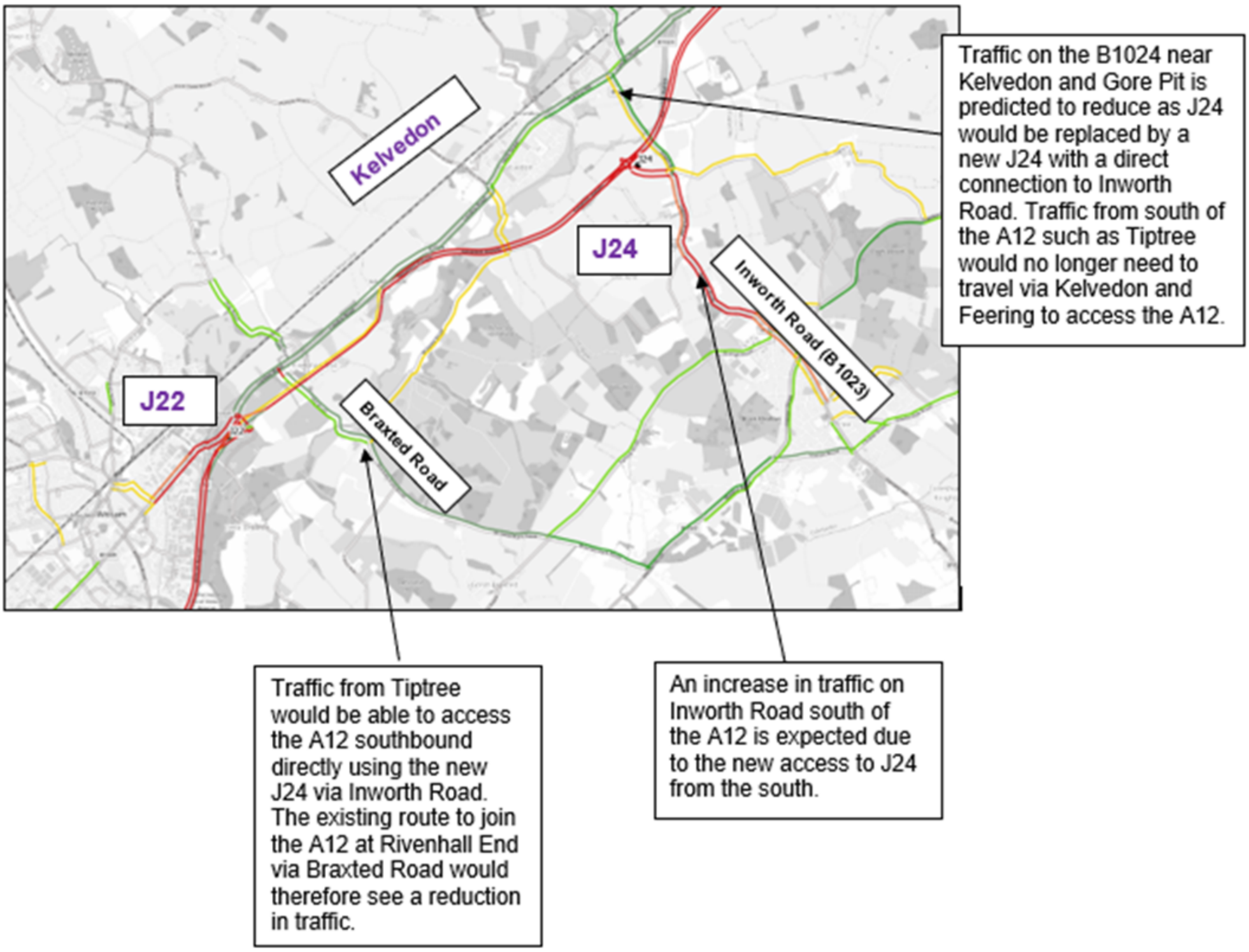
Plate 9-2 Detailed flow change Do Something vs Do Minimum (2027 AM) – junctions 19 to 21





Key = as provided in Plate 9-1

Plate 9-3 Detailed flow change Do Something vs Do Minimum (2027 AM) – junctions 22 to 25



Key = as provided in Plate 9-1

9.3 Journey time changes due to the scheme

9.3.1 Table 9-1 shows the impact of the proposed scheme on journey times along the proposed scheme route between A12 junctions 19 and 25. Journey times are measured between the following points:

- Northbound: junction 19 offslip to junction 25 onslip
- Southbound: junction 25 onslip to junction 19 onslip

9.3.2 As expected, there is a decrease in journey time along the A12 due to the proposed scheme. This is due to the increase in capacity along the A12 which reduces delay.

9.3.3 The biggest journey time savings due to the proposed scheme are for northbound trips in the PM, and for southbound trips in the AM. These are where there are the largest delays in the Do Minimum scenario (i.e. if the scheme was not built).

Table 9-1 Journey time changes Do Something vs Do Minimum (mm:ss)

Whole A12 route	2027 without scheme	2027 with scheme	2027 change due to scheme	2042 without scheme	2042 with scheme	2042 change due to scheme
NB AM	18:40	14:48	**-03:53**	21:36	15:55	**-05:41**
NB IP	16:29	14:01	**-02:28**	18:21	14:46	**-03:36**
NB PM	24:44	16:41	**-08:02**	27:44	18:07	**-09:37**
SB AM	19:59	14:43	**-05:16**	22:22	15:36	**-06:46**
SB IP	15:35	13:04	**-02:31**	17:58	13:54	**-04:04**
SB PM	16:53	13:39	**-03:13**	19:58	14:50	**-05:08**

9.4 Operational modelling

9.4.1 Operational modelling of key junctions has been undertaken. This includes junctions constructed or improved as part of the proposed scheme, as well as other junctions identified as being affected by changes in traffic flows. The modelling has been undertaken in either Vissim, LinSig or Junctions 9 software, depending on the junction type. The results of this assessment are presented in the Transport Assessment report [TR010060/APP/7.2].

10 Economic appraisal approach

10.1 Overview

10.1.1 Economic appraisal has taken place to understand the impact of the proposed scheme, to help determine whether the scheme is likely to be value for money. The economic assessment is based on information extracted from the traffic models.

10.1.2 Full details of the forecast model development process are provided in the Economic Appraisal Package found in Appendix D.

10.2 Economic impacts assessed

10.2.1 The economic assessment of the proposed scheme included consideration of the following impacts:

- **Transport Economic Efficiency (TEE) benefits**, consisting of two elements: travel time and Vehicle Operating Cost (VOC) benefits and disbenefits (predicted using Transport Users Benefit Appraisal (TUBA) software); and travel time and VOC disbenefits as a result of construction and maintenance activities (predicted using QUADRO software).
- Changes in **Indirect Taxes** (predicted using TUBA software).
- The impacts of the proposed scheme on **Accidents** (predicted using COBA-LT software).
- The **Environmental Impacts** (predicted using a standard TAG calculation approach): noise, air quality, greenhouse gases.
- The **Wider Impacts** of the proposed scheme (predicted using Wider Impacts in Transport Appraisal (WITA) software).
- The impacts of the proposed scheme on **Journey Time Reliability** (predicted using Motorway Reliability Incidents and Delays (MyRIAD) software).
- The **Costs** of the proposed scheme, consisting of construction, land and compensation, preparation and supervision costs, and changes to future maintenance costs.

10.2.2 Further information and full details on the methodology of each aspect of the economic assessment can be found in the Economic Appraisal Package in Appendix D. A summary of the results is provided in Chapter 11.

