Post Opening Project Evaluation

M25 Junctions 5-7 Smart Motorway – One Year After

February 2016

Notice

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Foreword

Highways England's motorways are some of the safest in the world. Our road network carries a third of road traffic and we have seen demand grow by a quarter since 2000 with continued growth forecast.

One reason for the introduction is smart motorways is because there are more vehicles on the road. By making use of the full width of the road, smart motorways add that extra capacity to carry more vehicles and ease congestion.

They have evolved from **Controlled Motorways** (with variable speed limits) to **Dynamic Hard Shoulder Running** (opening the hard shoulder as a running lane to traffic at busy periods) to **All Lane Running** (permanently removing the hard shoulder and converting it into a running lane).

Compared to a traditional motorway widening they deliver:

- Increased capacity at significantly less cost than traditional motorway widening.
- New technology and variable speed limits to improve traffic flow.
- Less congestion and more reliable journeys for customers.
- Environmental benefits of not taking an extra corridor of land to use as new road.
- A safety record that's at least as safe, if not safer than conventional motorways.

The M25 junctions 5-7 scheme incorporates the all lane running standard between junctions 5 and 6 and a four-lane controlled motorway with a hard shoulder between junctions 6 and 7. Before the scheme, this section of the motorway experienced high levels of congestion during peak periods, most notably between junctions 5 and 6.

This report indicates how the scheme was performing within its first year of operation. This initial assessment forms part of a longer-term evaluation which reviews performance over five years. The one year after study is not intended to provide conclusive evidence about scheme benefits but gives an early indication about whether a scheme is heading in the right direction. This helps us identify areas where we can focus effort to optimise the benefits of the scheme.

The findings indicate that the scheme has increased capacity within the junctions, has helped to reduce customer journey times and made journeys more reliable during the most congested periods.

Personal injury collisions on the strategic road network are very rare and can be caused by many factors. Due to their unpredictable nature, we monitor trends over a number of years before we can be confident in concluding the safety impacts of a scheme. Within the first year, it has not been possible to conclude the safety impacts of the scheme, but the findings indicate that the scheme is as safe as the original road. Further monitoring data is available for this scheme which demonstrates that the safety objectives have been achieved.

We're working to continually improve our smart motorways so that they work better for customers. Our Traffic Officers work around the clock to operate our smart motorways, keeping customers safe from the control room and attending incidents the road. We've committed to additional signs and more visible markings for emergency areas and our latest set of standards will ensure that there's a safe place to stop in an emergency every mile on our upcoming schemes. All of this helps to provide one of the most modern and safe road environments in the world.

January 2020

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Executive summary

Scheme Description

The M25 Junctions 5 to 7 scheme is a Highways England major scheme to improve the M25 by providing additional capacity through turning a 12.2 mile (19.6 km) section in Surrey/Kent into a smart motorway.

The key smart motorway features in the scheme were the following in both directions:

- All Lane Running (ALR) i.e. conversion of the hard shoulder to a permanent running lane between J5 to J6; and
- Controlled Motorway (CM) through J6 and on J6 to J7 with existing hard shoulder remaining for emergency use only, except a short section of the clockwise carriageway west of J6.

Technology to help manage traffic flows by varying the speed limit was installed throughout the scheme. The works were entirely within existing Highways England owned land. The scheme remained within the existing fence line.

Scheme Objectives

Objective (stated in Client Scheme Requirements)	Objective Achieved?
Reduce congestion and to develop solutions that provide additional capacity, increase journey time reliability and ensure the safe and economic operation of the motorway	✓
Improve journey time reliability by improving and better managing traffic flow conditions	✓ but more data is required to be conclusive
Achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.	✓ but too early to determine any change in severity
Make best use of existing infrastructure providing additional capacity within the existing highway boundary, other than in exceptional circumstances	✓
Minimise detrimental environmental effects of the SM scheme by mitigation measures, taking account of costs, availability of funding and statutory obligations.	✓
Improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway	✓
Support the current role of the M25 as a major national and inter-urban regional transport artery.	✓

Key findings

- Congestion has reduced in the peak periods.
- Journey time reliability as measured by variation in journey times has improved.
- Initial results suggest safety has improved.
- Environmental impacts are in line with expectation.

Summary of Scheme Impacts

Traffic

Traffic Volumes

- Weekday traffic on the ALR section of the scheme (J5 – J6) is 141,500 vehicles per day (vpd), an increase of 7% from that before the scheme was built. This growth is likely to be partly due to the increased capacity provided by the additional lane and improved economic conditions.
- The scheme has experienced traffic growth of 1% between J6 – J7, which was not previously at capacity before the scheme was implemented and the scheme provides new technology on this section rather than additional capacity; this is in line with regional growth trends.
- The proportion of traffic which is made up of HGVs has increased by 3% on weekdays.

Journey Times

- Overall journey times have reduced in both directions. Clockwise has experienced a 3% overall reduction, but this varies from a 5% reduction between J5 and J6 to a 3% increase between J6 and J7. Anticlockwise journey times have reduced by 2% overall.
- Journey times have reduced most significantly where they were most affected by delays in the before period, the AM peak clockwise and the PM peak anticlockwise. Between J6 and J7, journey times have increased slightly, although journey reliability has improved. The journey time increases in the non-congested conditions are likely to be due to drivers being more compliant with the national speed limit and any Variable Mandatory Speed Limits (VMSLs) displayed.
- Speeds have increased predominantly around the J5 clockwise merge and between J6 – J7 anticlockwise, most likely as a result of road layout changes at these locations.
- Speeds have reduced in the downstream part of J5 – J6 on the clockwise carriageway, probably due to better compliance with speed limits.

Operation of the Smart Motorway

- The smart motorway capability means that the speed limit can be varied from the 70mph national limit to lower speeds to improve traffic flow during busy periods. A reduced speed limit of 60mph or below is most used in the in the AM peak clockwise (up to 65% of the period). This is shown to result in the average speeds in all 4 lanes being similar in this period, making lane change easier for all.
- Speed limits are only set for a minority of the time at other time periods.
- Analysis of traffic flows by lane shows a reasonable level of usage in all 4 lanes of the ALR section, albeit with slightly lower flows on the former hard shoulder probably due to HGV usage.

Reliability

- The biggest journey time reliability improvements relate to the times when journey times were most unreliable in the before period, i.e. the clockwise AM peaks and the anticlockwise PM peaks. At less congested times the journey time reliability has not significantly changed.

Forecast vs. Outturn Flows and journey time impacts

- Although traffic flows have increased this is less than forecast. Post opening traffic flows are significantly lower than expected (with the scheme in place) by between 7% and 15% within the scheme length, averaging 12% lower. Sections of the M25 up- and downstream of the scheme show even greater the differences from forecast.
- Traffic flows in 2012, before the start of construction were also lower than modelled which is linked to the economic downturn's impact of traffic in preceding years.
- Growth of traffic on the M25 between J5 – 7 was forecast to be between 8% and 11% due to the scheme and background trends but observed growth has been much lower except for J5 – J6 clockwise suggesting there has been lower levels of reassignment from other roads than expected.
- Journey time savings were forecast between J5 – J7 in all the modelled time periods in both directions of between 41 and 64 seconds, and this was almost all due to savings on the ALR section between J5 – J6.
- Journey time savings in the busiest periods, clockwise in the AM peak and anticlockwise in the PM peak, are close to the forecast savings.

