

Post Opening Project Evaluation

M25 J28 (A12 Brook Street) Improvements Five Years After Study



October 2014

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Executive Summary

Scheme Description

The M25 Junction 28 (A12 Brook Street) Improvement scheme was a Highways Agency major project which opened in March 2008. The purpose of the scheme was to make a number of improvements to increase safety and capacity at the junction. These included the provision of a dedicated left turn lane from the M25 to the A12, an extension of the merge lane onto the A12 and the widening of two slip roads from three to four lanes.

Scheme Objectives

Objectives (Non-Technical Summary, 2006)	Objective Achieved?
Improve safety at the junction	Inconclusive
Improve circulation of the junction to deliver a reduction in vehicle queuing and journey times.	

Key Findings

- Average journey times on key movements around the junction have reduced, with savings of approximately one minute seen in the PM peak between the M25 clockwise (CW) carriageway and the A1023 Brook Street.
- Observed average time savings per vehicle are better than predicted, particularly in the AM peak. The better than expected results may be due to traffic flows being lower than predicted on some slip roads.
- Post opening, an annual average increase of 2.9 collisions is seen, compared to a forecast saving of 1 collision per year.
- Deer grazing close to the scheme has had a negative impact on the planting, which in turn proved to have a detrimental impact on the ability to screen the road from nearby residential and sensitive heritage sites.
- Monetary benefits are significantly lower than forecast, with outturn present value benefits of between £36.2m and £44.4m compared to forecast £263.4m. This is partly due to not being able to monetise any observed safety benefits.

Summary of Scheme Impacts

Traffic

- Traffic levels decreased across both the M25 and A12 main carriageways from the pre-scheme stage to FYA stage. A number of slip roads show an increase in traffic flow, most noticeably on the A12 westbound (WB) offslip where an increase of 31% is seen. An increase of 5% is also seen on the M25 clockwise (CW) offslip (1,100 vehicles per day (vpd)) which is likely to be linked to the improvements as this is where the new jet lane has been implemented.
- Traffic levels on Brook Street have increased 2-3% between the one year after (OYA) and FYA stages.
- Observed flows on the M25 through the junction were between 14% and 21% lower than forecast. Forecast flows on the M25 slip roads varied in their accuracy, with only the M25 anticlockwise (ACW) offslip observed flows being below estimates. Others were close to that forecast, including on the A12 towards Chelmsford.

- Observed flows on the A12 WB onslip and the A12 eastbound (EB) offslip (to/from London) were shown to be between 16-19% lower than forecast.
- Journey time savings are seen on most routes considered and in all time periods. The greatest time savings have been seen in the PM peak, with an average saving of 1 minute and 5 seconds, compared with 53 seconds in the inter-peak and 48 seconds in the AM peak. The greatest journey time saving was shown on the route between the M25 clockwise and Brook Street during the PM peak.
- Observed average time savings per vehicle are better than predicted, particularly in the AM peak. The better than expected results may be due to traffic flows being lower than expected on some slip roads.

Safety

- An annual average collision saving of 1 collision per year was forecast at the appraisal stage, a 5% decrease between the pre and post scheme scenarios. However, observed data shows that there has been an average increase of 2.9 collisions a year, a 16% increase compared to pre scheme. However, collisions in the vicinity of the jet lane have reduced in the post scheme period.
- These changes could be due to chance, and therefore cannot be directly attributed to the scheme.
- The annual average casualty rate has decreased post opening, however the killed and seriously injured casualty rate has increased, due to an increase of serious casualties.

Environment

- Based on traffic flows, the noise and air quality impacts of the scheme are generally as expected. There has been no significant improvement or deterioration as a result of the scheme.
- The scheme's impact on Carbon emissions could not be evaluated.
- The landscape mitigation measures are generally as expected, with the exception of planting along the M25 CW off slip and the A12 WB slip road where the planting has suffered major grazing damage by deer and is not performing the screening function for which it was intended; although this has not materially changed the landscape setting of the ancient woodland
- Habitat establishment and maintenance is generally developing in line with the ecological mitigation proposals, but the function of the plant stock along the M25 CW off-slip road has not been realised and potentially has an adverse effect on the local bat population.
- The overall effect the scheme has had on water quality and drainage is as expected.
- Journey ambience has improved, however is considered to be slight beneficial, lower than the large beneficial forecast score. Whilst drivers have benefitted from improved journey times, the recorded increase in collisions may cause a rise in driver stress and frustration, poor lane discipline and sounding of vehicular horns (noted on site visit). The grazing damage to the planting means that traveller views have been impacted due to reduced vegetation screening.

Accessibility and Integration

- A small number of cyclists and pedestrians crossing the junction might experience reduced accessibility due to the need to cross an increased number of lanes on the slip roads; however the low number of these users means that this is rated as a neutral impact.
- The scheme supports local and regional land policies encouraging transport infrastructure improvements which address congestion and ease the trunk roads. It also supports regional policies to invest in overcoming bottleneck problems.

Summary of the Scheme's Economic Performance

Note: all monetary figures in 2002 prices discounted to 2002.		Forecast	Outturn evaluation	
			0% traffic growth	NTEM traffic growth
Present Value Benefits (PVB)	TEE	£259.564m	£36.2m	£44.4m
	Safety	£4.726m	£0	£0
	Total	£264.3m	£36.2m	£44.4m
Present Value Costs (PVC)		£14.8m	£15.7m	
Benefit Cost Ratio (BCR)		17.9	2.3	2.8

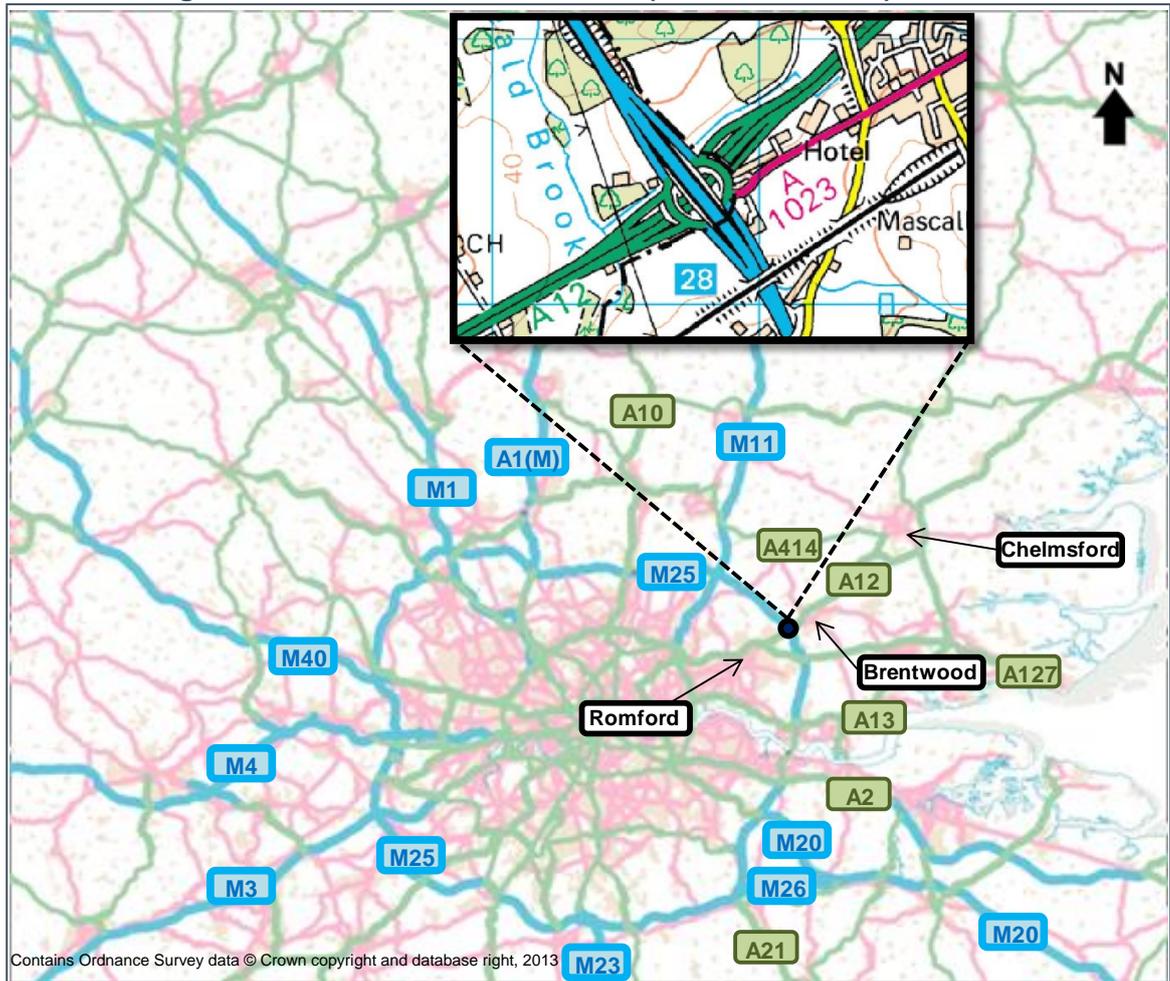
- Journey time benefits are significantly lower than predicted at the appraisal stage. The annual benefits were expected to rise exponentially through the appraisal period, with lower benefits in the first few years. The overall benefit over the full appraisal period is therefore difficult to assess at this stage.
- Outturn safety benefits have not been monetised due to the changes being statistically insignificant, and therefore cannot be directly linked to the scheme.
- Overall, the outturn PVB is between 14% and 17% of the forecast PVB of £264.3m.
- In spite of this, the outturn BCR indicates that the scheme has delivered high value for money.
- The study has found no evidence to suggest that the scheme has had a discernible impact in terms of stimulating economic activity. However, the scheme is aligned to local and regional socio-economic policy aspirations of improving the trunk road network.

1. Introduction

Scheme Context & Location

- 1.1. This report presents a Five Years After (FYA) opening evaluation of the M25 J28 (A12 Brook Street) Scheme (hereafter known as 'the scheme'), which opened in March 2008. The evaluation has been prepared as part of the Highways Agency's (HA's) Post Opening Project Evaluation (POPE) programme. The purpose of this report is to build upon the findings of the One Year After (OYA) study published in March 2009.
- 1.2. The scheme is located on Junction 28 of the M25 which connects with the A12, in between Brentwood and Romford and is situated on the boundary of HA Area 5 (for the M25 J28) and Area 6 (for the A12 North of the scheme). The location is shown in **Figure 1-1**.

Figure 1-1 – Location of the M25 J28 (A12 Brook Street) Scheme



- 1.3. The M25 motorway is the main orbital route around London and is one of the busiest motorways in the UK. The M25 is the busiest route at this junction; however the A12 is also a strategic route that serves as the strategic link between central Essex (Brentwood, Chelmsford and Colchester), Ipswich and London. The vast majority of the length of the A12 is dual carriageway and the remainder is of dual three lanes. All of the junctions on the A12 between Ipswich and Gallows Corner are grade separated and the speed limit is 70mph along most of its length.
- 1.4. Junction 28 is a three tier grade separated junction, with the A12 and M25 running under and over the roundabout respectively. The junction connects the M25, A12 and the A1023

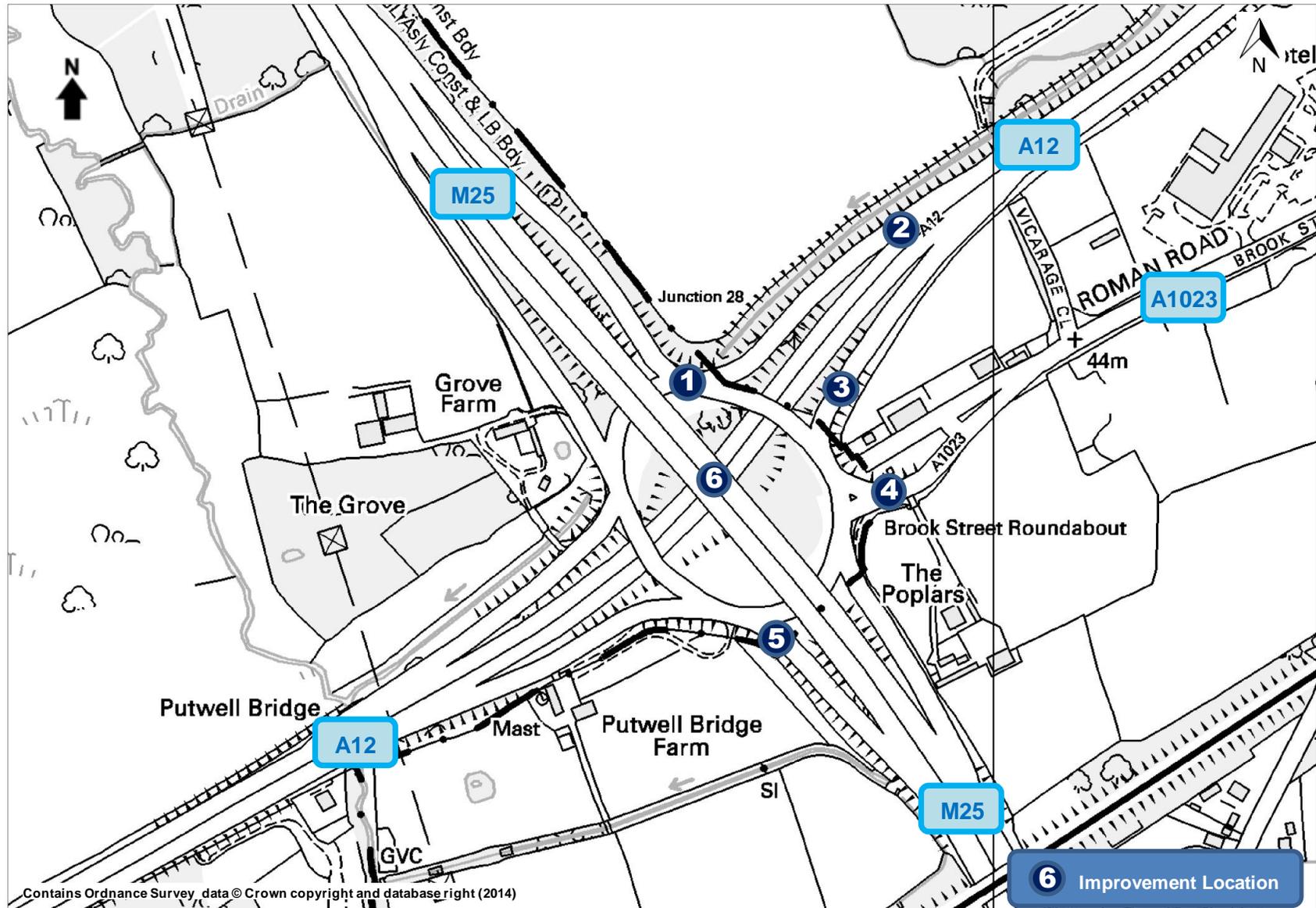
(Brook Street) via a roundabout and has straight-through traffic on the A12 and M25. All turning movements are possible. The A1023 is a local authority road that connects Junction 28 with Brentwood Town Centre.

- 1.5. Prior to the scheme, over 7,000 vehicles travelled through the junction each hour during the morning and evening peaks, causing major congestion. Traffic joining the A12 travelling north-east towards Ipswich has difficulty merging with traffic already travelling on it.

Scheme Description

- 1.6. Opening in March 2008, the scheme was implemented to relieve congestion and unreliable journey times experienced at the junction, which is particularly evident during peak periods. The main turning flow is between the A12 northeast arm and the M25 clockwise (CW) carriageway, which regularly results in significant congestion at the junction.
- 1.7. The main improvements are included here and illustrated in **Figure 1-2**. More details are given on each improvement in **Figures 1.3 to 1.7**, as per the numbers below):
- A new dedicated left turn lane with a splitter island (jet lane) from the M25 CW exit slip road to the A12 east (1).
 - Extension of the A12 merge lane towards Ipswich (eastbound) (2).
 - Widening of the A12 London-bound exit slip road to four lanes (3).
 - Realignment of the A1023 Brook Street to M25 clockwise on-slip as a result of widening of circulatory carriageway at this point (4).
 - Widening of the M25 anticlockwise exit slip road to four lanes (5).
 - Other minor works to improve junction safety. (6).

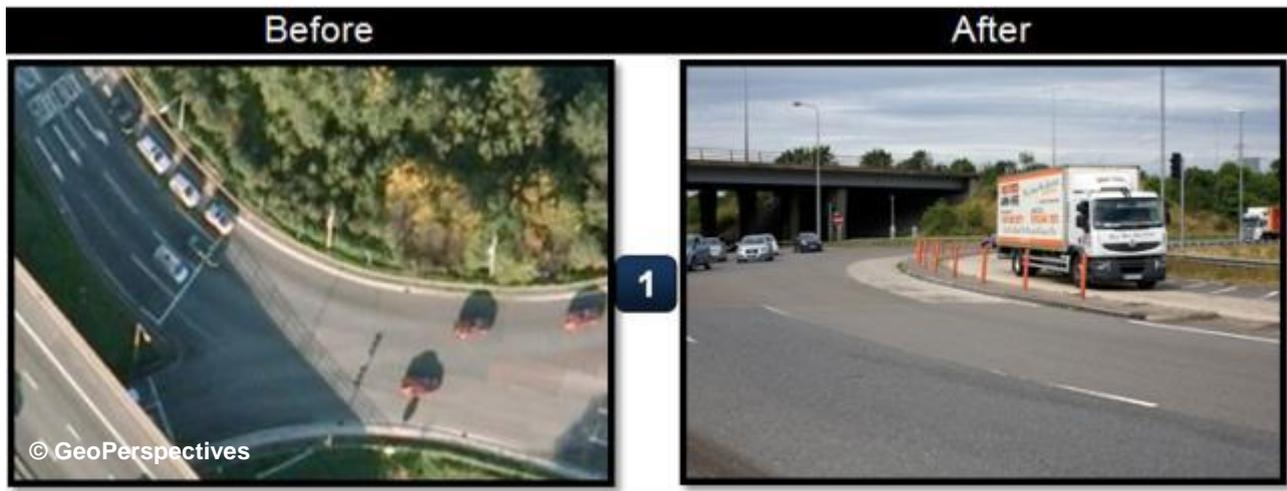
Figure 1-2 – M25 J28 (A12 Brook Street) Scheme Improvements.



Scheme Improvement 1: Installation of a dedicated Left Turn Lane (Jet Lane)

- 1.8. A jet lane has been installed between the M25 CW off-slip and the A12 EB on-slip. This is shown in **Figure 1-3**.
- 1.9. Prior to the installation of the jet lane, vehicles exiting the M25 CW and turning left onto the A12 EB were subject to traffic signals along with all other lanes approaching the roundabout (shown below left). The traffic signalling was causing vehicles to back up on to the M25 main carriageway due to the high volume of vehicles travelling between these slip roads. There was a significant collision risk as a result.

Figure 1-3 – Scheme Improvement 1: Installation of a dedicated Left Turn Lane (Jet Lane)

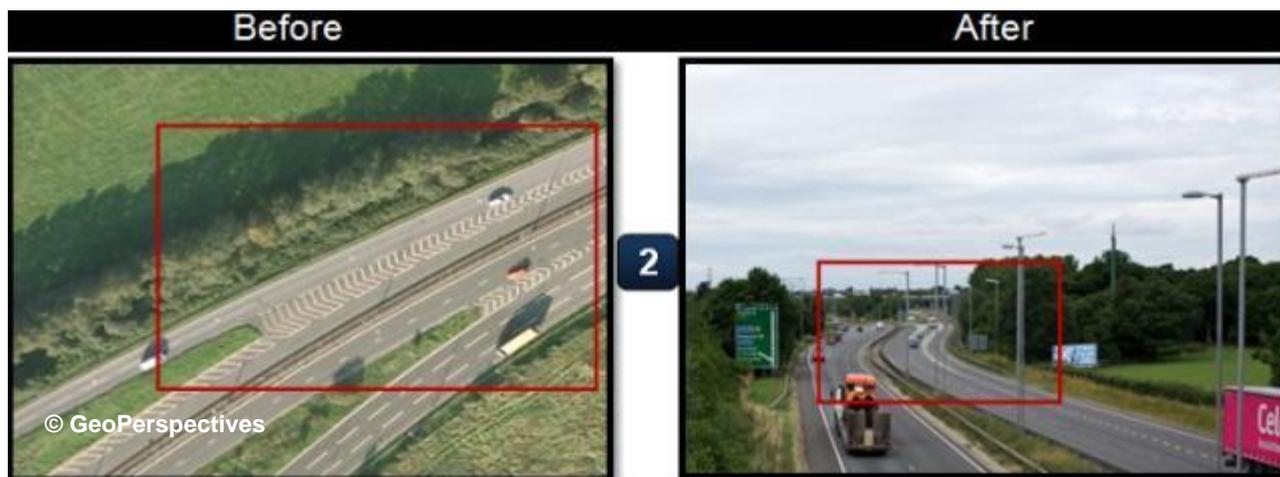


- 1.10. The new jet lane is designed to allow vehicles travelling between the M25 CW and A12 EB to bypass the traffic signals and enter onto the A12 without having to give way to traffic at the roundabout, thus reducing traffic queuing onto the M25 main carriageway.
- 1.11. High-visibility markers were installed on the splitter island (shown above right) in the period between opening and the OYA report. The markers were installed along with improved signage on the circulatory carriageway due to an increase in collisions as a result of the new splitter island.

Scheme Improvement 2: A12 Merge Lane extension

- 1.12. The A12 EB on-slip has been extended by 650m and the carriageway realigned using hatched markings.
- 1.13. Travelling north, the A12 EB carriageway reduces to one lane after the A12 EB off-slip to J28 (left of **Figure 1-4**) to travel through the junction. One lane of the A12 EB on-slip returns the route to a dual carriageway. The second slip lane has now been segregated (and lengthened) from the other slip lane and adjoins the A12 main carriageway further along to the east (shown below right).

Figure 1-4 – Scheme Improvement 2: A12 Merge Lane extension

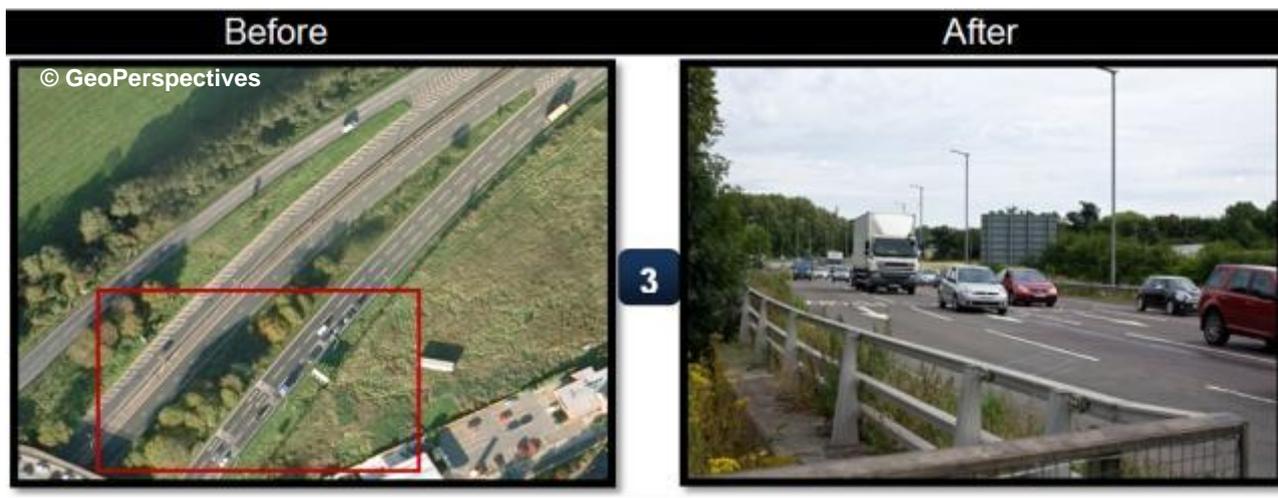


- 1.14. The longer slip lane is designed to allow vehicles to build up speed before attempting to merge with the traffic on the A12 EB main carriageway therefore:
- Reducing the number of collisions between merging vehicles and vehicles on the main carriageway.
 - Reducing congestion on the A12 EB on-slip and therefore onto the jet lane and the M25 CW off-slip.

Scheme Improvement 3: Widening of the A12 WB Off slip

- 1.15. The A12 WB off-slip has been widened from three lanes (shown below left in **Figure 1-5**) to four lanes (shown below right) as it joins the roundabout.
- 1.16. The additional lane is designed to provide increased capacity at the junction to benefit vehicles exiting at J28 from the A12 WB and reduce the possibility of traffic queuing back onto the A12 WB main carriageway.

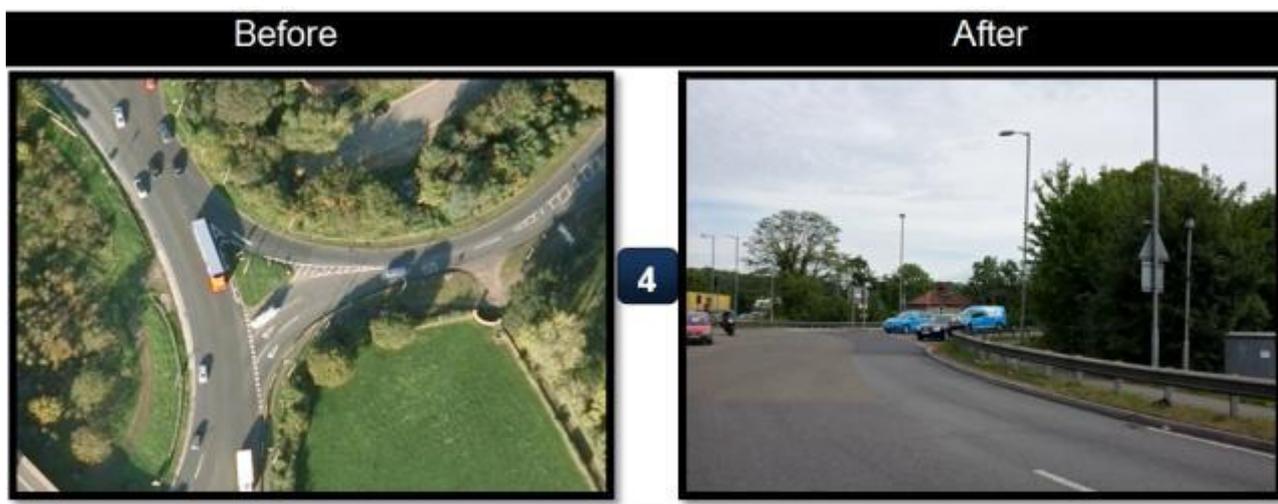
Figure 1-5 – Scheme Improvement 3: Widening of the A12 WB Off slip



Scheme Improvement 4: Realignment of A1023 Brook Street Junction

- 1.17. Minor realignment works have been carried out at the Brook Street junction with the roundabout. Prior to the work, the junction had hatched markings to separate vehicles approaching the roundabout and vehicles exiting the roundabout (shown below left in **Figure 1-6**)

Figure 1-6 – Scheme Improvement 4: Realignment of A1023 Brook Street Junction

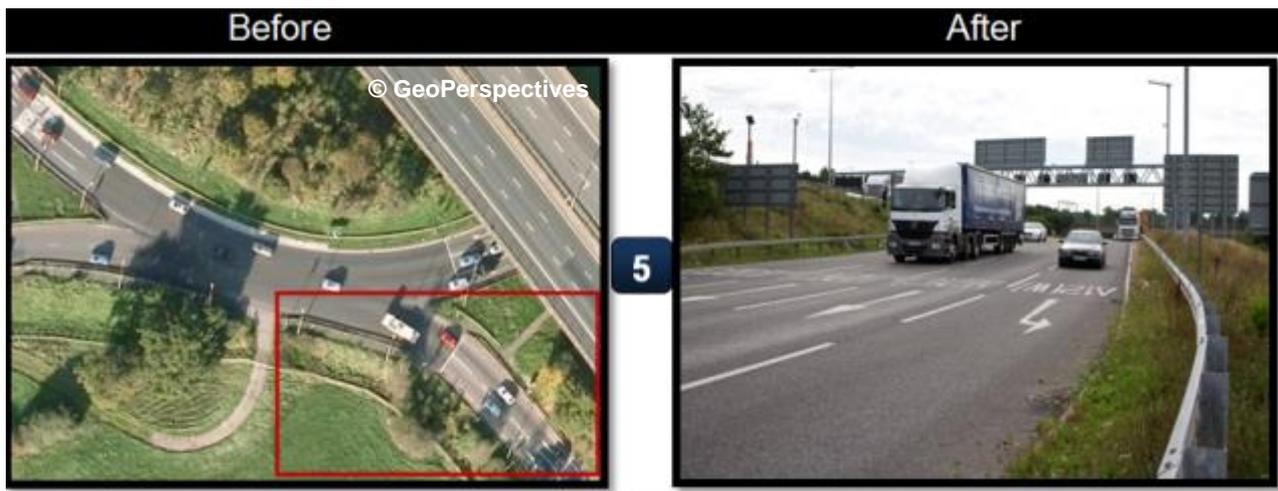


- 1.18. The give way markings have been realigned to follow the curvature of the roundabout (shown above right) and the hatched markings have been removed so that the traffic is now segregated by single dashed white lines.

Scheme Improvement 5: Widening of the M25 anticlockwise (ACW) off slip

- 1.19. **Figure 1-7** shows that the M25 ACW off-slip has been widened from two lanes (shown below left) to four lanes (shown below right) as it joins the roundabout.

Figure 1-7 – Scheme Improvement 5: Widening of the M25 anticlockwise (ACW) off slip



- 1.20. The additional lanes are designed to provide an increase in capacity at the junction to benefit vehicles exiting at J28 from the M25 ACW. The possibility of traffic queuing onto the M25 ACW main carriageway will be reduced.

Scheme Improvement 6: Minor Safety Improvements

- 1.21. A number of general improvements were carried out across the junction to improve safety for all users of the junction.

Scheme Objectives

- 1.22. The main objectives of the scheme obtained from the *HA Non-Technical Summary* (October 2006), and which were agreed with the Project Manager, were to:

- **Improve safety** at the junction.
- **Improve circulation of the junction** to deliver a reduction in vehicle queuing and journey times.

- 1.23. More specifically, the aim of the scheme is to reduce journey times for vehicles travelling west along the A12 and using J28 to connect with the M25 clockwise carriageway. Improvements on the M25 clockwise exit slip and at the M25 anticlockwise exit slip aim to improve safety and journey times at the junction; as well as contribute to improved junction circulation across all five arms.