11 Economic appraisal results

11.1 Overview

11.1.1 This chapter summarises the results of the economic appraisal.

11.1.2 Full details of the economic assessment results are provided in the Economic Appraisal Package found in Appendix D.

11.2 Transport economic efficiency – travel time and vehicle operating costs

11.2.1 The proposed scheme provides significant travel time benefits. The total travel time benefits are presented in Table 11-1.

Table 11-1 Summary of travel time benefits in 2010 prices discounted to 2010 (£000s)

Benefits and Costs	Benefits (£000s)
Travel time benefits	£523,670

11.2.2 Analysis of the travel time benefits by time period is shown in Table 11-2.

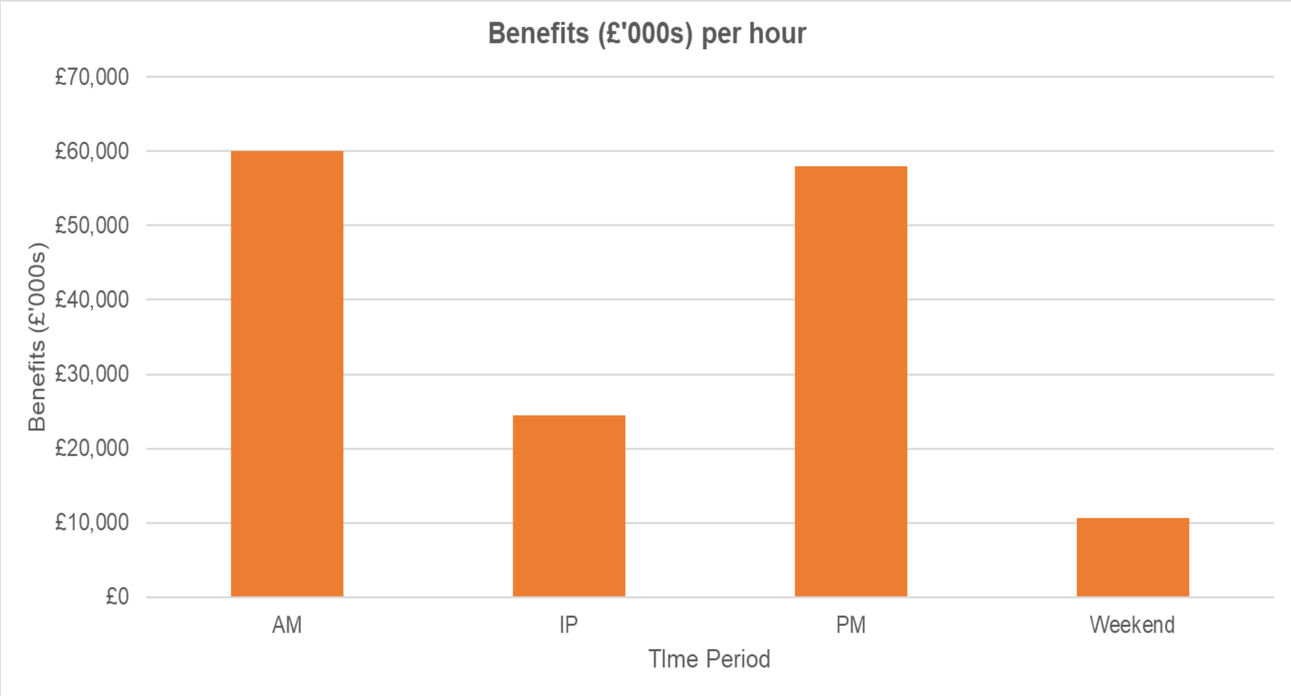
Table 11-2 Profile of travel time benefits in 2010 prices discounted to 2010 (£000s)

Period	Time period			
	AM	IP	PM	Weekend
60 years	£149,954	£146,859	£130,603	£96,254
% of total	29%	28%	25%	18%

11.2.3 The IP benefits are similar to those for the AM and PM peak. This is due to the significantly higher annualisation factors for the IP (i.e. it occurs for a longer period each day). The ‘benefits per hour’ are shown in Plate 11-1. This shows that the level of benefits during the AM and PM peak hours are considerably higher than during the IP. This reflects the fact that the proposed scheme provides the most benefits during periods of heavy congestion.

11.2.4 Weekend benefits per hour are lower than the IP, even though they are based on the same demand, time and distance skims from the traffic model. This is because the weekend demand was adjusted to have a lower proportion of business and commuter trips (which have higher values of time than leisure trips).

Plate 11-1 Travel time benefits per hour



11.2.5 Analysis of the travel time benefits by trip purpose shown in Table 11-3 indicates that the largest proportion of benefits come from business trips, while commute trip purposes account for the lowest proportion of benefits. This reflects the higher values of time for business trips compared to other trip purposes.

Table 11-3 Profile of travel time benefits by journey purpose in 2010 prices discounted to 2010 (£000s)

Period	Purpose		
	Business	Commute	Other
60 years	£238,828	£115,778	£169,064
% of total	46%	22%	32%

The proposed scheme is also expected to result in an increase in VOCs, resulting in a disbenefit to users. These results are shown in Table 11-4.

Table 11-4 Changes in vehicle operating costs in 2010 prices discounted to 2010 (£000s)

Vehicle operating costs	Benefits (£000s)
Fuel VOC	−£8,051
Non-fuel VOC	−£49,888
Total VOC	−£57,939

11.3 Transport economic efficiency – delays during construction

11.3.1 The impact of additional road user delays during construction has been assessed using both QUADRO and the SATURN model/TUBA.

11.3.2 Results for the total construction delay disbenefits are summarised in Table 11-5.

Table 11-5 Construction delays in 2010 prices discounted to 2010 (£000s)

Assessment	Total disbenefits (£000s)
Construction delay total	−£60,857

11.4 Transport economic efficiency – delays during maintenance

11.4.1 The proposed scheme will result in a change in the amount of road user delays during road maintenance. The maintenance delay results for the DM and DS scenarios are shown in Table 11-6. This table also shows the resultant maintenance benefit that the DS scenario provides over the DM.

Table 11-6 Maintenance benefits in 2010 prices discounted to 2010 (£000s)

	Maintenance delay cost	Maintenance benefit of scheme compared to Do Minimum
Do Minimum	£81,111	–
Do Something	£51,149	£29,962

11.4.2 The DS scenario provides a benefit over the DM. This reflects the ‘maintenance holiday’ once the proposed scheme is newly built, and the additional traffic management flexibility offered by an extra lane.

11.5 Transport Economic Efficiency table

11.5.1 The TEE benefits described above are reported in a standard table known as the TEE table. A summary of this table is presented in Table 11-7.

Table 11-7 Summary TEE table, 2010 prices discounted to 2010 (£000s)

User benefits	
Non-business commuting	
Travel time	£115,778
VOCs	−£31,030
User charges	£0
During construction and maintenance	−£6,443
NET NON-BUSINESS BENEFITS: COMMUTING	**£78,305**
Non-business (other)	
Travel time	£169,064
VOCs	−£37,269
User charges	£0
During construction and maintenance	−£10,717
NET NON-BUSINESS BENEFITS: OTHER	**£121,078**
Business	
Travel time	£238,828
VOCs	£10,360
User charges	£0
During construction and maintenance	−£13,734
NET BUSINESS BENEFITS IMPACT	**£235,454**
Present value of TEE benefits	**£434,836**

11.6 Indirect tax

11.6.1 There is likely to be an increase in indirect tax revenues as vehicles travel faster with the proposed scheme in place. The monetary impact is shown in Table 11-8.