Safety

- Analysis of observed collision data for the M25 scheme section shows a decrease (including taking into account the wider trend of collision reduction nationally during this period) of 7.5 collisions (10%) one year after opening, indicating that the scheme has had a beneficial impact on safety. Conversely, in the wider area, there has been a net increase in collisions (when background trend accounted for).
- At this stage it is too early to draw firm conclusions as the net changes in collision numbers are not statistically significant.
- When traffic flow changes are taken into account, the collision rate on the M25 between J5 – 7 has decreased by 11% even taking into account the background trend in collision reduction on motorways. This change is also not statistically significant.
- Collision severity as a proportion of all collisions has increased marginally over the scheme, although this is generally due to a large decrease in the number of slight collisions, rather than the increase in serious collisions. The Fatal and Weighted Index (FWI) per hundred million vehicle miles has fallen.
- Numbers of casualties on this section on the M25 have fallen by 25%, not including the wider trend of casualty reduction.
- Collision saving on the M25 J5 – 7 and the reduction in the collision rate of 11% are in line with that forecast.

Environment

- The impact on noise and air quality has been evaluated through examining changes to traffic flows. Observed post-opening traffic flows are lower than expected by between 7% and 15% , hence the impact on the noise climate is considered likely to be as expected; and for air quality where the percentage differences between forecast and observed traffic flows are considered significant the impacts on local air quality are likely to be better than expected.
- It was forecast that the scheme would result in a net increase in carbon emissions from M25 traffic. Due to lower than expected traffic the opening year impact has been a much lower increase than expected.
- Changes brought about by the final design, including changes to the proposed planting design and the type and location of new highways infrastructure, are evident along the length of the scheme. Although there are local variations in the effects expected, there is no reason to assume that the design changes have materially changed the expected landscape, visual amenity or heritage effects of the scheme overall.
- The reduction in highway infrastructure is considered likely to have not significantly altered the overall slight adverse impact of the proposals on the landscape setting of the designated heritage assets as predicted. Screening and integration functions of the planting proposals with respect to heritage assets are likely to be more apparent in future years.
- Excessive weed growth within the planting plots suggests that the environmental functions of the mitigation measures may not be developing in line with their potential at this stage.
- Journey quality impacts are adverse for views due to the gantries but an improvement for driver stress due to the reduction in congestion and the improved signage, as expected.

Summary of Scheme Economic Performance

All monetary values in £ million 2010 market prices, discounted		Forecast	Outturn re-forecast
Present Value Benefits	Journey Times	£564.2m	£478.0m
	Vehicle Operating Costs (VOC)	-£127.9m	-£227.2m
	Construction period & Future maintenance periods	-£57.2m	-£57.2m
	Safety	£11.9m	*
	Carbon	-£161.5m	-£59.8m
	Noise	-£0.9m	-£0.9m
	Air Quality	£0.0m	£0.0m
	Indirect Tax	£160.3m	£284.7m
	Total	£388.9m	£417.6m
Present Value Costs (including operational costs)		£155.6m	£134.6m
Benefit Cost Ratio (BCR)		2.5	3.1

*Safety benefits not included as not statistically significant at this stage

- Forecasts of the Journey time benefits over the long term included predictions of increasing congestion in future years without the scheme in place. Using this trend in the post opening evaluation shows the scheme with outturn journey time benefits of £478 million, similar to that forecast, despite the lower than forecast traffic flows the M25.
- A calculation of the journey time economic benefits of the ALR section (J5 – J6) in isolation shows £464.1 million of journey time benefits in the long term, based on predicted future congestion without the ALR.
- The monetisation of the Carbon impact of the scheme was forecast to be a large disbenefit (£161 million) due to the increase in emissions, but the outturn evaluation is significantly less negative at £59.8 million due to lower than expected traffic.
- The investment cost of building the scheme was £102 million (in 2010 prices), which was 21% lower than forecast.
- Long term costs of operating the smart motorway are assumed to be as forecast at £20.9 million.
- Outturn Benefit Cost Ratio represents over £3 benefits for every £1 spent which represents high value for money.

1. Introduction

1.1. M25 J5-7 Smart Motorway is a Highways England major scheme which was completed in April 2014.

1.2. This report presents a One Year After (OYA) opening evaluation of this scheme and has been prepared as part of the Highways England Post Opening Project Evaluation (POPE) programme. The purpose of this report is to present the initial impacts of the scheme in the one year after opening.

1.3. This POPE study compliments the 12month Smart Motorway Monitoring Evaluation Report published in February 2016. Traffic flow and safety analysis from that study has been used in this POPE report, but this report does not cover the in-depth operational analysis of the smart motorway. POPE reporting covers a wider scope of evaluation against the forecasts including economic and environmental impacts.

Scheme Context

1.4. The M25 is a strategic orbital road in South East England surrounding London and plays a pivotal role in Highways England's network. It is a vital route for freight, commuter and tourist traffic. It connects the many radial motorways and trunk roads serving London and provides a bypass for cross-city traffic. The M25 is of local, regional, national and international importance, forming part of the E30 route on the European E-road network. Junctions 5 through to 7 are on the southern section of the M25, as shown in ***Figure 1-1*** (overleaf).

1.5. As part of the strategic national corridor and one of Europe's busiest motorways, vehicle demand on the M25 is high, placing pressure of the network and leading to congestion and unpredictable journey times especially during peak hours.