Other Schemes in the Area

- 1.24. Other projects implemented in the locality of the scheme area can sometimes have an impact on traffic counts, journey times or collision figures. There are two other major schemes which are in the vicinity of M25 Junction 28, which are detailed in

1.25.

1.26.

1.27. Table 1.1.

Table 1.1 – Nearby Schemes

Name	Date	Scheme Description	Relation to M25 J28 Brook Street Scheme
M25 J27 – J30 Widening	Construction began in July 2009 and was completed in May 2012	Carriageway widening from dual 3 lanes to dual 4 lanes	The M25 J28 scheme has been designed to complement the M25 widening scheme. All OYA surveys were conducted before construction of this scheme begun. Post opening surveys were all undertaken after this scheme was completed
M25 J28 – J27 Speed Harmonisation Trial	Work began in March 2007	Automatic Number Plate Recognition (ANPR) cameras and roadside portable Variable Message Signs (VMS) used to set temporary speed limits to ease congestion	None

Scheme History

1.28. A recommendation of the London to Ipswich Multi-Modal Study (November, 2002) was that major improvements to the junction should be implemented involving dedicated free flow slip roads. Based upon this study, a scheme to improve journey time reliability and safety through the junction entered the government's targeted programme of improvements in March 2005.

1.29. **Table 1.2** provides a summary of the scheme history.

Table 1.2 – Summary of the Scheme History

Date	Event
November 2002	One of several measures suggested by London to Ipswich Multi-Modal Study
March 2005	Added to Programme of Major Schemes (formally known as TPI)
November 2006	Environmental Statement for the scheme was published
February 2007	Comments from the Environmental Statement and improvement

Date	Event
	proposals were submitted to the Secretary of State for Transport
April 2007	Approval of scheme by Secretary of State
May 2007	Start of construction period
10th March 2008	Opening of the scheme
August 2008	Permanent reflective posts erected on the new splitter island
March 2009	OYA study was completed

Post Opening Project Evaluation

Highways Agency's Appraisal Process

- 1.30. The HA is responsible for improving the strategic highway network (motorways and trunk roads) through the Major Schemes programme. At each key decision stage through the planning process, schemes are subject to a rigorous appraisal process to provide a justification for the project's continued development.
- 1.31. When submitting a proposal for a major transport scheme, the Department for Transport (DfT) specifies that an Appraisal Summary Table (AST) is produced. The AST records the degree to which the five objectives for transport (Environment, Safety, Economy, Accessibility and Integration¹) have been achieved. The AST for this scheme is presented in Chapter 7 of this report.

Post Opening Project Evaluation

- 1.32. POPE studies are undertaken at two main stages after all Major Schemes have opened: one year after scheme opening and five years after scheme opening. Due to the interest in this scheme, a Traffic Impact Study (TIS) was completed in June 2008 and provided an initial overview of the changes in traffic flow and journey times.
- 1.33. The purpose of POPE studies is to evaluate the strengths and weaknesses of the techniques used for appraising schemes so that informed improvements can be made to the appraisal process in the future. For POPE, this is achieved by comparing information collected before and after the opening of the scheme to traffic, against predictions made during the planning process. The outturn impacts of a scheme are summarised in an Evaluation Summary Table (EST) which summarises the extent to which the objectives of a scheme have been achieved. The EST for this scheme can be found in Chapter 7.

Summary of the M25 J28 (A12 Brook Street) POPE One Year After Study (2009)

- 1.34. The purpose of the FYA study is to verify and study in more detail the emerging trends and conclusions presented in the OYA study report. The main conclusions made in the M25 J28 (A12 Brook Street) OYA report were as follows:
- The scheme had no major impact on traffic flows, and journey times through the junction had improved as predicted.
 - There was potentially a small amount of re-routing of traffic accessing the M25 from north east of the scheme. Traffic may have therefore swapped from using Brook Street to the A12 Brentwood Bypass due to the widening of the A12 westbound off slip.

¹ As of August 2011, this approach has been revised. However, POPE is concerned with evaluation against the appraisal, and as such follows the objectives used at that time.

- There had been an increase in collisions at the junction with a high proportion due to poor lane discipline. A number of remedial measures have been implemented since the scheme opened including reflective marker post on the splitter island, and additional signing on the circulatory carriageway. The annual rate of collisions had increased from 15.6 pre-scheme opening to 23.0 post opening (at the OYA stage). This is worse than the forecast reduction of 3 collisions in the opening year. However, the observed changes in collision numbers were not statistically significant; therefore the change in collision rate is not necessarily due to the implementation of the scheme.
- The scheme cost is 35% lower than forecast.
- Using the evidence that was available, it was not possible to derive a Benefit Cost Ratio (BCR) at OYA stage.
- Work to upgrade the M25 between Junctions 27 and 30, including the installation of VMS (Variable Message Signs), will improve the ability of the HA to respond to major incidents and reduce the likelihood of severe congestion events at Junction 28 which have been known to occur.

1.35. **Table 1.3** provides an overview of the conclusions drawn from the OYA study.

1.36. This FYA report will reconsider the status of the above findings and provide further clarity on the longer term effects of the improvements on the immediate area affected by the scheme. This is of particular importance when considering collision and environmental impacts, and longer term economic regeneration effects.

1.37. The report will also determine the BCR for the scheme which was not possible in the OYA report.

Table 1.3- OYA Objectives Achieved Summary

HA Scheme Objective	OYA Evaluation	Achieved at OYA stage
Improve safety at the junction.	At the OYA stage, the personal injury collision (PIC) data shows there has been a statistically insignificant rise in collisions. More PIC data is required to draw any firm conclusions.	Too early to conclude.
Improve circulation of the junction to deliver a reduction in vehicle queuing and journey times.	The surveys generally show a reduction in journey times. The OYA survey times show journey times can vary from day to day and therefore more data would be required to draw any firm conclusions.	Variable success (More data required).

Report Structure

1.38. The remainder of the report is structured as follows:

- **Section 2 – Traffic Analysis:** A comparison of the traffic impacts of the scheme compared to those forecast.
- **Section 3 – Safety Analysis:** This section contains the analysis of the key safety impacts of the scheme and discusses whether changes in collision patterns have occurred at this stage as a result of the scheme.
- **Section 4 – Economic Assessment:** This section examines the economic impacts of the scheme in comparison with those that were forecast.
- **Section 5 – Environmental Assessment:** A review of the environmental impacts of the scheme is given in this section. This includes an evaluation of the mitigation measures described within the scheme’s Environmental Statement.

- **Section 6 – Accessibility and Integration:** This section reviews the accessibility and integration impacts of the scheme.
- **Section 7 – Appraisal and Evaluation Summary Tables:** This includes the original Appraisal Summary Table and the Evaluation Summary Table for the scheme.
- **Section 8 – Conclusions:** An overview of the above analysis/assessment and the outcome of the results.
- **Section 9 – Appendices**
 - **Appendix A:** Glossary of Terms
 - **Appendix B:** Tables and Figures used in the report
 - **Appendix C:** Environment information requested and photographic record of scheme

2. Traffic Impact Analysis

Introduction

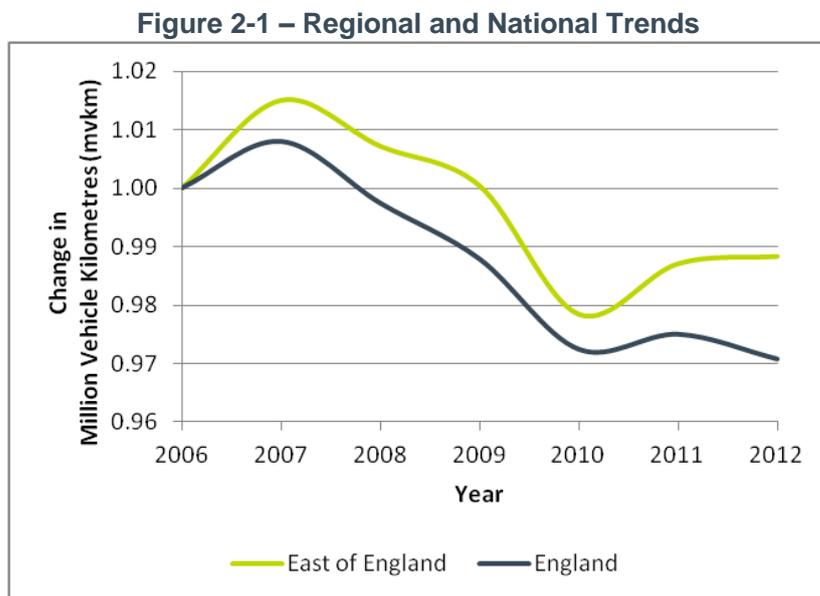
- 2.1. This section examines traffic data from a number of sources to provide a before and after opening comparison of traffic flows and journey times for vehicles using the M25 J28 (A12 Brook Street) junction. The same analysis will also be undertaken for other routes within the wider area in order to understand the broader traffic impacts of the scheme. The purpose of this evaluation is to understand whether changes in traffic flows and journey times may be attributable to the scheme.
- 2.2. This chapter comprises:
- A description of national, regional and local background traffic trends.
 - A summary of the sources used to compile data for this evaluation.
 - A detailed comparison of before, one year after and five years after traffic flows on key routes in the study area likely to be affected by the scheme.
 - A comparison of journey times on key routes before and after the scheme.
 - An evaluation of key differences between forecast and outturn impacts of the scheme in terms of traffic flows and journey times.

Background Changes in Traffic

- 2.3. Historically in POPE scheme evaluations, the ‘before’ counts have often been factored to take account of background traffic growth so that they are directly comparable with the ‘after’ counts. This usually involves the use of National Road Traffic Forecasts (NRTF), with local adjustments made using Local Growth Factors.
- 2.4. However, in light of the recent economic climate, which has coincided with widespread reductions in motor vehicle travel in the United Kingdom (UK) as a whole since 2008, it is no longer deemed appropriate to use this method of factoring ‘before’ counts to reflect background changes in traffic. Rather, recent POPE studies have taken a more considered approach in order to assess changes in the vicinity of the scheme, within the context of national, regional and locally observed background changes in traffic.
- 2.5. As such, this section will examine and discuss the regional and local trends in traffic flows.

Regional and National Traffic Trends

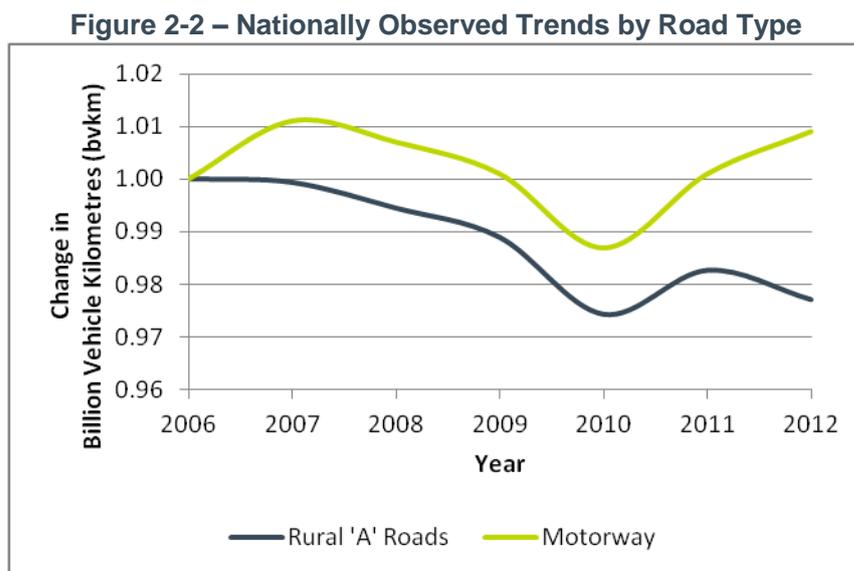
2.6. The DfT produces observed annual statistics for all motor vehicles by local authority². Data between 2006 (before construction) and 2012 (the latest available) is shown in million vehicle kilometres (mvkm) for the East of England and nationally in **Figure 2-1**.



2.7. Regional and local trends show a decrease in vehicle kilometres travelled between 2007 (pre-opening) and 2010 (two years after opening). Overall there has been a decrease in vehicle kilometres travelled regionally and nationally between 2006 and 2012 of between 1% and 3%.

Trends by Road Type

2.8. The DfT also produces observed annual statistics for all motor vehicles by road type³. Data between 2006 (before construction) and 2012 (the latest available) is shown in billion vehicle kilometres (bvkm). Motorway and rural 'A' road data has been used to represent the scheme and is shown in **Figure 2-2**.



² Motor vehicle traffic (vehicle kilometres) by region in Great Britain, annual from 1993 to 2012. Tables TRA8904a and TRA8904h (Department for Transport).

³ Motor vehicle traffic (vehicle kilometres) by road type in Great Britain, annual from 1993 to 2012. Tables TRA8904a and TRA8904h (Department for Transport).

- 2.9. The key point to note is that vehicle kilometres travelled on motorways have increased by 1% between 2006 and 2012, whereas vehicle kilometres travelled on rural 'A' roads have decreased by 2%.
- 2.10. The overall level of increase or decrease between 2006 (pre-construction) and FYA 2012 is:
- Motorways: +1%
 - Rural A road: -2%
 - East of England: -1%
 - National trends: -3%
- 2.11. When analysing the data in this report, it is important keep in mind that any changes in vehicle flow of between +1% and -3% potentially be attributed to background changes, and changes outside of this range may be attributable to the scheme.

Traffic Count Data Sources

- 2.12. At the OYA stage data was collected using counts from the HA's TRADS database, Essex County Council (ECC) and temporary surveys specially commissioned for this study. At both OYA and FYA stage temporary traffic counts were unable to collect data from the A12 EB on-slip due to equipment limitations and safety issues. At the FYA stage traffic counts were calculated using other TRADS sites within the scheme area. Traffic counts were also commissioned again on the A12 EB off-slip and the A12 WB on-slip.
- 2.13. The locations of counts used in this report are shown in **Figure 2-3**.
- 2.14. Count data was not available for site **C**, this has been calculated using available TRADS data. The calculation is shown below.

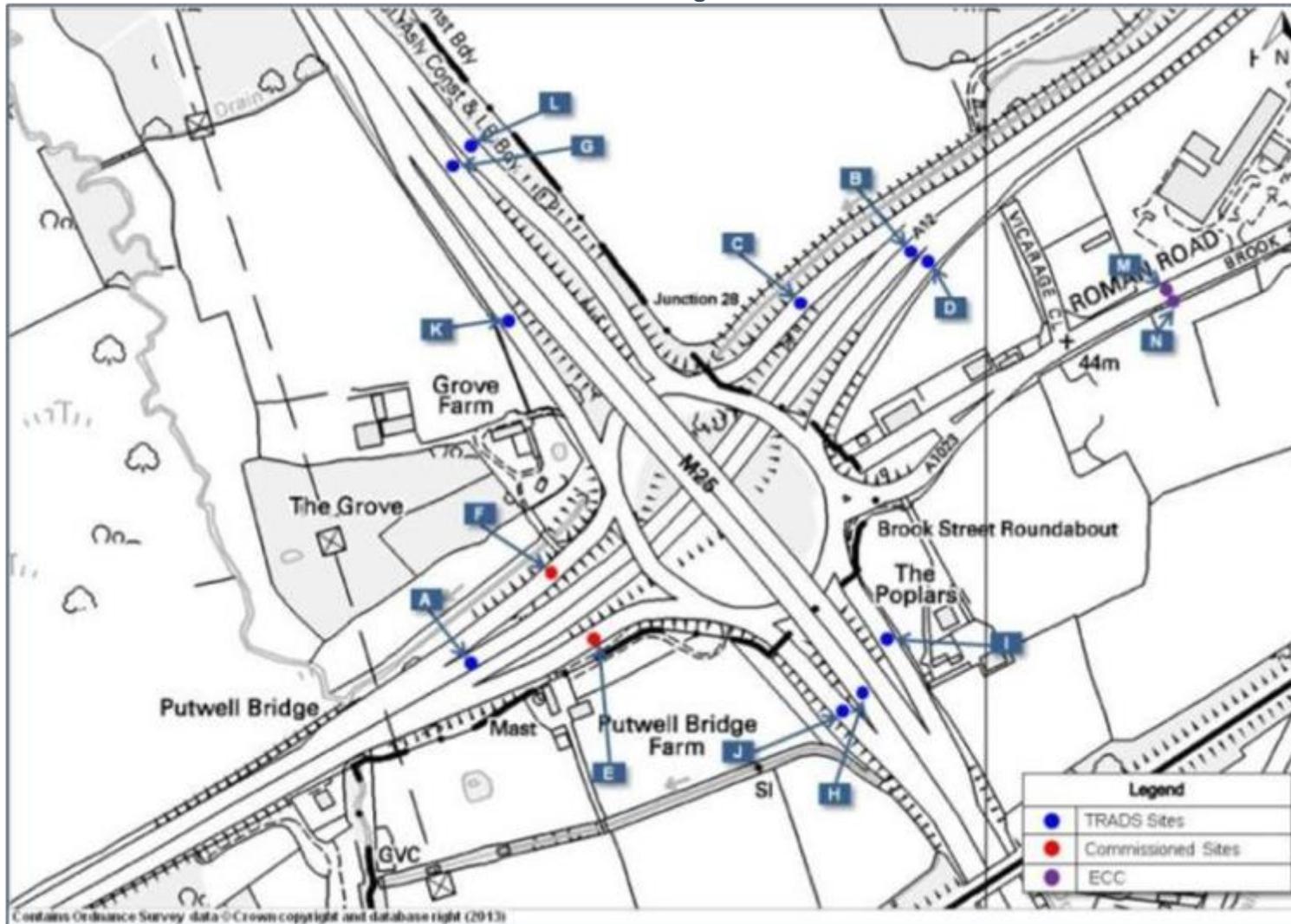
Site C Calculation: the number of vehicles travelling along the A12 EB⁴ (to the northeast of the scheme area) minus vehicles at location **A** (remaining on the main carriageway before additional vehicles join from the A12 EB on-slip) equals the number of vehicles at location **C** (entering the A12 EB via the EB on-slip).

Observed Flows

- 2.15. The observed flows (AWT) at each location are shown in **Figure 2-4** and **Figure 2-5** where traffic levels at the before, OYA and FYA stage are shown.

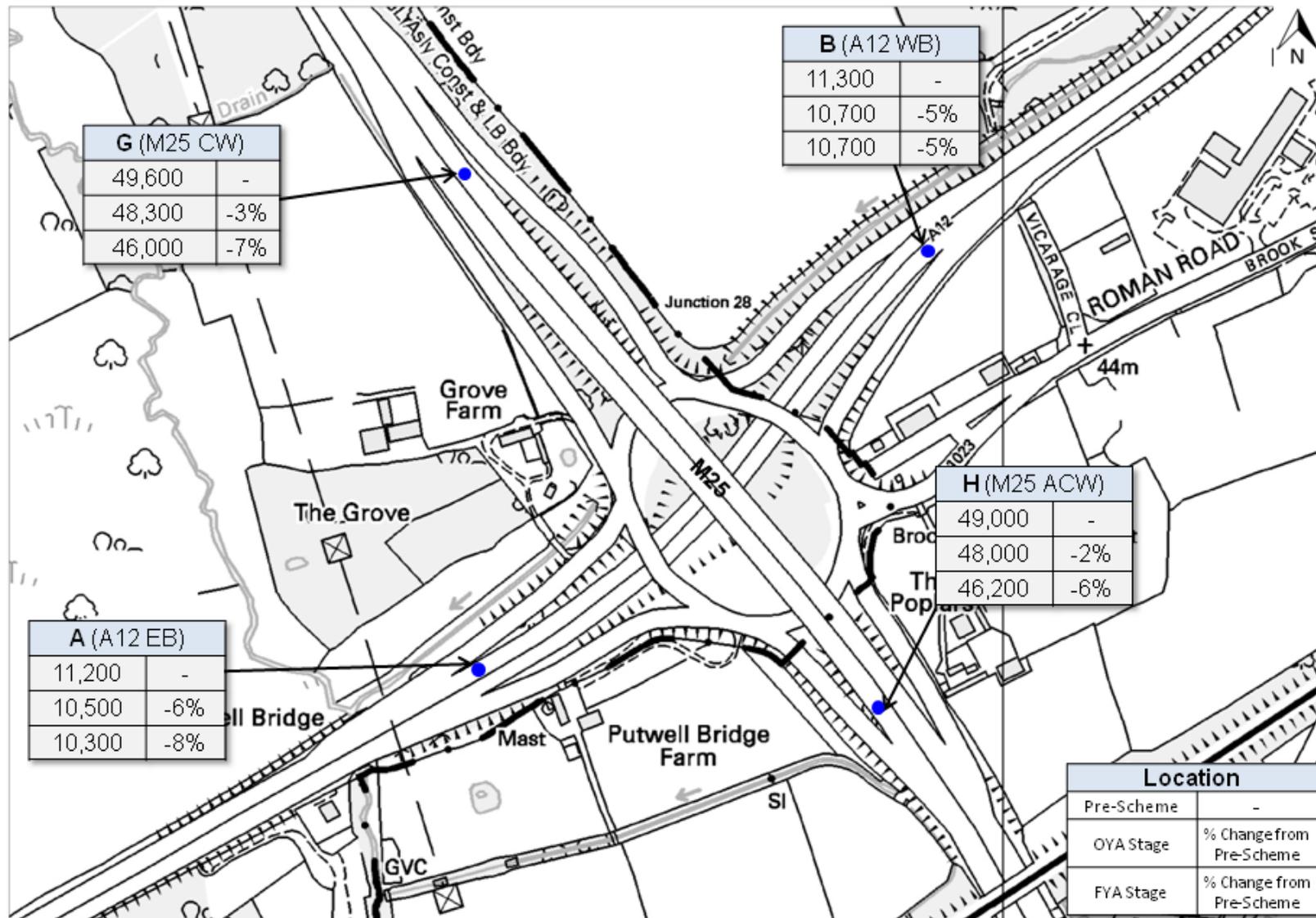
⁴ The data was collected to the north east of the scheme area on the A12 main carriageway. There are no junctions between this point and the scheme area; therefore the vehicles at this data collection accurately represent the vehicles entering the scheme area. This data was therefore used to calculate the number of vehicles on the A12 EB on-slip.

Figure 2-3 – Locations of Traffic Counts



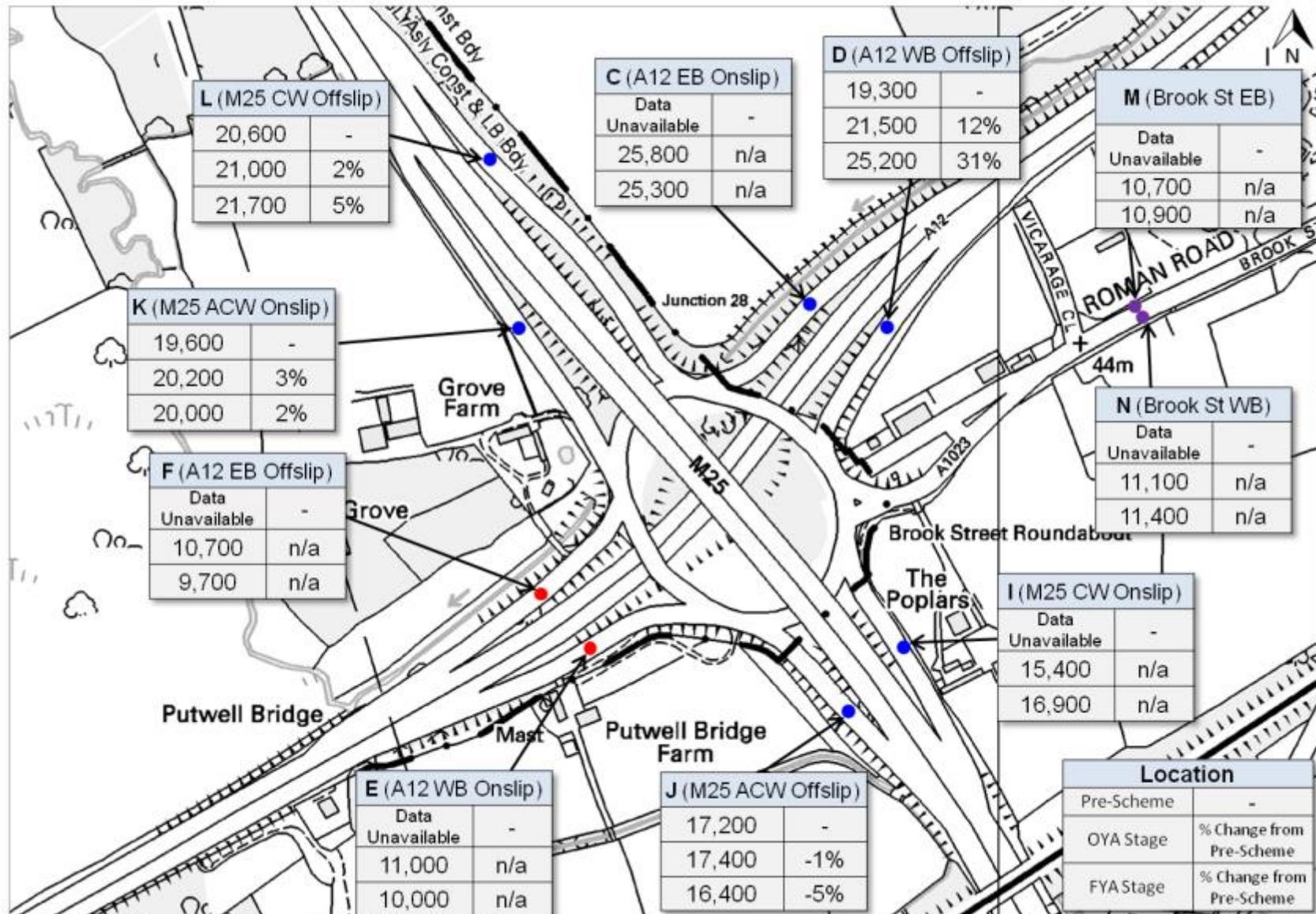
Site	Location
A	A12 Through EB
B	A12 Through WB
C	A12 Onslip EB
D	A12 Offslip WB
G	M25 Through CW
H	M25 Through ACW
I	M25 Onslip CW
J	M25 Offslip ACW
K	M25 Onslip ACW
L	M25 Offslip CW
E	A12 Onslip WB
F	A12 Offslip EB
M	Brook Street EB
N	Brook Street WB

Figure 2-4 –Traffic Counts at Before, OYA and FYA stages (AWT) on the Main Carriageways



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Figure 2-5 –Traffic Counts at Before, OYA and FYA stages (AWT) on the Slip Roads and Brook Street



Contains Ordnance Survey data © Crown copyright and database right (2013)

2.16. The main points to note from **Figure 2-4** and **Figure 2-5** are:

Main Carriageways

- Post opening, traffic levels on the M25 and the A12 have decreased.
- The A12 WB shows a traffic flow decrease of 5% at the FYA stage which is no change from the decrease seen at the OYA stage.
- The A12 EB shows an 8% decrease in traffic between the pre and post scheme periods. This equates to approximately 900 vehicles per day (vpd). This is a slight further drop compared to the decrease seen at the OYA stage.
- The M25 ACW show a 6% decrease at the FYA stage compared to the pre scheme observed flows, equating to 2,800 vpd. A 2% decrease was seen at this location at the OYA stage.
- Post opening, the M25 CW shows the largest decrease in terms of total traffic, seeing a drop of 3,600 vehicles (7%) between the pre and FYA opening flows. This is a further decrease compared to that noted at the OYA stage, where a 3% decrease was seen.

Slip Roads

- At the FYA stage, the M25 ACW offslip is the only slip road to show a decrease (-5%) compared to pre scheme which equates to approximately 800vpd. A small (1%) decrease was seen at this location at the OYA stage.
- Post opening at the FYA stage, the M25 CW offslip shows an increase of 5% which equates to around 1,100vpd, whilst the M25 ACW onslip shows a small increase of 400vpd which is a 2% increase when compared to the pre scheme flows.
- The greatest increase shown between pre-scheme and the FYA stage is on the A12 WB Offslip (31%). Between the OYA stage and the FYA stage the greatest increase is also on the A12 WB offslip (17%).
- The greatest decrease shown between the pre-scheme stage and the FYA stage is on the M25 ACW offslip. Between the OYA stage and the FYA stage the greatest decrease is also on the A12 EB offslip (9%).
- When FYA data is compared to OYA data (as opposed to pre-scheme), the following slip roads show a decrease in traffic:
 - A12 WB onslip (-9%)
 - A12 EB offslip (-9%)
 - A12 EB onslip (-2%)

Brook Street

- Traffic flows have increased slightly between the OYA and FYA stages on Brook Street, in the region of 2-3%.

2.17. The overall movement which has seen the most growth appears to be from the north east (A12 and Brook Street) to the M25.

Forecast Traffic Flows

Sources

2.18. The source of traffic forecasts is the 'Traffic Analysis and Review Report' published in September 2006. This includes forecasts for the years 2008 (opening year) and 2023 (design year).

2.19. The pre-scheme appraisal process for the M25 J28 (A12 Brook Street) scheme involved the forecasting of traffic flows on the main carriageways and on each of the eight slip

roads. These modelled forecast flows are compared with observed flows in order to ascertain the accuracy of the original predictions.

Traffic Modelling Approach

- 2.20. At the time the scheme was appraised, the London to Ipswich (LOIS) multi-modal study was used as the basis of the future years traffic flows. LOIS was prepared in 2001 and included wider area committed development and highway schemes. These included the assumptions that the M25 widening would go ahead.
- 2.21. VISSIM software was used to demonstrate how the junction was predicted to operate in the future with and without the improvement scheme. The results taken from VISSIM provide the total amount of traffic passing through the junction and the average for 2008, 2013 and 2023.
- 2.22. The results predicted marked improvements in queues and delays over the existing and future year assessments.

Forecast vs. Observed Flows

- 2.23. **Table 2.1** shows the forecast traffic levels for 2007 compared to the observed traffic flows pre scheme. **Table 2.2** shows the forecast traffic levels for 2013 compared to the observed traffic flows in 2013.