Table 11-8 Indirect tax revenues in 2010 prices discounted to 2010 (£000s)

	Benefits (£000s)
Indirect tax	£29,140

11.7 Greenhouse gas, noise and air quality

11.7.1 Greenhouse gas emissions, air quality and noise benefits are derived by using standard TAG environmental spreadsheets.

11.7.2 The results output from the greenhouse gas emissions spreadsheet for the study area predict an increase in carbon dioxide emissions, giving a monetary disbenefit of −£113.4 million. The change in emissions was calculated using Defra's Emission Factors Toolkit (v11).

11.7.3 The results from the air quality spreadsheet predict a disbenefit due to increases in PM_{10} (Particulate Matter < 10μm) and NO_x emissions, due to changes in traffic flows, distances and speeds once the proposed scheme is in place. The total value of the change in air quality is a disbenefit of −£16.3 million over 60 years.

11.7.4 The results output from the noise spreadsheet show that there is predicted to be a disbenefit from an increase in noise levels, equating to −£6.6 million over 60 years.

11.8 Accident impact

11.8.1 An assessment was made of the numbers of accidents and their associated costs, for the situations both with and without the proposed scheme. The total change in the number of accidents due to the proposed scheme is shown in Table 11-9. This shows there would be an increase in the total number of accidents with the scheme in place.

Table 11-9 Accident changes due to the scheme

Change in the number of accidents (PIAs) due to the scheme
+262

11.8.2 The proposed scheme's impact on the number of casualties over the 60-year appraisal period, split by severity, is shown in Table 11-10. This shows there is predicted to be a decrease in the number of fatal and serious casualties, but an increase in the number of slight casualties.

Table 11-10 Casualty changes due to the scheme

Severity	Predicted change in the number of casualties
Fatal	−2
Serious	−200
Slight	+496

11.8.3 Table 11-11 shows the change in the monetary cost of accidents over the 60-year assessment period.

Table 11-11 Monetary benefits due to accident savings in 2010 prices discounted to 2010 (£000s)

Section	Benefits (£000s)
Links – A12 J19–J25	£1,983
Links – A12 J15–J19 and J25–J28	−£2,862
Links – wider study area	£18,324
All links	**£17,445**
All junctions	**−£4,355**
Total	**£13,090**

11.8.4 The reduction in fatal and serious numbers of casualties brought about by the proposed scheme results in an overall monetary benefit of £13.1 million. On the A12 links between junctions 19 and 25, there is an overall benefit. Despite the increase in traffic on the A12, an improvement in accident rate leads to this benefit.

11.8.5 On the A12 outside of junctions 19–25, there is a disbenefit. This is because the amount of traffic increases, while accident rates remain unchanged. This results in more accidents.

11.8.6 On the wider non-A12 links in the network, there is an accident benefit as traffic reduces on those links and starts to use the improved A12 instead.

11.8.7 The impact on junctions is negative overall. This is primarily due to the introduction of new junctions.

11.9 Analysis of monetised costs and benefits table

11.9.1 Many of the economic analysis results for the proposed scheme are incorporated into the standard Analysis of Monetised Costs and Benefits (AMCB) table. This table is summarised in Table 11-12. All values are provided in 2010 prices, discounted to 2010.

Table 11-12 AMCB table in 2010 prices discounted to 2010 (£000s)

AMCB	Scheme
Noise	−£6,550
Local air quality	−£16,325
Greenhouse gases	−£113,418
Journey quality	–
Accidents	£13,090
Economic efficiency: consumer users (commuting)	£78,305
Economic efficiency: consumer users (other)	£121,078
Economic efficiency: business users and providers	£235,454
Wider public finances (indirect taxation revenues)	£29,140
Initial Present Value of Benefits (PVB)	**£340,773**
Broad transport budget	£452,122
Present Value of Costs (PVC)	£452,122
Initial Net Present Value (NPV)	−£111,349
Initial Benefit to Cost Ratio (BCR)	**0.8**

11.10 Journey time reliability

11.10.1 MyRIAD was used to assess the impact of the proposed scheme on journey time reliability. The results for the core scenario are provided in Table 11-13. The results are disaggregated by the benefits derived from changes in incident delay benefit and those from changes in travel time variability. The results represent monetary benefits over 60 years, and are provided in 2010 prices, discounted to 2010.

Table 11-13 Journey time reliability benefits in 2010 prices, discounted to 2010 (£000s)

Benefit Type	Benefits (£000s)
Incident delay benefit, MyRIAD links	£87,927
Incident delay benefit-diversion area	£22,630
Travel time variability	£70,190
Total	**£180,747**

11.10.2 The results show that the reduction in congestion caused by the proposed scheme will lead to reduced day to day variability in travel times, thus generating economic benefit. The proposed scheme will also lead to a reduction in incident delays, as a greater number of lanes and greater technology means delays are shorter when incidents do occur. Benefits are also predicted to occur on routes that are used as diversions when incidents do occur.

11.10.3 The Journey Time Reliability results are not included within the initial BCR or the AMCB tables. The results are however included within the overall Value for Money assessment and are reported in the Appraisal Summary Table (AST) found in Appendix E.

11.11 Wider impacts

11.11.1 A summary of the results for each Wider Impact is provided in Table 11-14. The agglomeration benefits are split by the various employment sectors.

Table 11-14 Wider impact summary, benefits over 60-year appraisal period, in 2010 prices discounted to 2010 (£000s)

Wider economic impact	Benefits (£000s)
Agglomeration – manufacturing	£12,937
Agglomeration – construction	£24,027
Agglomeration – consumer services	£64,995
Agglomeration – producer services	£114,262
Total agglomeration ('static clustering')	**£216,222**
Labour supply impacts	£6,257
Increased business output (output change in imperfectly competitive markets)	£31,438
Total wider impact benefits	**£253,917**

11.11.2 In line with guidance, it can be seen that the agglomeration results are by far the largest source of wider impact benefit.

11.11.3 The majority of agglomeration benefits accrue to the Producer Services employment sector. This reflects the higher agglomeration elasticity value for Producer Services, i.e. it is more sensitive than other employment sectors to changes in agglomeration.

11.11.4 The WITA results are at the top end of the typically expected range. However, the proposed scheme's economic narrative has provided context-specific evidence which suggests that benefits from wider impacts such as agglomeration would be material. Overall, it is considered that the scale of benefits is plausible given the spatial distribution of benefits and the robustness of the model used.

11.11.5 The A12 improves journey times between two major conurbations of Chelmsford and Colchester, each of which are listed as DfT core Functional Urban Regions. The area around Chelmsford is also part of the wider London Functional Urban Region hinterland. The proposed scheme delivers major journey time savings, with up to seven minutes southbound in the AM and ten minutes northbound in the PM being saved by 2042.

11.11.6 Benefits to other areas may be driven by improved connectivity to London. However, this is to be expected as their geographic locations are such that they are within the journey time limits at which agglomeration benefits typically disappear

11.11.7 The Wider Impact benefits are not included within the initial BCR or the AMCB tables. The results are however included within the overall Value for Money assessment and are reported in the AST.

11.12 Adjusted benefit to cost ratio

11.12.1 This chapter of the report has so far presented the results of the economic appraisal undertaken for the proposed scheme.