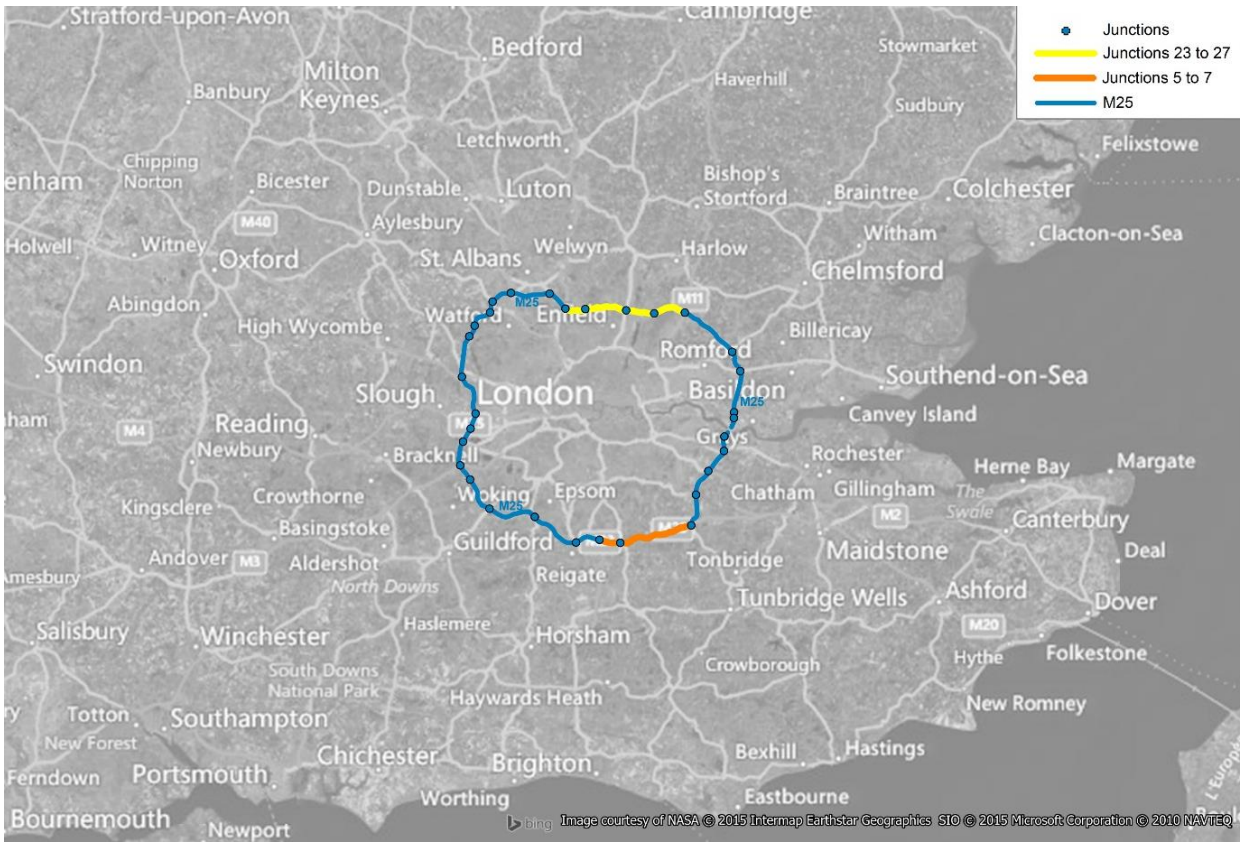
1.6. The strategic case for providing additional capacity on the M25 was examined in the early part of the last decade. This was to widen the remaining 3 lane sections to 4 lanes and was split into 5 sections for construction purposes. Three of these sections were built as widening schemes and opened between 2008 and 2012. In more recent years, however, proposals to widen the physical extents of motorways have been curtailed, with Smart Motorway schemes becoming the preferred option for increasing route capacity. The sections between J5-7 and J23-27 were together known as the Later Upgraded Sections (LUS). In January 2009, the Department for Transport (DfT) announced that the LUS sections would be taken forward as Dynamic Hard Shoulder Running (DHSR) schemes in place of widening to four lanes.

1.7. DHSR, also referred to as Managed Motorway HSR and now as Smart Motorway, makes use of the existing hard shoulder to provide the additional lane capacity during times of heavy congestion or during incident management. This is achieved by providing gantry mounted signals and variable message signs from a Controlled Motorway system to provide dynamic control of the use of the hard shoulder as a running lane together with emergency refuge areas (ERAs) for stopped vehicles. The western end of the M25 section between Junctions 6 and 7 was already 4 lanes and so was not proposed to be subject to any alteration as part of the DHSR scheme. As a result of development of the scheme plans and developments in managed motorway guidelines, the proposed scheme changed to make this section all 4 lanes through the permanent conversion of the hard shoulder a running lane under the Controlled Motorway system. This is now termed an All Lane Running (ALR) scheme.

Location

1.8. The section of the M25 between Junctions 5-7 lies to the south of London and connects with the M26 at Junction 5 and the M23 at Junction 7. ***Figure 1-1*** shows the location of this scheme and the other M25 LUS within the regional context.

Figure 1-1 Location of scheme Later Upgraded Sections of M25



Scheme Description

1.9. The M25 J5-7 scheme provided additional capacity through making a 12.2 mile (19.6 km) section of the M25 in Surrey/Kent into a smart motorway.

1.10. The works were entirely within existing Highways England owned land. The scheme remained within the existing fence line, leaving existing adjacent vegetation and land uses unaffected.

1.11. The key smart motorway features in the scheme were the following in both directions:

- All Lane Running (ALR) i.e. conversion of the hard shoulder to a permanent running lane on J5-6; and
- Controlled Motorway (CM) through J6 and on J6-7 with existing hard shoulder remaining for emergency use only, except a short section of the clockwise carriageway west of J6.

1.12. The scheme features are outlined in ***Figure 1-2*** and can be summarised as follows:

J5-6:
- conversion of the existing hard shoulder (HS) to a permanent running lane (all-lane running, ALR) giving 4 lanes on this section, including through the Clacket Lane Motorway Services Area (MSA) on this section;
- 10 Emergency Refuge Areas (ERA) with Emergency Roadside Telephones (ERT);

Through J6:
- existing 3 lanes and hard shoulder retained;

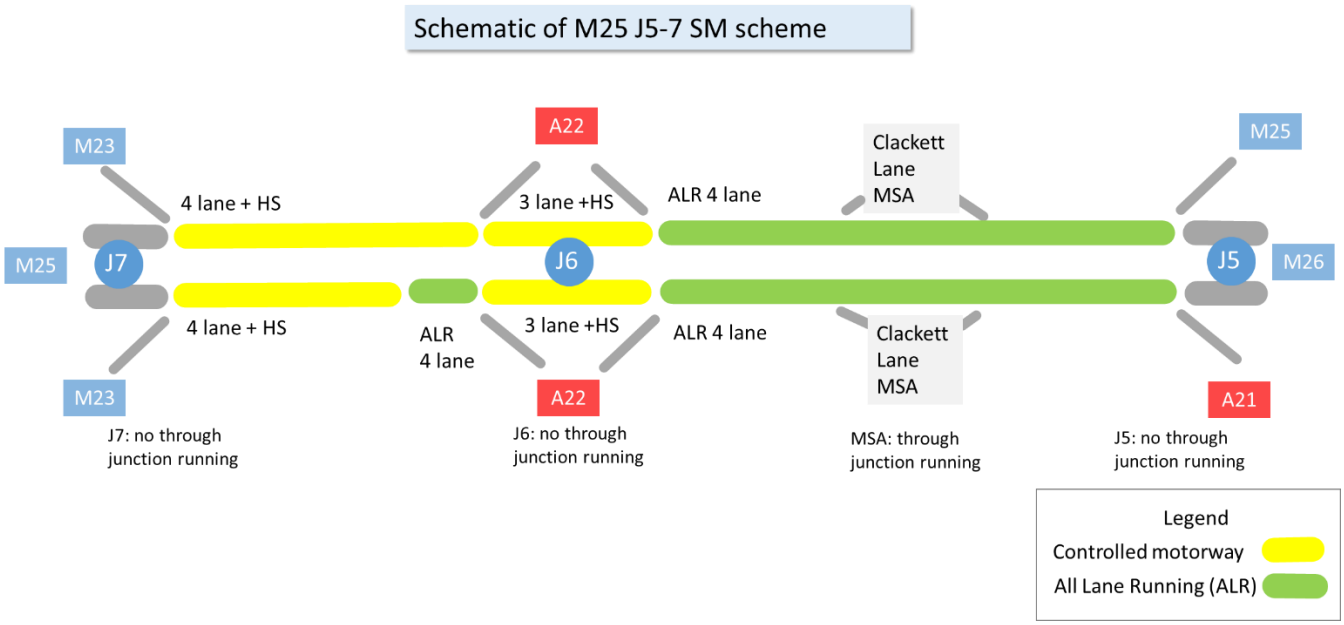
J6-7:
- existing 4 lanes and hard shoulder retained, except for short section on clockwise carriageway, west of J6;

Through the scheme

- Variable Mandatory Speed Limits (VMSL) with an associated enforcement/compliance system;
- Gantries with driver information, including lane availability, provided through a mixture of signs and signals capable of displaying appropriate combinations of: mandatory speed limits; lane closure wickets; pictograms; and text legends;
- A queue protection system and congestion management system;
- Comprehensive low-light CCTV coverage;

1.13. Also, prior to start of main scheme work, the central reserve was replaced with a concrete barrier from J5-6 including though J6.