Table 2.1 – 2007 (pre scheme) Predicted and Observed Traffic Flows

Map ref	Location	Direction	Predicted AADT 2007	Observed ADT pre scheme	2007 % Difference
A	A12 Through	EB	10,600	10,600	0%
B	A12 Through	WB	10,000	10,700	7%
C	A12 On-Slip	EB	21,800	19,400	-12%
D	A12 Off-Slip	WB	20,900	18,900	-11%
E	A12 On-Slip	WB	10,600	10,000	-6%
F	A12 Off-Slip	EB	11,000	10,200	-8%
G	M25 Through	CW	49,500	46,600	-6%
H	M25 Through	AC	45,400	46,800	3%
I	M25 On-Slip	CW	15,200	14,900	-2%
J	M25 Off-Slip	AC	16,400	16,500	1%
K	M25 On-Slip	AC	15,300	18,400	17%
L	M25 Off-Slip	CW	17,600	19,300	9%
M	Brook Street	EB	10,100	10,900	7%
N	Brook Street	WB	9,300	11,300	18%

- 2.24. Pre scheme, traffic levels were generally overestimated, with observed flows, particularly on the A12 slip roads being below that expected.
- 2.25. Observed flows on Brook Street pre scheme were higher than forecast, particularly westbound.
- 2.26. Observed flows on the M25 ACW on slip are 17% higher than forecast. The OYA report noted that this was likely to be due to an error in the traffic forecasts.

Table 2.2 – 2013 (post opening) Predicted and Observed Traffic Flows

Map ref	Location	Direction	Predicted AADT 2013	Observed ADT 2013	2013 % Difference
A	A12 Through	EB	9,900	9,800	-1%
B	A12 Through	WB	10,300	10,100	-2%
C	A12 On-Slip	EB	23,900	24,100	<1%
D	A12 Off-Slip	WB	22,000	24,400	11%
E	A12 On-Slip	WB	11,200	9,500	-16%
F	A12 Off-Slip	EB	11,600	9,500	-19%
G	M25 Through	CW	50,300	43,300	-14%
H	M25 Through	AC	54,700	43,400	-21%
I	M25 On-Slip	CW	15,800	16,400	4%
J	M25 Off-Slip	AC	18,000	15,700	-13%
K	M25 On-Slip*	AC	15,900	19,000	20%
L	M25 Off-Slip	CW	19,300	20,400	6%
M	Brook Street	EB	10,900	11,200	3%
N	Brook Street	WB	9,200	11,500	25%

* The OYA report highlights an error with the M25 CW Onslip. It was suggested that the prediction was too low and this may account for the significant difference between the predicted AADT and the observed ADT.

- 2.27. Post opening, the traffic flows on Brook Street WB were 25% higher than predicted. This suggests that the improvements have encouraged more traffic to use J28 than expected.
- 2.28. Observed flows on the A12 through the junction are very close to forecast. Flows on the A12 WB onslip and the A12 EB offslip are much lower than forecast, however observed flows have seen a decrease post opening, whereas an increase was forecast.
- 2.29. Other locations where the predicted flows for 2013 were significantly different than the observed flows in 2013 were:
- M25 AC Through (-21%)
 - M25 AC Onslip (20%)
 - A12 Offslip EB (-19%)

Journey Time Analysis

- 2.30. This section examines the journey times through the M25 J28 (A12 Brook Street) scheme area before the junction improvements and FYA the scheme improvements.

Sources

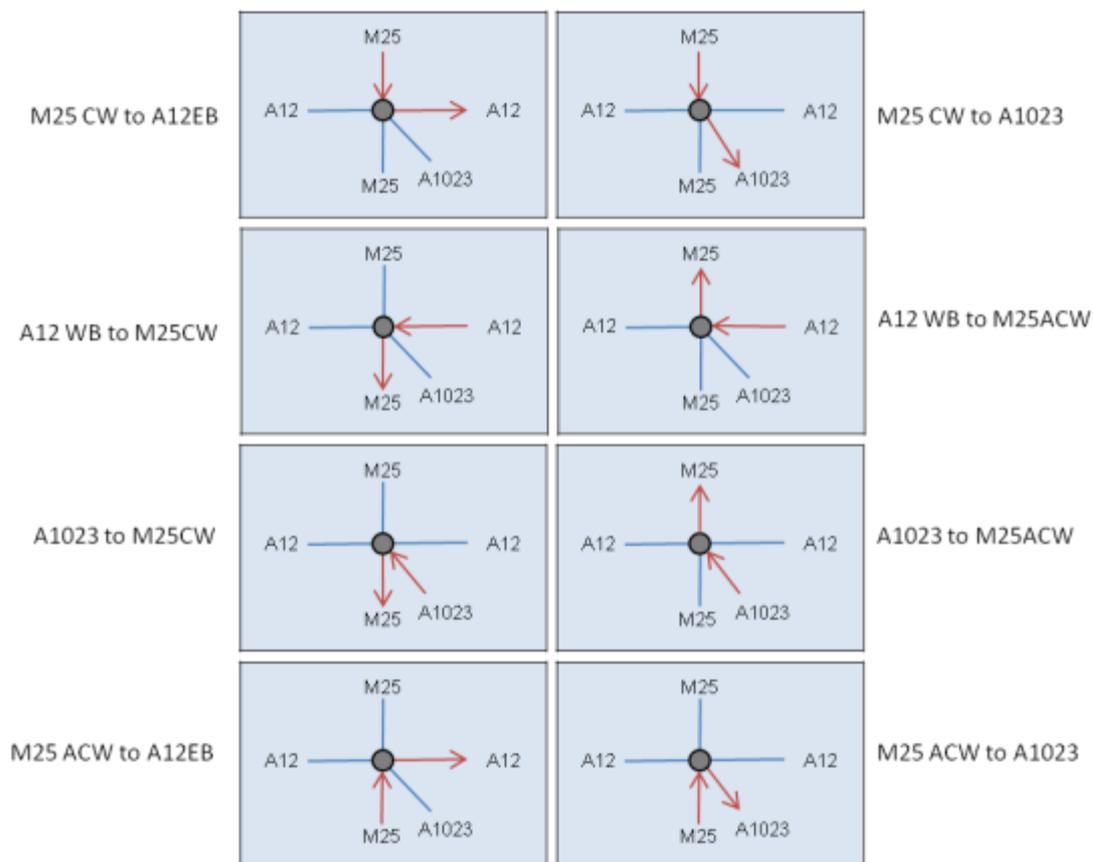
- 2.31. At the before stage six routes were selected to be recorded by the moving observer whereas at the FYA stage satellite navigation data was used. This data was available for all possible routes through the junction, however to ensure that the analysis remained relevant, atypical and irrelevant routes were not included; these routes were u-turns and routes that start and end on the same road (i.e. from the A12 WB back onto A12 WB). In total, 16 routes were assessed using the satellite navigation data.

2.32. Satellite navigation data was sourced for the period between May 2012 and May 2013 and included the following three time periods:

- **AM Peak Period:** 07:00 to 10:00
- **Inter-peak Period:** 12:00 to 15:00
- **PM Peak Period:** 16:00 to 19:00

2.33. Out of the 16 routes, 8 were selected for further analysis as these routes were most impacted most by the scheme. The remaining 8 routes were reviewed for any anomalies in data (e.g. major increases or decreases in journey times) and none were found. The 8 routes selected for further journey time analysis are illustrated in **Figure 2-6**.

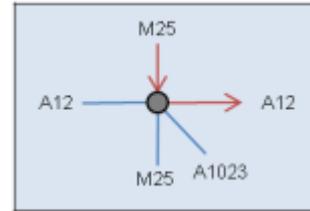
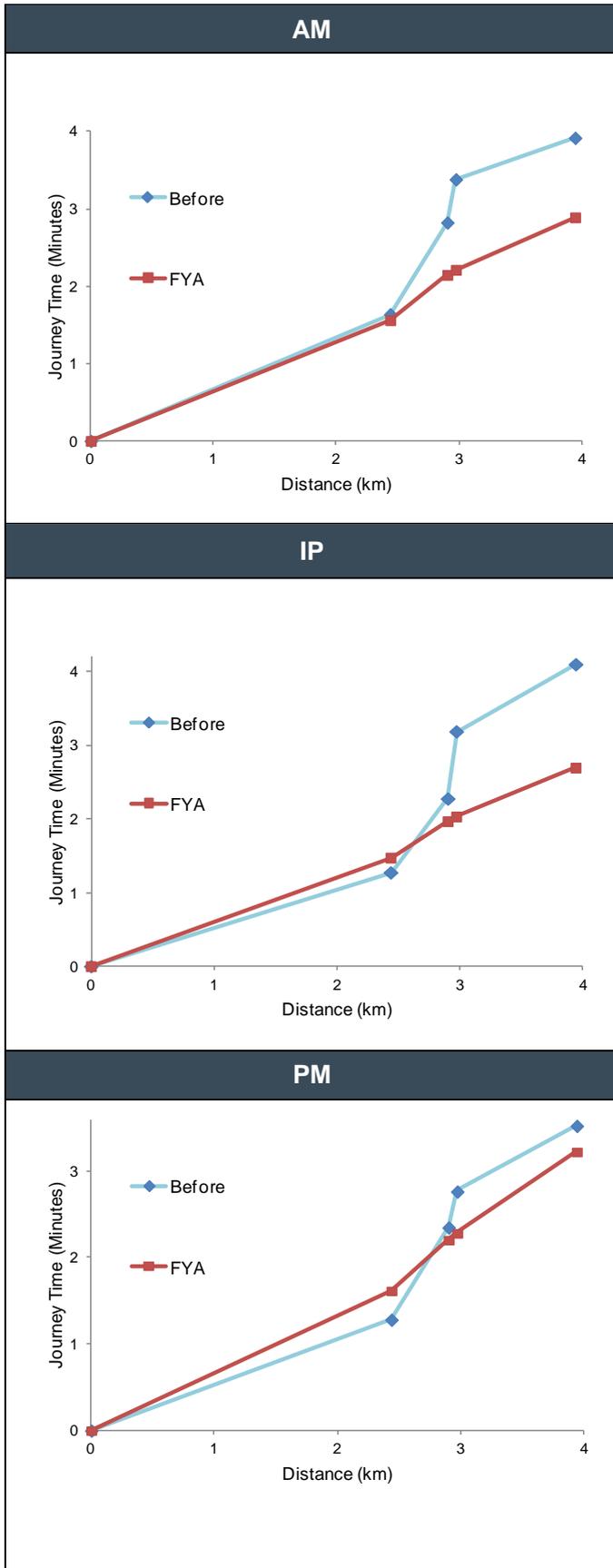
Figure 2-6 – Journey Time Routes



Before vs. After Journey Times

2.34. The eight routes have subsequently been analysed through a series of three graphs for each route. These compare the journey time before scheme and FYA, over the length of each route, for the AM, Inter and PM peak time periods.

Route: M25 CW Chequers Road Bridge to A12 E/B Spital Lane Bridge



Timing Points:

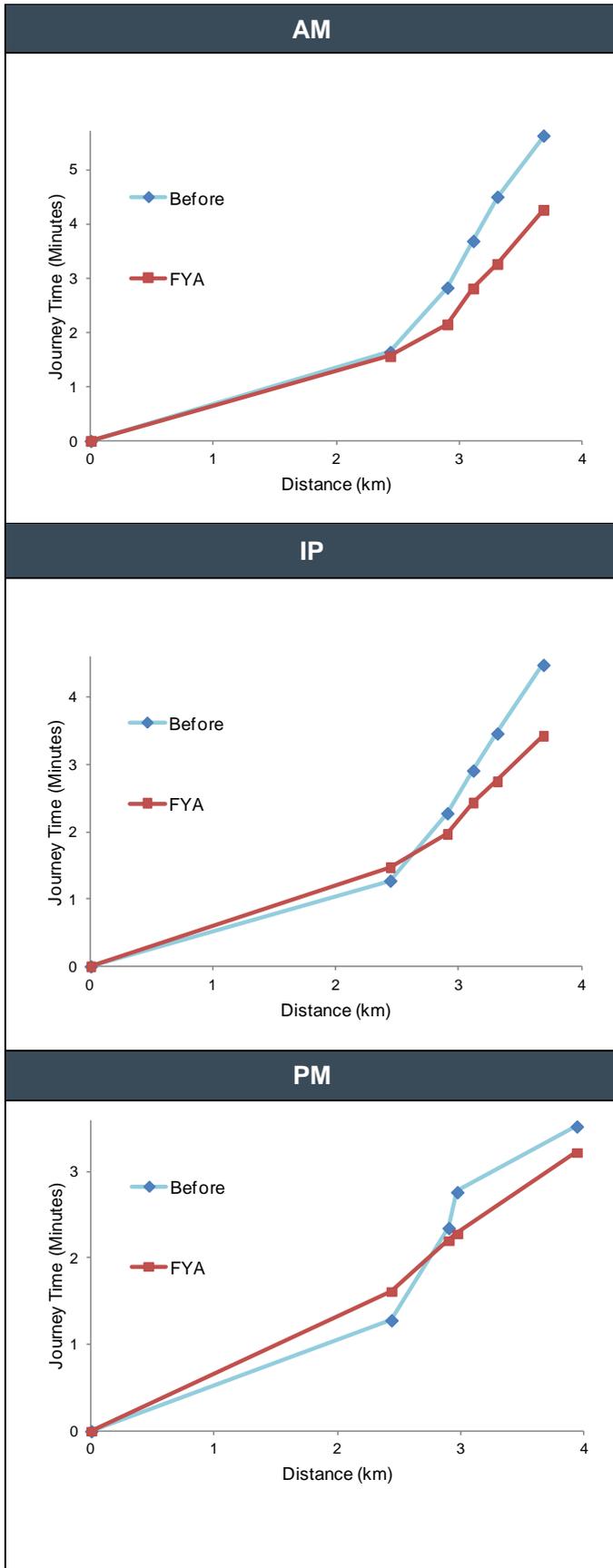
1. M25 – Chequers Road Bridge;
2. M25 Southbound J28 Start of Offslip
3. M25 J28 End of Offslip (Stopline)
4. A12 Eastbound End of Onslip
5. Spital Lane (Overbridge)

Summary of Changes:

The jet lane, installed as part of the scheme, is located on the section of roundabout between the M25 CW and the A12 EB. Therefore the jet lane is expected to have had a direct impact on journey times for this route. In addition to this, the extension to the merge lane is also expected to impact journey times as vehicles enter onto the A12 EB.

In the AM peak the timings are approximately equal until the start of the M25CW offslip. However, from this point through to Spital Lane Bridge (end point) the journey times have improved significantly; resulting in a total journey time saving of 1 minute 02 seconds. In the inter-peak and the PM peak, the journey times have increased between Chequers Road Bridge and the start of the M25 CW offslip, however the journeys times beyond this point have decreased resulting in an overall journey time saving of 1 minute 24 seconds and 18 seconds in the inter-peak and PM peak respectively.

Route: M25 CW Chequers Road Bridge to A1023 EB Nags Head Lane Junction



Timing Points:

1. M25 – Chequers Road Bridge;
2. M25 Southbound J28 Start of Offslip
3. M25 J28 End of Offslip (Stopline)
4. Roundabout A12 Westbound Offslip (Traffic Lights Stopline)
5. A1023 The Garden Centre
6. A1023 Nags Head Lane Junction

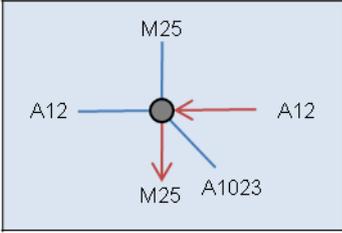
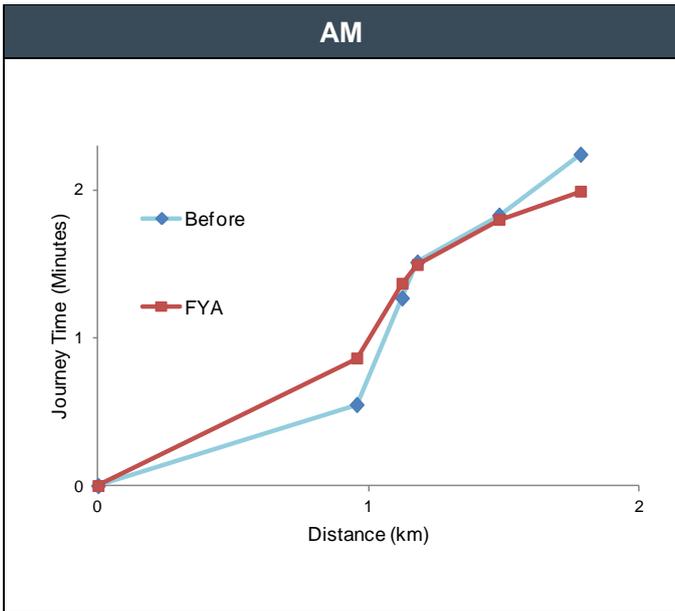
Summary of Changes:

The new jet lane was expected to have an indirect impact on this route across the M25 J28 (A12 Brook Street) roundabout due to reduced queuing at the end of the M25 CW offslip.

Journey time improvements are observed in all three periods. The improvements are very similar to those in the previous route (M25 CW to A12EB); having no impact on journey times between Chequers Road Bridge and the start of the M25 CW offslip in the AM peak and an increase in journey times in the inter-peak and PM peak periods.

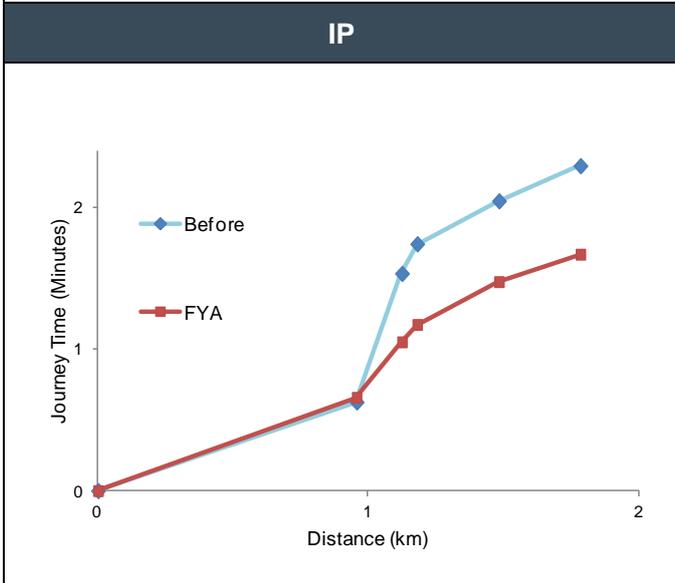
The greatest journey time saving overall was in the AM peak (1 minute 22 seconds) and the least saving was in the PM peak (47 seconds).

Route: A12 E/B Spital Lane Bridge to M25 ACW Nags Head Lane Bridge



Timing Points:

1. Spital Lane (Over Bridge)
2. A12 to J28 M25 Westbound Start of Offslip
3. A12 to J28 M25 Westbound End of Offslip (Stopline)
4. M25 J28 Southbound Start of Onslip
5. M25 J28 Southbound End of Onslip
6. Nags Head Lane (Overbridge)

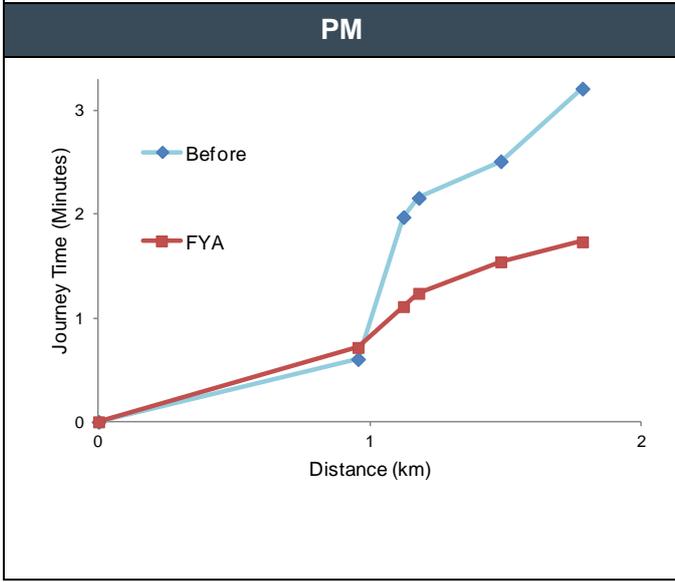


Summary of Changes:

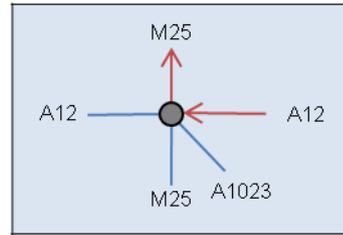
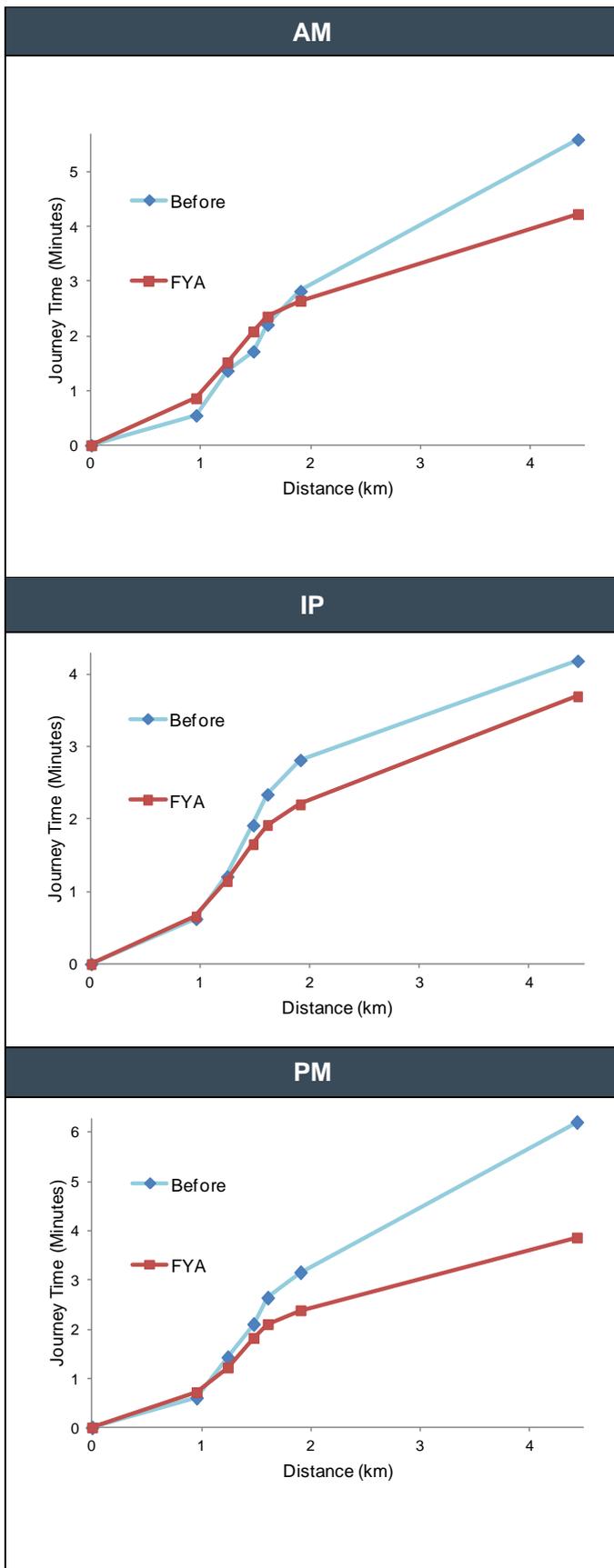
It is expected that the widening of the A12 WB offslip from three lanes to four lanes will have impact on journey times for this route.

In the AM peak the journey times at each stage have improved with the exception of the M25 ACW onslip (between the end of the A12 EB offslip and the M25 ACW end of onslip). The journey time saving on the M25 make up for this and results in a total journey time saving of 1 minute 22 seconds.

Journey time savings in the inter-peak and PM peak are 29 seconds and 2 minutes 21 seconds respectively.



Route: A12 W/B Spital Lane Bridge to M25 CW Chequers Road Bridge



Timing Points:

1. Spital Lane (Overbridge)
2. A12 to J28 M25 Westbound Start of Offslip
3. A12 to J28 M25 Westbound End of Offslip (Stopline)
4. M25 Northbound Offslip (Traffic Lights Stopline)
5. A12 Eastbound Offslip (Traffic Lights Stopline)
6. M25 J28 Northbound End of Onslip
7. Chequers Road (Overbridge)

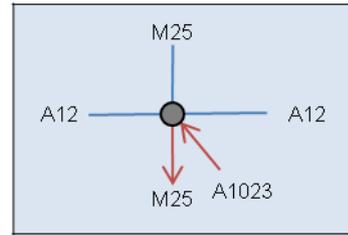
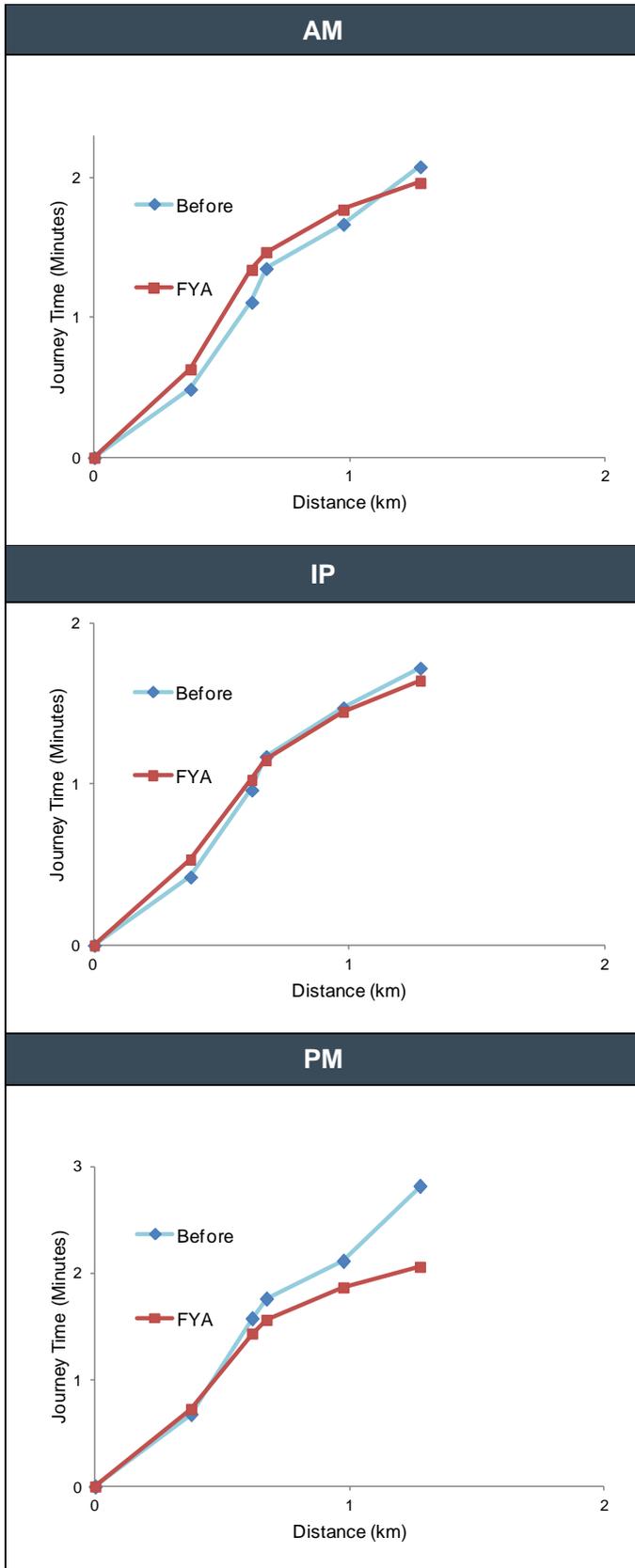
Summary of Changes:

It is expected that the widening of the A12 WB offslip from three lanes to four lanes will have impact on journey times for this route.

In the AM peak, there are journey time savings between the A12 Spital Bridge and the end of the A12 WB offslip, however the journey time difference on the M25 CW onslip is marginal. There are journey time savings on the M25 which results in a total saving of 15 seconds for the entire route.

In the inter-peak and the PM peak, journey time increase slightly on the A12 main carriageway but there are greater journey time saving from the start of the A12 WB offslip to the M25 Chequers Road bridge (i.e. journey time savings occur within the junction). The total journey time saving is 37 seconds (inter-peak) and 1 minute 29 seconds (PM peak).

Route: A1023 E/B Nags Head Lane Junction to M25 ACW Nags Head Lane Bridge



Timing Points:

1. A1023;
2. A1023 The Garden Centre
3. A1023 / M25 R'bout Stopline
4. M25 J28 Southbound Start of Onslip
5. M25 J28 Southbound End of Onslip
6. Nags Head Lane (Overbridge)

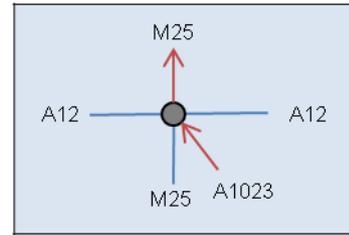
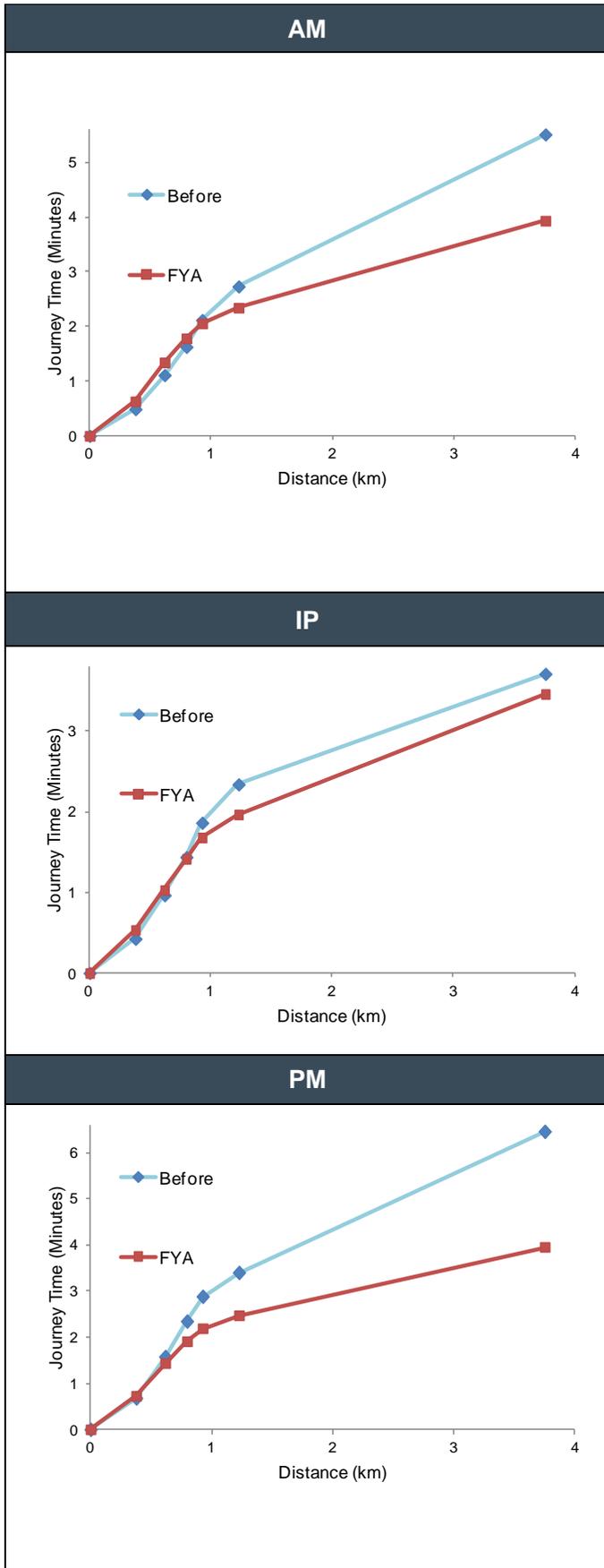
Summary of Changes:

The A1023 provides an alternative route between Brentwood and the M25 (other than the A12). It is unclear whether the improvements carried out on the A12 EB or the improvements carried out at the junction between the A1023 (Brook Street) and the J28 roundabout will have an impact on the A1023 journey times.