11.12.2 The AMCB table showed the Initial BCR is 0.8. Table 11-15 shows an Adjusted BCR of 1.7 which takes into account Journey Time Reliability benefits and Wider Impacts.

Table 11-15 Adjusted BCR and overall PVBs in 2010 prices, discounted to 2010 (£000s)

	Benefits (£000s)
Initial PVB	**£340,773**
PVC	£452,122
Initial BCR	**0.8**
Wider Impacts (WI)	£253,917
Journey Time Reliability Benefits (JTR)	£180,747
Adjusted PVB	**£775,438**
Adjusted BCR including JTR and WI	**1.7**

11.13 Non-monetised benefits

Some economic impacts of the proposed scheme are unable to be monetised. This includes several social and environmental impacts. Non-monetised assessments of these impacts have been undertaken and are summarised in Table 11-16. Further details are provided in the Appraisal Summary Table and Worksheets found in Appendix E.

Table 11-16 Non-monetised benefit assessment

Impact	Score	Key information
Landscape	Moderate adverse	The proposed scheme would be set within the context of the existing A12. However, the proposed scheme would exacerbate the extent of highway infrastructure within the landscape and erode the rural character and sense of tranquillity, particularly where offline bypasses and major new junctions 21, 22 and 24 would encroach on the landscape surrounding the A12. Raised structures would present conspicuous elements that would be at odds within the low-lying landscape, particularly within valleys. Vegetation loss along online sections to accommodate widening would exacerbate views of traffic flow and highway infrastructure. Proposed planting would established to reduce landscape and visual effects.
Historic environment	Moderate adverse	Offline sections of the proposed scheme would remove non-designated archaeological remains identified as cropmarks, geophysical anomalies and features recorded during trial trenching. A programme of archaeological mitigation involving a programme of archaeological excavation and dissemination of the results is proposed to mitigate this impact. No designated cultural heritage assets lie within the footprint of the proposed scheme, and mitigation for impacts on the setting of those affected has been proposed.
Biodiversity	Very large adverse	Despite the impacts to ancient woodland and veteran trees, the proposed scheme would provide a benefit to biodiversity due to the net gain of habitats. Impacts to Perry's Woodland AW would be offset through woodland creation, and albeit this site is assessed as being of National value in line with DMRB guidance, the condition of the woodland is suboptimal. Similarly impacts to veteran trees are assessed as 'very large adverse' and albeit the diversity of nitrogen sensitive lichens they support could be reduced, the actual trees would be largely unaffected.
Water environment	Neutral	The significance of effect for the water environment varies between Low Significance and Insignificant. The overall Assessment Score has been assessed as neutral.
Physical activity	Neutral	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 proposed scheme is therefore expected to have minimal impact on physical activity.
Journey quality	Large beneficial	Improved journey quality due to a reduction in frustration from congestion and unreliability, more consistent junction layouts, and improved signing and other traveller information (e.g. Variable Message Signs). Existing issues with road surfacing, flooding and potholes will also be resolved as part of the scheme.
Security	Slight beneficial	The proposed scheme would offer slight improvements in security compared to the existing situation. CCTV, Stopped Vehicle Detection and emergency call facilities will be introduced, while limiting the access points to the A12 carriageway reduces the potential for disruption from

Impact	Score	Key information
		unauthorised access. Moving bus stops away from high-speed heavily trafficked routes may offer security benefits by improving car drivers' awareness of bus stop users.
Access to services	Neutral	The scheme is not expected to affect accessibility to transport services, outside the improvements to journey times.
Severance	Moderate beneficial	Impact of severance for pedestrians is improved with the inclusion of improved crossing facilities. Some communities experience a decrease in traffic flows while others experience increases. Grade-separated crossing points replace current at-grade points; this will provide better and safer access for users as they will no longer be required to wait for traffic to cross along the carriageway.
Options and non-use values	Neutral	The proposed scheme does not substantially change the availability of transport services within the study area.

11.14 Distributional impacts

11.14.1 Details on how the scheme's impacts are distributed across different income groups and vulnerable groups are summarised in Table 11-17 and Table 11-18. Further information is provided in the Distributional Impacts report found in Appendix F.

Table 11-17 Distributional impacts – impacts across income groups

	Distributional impact of income deprivation					Are the impacts distributed evenly?	Key impacts – qualitative statements	Overall assessment for comparison
	← Most deprived			Least deprived →				
	1 (0%–20%)	2 (20%–40%)	3 (40%–60%)	4 (60%–80%)	5 (80%–100%)			
User benefits	✓✓	✓✓	✓✓	✓✓✓	✓✓	No	Beneficial impacts are forecast for all income groups.	Beneficial. Monetised in TUBA as £121.8 million
Noise		×××	×××	××	×	No	The scheme results in noise disbenefit to all income quintiles. There are no receptors in the most deprived income quintile, however, the next two most deprived income quintiles both receive a greater disbenefit than their share of total population.	Adverse. Monetised as −£6.6 million
Air quality NO_2		××	×	×××	××	No	The scheme results in air quality disbenefits across all income quintiles for NO_2 and all but the middle quintile for PM_{10}. The most negatively impacted quintile is the second to least deprived.	Adverse. Monetised as −£16.3 million
Air quality PM_{10}		××	✓✓✓	×××	××	No		
Affordability	××	××	×	×××	××	No	Adverse impacts are forecast for all income groups. There are large adverse impacts for income group four. The magnitude of the disbenefits is small and the lowest income group, which is sensitive to baseline cost of travel, is not impacted in that respect.	Adverse

Key: ✓ = slight beneficial, ✓✓ = moderate beneficial, ✓✓✓ = large beneficial

× = slight adverse, ×× = moderate adverse, ××× = large adverse

Table 11-18 Distributional impacts – impacts on vulnerable groups

Impact	AST entry										Qualitative statement (including any impact on residential population AND identified amenities)
	Social groups						User groups				
	Children & young people	Older people	Carers	Women	Disabled	BME	Pedestrians	Cyclists	Motorcyclists	Young male drivers	
Noise	Neutral	Neutral									Children and older people receive disbenefit in noise levels at home which is in line with the overall population. All school and care home receptors have negligible changes in noise.
Air quality NO_2	×										Children receive disbenefit in NO_2 levels at home in line with the overall population. One school and two nurseries receive a small increase in levels of NO_2.
Air quality PM_{10}	Neutral										Children receive disbenefit in PM_{10} levels at home in line with the overall population. No school or nursery receptors receive a perceptible change in levels of PM_{10}.
Accidents	Neutral	Neutral					Neutral	Neutral	Neutral	Neutral	No vulnerable group is expected to receive a particularly strong safety impact compared to the wider population.
Severance	✓✓	✓✓			✓✓						All vulnerable groups are expected to receive moderate reductions in severance, as they are particularly affected by the current uncontrolled crossings across the A12 which would be replaced with bridges designed to be accessible to vulnerable users.