Figure 1-2 Schematic of the Key Features of scheme



Scheme Objectives

Problem

1.14. The Impact Assessment (August 2012) stated that the problem addressed by the scheme was:

Considerable congestion on M25 between J5 and J7 during peak periods due to high traffic volumes.

Defined Objectives

1.15. The objectives of the scheme, summarised from the Client Scheme Requirements (February 2012) were:

- Reduce congestion and to develop solutions that provide additional capacity, increase journey time reliability and ensure the safe and economic operation of the motorway.
- Improve journey time reliability by improving and better managing traffic flow conditions.
- Achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.
- Make best use of existing infrastructure providing additional capacity within the existing highway boundary, other than in exceptional circumstances.
- Minimise detrimental environmental effects of the SM scheme by mitigation measures, taking account of costs, availability of funding and statutory obligations.
- Improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway.

- Support the current role of the M25 as a major national and inter-urban regional transport artery.

History

1.16. A brief history of the key events in the development of the scheme is provided in ***Table 1-1***.

Table 1-1 Timeline of M25 J5-7 improvement

Date	Summary	
2002/3	London Orbital Multi-Modal Study (ORBIT MMS), looked at operational issues on the M25. As a result, the strategy set by the Secretary of State was: - Widening of M25 would be pursued - Measures to include improvement of the management of traffic flow, in order to lock in the benefits of widening further investigation be carried out on how measures such as ramp metering and other technologies could be used to reduce congestion.	
2004	Schemes to widen **M25 J5-7 (Section 2)** and **J23-27 (Section 5)** included in Targeted Programme of Improvements programme TPI.	
2009	Schemes for **Sections 2 and 5** known as the **M25 Later Upgraded Sections (M25 LUS)** to be taken forward as Dynamic Hard Shoulder Running schemes (DHSR) as assessment had shown that this would provide additional road capacity and be more economically viable than widening.	
	M25 J5-7 (section 2)	**Other adjacent scheme**
2011	New guidance on Smart Motorways stated that for schemes under development, DHSR was to be replaced by Managed Motorway All Lanes Running (MM-ALR), therefore this option was assessed in the appraisal of the J5-7 scheme.	
2011/2	Development of J5-7 scheme.	
Sept 2012	Site clearance works.	
Nov 2012	Start of works to install rigid concrete barrier (RCB) on J5-6.	
May 2013	Start of works for M25 J5-7 SM.	
Oct 2013		*Start of works for Controlled Motorway on J7-8*
March 2014		*J7-8 complete*
April 2014	Completion of J5-7 SM and VMSL comes into force.	

1.17. The other LUS scheme, M25 J23-27 (Section 5) SM was also constructed and opened in Nov 2014.

1.18. The evaluation in this report takes into account this timeline to ensure that the analysis compares the changes between before and after the Smart Motorway was built, excluding the impact of its construction period. Works on the adjacent controlled motorway J7-10 (Pinch point scheme) took place at the same time as this scheme so do not impact this post opening study in terms of construction issues.

Overview of POPE

1.19. Highways England are 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 scheme's continued development.

1.20. When submitting a proposal for a major transport scheme, the Department for Transport (DfT) specifies that an Appraisal Summary Table (AST) is produced which records the degree to which

the Government objectives for Transport grouped under the categories, Economy, Environmental, Social and Public Accounts.

1.21. The contents of the AST allow judgements to be made about the overall value for money of the scheme. The AST for this scheme is presented in Appendix A of this report.

1.22. POPE studies are carried out for all Major Schemes to evaluate the strengths and weaknesses in the techniques used for appraising schemes. This is so that improvements can be made in the future. For POPE, this is achieved by comparing information collected before and after the opening of the scheme, 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 Appendix A of this report.

Contents of this Report

1.23. Following this introduction, the report is divided into eight further chapters as follows:

- Chapter 2 – Traffic Impact Evaluation;
- Chapter 3 – Safety Evaluation;
- Chapter 4 – Economic Evaluation;
- Chapter 5 – Environmental Evaluation;
- Chapter 6 – Accessibility and Integration Evaluation;
- Chapter 7 – Conclusions;
- Appendix A – Appraisal Summary Table (AST) and Evaluation Summary Table (EST);
- Appendix B – Environment;
- Appendix C – Tables and Figures in this Report; and
- Appendix D – Glossary.

2. Traffic Impact Evaluation

Introduction

2.1. In order to evaluate the traffic flow, journey time and reliability impacts of the scheme, the following section reports on:

- Sources;
- Summary of the traffic modelling approach and forecast assumptions;
- Background traffic changes;
- Observed traffic volume changes;
- Traffic Flow forecasting accuracy;
- Journey time changes on the M25;
- Journey time changes forecasting accuracy;
- Operation of the Smart Motorway; and
- Reliability impacts.

Sources

2.2. The analysis of traffic in this section of the report is based on data collected from the following sources.

- Operation of the Smart motorway
  - Highways England's HALOGEN (Highways England Logging Environment) data[1]. This is a record of the signs displayed on the overhead gantries for the smart motorway. The data can be used to determine when, and for how long, the hard shoulder was open for traffic and the different speed limits in place as part of the variable speed limit (queue protection) used in Smart Motorways.
- Traffic volumes and classifications
  - Highways England's TRADS (Traffic Flow Data System) database for motorway locations and A21;
  - Radar data for the M25 J5-6 sourced from MIDAS;
  - DfT data on national and regional traffic levels.
  - Count data collected by Surrey County Council on its roads;
- Traffic speeds and journey times
  - Highways England's MIDAS (Motorway Incident Detection and Automatic Signalling) data[2].
  - Journey time data was obtained from sat-nav[3] data from vehicles using the M25 along the full length of the scheme in the year before start of construction and year following completion.

2.3. Documents which have been sourced for the background to the traffic modelling and forecast traffic impacts are:

- M25 DBFO LUS Traffic Forecasting Report – Section 2 (April 2012), (TFR)

[1] Halogen data is available from Highways England and can be downloaded for the message screens displayed on overhead gantries forming part of a smart motorway scheme. The data can be used to determine when, and for how long, the hard shoulder was open for traffic and the different speed limits in place as part of the variable speed limit (queue protection) used in Smart Motorways.
[2] MIDAS data available from Highways England provides lane by lane traffic flows and speeds. MIDAS technology forms part of the Smart motorway operation, but records of lane by lane speeds and flows, together with the settings from the overhead gantries from Halogen data (i.e. whether the hard shoulder is open and what speed the Variable Mandatory Speed Limit is operating at) can provide additional insight into the operation of the Smart Motorway. As this data forms part of the Smart Motorway, it is not possible to perform a pre and post analysis.
[3] Drivers who use satellite navigation devices have the option to voluntarily allow anonymous data about their journeys to be collected and used to provide a range of services, including the analysis of historic journey times along specific routes.