In the AM peak the journey times between the Nags Head Lane junction and the end of the M25 CW onslip have increased. Although the overall journey times have decreased by 7 seconds, all of the journey time savings have occurred on the M25 CW between the onslip and M25 Nags Head Lane (also counteracting the increased journey times prior to this stage).

In the interpeak journey time savings only occurred from the start of the M25 CW onslip (producing an overall saving of 4 seconds). Journey time savings occurred at an earlier stage in the PM peak (prior to the J28 roundabout) and journey times reduced by 46 seconds overall.

Route: A1023 E/B Nags Head Lane Junction to M25 CW Chequers Road Bridge



Timing Points:

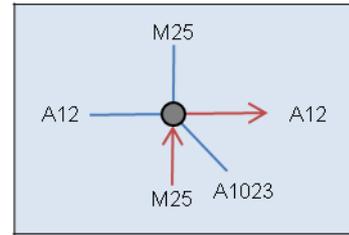
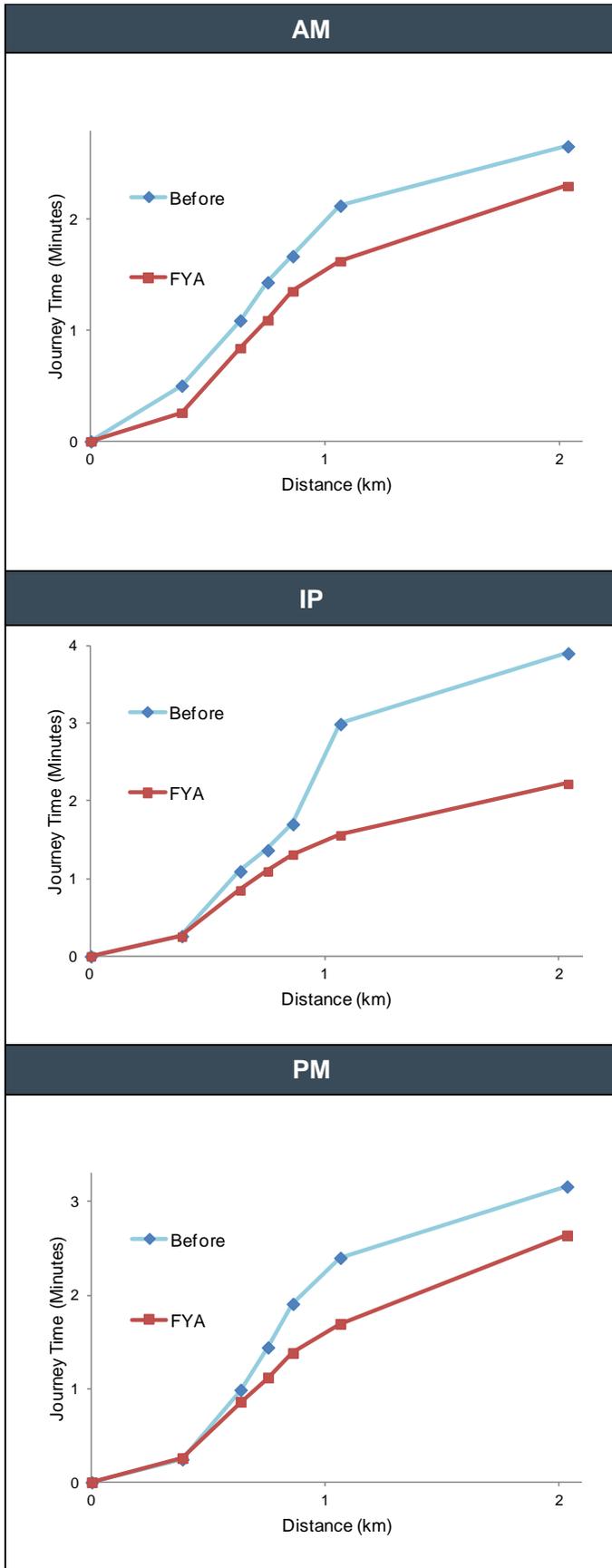
1. A1023 Nags Head Lane junction;
2. A1023 The Garden Centre
3. A1023 / M25 Roundabout Stopline
4. M25 J28 Northbound Offslip Traffic Lights Stopline
5. A12 Eastbound Offslip (Traffic Lights Stopline)
6. M25 J28 Northbound End of Onslip
7. Chequers Road (Over bridge)

Summary of Changes:

In the AM peak there is no journey time saving until the stop-line for the A12 EB offslip (on the roundabout), following this point the journey times reduce at each stage and by 1 minute 35 seconds overall. The inter-peak pattern is similar to the AM peak patterns but journey time savings begin at the end of the M25 ACW Offslip and the reduction is significantly less (15 seconds).

The greatest saving is in the PM peak where journey times are reduced by 2 minutes 30 seconds and journey time savings occurred from the A1023 / roundabout stop-line.

Route: M25 ACW Nags Head Lane Bridge to A12 E/B Spital Lane Bridge



Timing Points:

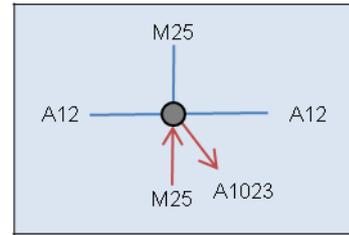
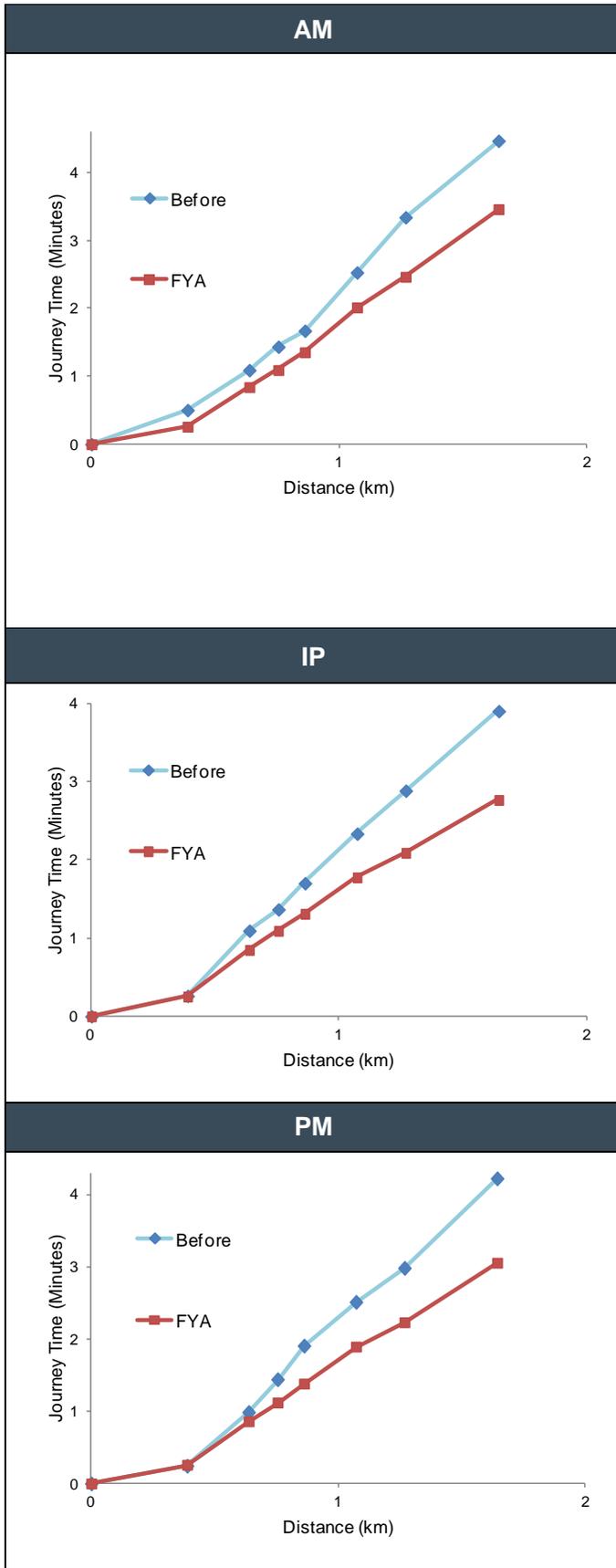
1. M25-South;
2. M25 J28 Northbound Start of Offslip
3. M25 J28 Northbound End of Offslip (Stopline)
4. A12 Eastbound Offslip (Traffic Lights Stop Line)
5. M25 Southbound J28 Offslip (Traffic Lights Stop Line)
6. A12 Eastbound End of Onslip;
7. Spital Lane (Overbridge)

Summary of Changes:

An additional two lanes were created on the M25 ACW offslip as part of the scheme and it is expected that this, along with the merge lane extension onto the A12 EB, will have an impact on journey times for this route.

Journey time savings are observed in all time periods for this route. The greatest saving is in the inter-peak period (1 minute 41 seconds), followed by the PM peak (31 seconds) and the least saving is in the AM peak (22 seconds). The journey times have reduced throughout each of the routes (all stages) and in all periods.

Route: M25 ACW Nags Head Lane Bridge to A1023 E/B Nags Head Lane Junction



Timing Points:

1. M25-South;
2. M25 J28 Northbound Start of Offslip
3. M25 J28 Northbound End of Offslip (Stopline)
4. A12 Eastbound Offslip (Traffic Lights Stop Line)
5. M25 Southbound J28 Offslip (Traffic Lights Stop Line)
6. Roundabout A12 Westbound Offslip (Traffic Lights Stopline)
7. A1023 The Garden Centre
8. A1023 Nags Head Lane Junction

Summary of Changes:

It is expected that the creation of two additional lanes at the end of the M25 ACW offslip will have an impact on journey times for this route.

There are journey time savings in all time periods for this route. The greatest saving is in the PM period (1 minute 10 seconds), followed by the inter-peak (1 minute 8 seconds) and the least savings are in the AM peak (1 minute 1 second). The journey times have reduced throughout each of the routes (all stages) and in all periods.

Overview of the 8 Key Routes

- 2.35. The route between the M25 CW and the A12 EB is perhaps the most important element of this scheme due to the anticipated benefits of the creation of the jet lane and the extension of the merge lane. The results show that the greatest journey time saving on this route is between the end of the M25 CW offslip and the start of the A12 onslip in all three timing periods – this is where the jet lane has been created as part of the scheme. The results suggest the jet lane has had a positive impact.
- 2.36. Vehicles travelling between the A12 WB to the M25 ACW in the AM peak saw an increase in journey times within the junction followed by significant journey time savings between the A12 EB offslip stop-line and the M25 Chequers Road Bridge which resulted in a journey time saving overall.
- 2.37. Journey times on the A12 WB offslip showed journey time saving in all periods (for the A12 WB – M25 CW route and the A12 WB – M25 ACW route). The savings ranged from 5 seconds (inter-peak) and 58 seconds (PM peak). The AM peak saving was between 10 seconds and 13 seconds. It is anticipated that, in part, these journey time savings were due to the creation of an addition lane on the slip road.
- 2.38. The M25 ACW offslip had an additional two lanes created as part of the scheme and it is expected that journey times will decrease as a result. In the inter-peak and the PM peak journey times decreased by 14 seconds and 8 seconds respectively. In the AM peak there was very little difference in the journey times.
- 2.39. Overall, the vast majority of routes and individual sections of routes had journey time savings. Many routes had increases of journey times in particular sections which were offset by decreases in journey times in other sections and resulted in an overall journey time saving. In the majority of cases the increase in journey times occurred within the junction and the journey time savings occurred on the main carriageways of the A12 and M25.

All Routes

- 2.40. The combined journey time savings for all stages on all routes are shown in **Table 2.3**, **Table 2.4** and **Table 2.5** for the AM, inter peak and PM peaks. The 8 key routes (analysed on the previous pages) are shown in bold.
- 2.41. In the analysis of journey times, u-turns and journeys that return to the main carriageway in the same direction are not included (e.g. M25 CW to M25 CW or M25 CW to M25 ACW).

Table 2.3 – 2013 AM Journey Time Savings (mm:ss)

From	To	M25 (CW)	A12 (WB)	Brook Street	M25 (ACW)	A12 (EB)
M25 (CW)			01:02	01:22		01:00
A12 (WB)		01:22		00:24	00:15	
Brook Street		01:35	00:05		00:08	-00:07
M25 (ACW)			00:22	01:01		00:17
A12 (EB)		01:31		00:57	00:48	

Table 2.4 – 2013 Inter-peak Journey Time Savings (mm:ss)

From	To	M25 (CW)	A12 (WB)	Brook Street	M25 (ACW)	A12 (EB)
M25 (CW)			01:25	01:04		01:07
A12 (WB)		00:30		01:04	00:38	
Brook Street		00:16	01:36		00:05	00:34
M25 (ACW)			01:42	01:09		00:48
A12 (EB)		-00:01		00:54	00:28	

Table 2.5 – 2013 PM Journey Time Savings (mm:ss)

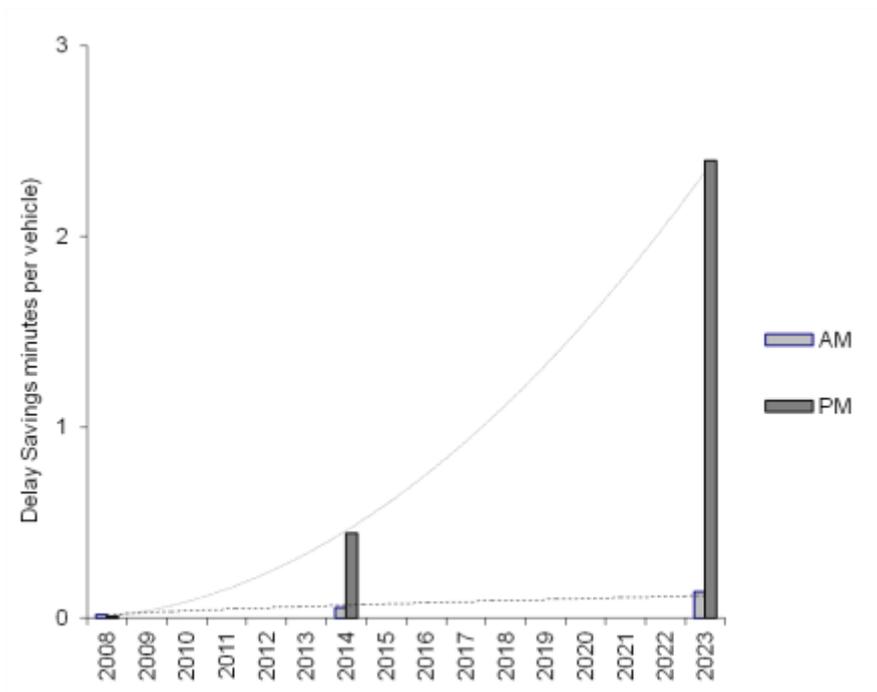
From	To	M25 (CW)	A12 (WB)	Brook Street	M25 (ACW)	A12 (EB)
M25 (CW)			00:19	00:48		01:12
A12 (WB)		02:21		01:25	01:29	
Brook Street		02:31	00:54		00:46	01:07
M25 (ACW)			00:32	01:10		00:48
A12 (EB)		01:08		00:23	00:27	

- 2.42. The greatest time savings have mainly been seen in the PM peak, where the average saving is 1 minute and 5 seconds. The average saving is 53 seconds and 48 seconds in the inter-peak and AM peak respectively.
- 2.43. The route with the greatest journey time saving was the route between the M25 CW (Nags Head Lane Bridge) and Brook Street in the PM peak period. Out of the three routes which originated from the M25 CW, 2 have had journey time savings of over 2 minutes in the PM peak period. It is worth noting that the remaining route is where the jet lane has been created and has received a lower journey time saving of 1 minute 8 seconds – this may be due to a greater level of use.
- 2.44. Two routes showed increased journey times, however these increases are too small to be considered significant and therefore are not a cause for concern.

Forecast vs. Observed Journey Times

- 2.45. The time savings forecast for this scheme were modelled using the micro-simulation software VISSIM. The results taken from VISSIM provide the total amount of traffic passing through the junction and the average vehicle delay in each individually modelled year. In the case of this scheme, it was for 2008, 2014 and 2023 as illustrated in Figure 2-7.

Figure 2-7 – Forecast average time savings per vehicle by year from VISSIM modelling up to design year



2.46. This graph makes it clear that the modelling was based on small impacts in the first few years, then steeply rising to the design year, especially in the AM peak. The benefits are based on the worsening of congestion in the DM scenario in response to traffic growth. The comparison between the forecast and observed FYA is illustrated in Table 2.6.

Table 2.6 – Forecast vs. Observed Journey Time Savings (mm:ss)

Time period	Average time saving per vehicle using junction (mm:ss)	
	Forecast	Observed FYA
AM	0:03	0:55
PM	0:27	1:00

2.47. In our observed data, the savings have been better than predicted, especially in the AM period. The better than expected results may be due to traffic flows being lower than predicted.

Journey Time Reliability

2.48. WebTAG states that reliability is a sub-objective of the economic assessment of a scheme and refers to the impact of the scheme on improving journey time variability. It also states that assessment of reliability is a rapidly developing area.

2.49. The AST states that a ‘reduction in accidents and delays would lead to improved reliability of trips through the junction’. However it also states that it has not been possible to quantify this’.

- 2.50. We have not compared the standard deviations of journey times because the before and after observed data is from different sources and sample sizes thus variation cannot be compared on a like-for-like basis.

Key Points

Traffic Flows

- Traffic levels decreased across both the M25 and A12 main carriageways from the pre-scheme stage to FYA stage in line with national trends.
- A number of slip roads show an increase in traffic flow, most noticeably on the A12 WB offslip where an increase of 31% is seen.
- An increase is also seen on the M25 CW offslip (1,100vpd, 5%) which is likely to be linked to the improvements, as this is where the new jet lane has been implemented.
- Traffic levels on Brook Street have increased 2-3% post opening between the OYA and FYA stages.

Traffic Forecasting

- Predicted flows were accurate for the A12 through traffic, although were slightly higher than expected for the A12WB off slip.
- Observed flows on the M25 through the junction were between 14% and 21% lower than expected.
- Forecast flows on the M25 slip roads varied in their accuracy, with the only the M25 ACW offslip observed flows being below the forecasts. Others were close to that forecast.
- Observed flows on the A12 WB onslip and the A12 EB offslip (to/from London) were shown to be between 16-19% lower than forecast.

Journey Times

- Journey time savings are seen on most routes considered and in all time periods.
- The greatest time savings have been seen in the PM peak, where there is an average saving of 1 minute and 5 seconds, compared with 53 seconds in the inter-peak and 48 seconds in the AM peak.
- The greatest journey time saving was shown on the route between the M25 CW and Brook Street during the PM peak.

Journey Time Forecasting

- Observed average time savings per vehicle are better than predicted, particularly in the AM peak. The better than expected results may be due to traffic flows being lower than predicted on some slip roads.

Journey Time Reliability

- The data available does not enable us to quantify the observed changes in reliability.

3. Safety

Introduction

- 3.1. This section examines how successful the scheme has been in addressing the objective of improving safety. The focus of this objective is to reduce the loss of life, injuries and damage to property resulting from transport collisions and crime. This is assessed by analysing the changes in numbers of incidents in which someone was injured occurring in the five years before start of construction and five years after opening. Evaluation of the scheme's impact on personal security has also been undertaken through the use of observations made during a site visit.
- 3.2. For the safety objective, the AST states the following objectives:
- Traffic queues removed from affecting A12 and M25 main carriageways.
 - Reduction in shunt-type collisions.

Changes since opening

- 3.3. Since the opening of the scheme new permanent reflective posts at the splitter island have been added, as well as a new lane allocation sign due to concerns over visibility/safety.

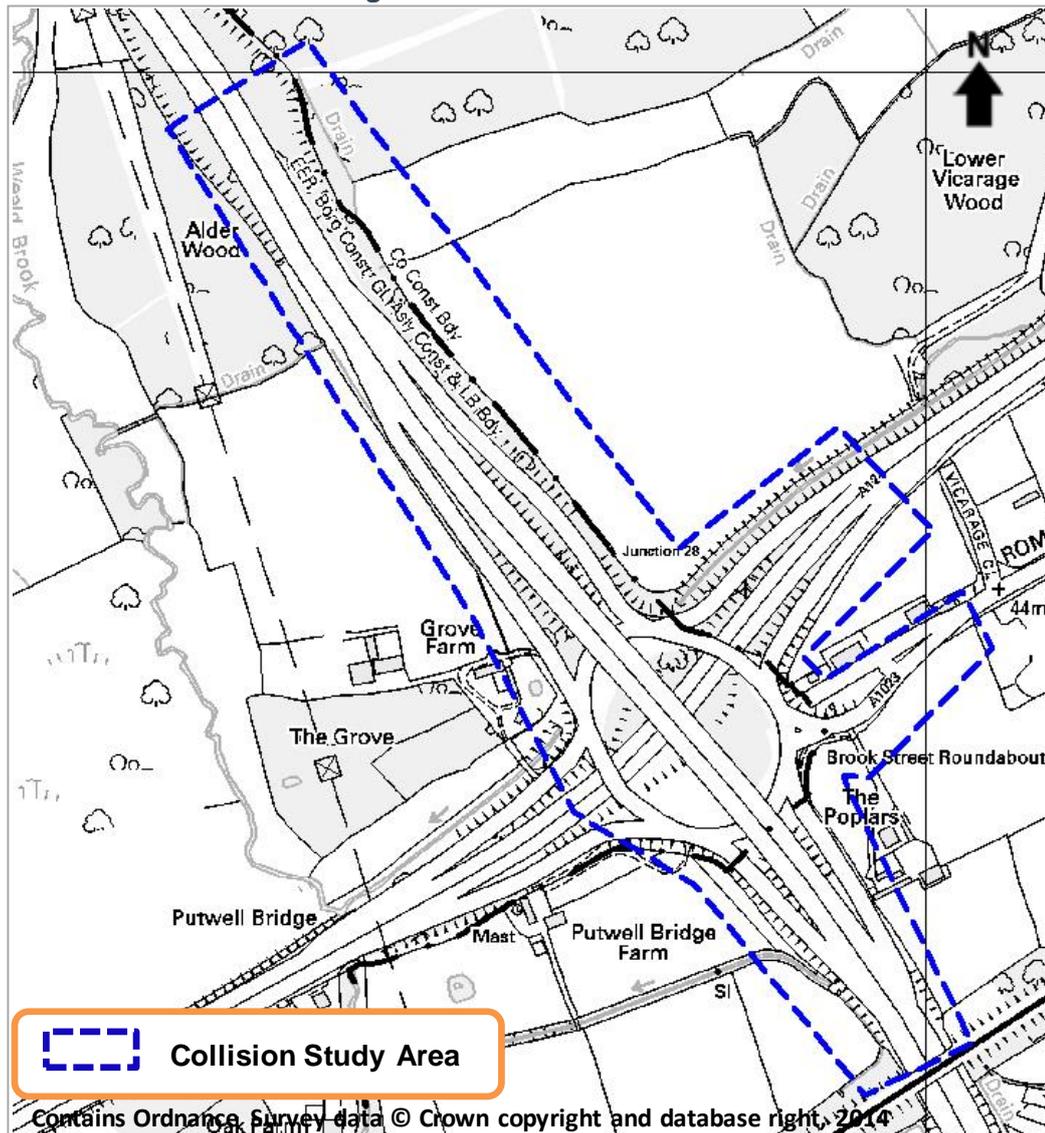
Forecast Data

- 3.4. For the purposes of assessing the collision impacts of the scheme, forecasts were produced of the numbers of collisions the scheme was expected to save, together with the associated numbers of casualties and monetary benefit of the savings. These forecasts have been obtained a spreadsheet model which based on a Cost Benefit Analysis (COBA) model. The forecast impact on safety is expressed in terms of numbers of Personal Injury Collisions (PICs) saved with the associated numbers of casualties and the long term economic benefit of the saving. It should be noted that forecasts of the economic or monetary impact of the forecast changes in collisions is evaluated in Chapter 4 of this report.

Study Area

- 3.5. The area used for the POPE safety analysis for the M25 J28 (A12 Brook Street) scheme is shown in **Figure 3-1**.
- 3.6. Collision data for the A12 southwest arm of the junction has not been included. This due to the data not being available at OYA stage and therefore a comparison could not be made at FYA stage. The boundary was considered to be of adequate distance from the junction on each arm to include slip roads and areas where deceleration / queuing or accelerating / merging were anticipated.

Figure 3-1 – Collision Scheme Area



Observed Data

- 3.7. The collision data was collected from the MACs for the sections of the M25 and A12 included in the study area, including the circulatory carriageway.
- 3.8. The five year 'before' period was 1st May 2002 to 30th April 2007, and the five year 'after' period was 1st April 2008 to 31st March 2013.
- 3.9. The collision data is based on PIC's (i.e. collisions that may involve injuries to one or more persons) as recorded in STATS19 data collected by the police when attending collisions. Collisions that do not result in injury are not included in this dataset and are thus not considered in this evaluation.
- 3.10. It should be noted that at this stage the collision data has not yet been validated by the DfT. The requirement for up to date and site specific information necessitated the use of unvalidated data sourced from the local authority. Thus the data is judged to be sufficiently robust for use in this study, but it may be subject to change. However, it is not anticipated that that this would be significant in terms of the analysis of collision numbers presented in this report.

Collision Numbers

- 3.11. An analysis of collisions which have occurred within the scheme boundary has been undertaken to investigate the impact of the scheme on both number of collisions and casualties. Collision data over a period of ten years was included – five years before opening and five years after opening – to determine the impacts of the scheme on collision levels.

Background Collision Reduction

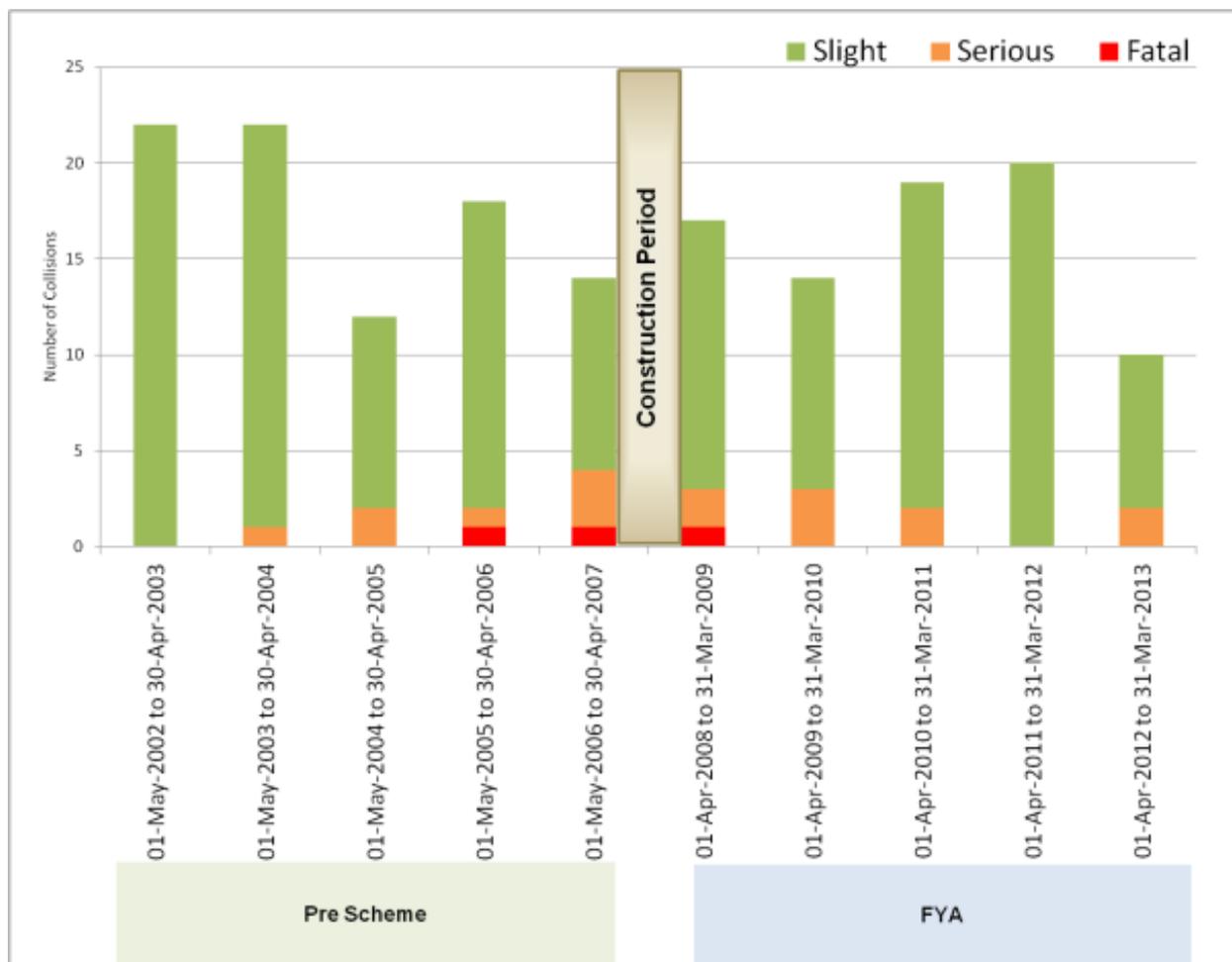
- 3.12. It is widely recognised that for over a decade there has been a year-on-year reduction in the numbers of personal injury collisions on the roads nationally, even against a trend of increasing traffic volumes during much of that period. The reasons for the reduction are considered to be multi-factorial and include improved safety measures in vehicles and reduced numbers of younger drivers. We need to consider this background trend when considering the changes in collision numbers within the study area. If the scheme had not been built, collision numbers in the area may still be influenced by wider trends and reduced.
- 3.13. When we compare the numbers of collisions in this area before and after the scheme was built and associate the net change with the scheme, we need to take this background reduction into account. The best way to do this is to assume that, if the scheme had not been built, the number of collisions on the roads considered here would have dropped at the same rate as they did nationally during the same period. This gives us what is known as the counterfactual 'without scheme' scenario on a like for like basis with the observed post opening data which is the 'with scheme' scenario.
- 3.14. The comparison needed is between the middle year in the after period (2010) and the middle of the pre-construction period (2004). The approach is to use national data for the changes in the numbers of collisions in this period occurring on all roads⁵.
- 3.15. The difference between the numbers of collisions in these two scenarios can then be attributed to the scheme rather than the wider national trends. This result will inform the calculation of monetised safety benefits achieved by the scheme as discussed in the economy chapter of this report.
- 3.16. **Figure 3-2** and **Table 3.1** compare the collision data from the pre-scheme five-year period and the post-scheme five-year period **Table 3.1** also includes the pre scheme counterfactual which is comparable to the FYA data.