12 Sensitivity tests

12.1 High and low growth

12.1.1 TAG recommends that, in addition to the core scenario, at least two sensitivity tests must be considered to investigate the impact of alternative predictions on the value for money of the proposed scheme. Low growth and high growth scenarios have therefore been developed. These reflect different predictions surrounding the national factors of demographic change (population and employment), GDP growth, fuel price trends and vehicle efficiency changes. These factors have been allowed for by adding (for high growth) or subtracting (for low growth) a variable proportion of the base year matrix from the forecast year matrix. The proportion for each modelled year was calculated using the following formula:

- High Growth Scenario, 2019 to 2027 = +2.5% x √(2027-2019) = +7.07%
- High Growth Scenario, 2019 to 2042 = +2.5% x √(2042-2019) = +11.99%
- High Growth Scenario, 2019 to 2051 = +2.5% x √(2051-2019) = +14.14%

12.1.2 For the high growth scenario, local demand related factors were also adjusted. The uncertainty threshold was lowered so that all the Reasonably Foreseeable developments from the Uncertainty Log were included in addition to the Near Certain and More Than Likely developments already present in the core scenario. For the low growth scenario, the local demand assumptions were the same as in the core scenario.

12.1.3 The matrices were then assigned to the network following the same process as that for the Core Scenario, including Variable Demand.

12.1.4 The model results for the high growth test showed that traffic is higher on the A12 compared to the core scenario, especially in the IP. This is because IP has less demand and delay on the A12 and therefore is able to accommodate more traffic when demand is higher in the high growth scenario. Some of the local roads around the A12 also show increases due to the A12 traffic increase.

12.1.5 In the low growth scenario, traffic is generally lower than in the core scenario.

12.1.6 In terms of journey times, the journey time savings offered by the proposed scheme are higher in the high growth scenario than the core. This is because, although journeys using the proposed scheme would be slower in the high growth scenario, the predicted congestion if the proposed scheme is not built is greater still.

12.1.7 Conversely, the journey time savings are lower in the low growth scenario. This is because delays if the proposed scheme is not built are not as high as in the core scenario.

12.1.8 Economic assessment was undertaken using these low and high growth traffic models, with all other economic assumptions kept consistent. The results of these sensitivity tests are provided in Table 12-1, together with the core scenario results for comparison purposes. It can be seen that under the low growth scenario the proposed scheme's BCR would be lower, but under the high growth scenario the BCR would be higher.

Table 12-1 High and low growth scenario economic results (2010 prices, discounted to 2010)

	Low growth	Core scenario*	High growth
Adjusted PVB including JTR and WI	£641,864	£775,282	£995,791
Adjusted BCR including JTR and WI	1.4	1.7	2.2

** Core scenario results assumed to apply across all scenarios*

12.2 Greenhouse gas – Transport Decarbonisation Plan

12.2.1 A sensitivity test has been undertaken to test the impact that the Government's Transport Decarbonisation Plan (TDP) would have on the proposed scheme's greenhouse gas (GHG) emissions. This sensitivity test assumes a greater take-up of electric vehicles than the core assessment. The results of this test show that the proposed scheme would still increase greenhouse gas emissions, but to a much lower extent. It predicts that the proposed scheme would cause an increase of 292,376 tonnes of carbon dioxide emissions over 60 years, giving a monetary disbenefit of −£30.0 million.

12.2.2 Incorporating this result into the core scenario would give an increase in the total proposed scheme benefits and a resultant increase in the BCR, as shown in Table 12-2.

Table 12-2 Greenhouse gas – upper estimate carbon values economic results (2010 prices discounted to 2010)

	Core scenario	Core scenario with TDP assumptions for GHG
Adjusted PVB including JTR and WI	£775,282	£858,742
Adjusted BCR including JTR and WI	1.7	1.9

12.2.3 Further details of this sensitivity test are provided in the Economic Appraisal Package found in Appendix D.

13 Data annex

13.1 Overview

13.1.1 This data annex provides a summary of additional proposed scheme data.

13.2 Scheme costs

Table 13-1 Scheme investment cost profile in 2010 prices

Year	2010 Factor prices (not discounted)	2010 Market prices (discounted)
2022	£21,660,656	£17,058,246
2023	£27,599,015	£20,999,840
2024	£175,323,690	£128,891,022
2025	£164,982,023	£117,186,704
2026	£142,518,430	£97,807,553
2027	£118,164,282	£78,351,486
2028	£2,554,879	£1,636,783
2029	£1,576,728	£975,972
2030	£142,727	£85,358
2031	£71,363	£41,236
2032	£71,363	£39,841
2033	£71,363	£38,494

Table 13-2 Scheme Maintenance cost profile in 2010 prices

Year	2010 Factor prices (not discounted)	2010 Market prices (discounted)
2038	£4,449,223	£2,020,698
2042	£7,651,484	£3,028,318
2048	£5,637,159	£1,814,989
2049	£1,313,369	£408,564
2057	£11,281,696	£2,743,744
2058	£3,822,053	£902,462
2059	£2,139,759	£490,523
2067	£5,637,159	£1,020,134
2069	£1,313,369	£224,032
2072	£7,651,484	£1,194,419
2076	£3,822,053	£530,101
2079	£2,139,759	£271,591
2085	£5,637,159	£599,221
2086	£11,289,074	£1,165,059

** NB. Costs shown are road maintenance costs with the proposed scheme in place. As discussed in the Economic Appraisal Package, maintenance costs would also be incurred if the scheme is not built.*

13.3 Scheme benefits/disbenefits

Journey times

Table 13-3 Average journey times during construction period along route by phase (mm:ss)

Year	Phase 1			Phase 2			Phase 3		
		NB	SB		NB	SB		NB	SB
Without scheme	AM	13:33	14:47	AM	24:43	26:20	AM	20:07	21:49
	IP	11:34	10:56	IP	20:48	19:04	IP	16:30	15:51
	PM	16:49	11:53	PM	32:29	21:26	PM	24:01	17:50
		NB	SB		NB	SB		NB	SB
During scheme construction	AM	17:56	19:18	AM	30:16	32:09	AM	24:17	26:21
	IP	16:00	15:32	IP	27:12	25:20	IP	21:04	20:35
	PM	20:53	16:40	PM	37:27	27:53	PM	28:01	22:40

Phase 1 = J20A to J24, Phase 2 = J19 to J25, Phase 3 = J20A to J25.

Note that these are the three phases of long-term traffic management, with narrow lanes and reduced speed limits. It excludes weekend or night-time closures

Table 13-4 Average journey times along route (mm:ss)

			Opening year	Design year	Change (%)
NB	AM	Without scheme	18:40	21:36	16%
		With scheme	14:48	15:55	8%
	IP	Without scheme	16:29	18:21	11%
		With scheme	14:01	14:46	5%
	PM	Without scheme	24:44	27:44	12%
		With scheme	16:41	18:07	9%
SB	AM	Without scheme	19:59	22:22	12%
		With scheme	14:43	15:36	6%
	IP	Without scheme	15:35	17:58	15%
		With scheme	13:04	13:54	6%
	PM	Without scheme	16:53	19:58	18%
		With scheme	13:39	14:50	9%