Scheme modelling and Forecast Assumptions

2.4. The scheme modelling was based on the M25 Assignment Model (M25AM) in SATURN.

2.5. Full variable demand modelling (VDM) approach was used in developing the future year matrices in the highway model of this scheme. Only Gatwick airport traffic flows were not subject to variable demand.

2.6. Modelling for this scheme was done at the same time as for the other LUS scheme (J23-27) known as section 5, and scenarios included all combinations or with and without each LUS scheme. Do Minimum (DM) modelling presented here included all other expected schemes on the network including local authority schemes as of early 2011, which includes the Pinch Point scheme on the adjacent J7 – 10 and the other M25 LUS scheme. The Do Something (DS) model included the same schemes as the DM except the smart motorway on J5-7.

2.7. The ALR on J5-6 was expected to operate as a 4-lane motorway with a maximum speed of 70mph. Through J6 and a short (1km) section of J6-7 CW (clockwise) would be maintained as D3M (dual 3 lane motorway) and the rest of J6-7 would remain as D4M (dual 4 lane motorway).

2.8. Traffic modelling had a base year of 2004, and three forecast years: 2015 (opening year), 2030 (design year) and 2040 (horizon year).

2.9. It was developed using NTEM (National Trip End Model) 6.2 central dataset (July 2011 definitive version) for car and public transport demands. The economic parameters were derived from WebTAG 3.5.6 released in April 2011. Growth for good vehicles (LGV and HGV) was derived from NTM (RTF09).

2.10. Additional sensitivity tests were undertaken as detailed in the TFR using RTF2011 which had just become the current guidance at the time the traffic forecasts were being finalised. The conclusions from the sensitivity tests were that there was a marginal increase in LGV and HGVs and 0.2% more traffic in the opening year but is was not expected to have any significant effect on the economic appraisal.

2.11. The modelled area in SATURN included the entire area within the M25 and an area bounded approximately by Luton, Reading, Guildford, Crawley, Maidstone, Chelmsford and Stansted, covering all motorways, A and B roads, as well as important unclassified roads.

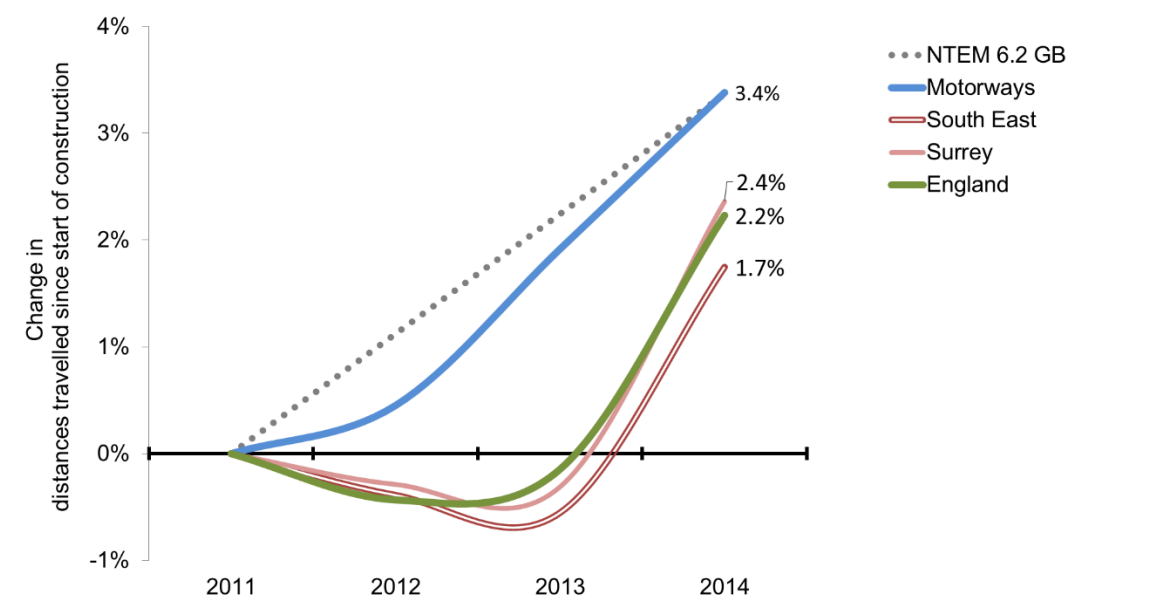
Background Changes National, Regional Traffic Trends

2.12. Historically in POPE scheme evaluations, the ‘before’ counts have 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 National Transport Model (NTEM) Local Growth Factors.

2.13. However, in light of the recent economic climate, which has seen widespread reductions in motor vehicle travel in the 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.

2.14. The best measure of the wider trends in overall traffic levels both regionally and nationally is shown in DfT annual statistics for total distance travelled (million vehicle kilometres). ***Figure 2-1*** shows the changes by year in the period from 2011 (when traffic forecasting was done) and 2014 (the latest available) for the region in which it lies, and motorways managed by Highways England, and for England as a whole. Also shown here is the growth rate from NTEM 6.2 as used in the traffic forecasts.

Figure 2-1 National and Regional Trends[4]



2.15. The key points regarding the wider trends in recent years are:

- Motorways nationally have shown growth of traffic in line with NTEM forecast over the period.
- Overall traffic levels in England and the South East have seen have been lower than the forecast and this is largely due to traffic trends during 2011/12 which are associated with the economic downturn.

2.16. The observed traffic flows presented in the traffic analysis in this chapter are as recorded in the before construction and post opening periods and have not been adjusted for the background trend of net growth of traffic seen regionally on all roads and nationally on motorways in the years between 2011 and 2014.