⁵ The index of change on all road types between 2004 and 2010 is 0.74.

Table 3.1- Number of Collisions by Severity

Time Period	Date		Number of Collisions				Annual Average			
	From	To	Fatal	Serious	Slight	All	Fatal	Serious	Slight	All
Pre-scheme	May 2002	April 2003	0	0	22	22	0.4	1.4	15.8	17.6
	May 2003	April 2004	0	1	21	22				
	May 2004	April 2005	0	2	10	12				
	May 2005	April 2006	1	1	16	18				
	May 2006	April 2007	1	3	10	14				
Pre Scheme Counterfactual										13.1
FYA	April 2008	March 2009	1	2	14	17	0.2	1.8	14.0	16.0
	April 2009	March 2010	0	3	11	14				
	April 2010	March 2011	0	2	17	19				
	April 2011	March 2012	0	0	20	20				
	April 2012	March 2013	0	2	8	10				
Annual Average Collision Change (with counterfactual background reduction applied)										-2.9

Figure 3-2 - Number of Collisions by Severity



3.17. The following conclusions can be drawn from **Figure 3-2** and **Table 3.1**

- The average number of collisions reduced slightly, however when background reduction in collisions is taken into account, the scheme shows that there has been an increase of an average of 2.9 collisions a year, from a baseline of 13.1 to a post opening level of 16 per year.
- Collision severity has decreased slightly, with fatal collisions reducing by 50%, however serious collisions have increased by 29%. Due to the low numbers of fatal and serious collisions in both pre-scheme and post-scheme periods, the reduction in these collisions should not be overstated.

Casualty numbers

3.18. Reducing the number of people killed or seriously injured (KSI) in road collisions is also a Government objective. The number of casualties as a result of the collisions (including non-motorised users) occurring within the M25 J28 (A12 Brook Street) scheme area have been analysed. The results are presented in **Table 3.2** and **Figure 3-3**. It should be noted that the 'without scheme' counterfactual value (accounting for background reduction in associated collisions) has not been calculated for casualty numbers here, therefore a saving is still seen.

Figure 3-3- Number of Casualties

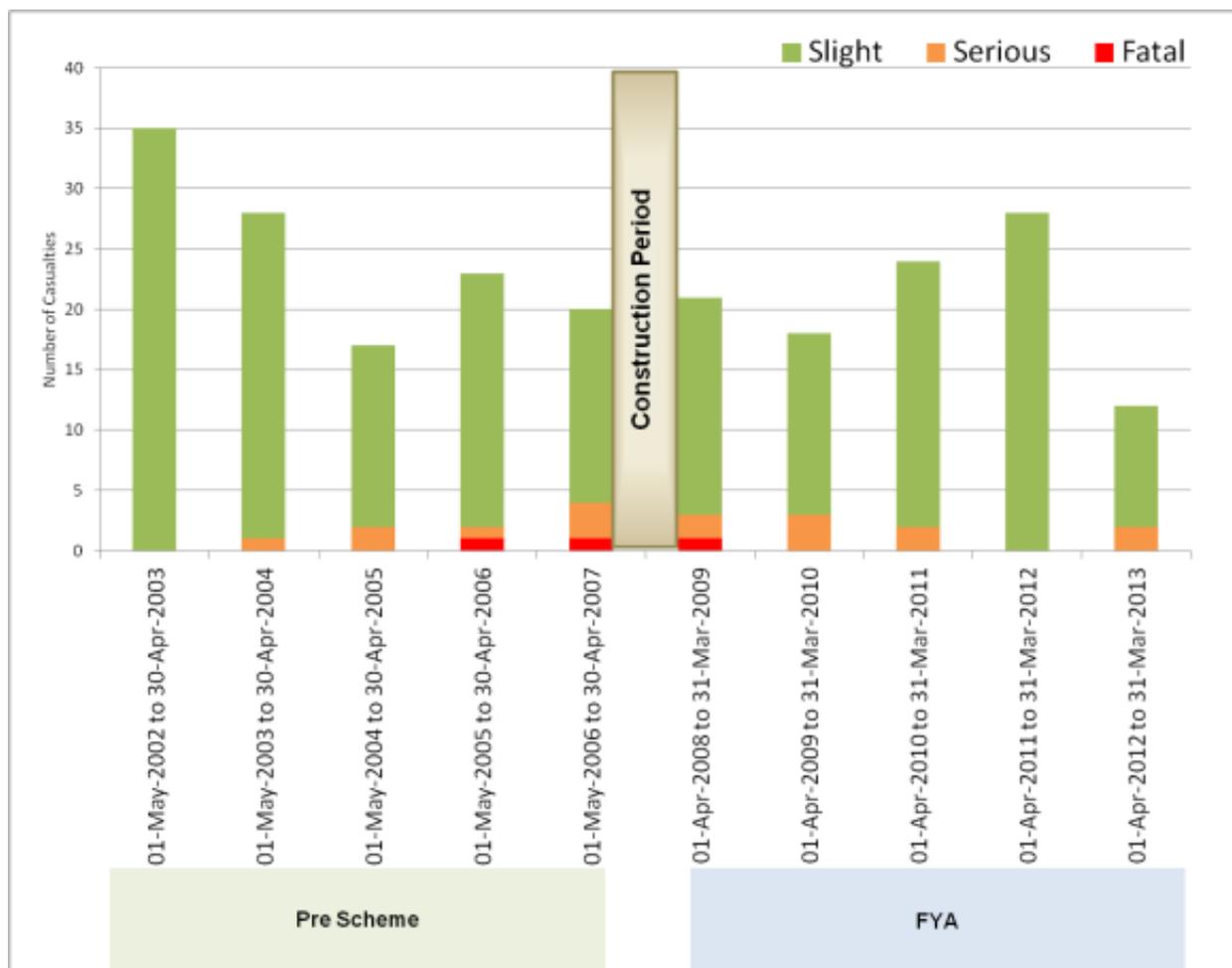


Table 3.2- Number of Casualties by Severity

Time Period	Date		Number of Casualties				Average Annual Casualties	KSI %
	From	To	Fatal	Serious	Slight	All		
Pre-scheme	May 2002	April 2003	0	0	35	35	24.6	7%
	May 2003	April 2004	0	1	27	28		
	May 2004	April 2005	0	2	15	17		
	May 2005	April 2006	1	1	21	23		
	May 2006	April 2007	1	3	16	20		
Post Opening	April 2008	March 2009	1	2	18	21	20.6	10%
	April 2009	March 2010	0	3	15	18		
	April 2010	March 2011	0	2	22	24		
	April 2011	March 2012	0	0	28	28		
	April 2012	March 2013	0	2	10	12		
Annual Average Casualty Reduction						4		

3.19. The results show that the number of casualties (annual average) has decreased, whereas the KSI index has increased. Fatalities have decreased between the pre-scheme period and the post-scheme period (from 2 fatalities to 1 fatality). However, serious casualties have increased (from 7 to 9). It is the increase in serious casualties and the reduction in overall casualties that has resulted in a greater severity index. Again, due to such low incidences of fatal and serious collisions, this result should not be overstated.

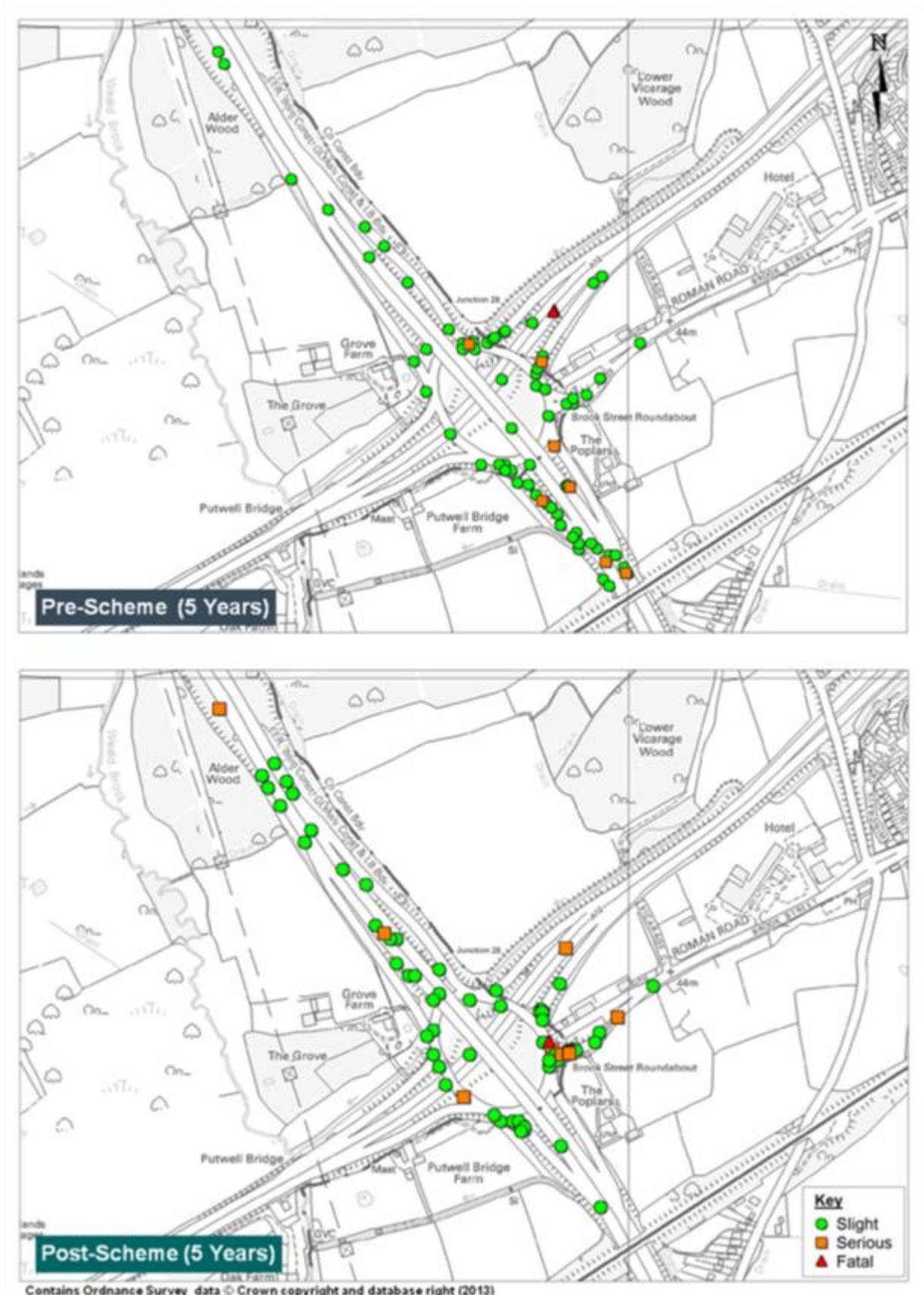
Non-Motorised Users

3.20. In the five year post-scheme period, there has been one incident involving a non-motorised user. This incident occurred on a private road leading onto Brook Street and it is not considered to be part of the scheme area.

Collision Locations

3.21. The locations of each collision in the pre-scheme and post-scheme period are shown in **Figure 3-4**.

Figure 3-4- Location of Collisions Pre-Scheme and Post-Scheme



3.22. The key points regarding the locations of collisions around M25 J28 as shown in **Figure 3-4** are:

- At the junctions between the M25 CW off-slip, the roundabout and the A12 EB on-slip, where the jet lane has been created, the number of collisions has reduced between the pre-scheme and post-scheme periods. No serious or fatal collisions have been seen at this location post opening.
- Following the creation of the additional two lanes on the M25 ACW off-slip, the number of collisions on the approach to the slip road (on the main carriageway) and on the beginning of the slip road has been reduced significantly. However, there has been no reduction in the number collisions in the vicinity of the junction between the slip road and the roundabout.
- A reduction is seen in serious collisions on the M25 ACW off-slip with no serious collisions recorded at this location post-scheme.
- Collisions at the junction between Brook Street and the roundabout have increased between the pre-scheme period and the post-scheme period. Also, there have been three serious collisions and a fatality recorded post-scheme, whereas in the pre-scheme period there were only slight collisions.

Statistical Significance

3.23. In order to determine whether the changes in collision numbers observed before and after the scheme opened are statistically significant, a Chi-Square test has been undertaken. This test uses the before and after numbers of collisions to establish whether the change in collision numbers is significant or is likely to have occurred by chance.

3.24. The result shows that the change in collision rate is not significant, and therefore the change in collisions post opening cannot be directly linked to the M25 J28 (A12 Brook Street) scheme and is likely to be due to chance.

Forecast vs. Observed Collision Numbers

3.25. This section compares the number of observed collisions with those that are forecast to occur. In order to ensure a valid comparison, it is necessary to compare the observed savings for the whole of the scheme area. For the observed collisions, the do minimum figures are based on the annual average of five years data before scheme construction, whilst the do something figures are based on an annual average of five years of post opening data.

Table 3.3 – Annual Collision Numbers: Forecast vs. Observed

Forecast		Observed	
Scenario	Annual Average Collisions	Scenario	Annual Average Collisions
Do Minimum (without scheme)	19	Pre-scheme	17.60
		Counterfactual pre-scheme	13.10
Do Something (with scheme)	18	Post Opening	16.00
Saving	1 (5%)	Saving	-2.90 (-16%)

- 3.26. The observed number of collisions (both pre-scheme and post-scheme) is lower than the forecast.
- 3.27. It was forecast that there would be 1 less collision per annum (5% reduction) in the post-scheme period than in the pre-scheme period.
- 3.28. Assuming that the national trend of safety improvement on roads would have occurred in this area, there would be an increase of 2.9 annual accidents on the road, representing an increase in accidents of 16%. Without factoring of the after collisions, there was an actual reduction of 1.6 collisions observed.

Personal Security

- 3.29. The aim of this sub-objective is to reflect both changes in security and the likely number of users affected. In terms of roads, security includes the perception of risk from personal injury, damage to or theft of vehicles, and theft of property for individuals or from vehicles.
- 3.30. For highway schemes, security issues may arise from the following:
- On the road itself (e.g. being attacked whilst broken down)
 - In service areas, car parks, and so on (e.g. vehicle damage while parked at a service station, being attacked while walking to a parked car)
 - At junctions (e.g. smash and grab incidents while queuing at lights).
- 3.31. The primary indicators for roads include surveillance, landscaping, lighting and visibility, emergency call facilities and pedestrian and cyclist facilities.

Forecast

- 3.32. The scheme appraisal in the AST (**Table 7.1**) states that 'upgraded road lighting' and the lighting of the 'footway under M25 flyover' will form part of the scheme improvements, causing an improvement in security. The AST has therefore predicted that the scheme will have a slight beneficial impact on personal security.

Observed

- 3.33. The OYA report stated that the lighting improvements had not been carried out. No further information was supplied at the FYA stage therefore the evaluation concludes that the impact of the scheme on personal security is neutral, given the absence of the lighting that gave the original assessment of slight beneficial.

Key Points

Collisions

- Assuming that the national trend of safety improvement on roads would have occurred in this area without the scheme, there has been an increase of 2.9 annual accidents at this junction, representing an increase in collisions of 16%.
- The number of collisions has reduced significantly between the pre-scheme and post-scheme periods where the jet lane has been built.
- Analysis of the statistical significance of the changes in collision numbers at this location shows that the changes could be due to chance, and therefore cannot be directly attributed to the scheme.

Casualties

- The annual average casualty rate has decreased post opening without any factoring of the post opening rate, however the KSI rate has increased, due to an increase of serious casualties.

Forecast vs Observed Collision changes

- At the appraisal stage, an annual average collision saving of 1 collision per year was forecast, a 5% decrease between the DM and DS scenarios. Observed data shows that there has been an average increase of 2.9 collisions a year (when the background reduction in collisions is applied), a 16% increase compared to pre scheme.

Personal Security

- In the absence of the planned lighting improvements, the scheme has been considered to have had a neutral impact on this sub objective.

4. Economy

Introduction

- 4.1. This section presents an evaluation of how the scheme is performing against the DfT's economy objective, which is defined in WebTAG as:

To support sustainable economic activity and get good value for money

- 4.2. The five sub-objectives for economy are to:

- Get good value for money in relation to impacts on public accounts
- Improve transport economic efficiency for business users and transport providers
- Improve transport economic efficiency for consumer users
- Improve reliability
- Provide beneficial wider economic impacts.

- 4.3. When a scheme is appraised, an economic assessment is used to determine the scheme's value for money. This assessment is based on an estimation of costs and benefits from different sources:

- Transport Economic Efficiency (TEE) benefits (savings related to travel times, vehicle operating costs and user charges)
- Collision costs (savings related to numbers and severity level of collisions)
- Costs to users due to construction and maintenance.

- 4.4. This section provides a comparison between the outturn costs and benefits and the forecast economic impact, and the scheme's wider economic impacts. Reliability is considered in Chapter 3 of this report.

Sources

- 4.5. The economic assessment presented in this section is based upon:

- M25 J28 (A12 Brook Street) Junction Improvement Economics Report (EAR) (September 2006)
- AST (October 2006)
- Outturn costs from the Regional Finance Manager

- 4.6. It should be noted that the AST was updated in May 2007. In particular a higher scheme cost and lower journey time benefits were quoted, but it was unclear how these figures were obtained, and hence this report will use figures from the October 2006 AST which match the Economics Report

- 4.7. The economic benefit of this forecast reduction in delay was estimated using the Highways Agency JUICE-9 spreadsheet model which is based on COBA and TUBA.

Journey Time Benefits

Appraisal Methodology

- 4.8. The Economics Report expressed the journey time benefits in terms of the value of delay saved. These forecasts were based on scheme modelling undertaken using the VISSIM micro-simulation software for the scenarios of with and without the scheme (Do Something and Do Minimum). The model covered the Junction 28 circulatory, the M25 and A12 either side of the junction, and a small section of Brook Street. It should be noted that the signalised junction at the Wigley Bush Lane junction on Brook Street (0.6km east of J28) was not modelled.

- 4.9. Forecast junction delays and traffic levels for the DM and DS scenarios output from the VISSIM model were then fed through a spreadsheet model called JUICE-9 which uses COBA and TUBA parameters to convert these delays into a monetary value. The net impact of delay saving with the scheme is then given a monetary value which is the journey time benefit for the scheme
- 4.10. The Economics Report predicted a 60 year benefit of £259.564m (2002 prices discounted to 2002) on, and around Junction 28 due to the scheme being implemented. A significant proportion of benefit occurs in the PM peak from 2023 onwards when delay time was expected to triple unless the scheme was built, as shown in **Figure 2-7**. The Economics Report stated that the first year rate of return (return on investment in the first year of scheme) to be only 0.2%. Examination of the benefits in the juice model show that it was in fact 0.01% in the first year rising to 0.4% in 2014. Benefits would rise steeply year-on-year to 2028, then dropping slowly for the remainder of the appraisal period. The spread of the benefits by year is due to the rise on the delay savings per vehicle in the peak periods. Expected benefits were low in the early years because projected traffic levels were not quite sufficient to seriously reduce the performance of the junction in the very short term
- 4.11. As discussed in Section 2 of this report, the VISSIM model's forecast time savings were expected to be low initially, but rising steeply. Clearly, the junction was forecast to become very congested in the PM period, when a certain traffic level is reached, if the scheme was not implemented.
- 4.12. The long term modelling was based on peak congestion in 2028, five years after the design year of 2023.
- 4.13. In the OYA study, it was stated that the widening of the M25 between junctions 27 and 30 would lead to congestion at junction 28 in the longer term. However at the time of writing in early 2014, the data on the OYA study for the J27-30 widening shows no real traffic growth as a result of the widening, thus the increase in congestion year-on-year around the junction without the J28 improvements cannot be assumed to be at the rate modelled in VISSIM.

Evaluation of Journey Time Benefits

- 4.14. Vehicle hours have been calculated using the observed journey time data as described in the Traffic section of this report for the key movements as follows:
- M25 CW to A12 EB (jet lane constructed to help this movement)
 - M25 CW to A1023 Brook St
 - A1023 Brook Street to M25 ACW
 - A1023 Brook Street to M25 CW
 - M25 ACW to A12 EB
 - M25 ACW to A1023 Brook Street
 - A12 WB to M25 CW
 - A12 WB to M25 ACW.
- 4.15. Traffic flows making each of these movements have been taken from the turning movements survey used in the traffic forecasting report (2003). As no significant change in routing at the junction was expected, the flows have not been 'growthed' up as the long term trend data on the M25 shows little growth. This ensures that we present a conservative approach to the benefits.
- 4.16. The OYA report presented several approaches to the evaluation of the journey times:
- Utilising PAR guidance to convert observed OYA daily vehicle hour savings into 60 year benefits.

- Using the JUICE-9 program, assuming a higher level of benefits occurring sooner than predicted on the basis that the small opening year savings were although low, equivalent to that predicted for one year later.
 - Using the JUICE-9 program, assuming lower traffic flows than predicted.
- 4.17. The conclusion at OYA was that given the high level of benefits predicted by JUICE to occur from 2023 onwards and the very low benefits predicted for the first year after opening, it was considered that it was too early at the OYA stage to conclude whether the scheme will achieve the predicted level of benefits.
- 4.18. At the FYA stage, we are now in a better position to evaluate the longer term financial impact. In particular:
- We see that the observed JT savings for turning movements at the junction are much higher than at OYA.
 - Traffic growth around the junction has not occurred at the rate predicted, so the predicted future year congestion from VISSIM is now further into the future, meaning the profile of the benefit stream in JUICE will overestimate the benefits.
- 4.19. The methodology selected for JT evaluation at the FYA stage is therefore is to use the PAR guidance to monetise the vehicle hours savings of the key journeys around the junction by using the Value of Time (VOT) to value each hour recognising that this ignores the high potential benefits in the later years. Here we present the results for the most conservative approach (0% growth) and for the expected national forecast growth (NTEM). The growth rate used in the appraisal was standard rate set out COBA at that time. We have used the PAR capitalisation from the guidance at the same period as the COBA used in the appraisal so that it will use the same growth rate. This is set out in Table 4.1 below.

Table 4.1 – FYA Outturn Economic Evaluation of TEE Benefits

Journey Time Benefits in 2002 prices based on PAR guidance		Calculation	
Observed Vehicle Hours saved in 2008	(a)	25,220	
Observed Vehicle Hours saved in 2013	(b)	102,541	
VOT in 2012	(c)	£12.66	
VOT Savings in 2012 £m	(d) = (a) x (c)	£0.32m	
VOT Savings in 2012 £m	(e) = (b) x (c)	£1.30m	
Interpolated benefits for years 2009-2012	(f) = interpolation between (d) and (e)	£3.23m	
VOT Savings in 2008-2012 discounted to 2002	(g) = ((d) + (f)) x disc factor	£2.89m	
	Growth:	0%	NTEM
Capitalisation Factor for 55 years	(h)	37.44	46.70
VOT Savings in 2013-2067 discounted to 2002	(j) = ((e) x (h)) x disc factor	£33.29 m	£41.53m
60- years VOT	(g) + (j)	£36.2 m	£44.4m

4.20. From this evaluation of the expected impact on VOT over 60 years, the forecast benefits are £44.4m in 2002 prices, discounted, based on expected national traffic growth.

4.21. **Table 4.2** compares the forecast with the outturn assessment.

Table 4.2 -TEE Benefits: Forecast vs. Outturn

Benefits in 2002 and values	Forecast based on JUICE	Outturn based on PAR guidance	
		0%	NTEM
TEE based on VOT	£259.6m	£36.2m	£44.4m

4.22. This shows that based on the PAR guidance, TEE benefits are only 17% of those forecast. This is due to the fact that unlike the more complex JUICE approach, this method does not include non-linear treatment of the increased in congestion impacts at the junction, hence we recognise that this represents a conservative estimate.

Safety Benefits

Forecast of Safety Benefits

4.23. For the purpose of assessing the economic impacts of road schemes, changes in safety as measured by changes in collision numbers and severity are monetised. Forecasts are generated using the methods and collision rates contained in the COBA Manual (DMRB Volume 13, Section 1) and embodied in the computer program COBA. For this scheme, as the values for traffic flows are available from the VISSIM model it was considered to be more robust to calculate the savings from the first principles contained within COBA rather than just apply average growth factors from the HA guidance.

4.24. This approach predicted a saving of three collisions in the opening year resulting in a 60 year monetary benefit of £4.73m in 2002 prices discounted to 2002. The scheme was predicted to achieve these savings by saving one shunt type collision in the opening year at three of the improved off-slips joining the roundabout.

Evaluation of Safety Benefits

4.25. The post opening evaluation of the safety benefits is normally based on monetising the observed changes in numbers of collisions. However for this scheme as noted in the safety chapter, the change in the numbers of collisions was not statistically significant, so we conclude zero monetary impact of on safety.

Scheme Costs

Introduction

4.26. This section compares the forecast costs of the scheme as of the start of the construction period with the actual spend at the time of this study.

4.27. Costs of the scheme are also considered for the full appraisal period of 60 years such that they can be compared with the benefits over the same period. The full costs examined for this scheme were made up of the following:

- Investment costs: before and during construction
- Renewal costs 30 years after opening.

- 4.28. The predicted scheme costs have been obtained directly from the Economics Report and were given in Q1 2005 prices; these have been re-based common price base of 2002 for comparison with outturn. For comparison with the economic benefits, overall costs are expressed in terms of present value, termed Present Value Cost (PVC).

Investment Costs

- 4.29. The investment cost is the cost to the HA of the following:
- Costs of construction
 - Land and property costs
 - Preparation and supervision costs
 - Allowance for risk and optimism bias.
- 4.30. The outturn spend profile for this scheme has been obtained from the HA Regional Finance team for the purpose of this study and covers the period 2005 – 2013. For the purpose of comparison between forecast and actual, and with other major schemes, prices have been converted to 2002 prices. This figure can then be compared with the forecast cost on a comparable basis.
- 4.31. Comparison between the forecast and outturn is presented in **Table 4.3**.

Table 4.3 – Scheme Investment Costs (£m, 2002 prices)

	Forecast Cost (Sept 2006)	Outturn Cost (Sept 2013)	% difference
Works, preparation, supervision	7.06	11.03	
Risk, Optimism bias, inflation	3.03	-	
Land	0.38	0.03	
Cost in £million 2002 prices, undiscounted	10.47	11.09	6%

- 4.32. The key point regarding scheme cost as shown in **Table 4.3** is that the outturn cost was 6% more than forecast.

Present Value Costs (PVC)

- 4.33. Cost benefit analysis of a major scheme requires all the costs to be considered for the whole of the appraisal period and they need to be expressed on a like-for-like basis with the benefits. This basis is termed Present Value. Present Value is the value today of an amount of money in the future. In cost-benefit analysis, values in differing years are converted to a standard base year by the process of discounting giving a present value.
- 4.34. Following current Treasury Green Book guidance, calculation of the present value entails the conversion to market prices, then discounting by year. This using a rate of 3.5% for the first 30 years and 3% thereafter. Calculation of the PVC in the EAR included the future renewal costs in the PVC, as a ratio of the original costs, and provision for additional costs associated with night time working.

Table 4.4 – Present Value Costs (£m)

Present Value £m (Costs in 2002 prices, discounted)	Forecast	Outturn
Costs including renewal at 30 years	14.8	15.7

- 4.35. Note that, in the appraisal of this scheme, the impact of the scheme on Indirect Tax Revenue was not included as JUICE does not cover it. Likewise it has not been evaluated here. Also noted that market prices were not used in the presentation of the costs in the EAR.

Benefit Cost Ratio

- 4.36. The benefit-cost ratio (BCR) is an indicator used in the cost-benefit analysis of a road scheme that attempts to summarize the overall value for money of a project or proposal. The BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. All benefits and costs are expressed in present values as detailed in the above sub-sections.
- 4.37. **Table 4.5** shows the calculation of the BCR using the costs and benefits presented earlier in **Table 4.4** and **Table 4.2**. Note that unlike many other major schemes, indirect tax was not included in the appraisal and has likewise not been considered here.

Table 4.5 – Benefit Cost Ratio (BCR)

		Forecast	Outturn evaluation	
			0% traffic growth	NTEM traffic growth
Present Value Benefits	TEE	£259.564m	£36.2 m	£44.4m
	Safety	£4.726m	£0	£0
	Total	£264.3m	£36.2m	£44.4m
Present Value Costs		£14.8m	£15.7m	
Benefit Cost Ratio		17.9	2.3	2.8

- 4.38. The key points regarding the BCR are:
- BCR is much lower than predicted due to lower TEE benefits but the outturn BCR still represents a return of over £2 for every £1 spent.
 - It is also recognised that the outturn BCR excludes longer term increases in benefits as it cannot be currently justified using observed data.
- 4.39. It should be noted that the BCR ignores non-monetised impacts. In the former NATA assessment and its replacement, the Transport Business Case, the impacts on wider objectives must be assessed but are not monetised. The evaluation of the environmental, accessibility and integration objectives is covered in the following sections.

Wider Economic Impacts

- 4.40. It is inherently difficult to isolate wider economic impacts which could be attributed to the scheme. However, it is important to understand the socio-economic context in which the scheme opened and how the M25 J28 (A12 Brook Street) Improvements scheme may have assisted local and regional socio-economic aspirations.

Forecast of Wider Economic Impacts

- 4.41. The AST, as shown in **Table 7.1**, forecast that the scheme would provide improved accessibility to/from major national and regional economic centres by providing journey time savings. The level of benefit was not valued and the wider economic impact was predicted to be neutral.