Journey times measured between A12 junction 19 to junction 25

Safety

Table 13-5 Number of accidents per year

Year	Without scheme	With scheme	Difference
2027	359.5	361.8	+2.3
2028	355.2	357.6	+2.4
2029	350.9	353.4	+2.5
2030	350.3	353.0	+2.7
2031	349.9	352.6	+2.8
2032	349.4	352.3	+2.9
2033	348.9	351.9	+3.0
2034	348.4	351.5	+3.2
2035	347.8	351.1	+3.3
2036	347.3	350.7	+3.4
2037	346.7	350.2	+3.5
2038	346.1	349.8	+3.6
2039	345.5	349.3	+3.8
2040	348.4	352.3	+3.9
2041	351.3	355.4	+4.0
2042	354.3	358.4	+4.1
2043	355.9	360.1	+4.2
2044	357.6	361.9	+4.3
2045	359.2	363.6	+4.4
2046	360.9	365.3	+4.5
2047	362.5	367.0	+4.5
2048	364.1	368.8	+4.6
2049	365.8	370.5	+4.7
2050	367.4	372.2	+4.8
2051	369.1	373.9	+4.8
2052	369.1	373.9	+4.8
2053	369.1	373.9	+4.8
2054	369.1	373.9	+4.8
2055	369.1	373.9	+4.8
2056	369.1	373.9	+4.8
2057	369.1	373.9	+4.8
2058	369.1	373.9	+4.8
2059	369.1	373.9	+4.8
2060	369.1	373.9	+4.8
2061	369.1	373.9	+4.8
2062	369.1	373.9	+4.8
2063	369.1	373.9	+4.8
2064	369.1	373.9	+4.8
2065	369.1	373.9	+4.8
2066	369.1	373.9	+4.8
2067	369.1	373.9	+4.8
2068	369.1	373.9	+4.8

Year	Without scheme	With scheme	Difference
2069	369.1	373.9	+4.8
2070	369.1	373.9	+4.8
2071	369.1	373.9	+4.8
2072	369.1	373.9	+4.8
2073	369.1	373.9	+4.8
2074	369.1	373.9	+4.8
2075	369.1	373.9	+4.8
2076	369.1	373.9	+4.8
2077	369.1	373.9	+4.8
2078	369.1	373.9	+4.8
2079	369.1	373.9	+4.8
2080	369.1	373.9	+4.8
2081	369.1	373.9	+4.8
2082	369.1	373.9	+4.8
2083	369.1	373.9	+4.8
2084	369.1	373.9	+4.8
2085	369.1	373.9	+4.8
2086	369.1	373.9	+4.8
Total for all years	21,780.5	22,042.4	+261.9

Table 13-6 Number of fatal casualties by year

Year	Without scheme	With scheme	Difference
2027	5.5	5.4	-0.1
2028	5.4	5.3	-0.1
2029	5.3	5.2	-0.1
2030	5.3	5.2	-0.1
2031	5.3	5.2	-0.1
2032	5.3	5.2	-0.1
2033	5.3	5.2	-0.1
2034	5.2	5.2	-0.1
2035	5.2	5.2	-0.1
2036	5.2	5.2	-0.1
2037	5.2	5.1	-0.1
2038	5.2	5.1	-0.1
2039	5.2	5.1	-0.1
2040	5.2	5.2	0.0
2041	5.3	5.2	0.0
2042	5.3	5.2	0.0
2043	5.3	5.3	0.0
2044	5.3	5.3	0.0
2045	5.4	5.3	0.0
2046	5.4	5.3	0.0
2047	5.4	5.4	0.0
2048	5.4	5.4	0.0
2049	5.4	5.4	0.0
2050	5.5	5.4	0.0
2051	5.5	5.5	0.0
2052	5.5	5.5	0.0
2053	5.5	5.5	0.0
2054	5.5	5.5	0.0
2055	5.5	5.5	0.0
2056	5.5	5.5	0.0
2057	5.5	5.5	0.0
2058	5.5	5.5	0.0
2059	5.5	5.5	0.0
2060	5.5	5.5	0.0
2061	5.5	5.5	0.0
2062	5.5	5.5	0.0
2063	5.5	5.5	0.0
2064	5.5	5.5	0.0
2065	5.5	5.5	0.0
2066	5.5	5.5	0.0
2067	5.5	5.5	0.0
2068	5.5	5.5	0.0
2069	5.5	5.5	0.0
2070	5.5	5.5	0.0

Year	Without scheme	With scheme	Difference
2071	5.5	5.5	0.0
2072	5.5	5.5	0.0
2073	5.5	5.5	0.0
2074	5.5	5.5	0.0
2075	5.5	5.5	0.0
2076	5.5	5.5	0.0
2077	5.5	5.5	0.0
2078	5.5	5.5	0.0
2079	5.5	5.5	0.0
2080	5.5	5.5	0.0
2081	5.5	5.5	0.0
2082	5.5	5.5	0.0
2083	5.5	5.5	0.0
2084	5.5	5.5	0.0
2085	5.5	5.5	0.0
2086	5.5	5.5	0.0
Total for all years	324.6	322.3	-2.3

Table 13-7 Number of serious casualties by year

Year	Without scheme	With scheme	Difference
2027	53.4	49.8	-3.6
2028	52.7	49.2	-3.6
2029	52.0	48.5	-3.5
2030	51.9	48.4	-3.5
2031	51.8	48.3	-3.5
2032	51.7	48.2	-3.4
2033	51.6	48.1	-3.4
2034	51.4	48.0	-3.4
2035	51.3	47.9	-3.4
2036	51.2	47.8	-3.3
2037	51.1	47.7	-3.3
2038	50.9	47.6	-3.3
2039	50.8	47.5	-3.3
2040	51.2	47.9	-3.3
2041	51.6	48.3	-3.3
2042	52.1	48.8	-3.3
2043	52.3	49.0	-3.3
2044	52.5	49.2	-3.3
2045	52.7	49.4	-3.3
2046	53.0	49.7	-3.3
2047	53.2	49.9	-3.3
2048	53.4	50.1	-3.3
2049	53.7	50.4	-3.3
2050	53.9	50.6	-3.3
2051	54.1	50.8	-3.3
2052	54.1	50.8	-3.3
2053	54.1	50.8	-3.3
2054	54.1	50.8	-3.3
2055	54.1	50.8	-3.3
2056	54.1	50.8	-3.3
2057	54.1	50.8	-3.3
2058	54.1	50.8	-3.3
2059	54.1	50.8	-3.3
2060	54.1	50.8	-3.3
2061	54.1	50.8	-3.3
2062	54.1	50.8	-3.3
2063	54.1	50.8	-3.3
2064	54.1	50.8	-3.3
2065	54.1	50.8	-3.3
2066	54.1	50.8	-3.3
2067	54.1	50.8	-3.3
2068	54.1	50.8	-3.3
2069	54.1	50.8	-3.3
2070	54.1	50.8	-3.3

Year	Without scheme	With scheme	Difference
2071	54.1	50.8	-3.3
2072	54.1	50.8	-3.3
2073	54.1	50.8	-3.3
2074	54.1	50.8	-3.3
2075	54.1	50.8	-3.3
2076	54.1	50.8	-3.3
2077	54.1	50.8	-3.3
2078	54.1	50.8	-3.3
2079	54.1	50.8	-3.3
2080	54.1	50.8	-3.3
2081	54.1	50.8	-3.3
2082	54.1	50.8	-3.3
2083	54.1	50.8	-3.3
2084	54.1	50.8	-3.3
2085	54.1	50.8	-3.3
2086	54.1	50.8	-3.3
Total for all years	3,200.3	3,000.6	-199.7