Traffic Volumes before and after scheme construction

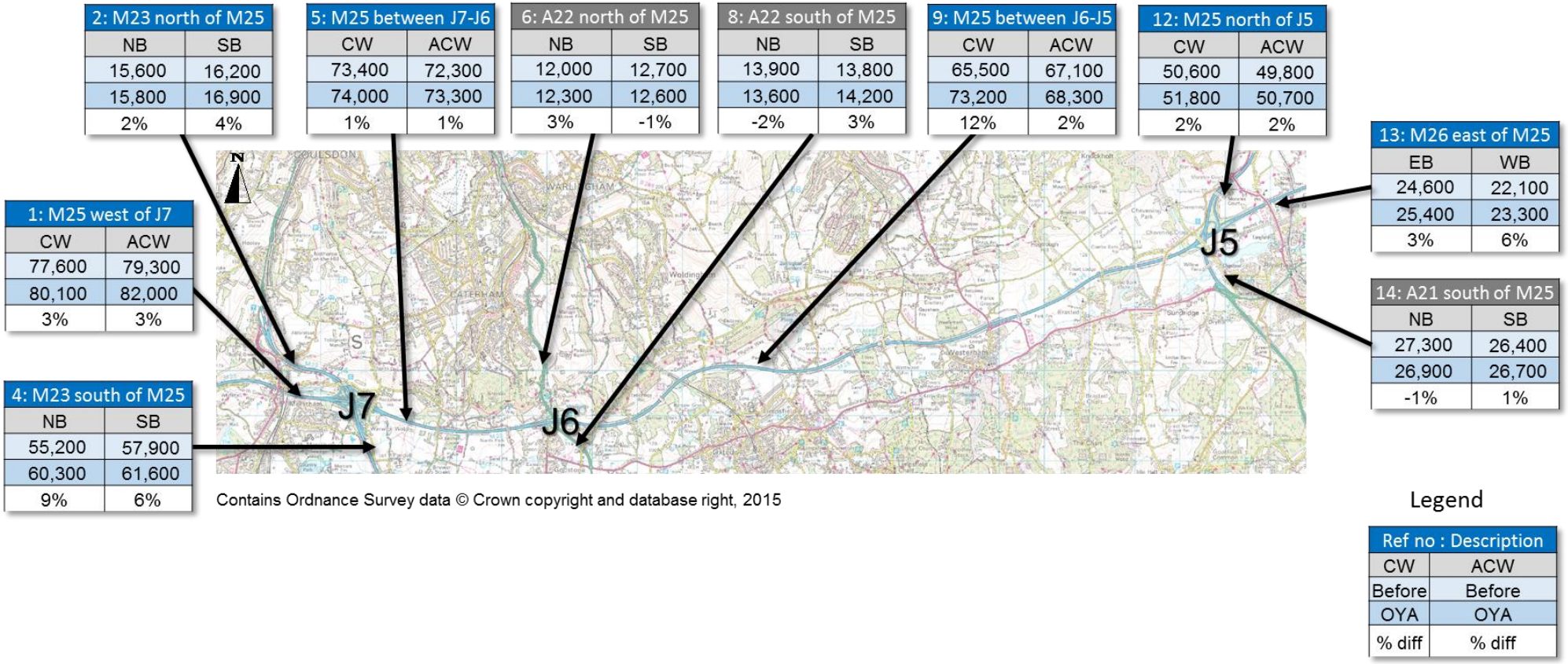
2.17. Weekdays traffic flows have been analysed for the M25 through the scheme and for the other motorways and 'A' roads at junctions 5, 6 and 7. The results for the Average Weekday Traffic (AWT) flows on the links are presented in ***Figure 2-2***.

2.18. The key points shown for the weekday traffic flows on the M25 and adjacent roads are:

- Traffic on the ALR section J5-6 is 141,500 vehicles per day (vpd, site 9), an increase of 7% from that before scheme was built.
- This growth on the ALR is greater than background traffic growth both regionally and on motorways in this period, however the increase is mainly seen to the CW section (12%) whereas ACW (anti-clockwise) only increased by 2% ACW. The observed growth reflects the impact of the extra capacity provided by ALR.
- The 4 lane CM section, J6-7 now has 147,300 vpd (site 5), only a 1% increase. This reflects that this section already had 4 lanes (plus a hard shoulder).
- Flows up and downstream on the M25 have increased in line with the background trend.
- M23 traffic north and south of J7 has above average increases, as does M26 east of J5, which indicates the sources of the extra M25 traffic through the scheme.
- At J5, A21 traffic flows are likely to be impacted by ongoing roadworks during 2015.

[4] Graph based on data in DfT tables TRA8904 and TRA4112

Figure 2-2 Traffic flows on M25 and other adjecent links before and after (AWT)



HGV traffic flows

2.19. Analysis of HGV levels is through vehicle classification by length, in which HGV is classed as a vehicle over 6.6m in length. Due to technical limitations of the traffic counting at sites through the scheme, only J6-7 anticlockwise can be analysed. Results by time period are shown in ***Table 2-1***.

Table 2-1 Percentages of HGVs between J6 and J7 Anticlockwise

Location	Value	Mon-Thurs			Friday			Saturday-Sunday
		AM Peak	Inter-peak	PM Peak	AM Peak	Inter-peak	PM Peak	
J6 – J7	Before	13%	18%	10%	14%	16%	10%	5%
	After	16%	22%	13%	17%	18%	13%	6%
	Change (% points)	+3	+4	+3	+3	+3	+3	+1

2.20. It can be seen that there has been an increase in the percentage of HGVs across all time periods in the anticlockwise direction between J7 and J6. It is expected that this would be mirrored on the other three sections.

Traffic Flow forecasting accuracy

2.21. Justification of the scheme was based on detailed forecasting of the traffic impacts. We will now compare the observed traffic impacts with those forecast. As noted earlier (page 15), the final detailed traffic flow forecasts were modelled for the central growth option only using TEMPRO and NTEM 6.2 and for opening year of 2015.

2.22. As the modelled opening year was 2015 for the Do Minimum (DM) and Do Something (DS) scenarios, for comparisons with observed traffic data from before start of construction in 2012, we have created proxy forecasts for 2012 Do Minimum data to compare against observed pre-scheme data. The adjustment was made using factors from TEMPRO 6.2 for the SE England area.

2.23. ***Table 2-2*** shows the accuracy of the modelling before and after construction for the M25 within the scheme (emphasised in pale green) and adjacent sections for the Annual Average Daily Traffic (AADT).

Table 2-2 Traffic flow (AADT) on M25: Forecast and Observed

Map ref	Location	Dir	Without Scheme 2012			With Scheme 2015			Increase with scheme*	
			Forecast[5] DM	Observed	% diff	Forecast DS	Observed	% diff	F'cast	Obsv'd
1	M25 J7-8	CW	84,400	74,800	-11%	89,000	78,000	-12%	5%	4%
		ACW	89,800	76,300	-15%	93,200	79,600	-15%	4%	4%
5	M25 J6-7	CW	75,100	70,500	-6%	81,600	71,700	-12%	9%	2%
		ACW	77,000	69,200	-10%	82,800	70,800	-15%	8%	2%
9	M25 J5-6	CW	69,100	63,000	-9%	76,500	71,000	-7%	11%	13%
		ACW	70,400	64,200	-9%	77,600	66,000	-15%	10%	3%
12	M25 J4-5	CW	55,500	48,700	-12%	59,300	50,200	-15%	7%	3%
		ACW	57,300	48,100	-16%	60,900	49,400	-19%	6%	3%

* Difference between 2012 DM and 2015 DS including net impact of scheme and wider trend of traffic growth

[5] Forecast DM flows 2015 adjusted down to 2012 using TEMPRO 6.2 factors for SE England.

2.24. The key points regarding the accuracy of the forecasts for the scheme and adjacent M25 sections as shown in ***Table 2-2*** are:

- With the scheme in place, post opening traffic flows are lower than forecast (the DS scenario) by between 7% and 15% within the scheme length, averaging 12% lower. Sections of the M25 up- and downstream show the difference from forecast is even greater.
- Traffic flows in 2012, before the start of construction were also lower than forecast (DM scenario) by an average of 8% within J5-7. This discrepancy before construction started explains most of the gap between the forecast and the observed post opening flows. The inaccuracy of the DM forecasts suggests that the modelling of the traffic growth from the base year of 2004 to 2012, did not include the level of the impact of the recession on traffic flows during this period.
- Traffic was forecast to increase on the sections of the M25 within this scheme by between 8% and 11%, which were higher rates than on the adjacent sections; what has been observed is that growth is in line which that seen on the other sections except for the higher growth of 13% on the clockwise ALR (J5-6) which suggest that additional traffic has been attracted to the M25.
- As the traffic growth on the M25 within the scheme was forecast to be from reassignment from other routes, a key reason why this is less than expected is the existing congestion elsewhere in the network, discouraging rerouting to this part of the M25.