Evaluation of Wider Economic Impacts

Local Policy

- 4.42. As this report shows, the M25 J28 (A12 Brook Street) Improvements have reduced journey times. This is a strategic location on the network, and has therefore acted to improve connectivity between various communities and economies. This is therefore aligned with local policy. The Essex and Southend-On-Sea Replacement Structure Plan 1996-2011 states that a strategic transport priority is to improve access to Haven Ports and East Anglia; as the A12 route connects the London region with these areas, it is acting to fulfil this objective.
- 4.43. The Essex and Southend-on-Sea Replacement Structure Plan 1996-2011 prioritises multi-modal improvements to parts of the inter-urban transport network which are of international, national and strategic importance and can contribute to economic growth. The Essex Local Transport Plan 2011-2026 also states that the Council's Highways Strategic Transformation seeks to 'provide connectivity for Essex communities and international gateways to support sustainable economic growth and regeneration'. It should be noted that the M25 and A12 are part of the Trans European Network (TEN), which aims to improve interconnections between national networks. As the scheme has improved journey times, it is aligned with achieving the above policy aims.

Regional Policy

- 4.44. The Regional Spatial Strategy (RSS) for the East of England (2004) prioritises improving access to opportunities in London, while the Spatial Development Strategy for Greater London (2009) has a vision for a city where it is convenient for everyone to access jobs, opportunities and facilities. By improving journey times at Junction 28, connections into London have been improved by the scheme.

Summary of Wider Economic Impacts

- 4.45. The M25 J28 (A12 Brook Street) is in a strategically important location at a regional, national and international scale. Evidence in this report has shown that journey times in the scheme section have reduced (see tables **Table 2.3**, **Table 2.4** and **Table 2.5**).
- 4.46. Taking into account the importance placed on efficient transport connections in local and regional policy, and the findings of this report, it can be concluded that the scheme would have improved accessibility to and from major national and regional economic centres. However, as forecasted, this level of benefit is relatively low, the wider economic impact of neutral would be appropriate.

Key Points

Present Value Benefits

- Reductions in journey times for 8 key movements around the junction in the peak periods have been valued as £44.4m over 60 years. This is however much less than forecast because forecasting expects a high rate of increase in congestion in future years, peaking in 2028.
- No monetary safety benefits are attributed to the scheme, as there is no statistical confidence the change in the number of collisions identified in the observed data.

Present Value Costs

- Investment cost at £11m was close to that predicted, only 6% higher.

Benefit Cost Ratio

- The outturn BCR represents over £2 for every £1 spent which represents high value for money.
- This was much lower than forecast because that included higher benefits from journey times due to avoiding predicted congestion in future years, not just that observed before.

Wider Economic Impacts

- Due to the inherent difficulty in isolating the wider economic impacts of the scheme, it has not been possible to conclude whether the scheme has had a direct impact on stimulating local economic activity. However, the scheme has assisted in delivering local and regional socio-economic policy aspirations by improving the network through the reduction of journey times. However, as this benefit is relatively low level, it has been concluded that the scheme has been neutral regarding wider economic impacts.

5. Environment

Introduction

- 5.1. This section documents the evaluation of the environmental sub-objectives, focussing on those aspects not fully evaluated at the One Year After (OYA) stage or where suggestions were made for further study.

Summary of OYA Evaluation Recommendations

The OYA evaluation identified a number of areas where further analysis was required at the Five Year After (FYA) stage to confirm the longer term impacts of the scheme on the surrounding environment, these are summarised as follows:

Noise - At OYA it was confirmed that low noise road surfacing had been provided and that noise insulation had been discussed for three properties, with a final decision for noise insulation made from the Part 1 Claims process. At OYA it was reported that this information would be requested as part of the FYA evaluation.

Landscape – Existing lights have been replaced with new high pressure low cut-off lights on 10m or 12m columns at locations immediately adjacent to new carriageway construction. The existing carriageway was already lit and it was considered likely at OYA that the impact from the replacement lighting system would be similar to predicted. Night time lighting could be considered further at the FYA stage.

Biodiversity – A badger licence permitting work close to a sett adjacent to the works was issued in late 2007, and although the sett was not destroyed, it was not confirmed at OYA whether the sett had been re-occupied. Consultation should extend to the Local Wildlife Trust or Badger Group for the FYA report.

- 5.2. The ES assessed the potential impacts of the construction and operation of an improved interchange linking the M25 (Junction 28), the A12, and the A1023 (also known as Brook Street), and did not identify any major environmental constraints.
- 5.3. The following environmental sub-objectives were appraised in the ES and in the Appraisal Summary Table (AST) according to guidance in place at that time (2002):
- Noise
 - Local Air Quality
 - Greenhouse Gases
 - Heritage
 - Landscape
 - Townscape
 - Biodiversity
 - Water Environment
 - Physical fitness
 - Journey Ambience
- 5.4. For each of these environmental sub-objectives, the evaluation in this section assesses the environmental impacts predicted in the scheme's AST and ES against those observed FYA opening.
- 5.5. In the context of the findings from the OYA evaluation and using new evidence collected FYA opening, this section presents:

- An evaluation of the ongoing effectiveness of the mitigation measures implemented as part of the scheme
- An updated summary of key impacts against all of the nine environment WebTAG sub-objectives, with particular focus on assessment of sub-objectives where it was too early to conclude at the OYA evaluation stage
- Additional analysis relevant to close out issues/ areas for further study as identified at the OYA stage for consideration at the FYA stage

Methodology

- 5.6. This section focuses on those aspects not fully evaluated at OYA, or where at OYA, suggestions were made for further study and also any issues that have arisen since the OYA evaluation. The detail of the OYA study is not repeated here, and reference is made to the OYA report where required, although key points are incorporated into this FYA report where appropriate to provide contextual understanding.
- 5.7. No new modelling or survey work has been undertaken for this FYA environmental evaluation.

Data Collection

- 5.8. The following documents/ data have been used for the FYA evaluation:
- Appraisal Summary Table (May 2007)
 - M25 Junction 28 (A12 Brook Street) Improvement Environmental Statement (October 2006) Volume A (main text) and Volume B (figures, including Outline Landscape Mitigation plans)
 - M25 Junction 28 (A12 Brook Street) Improvement Handover Environmental Management Plan (April 2008)
 - Highways Agency Area 6 Deer Study (March 2010)
 - Environment Agency data on the Proportion of Sediment Sensitive Invertebrates;
 - Air Quality Progress Report for Brentwood Borough Council (August 2013)
 - Air Quality Detailed Assessment for Brentwood Borough Council (September 2013)
 - 'As Built' drawings
 - Post Opening Project Evaluation One Year After Study: M25 Junction 28 (A12 Brook Street) Junction Improvement (April 2011).
- 5.9. A full list of the background information requested and received to help with the compilation of this report is included in Appendix C.1.

Site Visit

- 5.10. As part of the FYA evaluation, a site visit was undertaken in early August 2013. This included the taking of photographs to provide comparison with material produced for the ES and at OYA (Appendix C.2).

Consultation

- 5.11. Statutory environmental organisations (Natural England, English Heritage and the Environment Agency), Local Authorities and relevant scoping Consultees were contacted as part of the FYA evaluation regarding their views on the impacts they perceive the road has had on the environment as shown in **Table 5.1**.

Table 5.1 – Summary of Environmental Consultation Responses

Organisation	Field of Interest	Comments at OYA	Comments at FYA
Natural England (Contacted by email)	Biodiversity & Landscape	No response as very little involvement in the scheme.	Did not respond to the invitation to provide feedback.
English Heritage (Contacted by email)	Heritage	No response as very little involvement in the scheme.	Did not respond to the invitation to provide feedback.
Environment Agency (Contacted by email)	Water	Commented on Water.	Responded that it was unable to provide any official comment. Data provided for interpretation by POPE.
Essex County Council (Contacted by phone and email)	General	Commented on Heritage.	Did not respond to the invitation to provide feedback.
Brentwood Borough Council (Contacted by phone and email)	General	Commented on Landscape, Biodiversity, Local Access, Water, Air Quality and Noise.	Did not respond to the invitation to provide feedback.
London Borough of Havering (Contacted by phone and email)	General	Commented on Water, Air Quality, and Noise. No response for Heritage as no involvement in scheme.	Did not respond to the invitation to provide feedback.
Greater London Authority (Not contacted)	Biodiversity	No response as no involvement in the scheme.	Not invited to provide feedback.
Essex Ecology Services Ltd (EESL) (Contacted by email)	Biodiversity	No response as EESL does not comment on developments.	Responded that it was unable to provide informed comment as no involvement in the scheme
Sustrans (Contacted by phone and email)	Physical Fitness	No response as no recent involvement.	Did not respond to the invitation to provide feedback.
Landscape Science Consultancy (Contacted by phone and email)	Biodiversity	No response as no recent involvement.	Did not respond to the invitation to provide feedback.
Greenspace Information for Greater London (GIGL) (Contacted by email)	Biodiversity & Landscape	No response as GIGL does not comment on developments.	Did not respond to the invitation to provide feedback.
Essex Wildlife Trust (Contacted by phone and email)	Biodiversity	Not contacted at OYA.	Did not respond to the invitation to provide feedback.
Essex Badger Protection Group (Contacted by phone and email)	Biodiversity	Not contacted at OYA.	Commented that badger sett occupancy is unknown, and no road kills have been reported in the area.

- 5.12. The Area 5 Managing Agent Contractor (MAC) has been consulted with regard to animal mortality figures, as has the Area 6 MAC. Figures have been made available for the M25 Junction 28 (A12 Brook Street) junction for the eight year period between 2006 and 2013 inclusive, and these are discussed in the biodiversity chapter.

Traffic Forecast Evaluation

- 5.13. Three of the environmental sub-objectives (noise, local air quality and greenhouse gases) are directly related to traffic flows. No new noise or air quality surveys are undertaken for Post-Opening Project Evaluation (POPE) and an assumption is made that the level of traffic and the level of traffic noise and local air quality are related.
- 5.14. The ES outlined the need for the scheme and included data on the Annual Average Daily Totals (AADT) for traffic flows. In order to provide a context for the following review and evaluation of environmental topics, the key findings and assumptions given in the ES, dated October 2006, are summarised as follows:
- There was no underlying development associated with the junction, and the Highways Agency (HA) had implemented proposals to widen the M25 to four lanes. The additional capacity on the M25 with underlying traffic growth was considered in the traffic analysis.
 - Existing (base year) 2003 traffic flows were 114,000 AADT (M25), 60,000 AADT (A12), and 19,000 AADT (A1023).
 - It was a basic assumption of the ES that traffic flows would not grow further as a result of the proposed improvements, apart from local changes within the junction itself.

Five Years After Environmental Assessment

- 5.15. Included in this section is a brief summary of statements from the AST, ES and OYA evaluations (including close out/ key issues identified for further reporting at the FYA stage) which have been included to provide the context for the FYA evaluation.

Noise

- 5.16. The AST stated that a total of 460 sensitive properties lay within 300m of the scheme, and that barely perceptible changes in traffic noise levels would arise as a result of the scheme with noise level changes at the closest properties being less than 2dB. The estimated population annoyed by traffic noise as a result of the scheme was 144, compared with an estimated population of 144 annoyed for the Do-minimum scenario. Overall it was assessed that zero additional residents would be annoyed by noise in the design year.
- 5.17. The ES traffic noise predictions indicated that although noise level changes associated with the scheme would be imperceptible and that no specific mitigation measures were considered necessary, a low noise road surfacing would be used. The ES also predicted that the scheme would have no vibration impact over and above than what would be expected through traffic growth were the scheme not to proceed, and that no properties would be eligible for noise insulation.
- 5.18. The OYA report concluded that the overall impact of the scheme in terms of noise was slightly better than expected, as observed traffic flows at the majority of locations were lower than predicted by the ES. However, it was noted that observed traffic flows on Brook Street westbound, the M25 clockwise off-slip, and the M25 anti-clockwise on-slip were all higher than forecast, and consequently the noise impact at these locations was considered to be slightly worse than expected.

Consultation

- 5.19. No responses to consultation requests were received.

Evaluation

- 5.20. Although it was confirmed at OYA that a low-noise surfacing had been provided, the high speed Road Surface Index (RSI) value to confirm the noise reduction properties of the surfacing has not been made available for the FYA study.
- 5.21. It was also confirmed at OYA that that noise insulation had been discussed for three properties, and that a final decision regarding the provision of noise insulation would result from the Part 1 Claims process; no information regarding the Part 1 Claims process was received for this study.
- 5.22. An assumption is made by POPE methodology that noise levels will be as expected if observed traffic flows are within 25% more or 20% less than predicted; as can be seen by the comparison of both the predicted and observed AADT flows **Table 2.2** the data indicates that the observed flows are:
- Between 3% and 20% greater than forecast at six locations, and 26% greater than forecast at one location (Brook Street westbound)
 - Between 1% and 19% lower than forecast at four locations, and 21% lower than forecast at one location (M25 through traffic anti-clockwise)
- 5.23. Consequently, it is considered that the local noise climate at Brook Street westbound is likely to be worse than expected, and that the local noise climate at the M25 through traffic anti-clockwise is likely to be better than expected.
- 5.24. Based on the information presented in this evaluation, it is therefore concluded that although there are variations from predicted noise climates at a local level, the overall effects of the scheme are broadly as expected in terms of noise.

Table 5.2 – Evaluation Summary: Noise

Sub-Objective	FYA Score	Evaluation
Noise	-	As expected, but with local variations

Local Air Quality

- 5.25. The AST stated that the scheme would have a negligible benefit to air quality within three Air Quality Management Areas (AQMA), and that the small magnitude of the scores indicated that the overall reduction in public exposure would be slight. Overall, the AST forecast an improvement in Air Quality at 787 properties, deterioration at 221 properties, and no change at 3 properties.
- 5.26. The ES noted that there were 3 Local Authority declared AQMA immediately adjacent to the Scheme, and the two key traffic related pollutants most relevant for these AQMA were nitrogen dioxide (NO₂) and particulate matter (PM₁₀); other pollutants were considered to fall significantly below the EU Limit Values and National Air Quality Objectives.
- 5.27. In summary, the ES assessed the scheme as providing an overall improvement in air quality, and concluded that although 20% of properties would experience a slight reduction in air quality on completion of the scheme in 2008, 80% of properties were likely to experience an improvement in air quality.
- 5.28. The OYA report stated that based on traffic flows, it was likely that local air quality impacts were as expected given that observed traffic flows were generally within +/- 5,000 vehicles per day as predicted by the ES. However, observed traffic flows on the M25 anti-clockwise were lower than expected by greater than 5,000 vehicles per day and as such, air quality was considered to be better than expected at this location.

Consultation

5.29. No responses to consultation requests were received.

Evaluation

5.30. An assumption is made by POPE methodology that air quality will be as expected if observed traffic flows are within 10% more or 10% less than predicted; as can be seen by the comparison of both the predicted and observed AADT flows in **Table 2.2** the data indicates that the observed flows are;

- Between 1% and 4% greater than forecast at three locations, and more than 10% forecast at:
 - Brook Street westbound
 - A12 Westbound off-slip
 - M25 anti-clockwise off-slip
 - M25 clockwise on-slip
- Between 1% and 2% lower than forecast at two locations, and greater than 10% lower than forecast at the following locations:
 - M25 clockwise off-slip
 - M25 clockwise through traffic
 - M25 anti-clockwise through traffic

5.31. Consequently, it is considered that the air quality is likely to be worse than expected at four locations, and likely to be better than expected at three locations.

5.32. A number of properties are located to the south-east of the junction that are close to the roads where the observed traffic was higher than forecast, specifically at Brook Street westbound, the A12 off-slip, and the M25 clockwise on-slip.

5.33. As the observed AADT flows at these locations exceed the upper 10% tolerance assumed by POPE methodology, NO₂ monitoring data provided by Brentwood Borough Council for this area was examined to determine whether any discernible trend could be interpreted at the monitoring sites near the M25/ A12 junction since the scheme opened. The data is given in **Table 5.3**.

Table 5.3 – Annual mean NO₂ concentrations (µg/m³) south east of the M25 J28

Site	Description	2006	2007	2008	2009	2010	2011	2012
BRW4	73 Brook Street	47.1	45.6	54.9	44.9	-	-	-
BRW5	Brook Street facing roundabout	47.7	47.0	57.3	48.2	53.5	52.3	55.8
BRW6	63 Brook Street	50.5	48.6	55.6	49.3	46.1	48.2	44.0
BRW32	The Poplars, Brook Street	-	41.0	44.6	37.8	40.9	37.4	38.8

- 5.34. There is no apparent trend at site BRW5 and although pollutant concentrations do show a general downward trend from 2008 onwards at two of the sites (BRW6 and BRW32), this cannot be directly attributed to the scheme improvements with any certainty, particularly as concentrations appear elevated in 2008 when compared with those measured in 2006 and 2007.
- 5.35. The properties close to the roads where the observed traffic is higher than forecast are also within AQMA 2, declared by Brentwood Borough Council in 2005 on account of NO₂ concentrations breaching the annual mean air quality criterion of 40µg/m³ at these locations.
- 5.36. As NO₂ concentrations at all sites have continued to breach the 40µg/m³ annual mean criterion since the scheme was constructed, air quality overall can be said to have remained the same on implementation of the scheme; that is to say that there has been no significant improvement or deterioration in air quality as a result of the scheme.
- 5.37. Consequently, even though observed AADT traffic flows are higher than those forecast for the links closest to the properties at the southeast of the junction, it is considered that the scheme has had no material impact on air quality.
- 5.38. Based on the information presented in this evaluation, it is therefore concluded that although there are variations from the predicted air quality climates at a local level, the overall effects of the scheme are likely to be as expected.

Table 5.4 – Evaluation Summary: Local Air Quality

Sub-Objective	FYA Score	Evaluation
Local Air Quality	-	As expected, but with local variations

Greenhouse Gases

Forecast

- 5.39. The scheme was predicted to reduce congestion and not induce any extra traffic. Despite this the AST predicted there would be an increase in CO₂ of 0.4% in the opening year as a result of implementing the scheme. 50,891 tonnes CO₂ were predicted for the 2008 Do Minimum scenario and 51,100 tonnes CO₂ were predicted for 2008 Do Something scenario. The AST therefore implies that traffic will be travelling at a less efficient speed as a result of the scheme.
- 5.40. The ES predicted that CO₂ emissions would increase by 5.6% between 2003 and 2008 (opening year), and by 12.4% between 2003 and 2023 (design year) if a 'Do Minimum' approach was adopted. With the scheme in place, CO₂ emissions were predicted to increase by an additional 0.4% in the opening year and 3.0% in the design year. The larger increase in the design year is likely to be due to the forecast increase in traffic over the appraisal period, in line with national forecasts.

Evaluation

- 5.41. The evaluation of outturn Carbon impacts is usually carried out using one of the following two methodologies:
- COBA 11
 - Design Manual for Roads and Bridges (DMRB) regional emissions worksheet.
- 5.42. The forecast was calculated using the DMRB emission spreadsheet approach for 32 separate links which make up the junction. The net differences between the DM and DS scenarios are very small differences in average daily speeds for some links.

- 5.43. The nature of the journey time data collected in POPE for this scheme is not sufficiently detailed to be able to replicate this level of precision where the net change is less than 1% i.e. the margin of error would be too high in any approximation for us to be able to say better or worse than expected, therefore no evaluation has been undertaken for greenhouse gases.

Landscape

- 5.44. The AST stated that an existing, established, well vegetated landscape of local importance was present, and that restricting the improvement works to within the existing highway boundary would minimise wider impacts and the impact of the scheme on landscape character. The AST also stated that there would be some localised loss of vegetation beside the River Ingrebourne but overall, assessed the impact of the scheme as Neutral.

- 5.45. The ES predicted that in terms of landscape impact:

- 5.46. The scheme would have a minimal local impact, principally due to the very small footprint of the works within the existing road corridor which is surrounded by a strong landscape structure.

- Although the scheme would have a slight adverse impact in the vicinity of the new retaining wall beside the A12 eastbound entry slip road, the overall impact of the scheme would be Neutral.

- 5.47. The ES predicted that in terms of visual impact:

- All viewpoints of the scheme would experience no change effects with the exception of 2 residential properties at 71 and 73 Brook Street, which would experience moderate beneficial effects by design year due to foreground planting along the highway boundary to the A12 London-bound exit slip road screening the current open views of traffic.
- Night time effects were considered to be slight adverse, as the light intensity of the existing luminary units would most probably be replaced by new, more modern low cut off luminaries around the junction along the A12 and the A1023.

- 5.48. The OYA report stated that most of the vegetation lost as a result of the scheme had been offset by replanting and that with the exception of a few minor variations including slightly less tree planting than proposed and no grass and shrub planting over the former lay-by on the A12, planting had generally been implemented in line with the mitigation proposals as detailed in the ES. The report concluded that tree and shrub planting appeared to be establishing well, but noted that ongoing maintenance would be required to ensure continued planting establishment. It was also recommended that night time lighting be considered further as part of the FYA evaluation.

Consultation

- 5.49. No responses to consultation requests were received.

Evaluation

- 5.50. Where landscape and visual impacts of the proposals were identified in the ES, mitigation measures were incorporated into the Scheme to avoid, minimise, or reduce potentially adverse landscape, and visual amenity impacts.

- 5.51. The landscape mitigation measures outlined by the ES included minimising loss/ damage to key landscape features and minimising the impact of the scheme on visual receptors, but the primary mitigation measures were stated as being tree and shrub planting, and local nature conservation enhancement.

- 5.52. Landscape proposals, incorporating ecological mitigation measures, were designed to help screen and integrate the scheme into the landscape and comprised tree, shrub, and grass planting works within the road corridor principally surrounding the junction, but with some planting along the A12 eastbound of the junction.
- 5.53. Comparison views with ES photomontages and OYA photographs are shown in **Appendix C.2**.
- 5.54. The Handover Environmental Management Plan (HEMP) stated that the main issue for the scheme was the aftercare of the landscape proposals on completion of the construction phase.
- 5.55. No target percentage cover figures for planted landscape elements are detailed in the HEMP, but a Landscape Maintenance Program (LMP) for 2008 to 2012 was included. Although the aftercare activity descriptions are considered to be minimal (comprising a timetable of spraying/ mowing/ replanting operations only) and not entirely clear, the LMP has been interpreted as follows for the purposes of this evaluation;
- Spraying (Planted areas only): Single application, annually during September. Additional application annually during May, if required.
 - Mowing (Seeded areas): Single cut, annually during October. Additional cut during April (2008 only), if required.
 - Replanting: Single visit, annually during February, if required.

Weeds

- 5.56. The FYA site visit to evaluate the ongoing establishment of the planting found a small, localised infestation of Himalayan balsam on the east bank of the River Ingrebourne; see **Figure 5-7**. The Area 6 MAC has been alerted to the presence of this invasive weed, and has confirmed that no previous instances of infestation by this species at this location have been recorded.
- 5.57. The OYA report stated that the designers were unaware of any incidents of contamination of the River Ingrebourne, and that the river was regularly monitored for contamination during construction. The invasive nature of Himalayan balsam and the current scale of infestation indicates that the arrival of this species is a comparatively recent event, and as such its presence is considered unlikely to be as a consequence of the scheme.

Figure 5-1 – Localised Infestation of Himalayan Balsam on the East Bank of the River Ingrebourne



- 5.58. In terms of other weeds observed during the FYA site visit, two areas of grassland were also notable;

- Brook Street/ M25 clockwise entry-slip road – Horse-radish was observed to be colonising the verge (**Figure 5-2**, below)
- Adjacent to the M25 anti-clockwise exit-slip road - An infestation of teasel was observed along the highway boundary (right hand side of **Figure 5-3**); this is an invasive species that can become dominant and reduce biodiversity value if not managed appropriately.

Figure 5-2 – Horse-Radish Colonising the Verge at the Brook Street/ M25 Clockwise Entry-Slip Road



Figure 5-3 – The Infestation of Teasel Adjacent to the M25 Anti-Clockwise Exit-Slip Road



Grassland

- 5.59. Species rich grassland areas were found to be well established and generally free of significant scrub cover at the time of the FYA site visit, the absence of woody species indicating that historic maintenance operations have been undertaken.
- 5.60. In terms of species diversity, the range of wildflower species observed during the FYA site visit appeared to be consistent with the general purpose meadow seed mix as specified by the Environmental Masterplan.
- 5.61. Consequently, both the landscape integration and ecological enhancement functions of the species rich grassland areas have generally been realised and are as specified by the landscape proposals; this is illustrated by **Figures 5.4 and 5.5**, below.

Figure 5-4 – Well Established Grassland Plots Performing Landscape Integration Function on the A12 Westbound Entry-Slip Road



Figure 5-5 – Ecological Enhancement/ Landscape Integration Functions along the A12 Eastbound Verge



Tree and shrub planting

- 5.62. The shrub planting adjacent to the M25 anti-clockwise exit-slip road appears to have established well and although there are some gaps where approximately 35% of the plants have failed, the surviving plants are now beginning to develop the ecological enhancement function for which the plot was intended in conjunction with the surrounding grassland; see **Figure 5.6**, below. The Environmental Masterplan indicates that this plot had no landscape integration or visual screening function intended and although replacement planting could be undertaken next planting season to reinforce the planting at this location, it is considered that subject to ongoing management and maintenance, the ecological function of this planting plot is likely to be realised by the Design Year should replacement planting not be carried out.

Figure 5-6 – Developing Ecological Enhancement Function of Shrub Planting Adjacent to the M25 Anti-Clockwise Exit-Slip Road



- 5.63. The reinforcement planting to the highway boundary along the A12 westbound exit-slip road has also established well and while performing the landscape integration function as intended by the landscape proposals, is also beginning to develop the screening function for 71 and 73 Brook Street as stated in the ES.
- 5.64. The ES text noted that the two storey residential property facing the roundabout would likely experience no change in views, and identified the property as Poplars Farm. However, the Zone of Visual Influence and Key Receptors plan referred to the property as The Poplars. The site visit confirmed that the property is called The Poplars, and the property is referenced as such in this study.
- 5.65. Mitigation proposals for The Poplars at the Brook Street/ M25 Clockwise entry-slip road comprised reinforcement of the existing boundary planting that included hedgerow reinstatement, particularly along the M25 clockwise entry-slip road. The intended environmental function of this plot is not shown on the As-Built drawings, but the Visual Effects Table in the ES records The Poplars as experiencing “No change” as a result of the scheme because the property already had a view of the roundabout; this suggests that the environmental function of this plot is unlikely to be visual screening.
- 5.66. The OYA study notes that a short section of hedge had been planted where there was a gap in the existing hedge at this location and environmental functions aside, what is clear from **Figure 5.7**, below, is that the planting has failed to establish and is not performing any environmental function to the degree that would reasonably be expected at the FYA stage. It is unclear as to why this planting has not established, but it is suggested that replacement planting be undertaken next planting season to ensure that subject to ongoing management and maintenance, the landscape objectives of this planting plot is fulfilled by the Design Year.

Figure 5-7 –View to The Poplars with failed Boundary Planting at Brook Street/ M25 Clockwise Entry-Slip Road



- 5.67. The As-Built drawings show plots of trees and shrubs with screening functions along the boundary fence of the M25 clockwise exit-slip road and adjacent to the extended culvert and new retaining wall, and 2 plots of shrubs, one with screening and one with ecological enhancement functions, along the River Ingrebourne/ A12 eastbound entry-slip road.
- 5.68. **Figure 5.8**, below, provides an overview of the planting along the M25 clockwise exit-slip road and adjacent to the extended culvert, and **Figure 5-9** illustrate typical planting stations within both this plot and those along the River Ingrebourne and the A12 eastbound entry-slip road.

Figure 5-8 – Overview of Boundary Fence Planting the between the M25 Clockwise Exit-Slip Road (foreground) and the Extended Culvert and Retaining Wall (left)



Figure 5-9 – Typical Planting Stations Along the M25 Clockwise Exit-Slip Road and the River Ingrebourne/ A12 Eastbound Entry-Slip Road



- 5.69. It can be seen from the figures above that although the plant stock appears to have established and is reasonably healthy with no sign of disease, it is heavily stunted and is not performing the intended screening or ecological enhancement functions to the degree as would reasonably be expected at the FYA stage.
- 5.70. The cause of this stunted growth is considered likely to have resulted from the plant stock being heavily grazed by deer; frequent instances of deer tracks and deer droppings were observed adjacent to these planting plots, the piles of round, individual droppings indicating a diet of leaves and twigs rather than of grass.
- 5.71. Further evidence that deer are responsible for the damage is corroborated by the deer reflectors and warning signs positioned on the verges of the A12 entry-slip road/ eastbound carriageway, and the deer study undertaken by the Area 6 MAC that identified the A12 at Brentwood as a hot spot for deer strikes and carcass removal.
- 5.72. It is suggested that measures to exclude deer from this location are investigated and implemented prior to replacement planting being undertaken, as continued grazing of both the existing and any new plant stock would likely ensure that the functions of these planting plots would remain unfulfilled by the Design Year.
- 5.73. Maintenance of the planting stations throughout the scheme was evident during the FYA site visit and appeared to be limited to herbicide application only, as specified by the HEMP; this is illustrated by **Figure 5-10**.

- 5.74. No evidence of annual replacement planting where plants have failed to establish fully or suffered grazing damage was observed.
- 5.75. Removal of plant shelters was not specified by the HEMP, and plant shelters remain in place throughout the scheme.

Figure 5-10 – Maintained Planting Plot Adjacent to the M25 Anti-Clockwise Exit-Slip Road



Lighting

- 5.76. The OYA report noted that existing lights had been replaced with new, high pressure low cut-off lights on 10m or 12m columns at locations immediately adjacent to new carriageway construction. The existing carriageway was already lit and it was considered likely that the impact from the replacement lighting system would be similar to that predicted by the ES; although suggested at OYA that lighting could be considered further at FYA no night time assessment of the effects of the scheme was undertaken as no further issues were identified during the FYA study.

Evaluation Summary

- 5.77. No target coverage of planting plots within a specific time period was stated in the HEMP. However, the current coverage, establishment, and condition of the grassland plots and the planting stock adjacent to the M25 anti-clockwise exit-slip road and along the A12 westbound exit-slip road indicates that the functions of the mitigation measures are developing reasonably well at these locations, and there is no reason to indicate that these functions will not be fulfilled by the Design Year subject to ongoing maintenance and management.
- 5.78. It therefore is concluded that the visual effects of the scheme are as predicted by the ES, the planting along the A12 westbound exit-slip road beginning to screen the current open views of traffic for the residential properties at 71 and 73 Brook Street.
- 5.79. However, a significant proportion of the planting stock has either failed to establish (The Poplars) or has suffered damage due to continued grazing by deer (M25 Clockwise Exit-Slip Road and the River Ingrebourne / A12 Eastbound Entry-Slip Road) and as the primary landscape mitigation measure is stated in the ES as being tree and shrub planting, it is concluded that the landscape effects of the scheme are slight adverse at FYA (worse than the expected neutral impact) due to the failure of these mitigation measures.