Table 13-8 Number of slight casualties by year

Year	Without scheme	With scheme	Difference
2027	441.8	447.2	+5.5
2028	436.6	442.2	+5.6
2029	431.4	437.2	+5.8
2030	430.8	436.7	+5.9
2031	430.3	436.4	+6.1
2032	429.7	436.0	+6.3
2033	429.2	435.6	+6.4
2034	428.6	435.2	+6.6
2035	428.0	434.8	+6.8
2036	427.4	434.3	+6.9
2037	426.8	433.8	+7.1
2038	426.1	433.3	+7.2
2039	425.4	432.8	+7.4
2040	429.0	436.6	+7.6
2041	432.6	440.3	+7.7
2042	436.2	444.1	+7.9
2043	438.2	446.2	+8.0
2044	440.2	448.3	+8.2
2045	442.2	450.4	+8.3
2046	444.2	452.6	+8.4
2047	446.2	454.7	+8.5
2048	448.2	456.8	+8.6
2049	450.2	458.9	+8.7
2050	452.2	461.0	+8.8
2051	454.2	463.1	+8.9
2052	454.2	463.1	+8.9
2053	454.2	463.1	+8.9
2054	454.2	463.1	+8.9
2055	454.2	463.1	+8.9
2056	454.2	463.1	+8.9
2057	454.2	463.1	+8.9
2058	454.2	463.1	+8.9
2059	454.2	463.1	+8.9
2060	454.2	463.1	+8.9
2061	454.2	463.1	+8.9
2062	454.2	463.1	+8.9
2063	454.2	463.1	+8.9
2064	454.2	463.1	+8.9
2065	454.2	463.1	+8.9
2066	454.2	463.1	+8.9
2067	454.2	463.1	+8.9
2068	454.2	463.1	+8.9
2069	454.2	463.1	+8.9
2070	454.2	463.1	+8.9

Year	Without scheme	With scheme	Difference
2071	454.2	463.1	+8.9
2072	454.2	463.1	+8.9
2073	454.2	463.1	+8.9
2074	454.2	463.1	+8.9
2075	454.2	463.1	+8.9
2076	454.2	463.1	+8.9
2077	454.2	463.1	+8.9
2078	454.2	463.1	+8.9
2079	454.2	463.1	+8.9
2080	454.2	463.1	+8.9
2081	454.2	463.1	+8.9
2082	454.2	463.1	+8.9
2083	454.2	463.1	+8.9
2084	454.2	463.1	+8.9
2085	454.2	463.1	+8.9
2086	454.2	463.1	+8.9
Total for all years	26802.0	27298.1	+496.1

Environment

Table 13-9 NO_x emissions (tonnes)

Year	Without scheme	With scheme	Difference
Opening year	289.54	338.34	48.80
Year 2	286.12	334.50	48.38
Year 3	282.70	330.66	47.96
Year 4	279.29	326.82	47.54
Year 5	275.87	322.99	47.12
Year 6	272.45	319.15	46.69
Year 7	269.04	315.31	46.27
Year 8	265.62	311.47	45.85
Year 9	262.20	307.63	45.43
Year 10	258.79	303.80	45.01
Year 11	255.37	299.96	44.59
Year 12	251.95	296.12	44.17
Year 13	248.54	292.28	43.74
Year 14	245.12	288.44	43.32
Year 15	241.70	284.61	42.90
Year 16	238.29	280.77	42.48
Year 17	238.29	280.77	42.48
Year 18	238.29	280.77	42.48
Year 19	238.29	280.77	42.48
Year 20	238.29	280.77	42.48
Year 21	238.29	280.77	42.48
Year 22	238.29	280.77	42.48
Year 23	238.29	280.77	42.48
Year 24	238.29	280.77	42.48
Year 25	238.29	280.77	42.48
Year 26	238.29	280.77	42.48
Year 27	238.29	280.77	42.48
Year 28	238.29	280.77	42.48
Year 29	238.29	280.77	42.48
Year 30	238.29	280.77	42.48
Year 31	238.29	280.77	42.48
Year 32	238.29	280.77	42.48
Year 33	238.29	280.77	42.48
Year 34	238.29	280.77	42.48
Year 35	238.29	280.77	42.48
Year 36	238.29	280.77	42.48
Year 37	238.29	280.77	42.48
Year 38	238.29	280.77	42.48
Year 39	238.29	280.77	42.48
Year 40	238.29	280.77	42.48
Year 41	238.29	280.77	42.48
Year 42	238.29	280.77	42.48

Year	Without scheme	With scheme	Difference
Year 43	238.29	280.77	42.48
Year 44	238.29	280.77	42.48
Year 45	238.29	280.77	42.48
Year 46	238.29	280.77	42.48
Year 47	238.29	280.77	42.48
Year 48	238.29	280.77	42.48
Year 49	238.29	280.77	42.48
Year 50	238.29	280.77	42.48
Year 51	238.29	280.77	42.48
Year 52	238.29	280.77	42.48
Year 53	238.29	280.77	42.48
Year 54	238.29	280.77	42.48
Year 55	238.29	280.77	42.48
Year 56	238.29	280.77	42.48
Year 57	238.29	280.77	42.48
Year 58	238.29	280.77	42.48
Year 59	238.29	280.77	42.48
Year 60	238.29	280.77	42.48

Table 13-10 PM_{10} emissions (tonnes)

Year	Without scheme	With scheme	Difference
Opening year	39.61	43.72	4.12
Year 2	39.94	44.14	4.21
Year 3	40.26	44.56	4.30
Year 4	40.59	44.98	4.39
Year 5	40.92	45.40	4.48
Year 6	41.25	45.82	4.57
Year 7	41.58	46.24	4.66
Year 8	41.91	46.66	4.76
Year 9	42.23	47.08	4.85
Year 10	42.56	47.50	4.94
Year 11	42.89	47.92	5.03
Year 12	43.22	48.34	5.12
Year 13	43.55	48.76	5.21
Year 14	43.88	49.18	5.30
Year 15	44.21	49.60	5.39
Year 16	39.61	43.72	4.12
Year 17	39.94	44.14	4.21
Year 18	40.26	44.56	4.30
Year 19	40.59	44.98	4.39
Year 20	40.92	45.40	4.48
Year 21	41.25	45.82	4.57
Year 22	41.58	46.24	4.66
Year 23	41.91	46.66	4.76
Year 24	42.23	47.08	4.85
Year 25	42.56	47.50	4.94
Year 26	42.89	47.92	5.03
Year 27	43.22	48.34	5.12
Year 28	43.55	48.76	5.21
Year 29	43.88	49.18	5.30
Year 30	44.21	49.60	5.39
Year 31	44.53	50.02	5.49
Year 32	44.53	50.02	5.49
Year 33	44.53	50.02	5.49
Year 34	44.53	50.02	5.49
Year 35	44.53	50.02	5.49
Year 36	44.53	50.02	5.49
Year 37	44.53	50.02	5.49
Year 38	44.53	50.02	5.49
Year 39	44.53	50.02	5.49
Year 40	44.53	50.02	5.49
Year 41	44.53	50.02	5.49
Year 42	44.53	50.02	5.49
Year 43	44.53	50.02	5.49
Year 44	44.53	50.02	5.49

Year	Without scheme	With scheme	Difference
Year 45	44.53	50.02	5.49
Year 46	44.53	50.02	5.49
Year 47	44.53	50.02	5.49
Year 48	44.53	50.02	5.49
Year 49	44.53	50.02	5.49
Year 50	44.53	50.02	5.49
Year 51	44.53	50.02	5.49
Year 52	44.53	50.02	5.49
Year 53	44.53	50.02	5.49
Year 54	44.53	50.02	5.49
Year 55	44.53	50.02	5.49
Year 56	44.53	50.02	5.49
Year 57	44.53	50.02	5.49
Year 58	44.53	50.02	5.49
Year 59	44.53	50.02	5.49
Year 60	44.53	50.02	5.49

Table 13-11 Greenhouse gas emissions CO_2e (tonnes)