2.25. ***Table 2-3*** shows the accuracy of the traffic flow forecasts for adjacent sections of motorway and 'A' road.

Table 2-3 Traffic flow (AADT) on adjacent roads: Forecast and Observed

map	Location	Dir	Without scheme 2012			With Scheme 2015			Increase with scheme*	
			Forecast[6] DM	Observed	% diff	Forecast DS	Observed	% diff	F'cast	Obsv'd
2	M23 J7-8	NB	13,900	15,200	10%	14,400	15,900	10%	4%	4%
	N of M25 J7	SB	17,100	15,600	-8%	17,700	16,400	-8%	4%	5%
4	M23 J8-9	NB	62,300	53,200	-15%	64,600	59,200	-8%	4%	11%
	S of M25 J7	SB	63,100	55,500	-12%	67,300	60,200	-11%	7%	8%
13	M26	NB	26,600	23,000	-13%	28,900	23,900	-17%	9%	4%
	E of M25 J5	SB	26,200	22,100	-20%	28,400	22,200	-22%	8%	7%
6	A22	NB	21,500	12,000	-46%	22,100	11,700	-47%	3%	2%
	N of M25 J6	SB	20,800	12,700	-42%	21,800	12,000	-45%	5%	0%
8	A22	NB	18,100	13,900	-27%	18,700	13,100	-30%	4%	-1%
	S of M25 J6	SB	17,000	13,800	-21%	17,700	13,500	-23%	4%	1%
14	A21	NB	28,600	26,100	-8%	29,800	26,100	-12%	4%	0%
	S of M25 J5	SB	28,800	25,100	-13%	30,000	25,800	-14%	4%	3%

* Difference between 2012 DM and 2015 DS including net impact of scheme and wider trend

2.26. The key points regarding the accuracy of the forecasts for the adjacent motorways and 'A' roads are:

- Traffic flows on the M26 and M23 are lower than expected but this is similar for both the pre-construction and one year after opening flows.
- A22 flows were overestimated, especially north of the M25 (over 45%).

[6] Forecast DM flows 2015 adjusted down to 2012 using TEMPRO 6.2 factors for SE England.

- The proportionate change in traffic flows between 2012 and 2015 with the scheme in place have been approximately as expected on the M23 north of the M25 and M26, although the A21 and A22 and seen negligible change where growth had been expected.

Journey Time Analysis

2.27. This section considers the impact on journey times following the scheme's implementation. Pre-scheme journey times along the M25 are compared with post-opening journey times for both directions as recorded by sat-nav devices in vehicles using the route.

2.28. The journey time analysis is split into three components:

- Analysis of pre and post-scheme journey time differences along the scheme.
- A comparison of forecast and outturn journey times along the scheme.
- A comparison of journey time reliability pre-scheme and post-opening.

Observed Journey Times before and after

2.29. Data was obtained for the pre and post-construction periods in the AM, inter-peak (IP) and PM peak periods as follows:

- Before: Sept 2011 – Aug 2012
- After: May 2014 – April 2015

2.30. The time periods examined are as follows:

- Monday – Thursday:
  - AM: 05:30 – 10:30
  - IP: 10:30 – 15:00
  - PM: 15:00 – 20:00
- Friday:
  - AM: 05:30 – 09:00
  - IP: 09:00 – 13:00
  - PM: 13:00 – 20:00
- Saturday and Sunday:
  - Peak: 08:00 – 20:00

2.31. ***Figure 2-3*** and ***Figure 2-4*** show the mean of the times observed between the junctions in the above time periods and each direction through the scheme.

2.32. Note that the journey times here are measured between the mid-points of the junctions on the mainline carriageway. All days were included, even those with abnormal levels of delay.