Table 5.5 – Evaluation Summary: Landscape

Sub-Objective	FYA Score	Evaluation
Landscape Impact	Slight Adverse	Worse than expected
Visual Impact	Slight Beneficial	As expected
Summary Score	Slight Adverse (worse than the Neutral score expected)	

Townscape

- 5.80. The AST stated that the suburban townscapes of Brook Street, Harold Hill, and Harold Park were located within 1km of the scheme. The AST also stated that areas located close to the scheme were considered to be of no distinctive appearance, and that existing screening would not be altered. Overall, a neutral impact on Townscape was predicted.
- 5.81. No environmental enhancements were proposed in the ES to be undertaken as part of the scheme in adjacent settlements, and the ES considered the impacts of the scheme on townscape to be to be neutral for both day and night-time effects in the opening year and the design year.
- 5.82. The OYA report concluded that, as expected, there had been a neutral impact on Townscape.

Consultation

- 5.83. No responses to consultation requests were received.

Evaluation

- 5.84. No further evaluation has been undertaken, as no changes regarding Townscape have been identified during the FYA site visit and there were no unresolved issues from the OYA report.
- 5.85. Based on this information, it is concluded that the effects of the scheme on Townscape remain as expected.

Table 5.6 – Evaluation Summary: Townscape

Sub-Objective	FYA Score	Evaluation
Townscape	Neutral	As expected

Heritage

- 5.86. The AST stated that the only known heritage feature within scheme footprint was the undesignated line of the London–Colchester Roman road, which had been previously disturbed. No further impact was expected as result of scheme, and a neutral impact was predicted overall.
- 5.87. The ES stated that impacts would be of Neutral significance (directly or indirectly) on any of the 3 Grade II listed structures, the Archaeological Priority Area, or Historic (ancient) Woodland within the area, and most likely on any hitherto unknown archaeological features.
- 5.88. The ES concluded that there were limited known archaeological and cultural heritage features within the study area and that the scheme area had already been heavily disturbed due to the original construction of the M25 and A12. The ES consequently suggested that no mitigation was required, and this was supported by a letter from Essex County Council (dated 12 October 2005) in which no mitigation was recommended.
- 5.89. The OYA study reported that although the new retaining wall and extended culvert beside the A12 eastbound entry slip road had opened up views to the carriageway from the Ancient Woodland, this was not considered to be particularly significant as this area was relatively open previously and that with time, the new planting would screen views of the carriageway. The OYA report concluded that as expected, the overall evaluation for heritage was neutral.

Consultation

- 5.90. No responses to consultation requests were received.

Evaluation

- 5.91. The technical report for Cultural Heritage produced for the ES stated that a small area of Ancient Woodland fell within the visual limits of the scheme, and the OYA report noted that views to the carriageway from the Ancient Woodland would be screened in time by the planting proposals.
- 5.92. As noted in the landscape sub-objective, the planting plot implemented to screen the carriageway from the Ancient Woodland has suffered continued damage by deer and is not performing the screening function for which it was intended; consequently, views to the carriageway from the Ancient Woodland remain open.
- 5.93. However, the OYA also noted this area as being open previously, and it is therefore considered that the effects of the scheme have not materially changed the landscape setting of the Ancient Woodland.
- 5.94. No archaeological reports were produced for the scheme and as stated in the ES, no archaeological mitigation was proposed.
- 5.95. No further evaluation has been undertaken for the FYA evaluation as there were no outstanding issues highlighted by the OYA report.
- 5.96. It is therefore concluded that the effects of the scheme on the heritage resource are neutral, as expected.

Table 5.7 – Evaluation Summary: Heritage

Sub-Objective	FYA Score	Evaluation
Heritage	Neutral	As expected

Biodiversity

- 5.97. The AST stated that the scheme would result in the loss of habitats within the highway boundaries of low to medium importance at the local scale, and that some reptile habitats would also be lost due to the extension of an existing culvert along the River Ingrebourne. An indirect adverse impact on foraging/ commuting bats through the increased risk of road traffic collisions as a result of the reduced verge width was also predicted. Overall, the impact of the scheme on biodiversity was assessed by the AST as slight adverse.
- 5.98. The ES stated that in order to enhance habitats and their potential for protected species, management of the areas impacted by the scheme during the operational phase would be secured by means of an Environmental Master Plan. The overall ecological interest of the site was assessed as being of between negligible and medium value, and the assemblages of protected species within and adjacent to the site were assessed as low value (bats, badgers, and water voles) and negligible value (birds and reptiles). The ES also stated that the likely ecological impacts were those relating to habitat disturbance, loss, and fragmentation.
- 5.99. The ES concluded that provided the mitigation and compensation strategies were implemented, the scheme should avoid, mitigate or compensate for all potentially significant adverse impacts. The ES went on to say that as the proposals were within the soft estate, there would be an inevitable net loss of habitat and subsequent impact on species but following mitigation, this was considered to be of no greater significance than slight adverse.
- 5.100. The OYA report noted that the impact on protected species was considered to be relatively minor and therefore no post-opening monitoring for protected species had been undertaken and no monitoring requirements for protected species were included in the HEMP.

- 5.101. The OYA report concluded that although less woodland planting than expected had been implemented, the overall assessment of the scheme's impact on biodiversity was as expected, Slight Adverse.

Consultation

- 5.102. Essex Ecology Services Ltd stated that they had no involvement with the scheme (beyond possibly supplying biological records), and so felt unable to provide an informed response.
- 5.103. Essex Badger Protection Group (EBPG) commented that badger sett occupancy was unknown, and no road kills had been reported in the area. The information presented in Table 5.8 shows reported animal mortalities, and does not include any reported badgers.

Evaluation

- 5.104. Ecological mitigation measures comprised local nature conservation enhancements, and were incorporated into the landscape proposals.
- 5.105. The ecological element of the landscape proposals comprised tree, shrub, and grass planting works within the road corridor along the M25 clockwise exit-slip road and the A12 eastbound entry-slip road, along with some habitat re-creation along the M25 anti-clockwise exit-slip road.
- 5.106. No monitoring requirements for protected species were included in either the ES or the HEMP, but as noted by the landscape sub-objective, the HEMP did state that the main issue for the scheme was the aftercare of the landscape proposals on completion of the construction phase.
- 5.107. The OYA report noted that the designers had confirmed that there were no known contamination incidents of the River Ingrebourne during construction, and no evidence of pollution or significant scouring of the river banks/ river bed was observed during the FYA site visit. Consequently, the effect of the scheme on the riverine habitat is considered to be as expected. However, and as discussed in the Landscape sub-objective, a small, localised infestation of Himalayan balsam on the southern bank of the river was observed.

Water Voles

- 5.108. In terms of the running water habitat loss arising from c.30m of the River Ingrebourne being replaced by culverting and the removal of bank side features as a result of bank stabilisation measures for the widening aspect of the scheme; the ES stated that compensatory enhancements to the retained riverine features within adjacent stretches of the river would be incorporated into the Environmental Masterplan, and could include tree and shrub clearance along the southern bank of the river to open up the habitat and enhance the opportunity for use by water voles.
- 5.109. Although not indicated by the Outline Landscape Mitigation drawings or on the Environmental Masterplan, the OYA report confirmed that clearance on the southern bank of the river had been undertaken, although the FYA site visit observed that these cleared areas were now closing over.
- 5.110. However, the failure of the planting stock along the River Ingrebourne/ A12 Eastbound Entry-Slip Road illustrated in Figure 5-11, below, has resulted in this part of the southern bank of the river remaining open, potentially providing an alternative location now more suited for use by water voles than those areas noted by the OYA report as having been cleared.

Figure 5-11 – Open Area on the Southern Bank of the River Ingrebourne



Bats

- 5.111. The tree, shrub, and grass planting works within the road corridor along the M25 clockwise exit-slip road and the A12 eastbound entry-slip road comprised the main ecological element of the landscape proposals, and was designed to deter foraging or commuting bats from the road.
- 5.112. Due to the increased width of the road and subsequent increased proximity of traffic to mature vegetation along the road corridor, it was stated in the ES that bats using this vegetation for foraging or commuting purposes would potentially be more vulnerable to collisions with road traffic.
- 5.113. A strip of grassland along the M25 clockwise exit-slip road/ A12 eastbound entry-slip road was implemented to deter bats from the road and as noted in the landscape sub-objective, this grassland was found to be well established and generally free of significant scrub cover at the time of the FYA site visit; in the absence of any monitoring of protected species required by the ES or the HEMP, there is no reason to suggest that this grassland is not deterring bats from the road as expected. **See Figure 5-12, below.**

Figure 5-12 – Bat Deterrent Grassland Separating Linear Belt of Trees and Shrubs (used by Bats for Commuting and Foraging, left) and the A12 Eastbound Entry-Slip Road



- 5.114. The ES noted that ideally, the continuous strip of trees, shrubs, and coarse vegetation running along the highway for the length of the scheme and along the A12 eastbound carriageway would be maintained as a commuting corridor for bats; no break in the retained vegetation was observed east of the new culvert during the FYA site visit and consequently, there is no reason to suggest that bat movements have been disrupted, foraging behaviour altered, or that roosts/ foraging habitats have been isolated east of the new culvert.
- 5.115. West of the new culvert and along the M25 clockwise exit-slip road however, the landscape proposals show a near continuous belt of planting, with an explanatory note highlighting the

necessity for a single, small gap in the planting to ensure that the forward visibility requirements of vehicles exiting the M25 are met.

- 5.116. As noted by the landscape sub-objective, heavy grazing by deer has left the plant stock along M25 clockwise exit-slip road heavily stunted and consequently, there is an approximate 150 metre gap between the retained vegetation east of the new culvert and the retained vegetation along the M25 clockwise exit-slip road.
- 5.117. A break in continuous vegetation such as this (and illustrated by **Figure 5-13**) is considered significant in that it is potentially disruptive to bat movements and could give rise to altered foraging behaviours leading to roost/ foraging habitat severance; as such, the failure of the plant stock at this location can only be considered to have had an adverse impact in terms of bats.

Figure 5-13 – A Section of the Significant Gap in the Boundary Planting along the M25 Clockwise Exit-Slip Road (left)



Reptiles

- 5.118. The ES identified a small population of slow worms and common lizards in the area of grassland along the M25 anti-clockwise exit-slip road, and this was recognised by the ecological mitigation proposals as an area for habitat re-creation with an opportunity for habitat enhancement. The OYA report noted that;
- Although the grassland/ scrub mosaic habitat had not been recreated as proposed, two rows of native shrubs had been planted and species rich grassland had been sown. The OYA report did not consider this change to be significant.
 - The opportunity for habitat enhancement via the provision of reptile hibernacula and refugia had not been undertaken, as the pre-scheme embankment had been replaced on a like-for-like basis; further enhancement for reptiles was not considered necessary.
- 5.119. As noted in the landscape sub-objective, the planting and grassland along the M25 anti-clockwise exit-slip road appears to have established reasonably well and apart from the infestation of teasel observed along the highway boundary that has the potential to reduce biodiversity if not managed appropriately (**Figure 5.3**, above), given the like-for-like replacement of the embankment at this location as noted by the OYA study, there is no reason to suggest that this area has not remained suitable for slow worms and lizards.

Badgers

- 5.120. The ES also noted evidence of badger activity at various locations around the junction, and the HEMP contains a badger licence (issued in November 2007) permitting works to be undertaken within 5m of a sett adjacent to the works. Although this sett was not destroyed, it was not confirmed at OYA whether the sett had been re-occupied.

- 5.121. The EBPG were contacted and stated that as they hadn't visited the sett for many years, they were unable to confirm whether the sett was currently in use. The EBPG were also unaware of any reports of badger road kills near the sett.

Animal Mortality

- 5.122. In terms of deer mortalities, an Area 6 MAC deer study undertaken in March 2010 identified the A12 at Brentwood as one of the four sites within Area 6 that were most prone to Deer/Vehicle Collisions (DVCs).
- 5.123. Animal mortality figures were received from the Area 6 MAC (responsible for the A12) at OYA, and further data was received at FYA (2013 only). Animal mortality figures were also received from the Area 5 MAC (responsible for M25 J28) at OYA, and further data was received at FYA.
- 5.124. Apart from a single, unidentified mortality reported by the Area 5 MAC in 2012, all animal mortalities reported at OYA and FYA by both the Area 5 and Area 6 MAC were deer; this data is shown below in **Table 5.8**, below, and indicates that the number of deer mortalities have not increased as a result of the scheme.

Table 5.8 – Animal Mortality Data, 2006-2013

Deer RTA	Construction			OYA			FYA	
	2006/7	2007/8	2008/ 09	2009	2010	2011	2012	2013
Area 5	4	3	3		1		2	1
Area 6				3				2

- 5.125. Based on the information presented in this evaluation, it is considered that there is no reason to suggest that the following ecological mitigation measures as stated by the ES are performing other than expected, specifically;
- The primary element of ecological mitigation, the grassland along the A12 eastbound entry-slip road to deter foraging or commuting bats from the road
 - The native shrub and grassland habitat along the M25 anti-clockwise exit-slip road, re-created for reptiles and slow worms.
- 5.126. However, the main issue for the scheme was stated by the HEMP as the aftercare of the landscape proposals on completion of the construction phase, and given the deer damage resulting in the failure of the plant stock along the M25 clockwise exit-slip road and the potential effect of this on the local bat population, it is concluded that the overall effects of the scheme on biodiversity are slightly greater than the Slight Adverse effect predicted.

Table 5.9 – Evaluation Summary: Biodiversity

Sub-Objective	FYA Score	Evaluation
Biodiversity	Slight/ Moderate Adverse	Slightly worse than expected

Water Quality and Drainage

- 5.127. The AST stated that there would be no significant change in the water quality of the River Ingrebourne resulting from modifications to the existing road drainage system or the implementation of an additional 30m length of culverting. The AST further stated that there would be no adverse effects on the existing flooding regime, that groundwater would remain unaffected, and that a neutral impact was predicted overall.
- 5.128. The ES predicted that all potential impacts fell into the Neutral category, except for water quality risks to the River Ingrebourne during construction which would be (potentially) Slight Adverse.

- 5.129. The OYA study reported that during construction, the River Ingrebourne was regularly monitored for:
- Contamination, of which there were no known incidents
 - Possible approaching storm waters which would have necessitated the removal of the in-river works to mitigate potential flooding

- 5.130. Based on the information made available at the time, the OYA evaluation concluded that:
- Mitigation measures had been incorporated into the scheme as expected
 - The impacts on the water environment were also as expected

Consultation

- 5.131. Although the Environment Agency (EA) responded that it was unable to provide any official comment, data was provided for interpretation by POPE regarding the Proportion of Sediment sensitive Invertebrates (PSI) at two sites downstream of the works.

Evaluation

- 5.132. The two sites downstream of the works for which the EA provided PSI monitoring data were (EA references) D/S A12 Roadbridge (Ingrebourne), and Harold Court Road; it should be noted that a decreasing PSI score is correlated to an increase in sediment load:
- Having remained broadly stable since 2000, the sediment load at the D/S A12 Roadbridge (Ingrebourne) monitoring site briefly increased in early 2007, but rapidly returned to previous levels.
 - The sediment load at the Harold Court Road monitoring site had been increasing until late 2006, at which point the sediment load sharply decreased. This trend of improvement suffered a slight deterioration in early 2007, but rapidly recovered and improvement continued.
- 5.133. Although the data provided by the EA cannot be fully interrogated and firm conclusions cannot be drawn, the start of the construction works in May 2007 broadly coincides with the temporary increases in sediment loads at both sites. It is possible that this is as a result of construction and it may be that the works did have a slight adverse impact on the River Ingrebourne. If this is the case, the impact was slight and temporary, and was as predicted by the ES.
- 5.134. All drainage facilities within the scheme noted during the FYA site visit were clear of vegetation and appeared to be maintained and functioning.
- 5.135. The new culvert was generally clear and appearing to operate as expected, and no evidence of pollution or significant scouring of the river banks/ river bed was observed during the FYA site visit.
- 5.136. No information was received at FYA to indicate whether any incidents had occurred that may have affected the drainage system, and no information regarding water quality monitoring other than that previously discussed has been made available for this report.
- 5.137. No further evaluation has been undertaken for the FYA evaluation as there were no outstanding issues highlighted by the OYA report.
- 5.138. Based on the FYA site visit and the data provided by the EA, it is concluded that the overall the effect of the scheme on water quality and drainage is likely to remain as expected.

Table 5.10 – Evaluation Summary: Water Quality and Drainage

Sub-Objective	FYA Score	Evaluation
Water Quality and Drainage	Neutral	As expected

Physical Fitness

- 5.139. The AST predicted that no change in physical fitness was expected as a result of the scheme, and that a neutral impact was predicted overall.
- 5.140. The ES stated that the operation of the scheme would not cause any additional severance in terms of preventing local residents moving around or accessing local facilities, and that although nominal improvements to the amenity of a number of footways intersecting the junction area could encourage use, the overall operational impact of the scheme on Non-Motorised Users (NMUs) was considered to be neutral.
- 5.141. In summary, the OYA study reported that new footways and improved carriageway lighting had been provided as proposed, although new dedicated lighting had not been provided on the footway between the M25 clockwise entry and anti-clockwise exit slip roads (although existing lights in varying condition were present at this location). The study also noted that the uncontrolled pedestrian crossing at the M25 clockwise entry slip road continued to be difficult to cross, but that in the context of a relatively low number of NMUs the overall evaluation was considered to be neutral.

Consultation

- 5.142. No responses to consultation requests were received.

Evaluation

- 5.143. No NMU survey has been undertaken specifically for this study and, as noted in the OYA report, no formal post opening NMU surveys have been undertaken, however informal observations made during Road Safety Audit 3 noted occasional cyclists and pedestrians present in similar numbers to the Environmental Statement NMU survey.
- 5.144. The OYA report noted that some cracking was visible in the new footway between the M25 anti-clockwise exit slip road and the A12 London-bound entry slip road, further noting that the HA had confirmed that the footway had been repaired since the OYA site visit in December 2009.
- 5.145. However, although the OYA/ FYA comparison pictures (**Figure 5-14**) do not show any evidence of these repairs having been undertaken and illustrate that the issue of cracking remains, **Figure 5-15** indicates that works have been undertaken on the new footway at Brook Street adjacent to the M25 clockwise entry slip road; it may be that these are the repairs to which the HA were referring to at OYA.

Figure 5-14 – Cracks in the Footway between the M25 Anti-Clockwise Exit Slip Road and the A12 London-bound Entry-Slip Road at OYA (left), and at FYA (right).



Figure 5-15 – Evidence of historic works to the Brook Street footway adjacent to the M25 Clockwise Entry-Slip Road (behind camera, left)



- 5.146. The ES predicted that nominal improvements to the amenity of a number of footways intersecting the junction area could encourage use. However, there was little evidence of use throughout the FYA site visit and as also noted in the OYA report, this may be due, at least in part, to the fact that while traffic lights facilitate pedestrian passage across the M25 anti-clockwise exit-slip road, the lack of any controlled pedestrian crossing at the M25 clockwise entry slip road continues to provide a difficult and dangerous pedestrian environment due to the high traffic volumes at and around the junction at this point.
- 5.147. No further evaluation was undertaken, as no further changes regarding physical fitness since the OYA report were identified during the FYA site visit.

- 5.148. It is therefore concluded that the operation of the scheme has not caused any additional severance in terms of NMU movements/ local facility access as predicted by the ES and as such, the effects of the scheme on physical fitness are as expected.

Table 5.11 – Evaluation Summary: Physical Fitness

Sub-Objective	FYA Score	Evaluation
Physical Fitness	Neutral	As expected

Journey Ambience

- 5.149. The journey ambience sub-objective considers traveller views, traveller care (facilities and information), and traveller stress (frustration, fear of potential collisions, and route uncertainty).
- 5.150. The AST predicted that an improvement in traffic flows and a reduction in congestion would result in an improvement in route certainty, reliability and safety, and reduced driver frustration and stress. A large beneficial impact was predicted overall.
- 5.151. The ES predicted:
- The overall effect on traveller views to be neutral, as the scale of the works, set in a well vegetated landscape, would not alter the views for travellers on the various road corridors.
 - The effect on traveller care would be worse than when compared to the pre-construction situation, resulting from the loss of a lay-by.
 - The scheme would result in beneficial effects on driver stress due to the significant improvement in terms of reduced congestion, enhanced highway design and safer driving conditions. Slip road widening and dedicated turnings would improve traffic flows resulting in an increase in route certainty, reliability of journey times and therefore a reduction in driver frustration. Fear of collisions would decrease with a reduction in the erratic starting and stopping of vehicular movements and increased hazard awareness arising from strategically placed warning signs within the junction.
- 5.152. The OYA report considered that in summary:
- Traveller views were slightly worse than expected due to the closure of a former lay-by on the A12 being left in-situ and unplanted as a result of Value Engineering to save on construction costs and to provide a potential location for a mobile Variable Message Sign (VMS).
 - The impact of the scheme on traveller care was as expected
 - Due to queuing back from the A1023 arm onto the roundabout during the morning peak period and concerns regarding signing and lane allocation, driver stress appeared to be worse than expected.

Consultation

- 5.153. No responses to consultation requests were received.

Evaluation

- 5.154. The ES predicted that mitigation works in the form of planting would aid the integration of the scheme into the surrounding landscape; however, it is considered that the impact on traveller views is slightly worse than expected as;
- as noted in the Landscape sub-objective, above, a significant proportion of the planting stock has either failed to establish or has suffered continued damage due to grazing by deer

- the former lay-by on the A12 remains in-situ and unplanted as a result of value engineering (as noted by the OYA study).

- 5.155. The OYA study also noted that the former lay-by on the A12 was considered to provide a potential location for a mobile VMS; no mobile VMS was observed during the FYA site visit.
- 5.156. In terms of the impact on driver stress, it can be seen from the comparison of predicted and observed AADT shown earlier that although there are variations from the predicted AADT traffic flows at a local level including number lower than forecast, Brook Street westbound, the A12 off-slip, and the M25 clockwise on-slip have higher than forecast flows post opening; it is considered that greater than predicted traffic flows are likely to have resulted in a greater than predicted degree of driver stress at these locations.
- 5.157. This may be corroborated by the fact that although the junction was observed to be busy at the time of the FYA site visit and did not appear to be congested, the sounding of vehicular horns was noted on several occasions throughout the visit; it is considered that this is likely indicative of driver frustration and stress, further observational evidence noting poor lane discipline and erratic vehicular movement around the junction.
- 5.158. The OYA study noted that signing around the junction met current standards at the time and that permanent reflective posts had been installed on the splitter island, both of which were considered likely to have a positive impact on route certainty. No further evaluation has been undertaken, as no changes regarding traveller care were identified during the FYA site visit and there were no unresolved issues from the OYA report.
- 5.159. Based on the information presented in this evaluation, it is concluded that although the overall effects of the Scheme on Journey Ambiance are likely to be Beneficial, they are less than predicted by the ES.
- 5.160. Table 5.12 summarises the evaluation of the scheme's impact on journey ambiance.

Table 5.12 – Summary of Journey Ambiance Evaluation

Traveller Factor	FYA Score	FYA evaluation
Views	Slightly Adverse	The former lay-by on the A12 remains unplanted and in other locations, a significant proportion of the planting stock has either failed to establish or has suffered damage by deer. Worse than expected.
Stress	Moderate Beneficial	As noted by the traffic chapter of this report, Journey Times have improved and are likely to have had a beneficial impact on driver stress. Please refer to the safety chapter of this report for collision data, any improvement in which is also likely to have a beneficial impact on driver stress. Signing around the junction meets current standards and permanent reflective posts have been installed on the splitter island on the M25 clockwise off-slip road/ A12 eastbound on-slip road; however, the poor lane discipline and sounding of vehicular horns noted during the FYA site visit is considered likely indicative of driver frustration and stress. Although no congestion was noted during FYA site visit (encompassing the peak morning flow), it is considered that the greater than predicted traffic flows overall may have resulted in a greater than predicted degree of driver stress arising from fear of collisions and/ or route uncertainty.
Care	Slightly Adverse	As expected due to removal of existing lay-by.
Summary Score		Slight Beneficial (worse than the large beneficial score expected)

Key Points

Noise and Air Quality

- Local AADT traffic flows vary from predictions, with observed flows being up to 20% less than predicted (M25 anticlockwise), and up to 26% more than predicted (Brook Street westbound).
- The observed AADT traffic flows for the scheme are 22% greater than predicted overall; this is within the 25% upper tolerance assumed by POPE for noise, but exceeds the 10% upper tolerance assumed by POPE for local air quality.
- The properties close to the roads where the observed traffic was higher than forecasted are within Brentwood AQMA 2, and NO₂ concentrations within AQMA 2 have continued to breach the 40µg/m³ annual mean criterion since the scheme was constructed. Consequently, air quality overall can be said to have remained the same, and it is considered that there has been no significant improvement or deterioration in air quality as a result of the scheme.
- The impacts of the scheme are therefore considered to be as expected for noise, and as expected for air quality.

Greenhouse Gases

- Greenhouse gases could not be evaluated precisely, hence has not been scored as part of this evaluation.

Landscape

- The road corridor generally remains free of noxious weeds, and grassland areas are well established, generally free of significant scrub cover, and performing as specified by the landscape proposals. No issues were identified regarding lighting provision.
- Although no target coverage of planting plots within a specific time period was stated in the HEMP, current levels of plant growth and establishment of the plant stock adjacent to the M25 anti-clockwise exit-slip road and along the A12 westbound exit-slip road indicates that their visual screening and landscape integration functions are developing as expected at FYA.
- Environmental functions of the landscape proposals are not being realised at The Poplars (where the plant stock at has failed to establish), or along the M25 Clockwise off-slip road and River Ingrebourne/ A12 Eastbound on-slip road (where the planting has suffered major grazing damage by deer).
- Overall the visual impact evaluation is as expected, slight beneficial. Due to the failure of some plant stock, the landscape evaluation is worse than expected (slight adverse).

Biodiversity

- Habitat establishment and maintenance is generally developing in line with the ecological mitigation proposals, but the function of the plant stock along the M25 clockwise off-slip road has not been realised and has potentially had an adverse effect on the local bat population.
- Animal mortality figures show that mortality rates have not increased since construction.
- Overall the impact of the scheme on biodiversity is slight/ moderate adverse, slightly worse than expected.

Cultural Heritage

- The planting plot implemented to screen the carriageway from the Ancient Woodland has suffered major grazing damage and is not performing the screening function for which it was intended; consequently, views to the carriageway from the Ancient Woodland remain open – although this has not materially changed the landscape setting of the woodland. Overall evaluation is neutral, as expected.

Water

- No information has been made available to POPE which would indicate that the scheme drainage measures are performing other than as intended. Based on the FYA site visit, the Landscape As-Built drawings, and the information provided by the EA, it is likely that the overall effect of the scheme on water quality and drainage is slight adverse as expected.

Physical Fitness

- No additional severance in terms of NMU movements/ local facility access has occurred as a result of the scheme. The overall impact of the scheme is neutral, as expected.

Journey Ambience

- Traveller views: The former lay-by on the A12 remains unplanted and in other locations, a significant proportion of the planting stock has either failed to establish or has suffered major grazing damage.
- Driver Stress: As noted by the traffic chapter of this report, Journey Times have improved and are likely to have had a beneficial impact on driver stress. Please refer to the Safety chapter of this report for collision data, any improvement in which is also likely to have a beneficial impact on driver stress.
- Signing around the junction meets current standards and permanent reflective posts have been installed on the splitter island on the M25 clockwise off-slip road/ A12 eastbound on- slip road; however, the poor lane discipline and sounding of vehicular horns noted during the FYA site visit is considered likely indicative of driver frustration and stress.
- Although no congestion was noted during FYA site visit (encompassing the peak morning flow), it is considered that the greater than predicted traffic flows overall may have resulted in a greater than predicted degree of driver stress arising from fear of collisions and/ or route uncertainty.
- Traveller Care: As expected, due to removal of lay-by.
- Overall evaluation is worse than expected (slight beneficial).

6. Accessibility and Integration

- 6.1. This section of the report assesses the accessibility and integration impacts of the M25 Junction 28 Brook Street scheme. Two of the five Government objectives for transport, Accessibility and Integration, were covered as part of the scheme's appraisal included in the AST.

Accessibility

- 6.2. The accessibility objective is concerned with how the scheme has affected the ability of people in different locations to reach different types of facility, using any mode of transport. The accessibility objective consists of three sub-objectives. These are:

- Option values
- Access to the transport system
- Severance

Option Values

- 6.3. Option values, as defined in webTAG, relate to the availability of different transport modes within the study area, even if they are not used. The AST for this scheme states that no additional public transport was included as part of this scheme, therefore this sub-objective is not applicable to this scheme.

Access to the Transport System

- 6.4. As reported at the OYA stage bus route 498, operated by Transport for London, is the only route which passes through the junction. This route runs between Romford and Brentwood and passes through the M25 Junction 28 interchange. In 2013, this route still passes through the junction.
- 6.5. The results of the journey time surveys in section 2 of this report showed that journey times had improved on most through the roundabout and therefore this will have had a positive impact on bus route 498 travelling through the junction at FYA.

Severance

- 6.6. The AST stated that there would be no relief to or additional severance to pedestrians and cyclists moving around or accessing local facilities via the junction. A cycle / pedestrian path was already place. The ES noted that pre scheme there were less than 40 pedestrians and cyclists using the routes around the junction in an 11 hour period, and that the numbers were likely to be low due to the undesirable nature of crossing busy roads.
- 6.7. The OYA assessment was that severance is likely to be slightly worse due to the increased number of lanes that cyclists and pedestrians now have to cross on the slip roads. The low number of Non Motorised Users (NMUs) using this junction however means that this is not a disbenefit impact according to the guidelines in WebTAG.

Table 6.1 – Evaluation Summary: Accessibility

Sub-Objective	FYA Score	Evaluation
Accessibility	Neutral	As expected

Integration

- 6.8. The integration objective consists of two main elements:
- Interchange with other transport modes: how the scheme assists different modes of transport in working together and the ease of people moving between them to choose sustainable transport choices.
 - Land Use Policy and Other Government Policies: how the scheme integrates with local land use and wider government objectives.

Transport Interchange

- 6.9. The transport interchange objective relates to the extent to which the scheme contributes towards the Government objective of improving transport interchange for passengers and freight. There are no passenger or freight interchanges within the scheme.