Year	Without scheme	With scheme	Difference
Opening year	719,366.04	748,048.14	28,682.10
Year 2	707,183.61	735,628.06	28,444.45
Year 3	695,001.17	723,207.97	28,206.80
Year 4	682,818.74	710,787.89	27,969.15
Year 5	670,636.30	698,367.80	27,731.50
Year 6	658,453.87	685,947.72	27,493.85
Year 7	646,271.43	673,527.63	27,256.20
Year 8	634,089.00	661,107.54	27,018.55
Year 9	621,906.56	648,687.46	26,780.90
Year 10	609,724.13	636,267.37	26,543.25
Year 11	597,541.69	623,847.29	26,305.60
Year 12	585,359.26	611,427.20	26,067.95
Year 13	573,176.82	599,007.12	25,830.30
Year 14	560,994.39	586,587.03	25,592.65
Year 15	548,811.95	574,166.95	25,355.00
Year 16	536,629.52	561,746.86	25,117.35
Year 17	536,629.52	561,746.86	25,117.35
Year 18	536,629.52	561,746.86	25,117.35
Year 19	536,629.52	561,746.86	25,117.35
Year 20	536,629.52	561,746.86	25,117.35
Year 21	536,629.52	561,746.86	25,117.35
Year 22	536,629.52	561,746.86	25,117.35
Year 23	536,629.52	561,746.86	25,117.35
Year 24	536,629.52	561,746.86	25,117.35
Year 25	536,629.52	561,746.86	25,117.35
Year 26	536,629.52	561,746.86	25,117.35
Year 27	536,629.52	561,746.86	25,117.35
Year 28	536,629.52	561,746.86	25,117.35
Year 29	536,629.52	561,746.86	25,117.35
Year 30	536,629.52	561,746.86	25,117.35
Year 31	536,629.52	561,746.86	25,117.35
Year 32	536,629.52	561,746.86	25,117.35
Year 33	536,629.52	561,746.86	25,117.35
Year 34	536,629.52	561,746.86	25,117.35
Year 35	536,629.52	561,746.86	25,117.35
Year 36	536,629.52	561,746.86	25,117.35
Year 37	536,629.52	561,746.86	25,117.35
Year 38	536,629.52	561,746.86	25,117.35
Year 39	536,629.52	561,746.86	25,117.35
Year 40	536,629.52	561,746.86	25,117.35
Year 41	536,629.52	561,746.86	25,117.35
Year 42	536,629.52	561,746.86	25,117.35
Year 43	536,629.52	561,746.86	25,117.35
Year 44	536,629.52	561,746.86	25,117.35

Year	Without scheme	With scheme	Difference
Year 45	536,629.52	561,746.86	25,117.35
Year 46	536,629.52	561,746.86	25,117.35
Year 47	536,629.52	561,746.86	25,117.35
Year 48	536,629.52	561,746.86	25,117.35
Year 49	536,629.52	561,746.86	25,117.35
Year 50	536,629.52	561,746.86	25,117.35
Year 51	536,629.52	561,746.86	25,117.35
Year 52	536,629.52	561,746.86	25,117.35
Year 53	536,629.52	561,746.86	25,117.35
Year 54	536,629.52	561,746.86	25,117.35
Year 55	536,629.52	561,746.86	25,117.35
Year 56	536,629.52	561,746.86	25,117.35
Year 57	536,629.52	561,746.86	25,117.35
Year 58	536,629.52	561,746.86	25,117.35
Year 59	536,629.52	561,746.86	25,117.35
Year 60	536,629.52	561,746.86	25,117.35

Acronyms

Term	Definition
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekday Traffic
AMCB	Analysis of Monetised Costs and Benefits
AQMA	Air Quality Management Area
AST	Appraisal Summary Table
ATC	Automatic Traffic Counts
BCR	Benefit to Cost Ratio
DM	Do Minimum
DS	Do Something
GDP	Gross Domestic Product
GHG	Greenhouse Gas
IP	Inter-Peak
JTR	Journey Time Reliability Benefits
KPI	Key Performance Indicator
KSI	Killed or Seriously Injured
LSOA	Lower-Layer Super Output Area
LTC	Lower Thames Crossing
MCC	Manual Classified link Counts
MCTC	Manual Classified Turning Counts
NB	Northbound
NPV	Net Present Value
NTEM	National Trip End Model
NTM	National Transport Model
OA	Output Area
ONS	Office for National Statistics
PCF	Project Control Framework

Term	Definition
PCU	Passenger Car Unit
PIA	Personal Injury Accident
PM_{10}	Particulate Matter < 10µm
PVB	Present Value of Benefits
PVC	Present Value of Costs
RFT18	DfT Road Traffic Forecasts
SB	Southbound
SERTM	South East Regional Traffic Model
TAG	DfT's Transport Appraisal Guidance
TDP	Transport Decarbonisation Plan
TEE	Transport Economic Efficiency
TERN	Trans-European Road Network
VOC	Vehicle Operating Cost
WCH	Walkers, Cyclists and Horse rides
WI	Wider Impacts

Glossary

The Glossary tables describes the terms used in the ComMA which have not been explained within the body of the report text.

Term	Definition
COBA-LT	Costs and Benefits Appraisal – Light Touch, DfT's accidents appraisal software
Defra's Emission Factor Toolkit	Toolkit used to estimate vehicle emissions based on traffic flows and speeds.
DIADEM	Dynamic Integrated Assignment & Demand Modelling, software tool to set-up variable demand models in accordance with TAG
DfT Road Traffic Forecasts	Government's traffic forecast of future traffic growth, used to forecast LGV and HGV growth in the A12 traffic model.
GEH	The GEH Statistic; formula used in traffic engineering, traffic forecasting, and traffic modelling to compare two sets of traffic volumes.
GIS	Geographic Information System, software that stores, retrieve, manage, display, and analyse all types of geographic and spatial data.
Junctions 9	Traffic modelling software for roundabouts and priority junctions
KPI	Key Performance Indicator, a metric used to track performance against an objective
LinSig	Software tool which allows traffic engineers/planners to model traffic signals and their effect on traffic capacities and queuing.
MyRIAD	Motorway Reliability Incidents and Delays, software tool used to assess the journey time reliability impacts of interventions or schemes affecting inter-urban motorways.
National Transport Model	Government's traffic model of the whole country, used to generate traffic growth factors used in the A12 scheme's traffic model
National Trip End Model (NTEM)	Government's demand model of the whole country, used to generate demand growth factors used in the A12 scheme's traffic mode

Term	Definition
PLANET rail model	National model of rail demand
QUADRO	QUeues And Delays at Roadworks software; estimates the effects of roadworks in terms of travel time, vehicle operating and accident costs on the users of the section of road affected.
SATURN	Software used to build transport models (Simulation and Assignment of Traffic to Urban Road Networks)
TRIS	National Highways' traffic data; source of highway traffic information is the Traffic Information System (WebTRIS), which contains traffic flow and journey time data.
TUBA	Transport Users Benefit Appraisal software, undertakes the economic appraisal of transport schemes in accordance with the DfT's cost benefit analysis guidance
Vissim	'Verkehr In Städten - SIMulationsmodell' (Traffic in Cities Simulation Model); a microscopic multi-modal traffic flow simulation software
WITA	Wider Impacts in Transport Appraisal software; undertakes the appraisal of wider impacts appraisals in accordance with the DfT's TAG Unit A.2 Wider Economic Impacts

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