Land Use Policy and Other Government Policies

- 6.10. The AST worksheet for the integration sub-objectives set out the detail of which policies the scheme helped or hindered, It stated that the scheme was supported by key policies relating improvements to infrastructure particularly making better use of existing infrastructure and that mitigation measures would ensure that there was no significant affect on local land use policies. No government policies would be significantly affected by the scheme.
- 6.11. The forecast and the evaluation of the scheme in relation to land use policy is summarised in **Table 6.3** on the following page. Given the findings presented, it is considered that the forecast assessment of the scheme on land use policy integration is neutral as expected.
- 6.12. Likewise, the forecast and evaluation of the scheme in relation to other Government policy is summarised in **Table 6.4** on the following page. Given the findings presented, it is considered that the forecast assessment of the scheme on land use policy integration is slight beneficial, better than expected as any that were not helped by the scheme, were mitigated against worsening where possible.

Table 6.2 – Evaluation Summary: Integration

Sub-Objective	FYA Score	Evaluation
Integration	Slight beneficial	Better than expected

Table 6.3 – Scheme Alignment with Land Use Policy

	Policy Document	Relevant Policy Objectives	Evaluation of Relevant scheme impacts	Alignment
Local	Brentwood Replacement Local Plan (2005)	The transport chapter encourages infrastructure improvements to address congestion.	Scheme has reduced journey times in the peak periods at some of the key movements at the junction	✓
	Havering Unitary Development Plan (1993)	Policy TRN4 encourages facilities to ease the flow of trunk road traffic in the Borough.	Improved journey times	✓
Regional	RPG9 Regional Planning Guidance for the South East (March 2001) - The draft East of England Plan (2004), The draft East of England Plan (2004),	Key Development Principle 12 of RPG9 and Policy T1 target investment to overcome existing bottlenecks.	Journey times at junction have improved	✓
		Policy E1 of RPG9 and Objective 10 of the draft East of England Plan seek to protect and enhance the natural environment.	Although this is not helped by the scheme, mitigation measures were put in place	As expected
	Essex and Southend-on-Sea Replacement Structure Plan (2000 and 2006)	The Plan supports the London to Ipswich Multi-Modal Study and sustainable transport improvements in the wider context.	Completion of scheme is consistent with these goals	✓
		Policy T10 seeks to minimise the adverse environmental impact of all new road schemes, partly through selecting routes which follow existing transport corridors in preference to new routes crossing the countryside.	The scheme was location on existing traffic corridor and mitigation measures were put in place.	✓
	Essex and Southend-on-Sea Replacement Structure Plan 1996-2011 (April 2001)	Replacement Structure Plan Policy CS2 seeks to maintain and conserve the natural and built environment.	Although this is not helped by the scheme, mitigation measures were put in place	As expected
	Essex Local Transport Plans (2000 and 2006)	Chapter 5 of the Local Transport Plans 2006 sets out a delivery programme for Chelmsford and the Heart of Essex. It identifies M25 J28 / A12 / Brook Street improvements as a major Scheme.	Construction of scheme fulfils this.	✓
National	National: PPG13 Transport (2001)	(Encourages more sustainable forms of transport and seeks to integrate planning and transport at all levels. Reducing congestion and improving safety are important policy objectives but care must be taken to minimise the environmental impact of new transport infrastructure projects or improvements to existing infrastructure)	Policies Helped: Reducing congestion and pollution and improving access. Flow of traffic through the junction has been improved	✓
			Polices Hindered: Reducing need to travel and growth in private car usage Promoting and use of sustainable public transport and managing demand	As expected

Table 6.4 – Scheme Alignment with Government Policies

Policy Document	Relevant Policy Objectives	Evaluation of Relevant scheme impacts	Alignment
DEFRA Air Quality Strategy for England, Scotland, Wales and Northern Ireland (2003)	Set health based standards for pollutants control and objectives for their achievement (the Scheme will lead to an overall reduction in public exposure to pollutants with the majority of local properties experiencing benefits).	Improved flow of traffic through the junction	✓
DEFRA Our Energy Future: Creating a Low Carbon Economy (2003)	Hinders Target to reduce carbon dioxide emissions by 60% by 2050.	Not known as could not evaluate	-

Key Points

Accessibility Impacts

- Severance is likely to be slightly worse to the small number of cyclists and pedestrians crossing the junction due to the need to cross an increased number of lanes on the slip roads; however the low number of these users means that this is rated as a neutral impact, as expected.
- The bus route which passes through the M25 Junction 28 will benefit from the improved journey times at the roundabout.

Integration Impacts

- The scheme supports local and regional land policies which encourage transport infrastructure improvements which address congestion and ease the trunk roads, and regional policies to invest in overcoming bottleneck problems.
- It is consistent with national policies at the time it was appraised to reduce congestion and pollution but not to promote sustainable transport and manage demand.
- The overall evaluation of the scheme for Integration, is neutral, as expected.

7. Appraisal Summary Table & Evaluation Summary Table

Appraisal Summary Table

- 7.1. The AST is a brief summary of the main economic, safety, environmental and social impacts of a highway scheme. **Table 7.1** presents the AST for the M25 J28 A12 (brook Street) scheme.
- 7.2. The AST presents a brief description of the scheme, a statement detailing the problems that the scheme planned to address, and makes an assessment of the scheme's predicted qualitative and quantitative impacts against the following core NATA objectives:
- **Environment** – an estimate of the impact of the scheme on factors such as noise, local air quality, landscape, biodiversity, and water.
 - **Safety** – measured reduction in the number and severity of collisions and qualitative assessment of impacts on security.
 - **Economy** – Estimated impact of the scheme upon journey times, vehicle operating costs, scheme costs, journey time reliability and wider economic impact.
 - **Accessibility** – A review of scheme impact upon access to the public transport network, community severance, and non-motorised user impact.
 - **Integration** – A description of how a scheme is integrated with wider local planning, regional and national policy objectives.

Evaluation Summary Table

- 7.3. The EST was devised for the POPE process to record a summary of the outturn impacts against the objectives and predictions in the AST.
- 7.4. Drawing on the results presented in this report, **Table 7.2** presents the EST for the scheme. An assessment of each of the objectives at the FYA stage is given. Where possible, the format of the EST mirrors the appearance and process of the AST to enable direct comparison between the two.

Table 7.1 – Appraisal Summary Table (October 2006)

M25 Junction 28 / A12 / Brook Street Improvement Scheme				
Option		Description	Problems	Present Value of Costs to Public Accounts (£13.6m)
OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE ASSESSMENT	ASSESSMENT
ENVIRONMENT	Noise	A total of 460 sensitive properties lie within 300m of the Scheme. Barely perceptible changes in traffic noise levels will arise as a result of the Scheme. Noise level changes at closest properties would be <2dB.	Congestion at Junction: reduced safety and journey time reliability Est. population annoyed by traffic noise: Do minimum = 144; Do something = 144.	Estimated net 0 additional residents will be annoyed by noise in design year
	Local Air Quality	The Scheme will have a negligible benefit to air quality within three Air Quality Management Areas. The small magnitude of the scores indicates that the overall reduction in public exposure would be slight.	Properties with: improvement = 787; deterioration = 221, no change = 3 (same for NO2 and PM10)	Net total assessment for: PM10 = -8.51; NO2 = -4.62
	Greenhouse Gases	Calculations show an increase in CO2 with Scheme of 0.4% compared to the Do Minimum in first year.	2008 Do min - 50,891 tonnes CO2 2008 Do Something – 51,100 tonnes CO2	+ 209 tonnes CO2
	Landscape	Existing, established, well vegetated landscape of local importance. Restricting improvement works to within existing highway boundary minimises wider impacts and impact on landscape character. Some localised loss of vegetation beside the Ingrebourne River.	Not applicable	Neutral
	Townscape	Suburban townscapes of Brook Street, Harold Hill and Harold Park within 1km of Scheme. Areas close to Scheme of no distinctive appearance, existing screening would not be altered. No impact on townscape character.	Not applicable	Neutral
	Heritage of Historic Resources	Only known feature within Scheme footprint is undesignated line of London–Colchester Roman road: previously disturbed and no further impact expected as result of Scheme.	Not applicable	Neutral
	Biodiversity	Scheme would result in loss of habitat within highway boundaries with low to medium importance at the local scale, including habitat along the Ingrebourne River due to extension of existing culvert, and some reptile habitat. Indirect adverse impact on foraging/commuting bats through increased risk of collisions with road traffic through reduced verge width.	Not applicable	Slight Adverse
	Water Environment	No significant change in water quality of Ingrebourne River due to modified existing road drainage system and additional 30m length of culverting. No adverse affect on existing flooding regime, groundwater unaffected	Not applicable	Neutral
	Physical Fitness	No change in physical fitness is expected as a result of the Scheme.	Not applicable	Neutral
SAFETY	Journey Ambience	Improved traffic flows and reduction in congestion would result in improved route certainty, reliability & safety, reduced driver frustration & stress.	Not applicable	Large Beneficial
	Collisions	Traffic queues removed from affecting A12 and M25 main carriageways. Reduction in shunt-type accidents.	Not applicable	£4.7m
ECONOMY	Security	Upgraded road lighting and footway under M25 flyover to be lit	Not applicable	Slight Beneficial
	Public Accounts	PV of Construction costs of scheme including allowance for night-time working, also includes renewal costs in the 30th year.	Central Govt PVC, Local Govt PVC	£14.8m BCR = 17.9
	Transport Economic Efficiency: Business Users & Transport Providers	PV of benefits accruing to business users and transport providers resulting from reduced delays at junction.	Users PVB, Transport Providers PVB, Other PVB	£157.4m
	Transport Economic Efficiency: Consumers	PV of benefits accruing to consumer users and transport providers resulting from reduced delays at junction.	Users PVB	£102.1m
	Reliability	Reduction in accidents and delays would lead to improved reliability of trips through the junction. However it has not been possible to quantify this.	Not applicable	Beneficial
ACCESSIBILITY	Wider Economic Impacts	Improved accessibility to/from major national and regional economic centres by journey time savings.	Not applicable	Neutral
	Option values	No additional public transport included as part of the Scheme.	Not applicable	Neutral
	Severance	No relief to or additional severance to pedestrians and cyclists moving around or accessing local facilities.		Neutral
INTEGRATION	Access to the Transport System	No additional public transport included as part of the Scheme	Not applicable	Neutral
	Transport Interchange	There is no inclusion of passenger or freight interchanges within the Scheme.	Not applicable	-
	Land-Use Policy	The Scheme is supported by key policies relating to reducing congestion, including PPG13, the draft East of England Plan and Policy TRN4 of the Havering Unitary Development Plan. The limited land take of the Scheme and proposed mitigation measures ensure that there is no significant affect on local land use policies.	Not applicable	Neutral
	Other Government Policies	Improvements to transport infrastructure reduce public exposure to pollutants and provide the opportunity for improved regional and local economic performance. However, no government policies are significantly affected by the scheme.	Not applicable	Neutral

Table 7.2 – Evaluation Summary Table

Obj	Sub-Objective	Qualitative Impacts	Quantitative Impacts	Assessment
Environment	Noise	Low noise surfacing has been provided. Based on available data on traffic flows, it is considered that the local noise climate at Brook Street is likely to be worse than expected, and that at the M25 through traffic anti-clockwise is likely to be better than expected. However, the overall effects of the scheme are broadly as expected.		As expected, but with local variation
	Local Air Quality	Based on traffic flows, it is considered that air quality is likely to be worse than expected at four locations, and likely to be better than expected in three locations. Based on data on NO2 concentrations for properties close to the roads where the observed traffic was higher than forecast, there has been no significant change in air quality as a result of the scheme. Therefore, although there are local variations in air quality, the overall effects of the scheme are broadly as expected.		As expected, but with local variation
	Greenhouse Gases	Not assessed		n/a
	Landscape	Grassland plots and the planting stock are developing reasonably well along the M25 anti-clockwise and A12 westbound exit slip. As this is beginning to screen traffic from residential properties, the visual effects of the scheme are considered as expected. However, a significant proportion of the planting stock has either failed to establish or has damaged, the landscape effects are considered as slight adverse.		<u>Visual impact:</u> As expected (Slight beneficial) <u>Landscape impact:</u> Worse than expected (Slight Adverse).
	Townscape	No changes regarding townscape have been identified during the FYA site visit and there were no unresolved issues from the OYA report.		As expected (neutral)
	Heritage of Historic Resources	Limited impact to heritage areas.	-	As expected (neutral)
	Biodiversity	It is considered that ecological mitigation measures as stated by the ES are performing as expected. However, the deer damage caused to the plant stock along the M25 clockwise exit-slip road and the potential impact of this on the local bat population means the overall effects can be considered as slight/ moderate adverse.	-	Slightly worse than expected (slight/ moderate adverse)
	Water	Based on the FYA site visit and the data provided by the EA, it is concluded that the overall effect of the water quality and drainage is likely to be as expected.	-	As expected (slight adverse)
	Physical Fitness	New footways and improved carriageway lighting have been provided. The scheme has not caused any additional severance in terms of NMU movements/ local facility access.	-	As expected (neutral)
	Journey Ambience	The impact on views is scored slight adverse which is worse than expected because a significant proportion of the planting stock has either failed to establish or has been damaged. The impact on stress has been considered as moderate beneficial. While journey times have improved and signing around the junction meets current standards, however, poor lane discipline and the sounding of horns noted at the FYA site visit, greater than predicted traffic flows may have increased stress. Care is considered slight adverse due to the removal of an existing lay-by.	-	Worse than expected (Slight beneficial)
Safety	Collisions	The number of accidents along the M25 have reduced slightly when compared to pre-scheme levels and are lower than that forecast at the appraisal stage. However, when the national background reduction in collisions is taken into account, collision levels show an increase.	Net change between pre-scheme and FYA post-scheme, with the consideration of the background reduction in accidents: -2.90 (-16%)	
	Personal Security	Lighting improvements have been carried out on the roads.	It is predicted that the scheme will have a slight beneficial impact on personal security.	As expected
Economy	Public Accounts	-	Forecast PVC: £14.8m Re-forecast PVC based on FYA outturn impact: £15.7m	As expected
	Transport Economic Efficiency	The data generally shows journey time savings, with an average journey time saving of 1 minute 5 seconds in the PM peak, 53 seconds in the inter-peak and 48 seconds in the AM peak.	NTEM outturn journey time benefits: £44.4m (forecast £259.6m)	Not comparable to AST
	Reliability	The scheme has acted to reduce delays. While collisions have reduced from a pre-scheme to post-scheme level, there is an increase when the national background reduction in collisions is taken into account. Therefore it is not possible to give an assessment as to the outturn impact on reliability.	-	-
	Wider Economic Impacts	The scheme has assisted in delivering local and regional socio-economic policy aspirations by improving the network through the reduction of journey times. However, this benefit is relatively low level.	-	As expected (Neutral)
Accessibility	Option Values	Not assessed as no additional public transport was included with the scheme.	-	-
	Severance	No change has been noted due to the scheme.	-	As expected (Neutral)
	Access to the Transport System	The scheme did not include any additional public transport, although journey time savings would have been beneficial for the existing bus route.	-	As expected (Neutral)
Integ	Transport Interchange	There are no passenger or freight interchanges within the scheme.	-	-
	Land-use Policy	The scheme is consistent with local, regional and national land use policies relating to reducing congestion and mitigation is in place for policies hindered.	-	As expected (neutral)
	Other Gov't Policies	The scheme is consistent with national policies.	-	As expected (neutral)

8. Conclusions

8.1. To conclude this report, this section summarises how the scheme is meeting its specified objectives.

Scheme Specific Objectives

8.2. **Table 8.1** presents an evaluation of the scheme’s objectives using the evidence presented in this study.

Table 8.1 – Success against Scheme Objectives

	Objective	Has the scheme objective been achieved?	
HA’s Non Technical Summary (2006)	Improve safety at the junction	Post opening, there has been an annual average increase of 2.9 collisions a year over the appraisal area. This increase is not shown to be statistically significant, therefore cannot be confidently attributed to the scheme.	Inconclusive
	Improve circulation of the junction to deliver a reduction in vehicle queuing and journey times.	Post opening, journey time savings are noted on a number of key routes where improvements were undertaken, demonstrating that the scheme has had an impact on journey times. A number of the routes circulate the junction and show an improvement, therefore the assumption can be made that the circulation of the roundabout has been improved.	

Appendices

Appendix A. Glossary

Terms	Definition
AADT	Annual Average Daily Traffic. Average of 24 hour flows, seven days a week, for all days within a year.
ACW	Anticlockwise
Accessibility	Accessibility can be defined as 'ease of reaching'. The accessibility objective is concerned with increasing the ability with which people in different locations, and with differing availability of transport, can reach different types of facility.
ADT	Average Daily Traffic. Average daily flows across a given period.
AST	Appraisal Summary Table. This records the impacts of the scheme according to the Government's five key objects for transport, as defined in DfT guidance contained on its Transport Analysis Guidance web pages, WebTAG.
ATC	Automatic Traffic Count
AAWT	Annual Average Weekday Traffic. As AADT but for five days (Monday to Friday) only.
AWT	Average Weekday Traffic. As ADT but for five days (Monday to Friday) only.
BCR	Benefit Cost Ratio. This is the ratio of benefits to costs when both are expressed in terms of present value i.e. PVB divided by PVC.
COBA	Cost Benefit Analysis. A computer program which compares the costs of providing road schemes with the benefits derived by road users (in terms of time, vehicle operating costs and collisions), and expresses the results in terms of a monetary valuation. The COBA model uses the fixed trip matrix unless it is being used in Accident-only mode.
CW	Clockwise
DfT	Department for Transport
Discount Rate	The percentage rate applied to cash flows to enable comparisons to be made between payments made at different times. The rate quantifies the extent to which a sum of money is worth more to the Government today than the same amount in a year's time.
Discounting	Discounting is a technique used to compare costs and benefits that occur in different time periods and is the process of adjusting future cash flows to their present values to reflect the time value of money, e.g. £1 worth of benefits now is worth more than £1 in the future. A standard base year needs to be used which is 2002 for the appraisal used in this report.
DM	Do Minimum. In scheme modelling, this is the scenario which comprises the existing road network plus improvement schemes that have already been committed.
DMRB	Design Manual for Roads and Bridges
DS	Do Something. In scheme modelling, this is the scenario detailing the planned scheme plus improvement schemes that have already been committed.
EA	Environment Agency
EB	Eastbound
EAR	Economic Assessment Report
ES	Environmental Statement
EST	Evaluation Summary Table. In POPE studies, this is a summary of the evaluations of the TAG objectives using a similar format to the forecasts in the AST.
EU	European Union
FYA	Five Year After
HA	Highways Agency. An Executive Agency of the DfT, responsible for operating, maintaining and improving the strategic road network in England.
HGV	Heavy Goods Vehicle
JUICE	Junction User Interface Cost Evaluation. A spreadsheet model used to calculate delay

Terms	Definition
	costs at a junction.
KSI	Killed or Seriously Injured. KSI is the proportion of casualties who are killed or seriously injured and is used as a measure of collision severity.
LCA	Landscape Character Areas
LNS	Low Noise Surfacing
LTP3	Local Transport Plan 3
MAC	Managing Area Contractor Organisation normally contracted in 5-year terms for undertaking the management of the road network within a HA area.
MVKM	Million Vehicle Kilometres
NMU	Non-Motorised User. A generic term covering pedestrians, cyclists and equestrians.
NRTF	National Road Traffic Forecasts. This document defines the latest forecasts produced by the Department of the Environment, Transport and the Regions of the growth in the volume of motor traffic. At the time this scheme was appraised, the most recent one was NRTF97, i.e. dating from 1997.
NTM	National Transport Model
NVC	National Vegetation Communities
ONS	Office for National Statistics
OYA	One Year After
POPE	Post Opening Project Evaluation. The before and after monitoring of all major highway schemes in England.
Present Value	Present Value. The value today of an amount of money in the future. In cost benefit analysis, values in differing years are converted to a standard base year by the process of discounting giving a present value.
PVB	Present Value Benefits. Value of a stream of benefits accruing over the appraisal period of a scheme expressed in the value of a present value.
PVC	Present Value Costs. As for PVB but for a stream of costs associated with a project
QUADRO	Queues and Delays at Roadworks. A software programme for calculating the monetary impacts of delays at roadworks.
SATURN	Simulation and Assignment of Traffic to Urban Road Networks. A strategic transport modelling software programme.
STATS19	A database of injury collision statistics recorded by police officers attending collisions.
TEE	Transport Economic Efficiency
TEMPRO	Trip End Model Program. This program provides access to the DfT's national Trip End Model projections of growth in travel demand, and the underlying car ownership and planning data projections.
TIS	Traffic Impact Study
TRADS	Traffic Flow Data System. Database holding information on traffic flows at sites on the strategic network.
UK	United Kingdom
VISSIM	VISSIM. Micro-simulation modelling software.
webTAG	DfT's website for guidance on the conduct of transport studies at http://www.webtag.org.uk/
WB	Westbound

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Appendix C. Environment

C.1. Data Requested for Environmental evaluation

Table E.1 Standard list of information required to evaluate the environmental sub-objective.

Environment Specific Requirements	OYA Response	FYA Response
Environment Statement (ES) or Stage 3 Scheme Assessment Report (SAR) or Environmental Assessment Report (EAR) including Environmental Masterplan (EMP) drawings.	✓	Received at OYA.
AST.	✓	Received at OYA.
Any amendments / updates, additional surveys or reports since the ES / SAR / EAR.	✓	No additional information received at FYA.
Any changes to the schemes since the ES/ SAR/ EAR e.g. to lighting and signs, retention of material on site in earthworks in the form of landscape bunds or other, or to proposed mitigation measures.	-	None received.
As built drawings for landscape/ biodiversity/ environmental mitigation measures/ drainage/ fencing/ earthworks etc.	✓	Received at OYA .
Construction Environment Management Plan (CEMP), Landscape and Ecology Aftercare Plan (LEAP), Landscape Management Plan (LMP) or Handover Environmental Management Plan (HEMP).	HEMP received.	HEMP received at OYA.
Health and Safety File – Environment sections (to include all environment As-Built reports).	-	None received.
Relevant Contact Names for consultation.	✓	Those received at OYA supplemented by those sourced by POPE.
Archaeological Reports (popular and academic).	No archaeological reports were produced.	-
The Road Surface Influence (RSI) value of any low noise surface installed.	-	None received.
The insulation performance properties of any noise barriers installed (The BS EN 1794-2 result provided by the noise barrier manufacturer).	-	Noise barriers were not a scheme requirement.
List of properties eligible for noise insulation.	Designers provided some information but Part 1 Claims will decide properties eligible for noise insulation.	No further information received.
Employers Requirements Works Information - Environment sections.	-	None received.
Part 1 Claims information.	HA Part 1 Team advised that it was too early in the claims	None received.

Post Opening Project Evaluation
M25 J28 (A12 Brook Street) - Five Years After Study

Environment Specific Requirements	OYA Response	FYA Response
	period for successful claims to be advised.	
Reports for any pre/ post opening survey and monitoring work e.g. for noise, biodiversity, water quality).	No monitoring surveys carried out and no monitoring requirements for protected species were included in the HEMP.	Highways Agency Area 6 Deer Study (March 2010) provided by the Area 6 MAC. Some water monitoring data provided by the EA.
Animal mortality data.	✓	Provided by the Area MACs.
Pre or Post opening Non-motorised User (NMU) Audits or Vulnerable User (VU) Surveys.	No formal NMU post opening survey. Informal observations were made during Road Safety Audit 3.	None received.
Information may be available regarding environmental enhancements to streetscape/townscape for bypassed settlements	No environmental enhancements required to streetscape/ townscape for nearby settlements.	No environmental enhancements required to streetscape/ townscape for nearby settlements.
Scheme Newsletters / publicity material/ Award information for the scheme.	Available on HA web page	Those received at OYA available at FYA.

C.2. Photographic Record of Scheme

Photographic Record of Scheme

Retaining Wall and Culvert Adjacent to A12 Eastbound Entry-Slip Road



OYA (May 2009)



FYA (August 2013)

A strip of grassland along the M25 clockwise exit-slip road/ A12 eastbound entry-slip road was implemented to deter bats from the road, and was found to be well established and generally free of significant scrub cover; in the absence of any monitoring of protected species required by either the ES or the HEMP, there is no reason to suggest that this grassland is not deterring bats from the road as expected.

Planting and Boundary Fence Adjacent to M25 Anti-Clockwise Exit-Slip Road



OYA (May 2009)



FYA (August 2013)

The HEMP stated that replacement planting was specified as being provisional subject to replacement requirements, and the like-for-like planting and grassland along the M25 anti-clockwise exit-slip road appears to have established reasonably well; apart from the infestation of dock and teasel along the highway boundary (that has the potential to reduce biodiversity if not managed appropriately), there is no reason to suggest that this area has not remained suitable for slow worms/ lizards and the planting will not fulfil its intended ecological function subject to ongoing management and maintenance.

View from Holiday Inn of Railings on Retaining Wall



OYA (May 2009)



FYA (August 2013)

Views of the A12 eastbound from the Holiday Inn are set within the existing highway context; the addition of the new retaining wall adjacent to the River Ingrebourne has not changed these views appreciably.

Coppiced Vegetation on Southern Side of River Ingrebourne



OYA (May 2013)



FYA (August 2013)

Although not indicated by the Outline Landscape Mitigation drawings or on the Environmental Masterplan, the OYA report confirmed that clearance on the southern bank of the river had been undertaken; the FYA site visit observed that these cleared areas were now closing over. It can also be seen where the plant stock has been heavily grazed by deer and is stunted (centre middle-ground).

Former Lay-by on A12 Eastbound



OYA (May 2009)



FYA (August 2013)

The former lay-by on the A12 remains in-situ and unplanted as a result of value engineering. No mobile VMS was observed during the FYA site visit.

Opening up of Southern Bank of River Ingrebourne



OYA (May 2009)



FYA (August 2013)

Although not indicated by the Outline Landscape Mitigation drawings or on the Environmental Masterplan, the OYA report confirmed that clearance on the southern bank of the river had been undertaken; the FYA site visit observed that these cleared areas were now closing over.

Photo Views: Photo 1



ES (October 2006)



FYA (August 2013)

Photo 1: M25 anti-clockwise slip road onto the junction – pedestrians can cross in front of stationary traffic at lights. The like-for-like planting and grassland (right) appears to have established reasonably well, and there is no reason to suggest that this area has not remained suitable for slow worms/ lizards and the planting will not fulfil its intended ecological function over time subject to ongoing management and maintenance.

Photo Views: Photo 3



ES (October 2006)



FYA (August 2013)

Photo 3: Commencement of A12 eastbound on-slip road – steep slope to River Ingrebourne. Open grassland has been reinstated on the embankment as specified by the Environmental masterplan to deter bats from the road. It can be seen that this grassland is well established and generally free of significant scrub cover at the time of the FYA site visit; in the absence of any monitoring of protected species required by the ES or the HEMP, there is no reason to suggest that this grassland is not deterring bats from the road as expected.

Photo Views: Photo 6



ES (October 2006)



FYA (August 2013)

Photo 6: A12 eastbound on-slip road. Open grassland has been reinstated on the embankment (left) as specified by the Environmental masterplan to deter bats from the road; in the absence of any monitoring of protected species required by the ES or the HEMP, there is no reason to suggest that this grassland is not deterring bats from the road as expected.

Photo Views: Photo 7



ES (October 2006)



FYA (August 2013)

Photo 7: A12 eastbound – road emerging from cutting under Junction. Traffic can also be seen emerging from the improved A12 east bound entry-slip road, and the changes to the signing informing traffic on the eastbound carriageway are clearly visible.

Photo Views: Photo 9



ES (October 2006)



FYA (August 2013)

Photo 9: A12 view eastwards from Wigley Bush Lane overbridge. No mobile VMS was observed during the FYA site visit in the former lay-by on the A12, the lay-by remaining in-situ and unplanted as a result of value engineering.

Photo Views: Photo 10



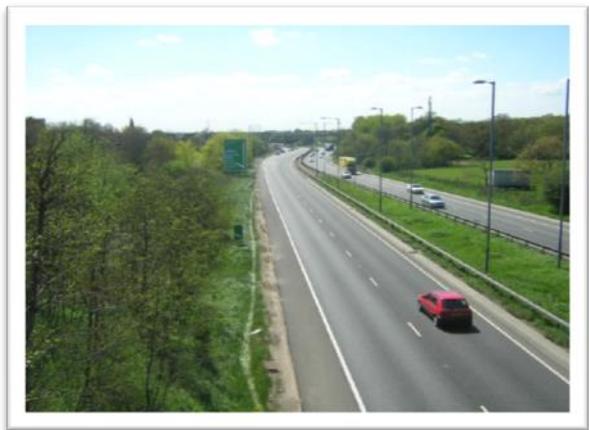
ES (October 2006)



FYA (August 2013)

Photo 10: A12 view westwards from Spital Lane footbridge. As predicted by the ES, no change in visual effects has been experienced at this location.

Photo Views: Photo 11



ES (October 2006)



FYA (August 2013)

Photo 11: A12 view westwards towards junction from Wigley Bush Lane over bridge. Traffic can be seen emerging from the improved A12 east bound on-slip road (just right of centre).

Photo Views: Photo 12



ES (October 2006)



FYA (August 2013)

Photo 12: View beside A12 London-bound off-slip road. Signage informing the A12 westbound exit-slip road is clearly visible to traffic.

Photo Views: Photo 13



ES (October 2006)



FYA (August 2013)

Photo 13: London-bound off-slip road at junction roundabout with A1023 and M25 clockwise on-slip road in the background. The Poplars can be seen just left of the centre of the photograph, left of the M25 clockwise on-slip road and behind the A1023. The gaps in the hedgerow can be seen where the planting has failed to establish on the boundary of the property.

Photo Views: Photo 14



ES (October 2006)



FYA (August 2013)

Photo 14: Roundabout at junction at commencement of M25 clockwise on-slip at pedestrian crossing point, with A1023 and A12 London-bound off-slip in the background. 71/ 73 Brook Street can be seen to the centre right of the photograph, at the junction of the A1023 with the roundabout. The gap in the hedgerow where the planting has failed to establish on The Poplars residential property boundary is immediately to the left of the photograph (not shown).

Photo Views: Photo 15



ES (October 2006)



FYA (August 2013)

Photo 15: M25 clockwise on-slip at pedestrian crossing point, with The Poplars residential property in the background. The gap in the hedgerow where the planting has failed to establish is visible to the left.

Photo Views: Photo 16



ES (October 2006)



FYA (August 2013)

Photo 16: Field between A12 London-bound off-slip and Brook Street (to right of view, back of No's 71 + 73 Brook Street). The foreground planting along the highway boundary is starting to screen the current open views of traffic from No's 71 + 73 Brook Street, as expected.