Figure 2-3 M25 J5 – 7 Clockwise Journey Time Comparison

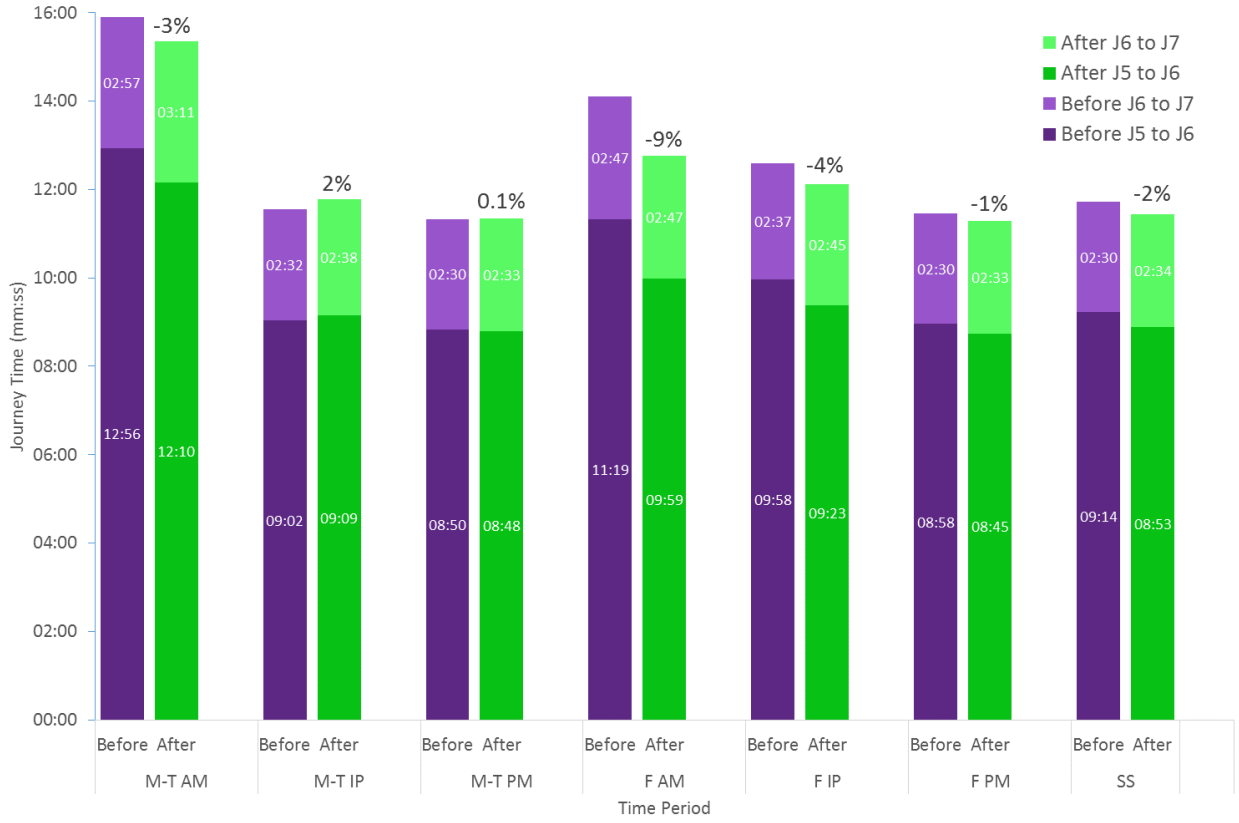
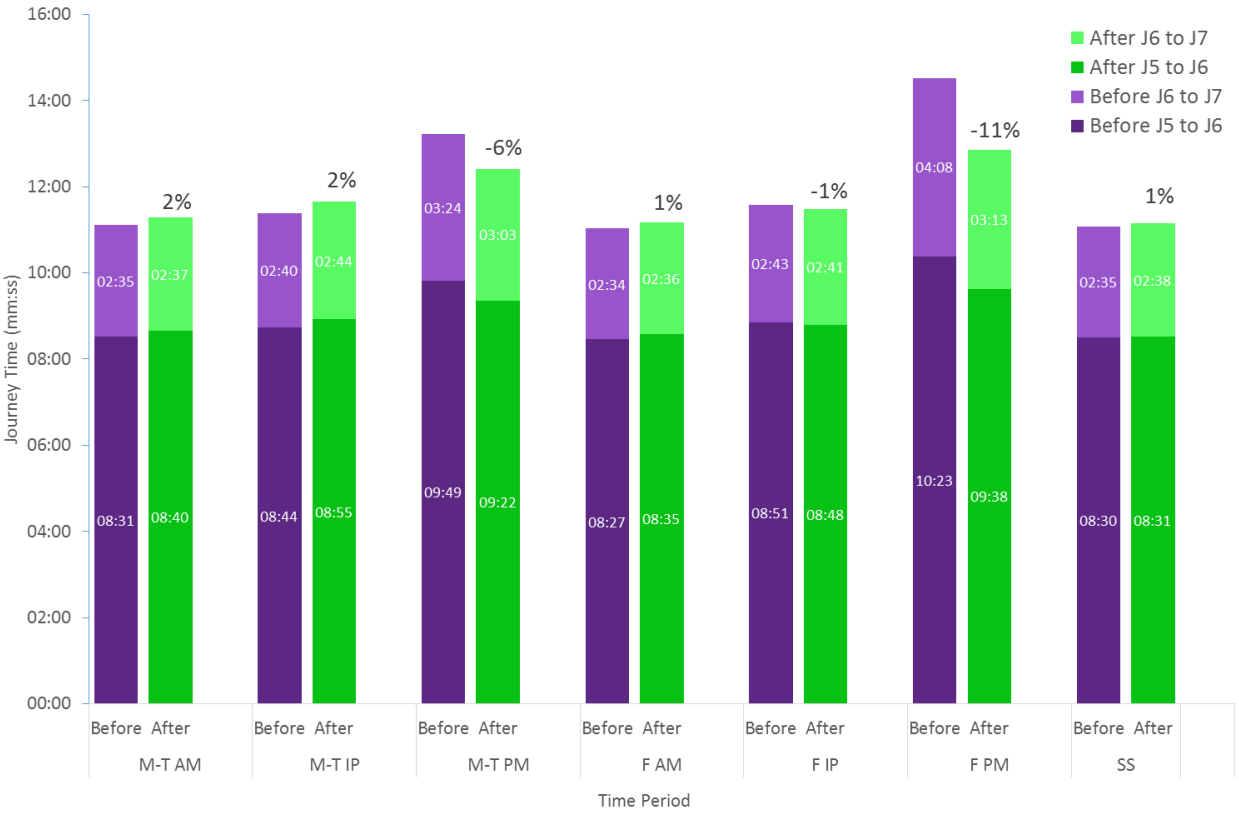


Figure 2-4 M25 J5 – 7 Anticlockwise Journey Time Comparison



2.33. These results presented in ***Figure 2-3*** and ***Figure 2-4*** demonstrate mixed findings, with the performance of the scheme differing depending on the day type, time period and direction being considered. However, the detail shows some clear findings which are outlined below.

2.34. Key findings for clockwise journeys shown in ***Figure 2-3*** include:

- Many of the time periods show reductions in journey times which shows the benefit of the increased capacity, especially in the congested AM peak period.
- The Monday to Thursday inter-peak period impact is only marginally adverse at 13 seconds longer in the after period over 19.9km with its corresponding PM peak remaining unchanged.
- The clockwise findings are largely positive but there is a strong contrast between J5 to J6 and J6 to J7. The longer link, J5 to J6, experiences journey time savings in almost all time periods, but the short J6 to J7 link shows journey time increases in almost all time periods. This reflects the impact of the greater step change of the ALR compared with only Controlled Motorway (CM) on the shorter section of J6 to J7.
- The greatest benefits in the clockwise direction are the AM weekday peaks.

2.35. Key findings for anticlockwise journeys shown in ***Figure 2-4*** include:

- The PM peak time periods demonstrate large benefits, with other smaller benefits on a Saturday. In contrast, the AM peak time period experiences a slight increase in journey times after.
- The greatest benefits in the anticlockwise direction are the PM peaks.

2.36. In summary, the main benefits are in the AM peak clockwise and the PM peak anticlockwise, tying-in with the before period delays and indicating the tidal pattern of flows typical of commuter traffic.

2.37. It should take 10 minutes and 40 seconds to traverse the scheme at 70mph or 12 minutes 26 seconds to traverse at 60mph. The results indicate that there is little delay apart from clockwise in the AM peak and anticlockwise in the PM peak. The scheme has reduced journey times where they were most affected by delays in the before period but has had only marginal impacts at other times when the speeds were nearly free-flow beforehand.

Speed by Distance Analysis

2.38. The average journey time impacts show substantial journey time savings in the most heavily delayed periods in the before but much smaller impacts in all other time periods. To understand how they accrue, analysis of average speed along the scheme has been carried out.

2.39. ***Table 2-4, Table 2-5*** and ***Table 2-6*** on the following pages show the average speed every 100m along the scheme by time period. Junction numbers are shown so it can be seen where performance improvements have been made and whether they relate to on or off slip locations. When the after line is above the before line, benefits are being accrued.

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Table 2-4 Speed over Distance before and after M25 J5-7: Monday-Thursday

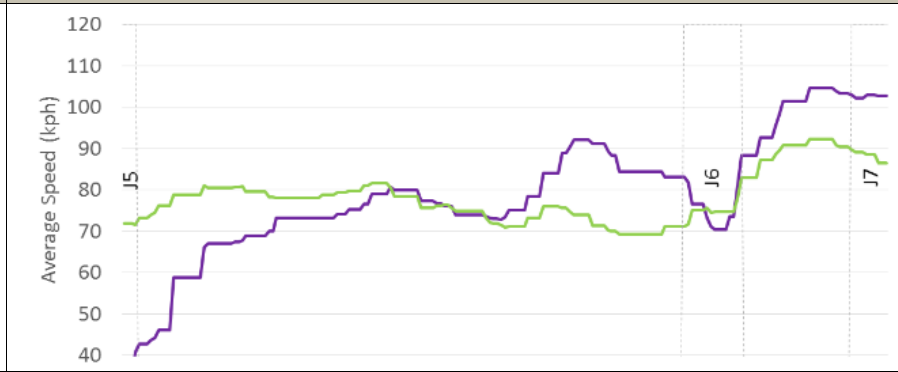
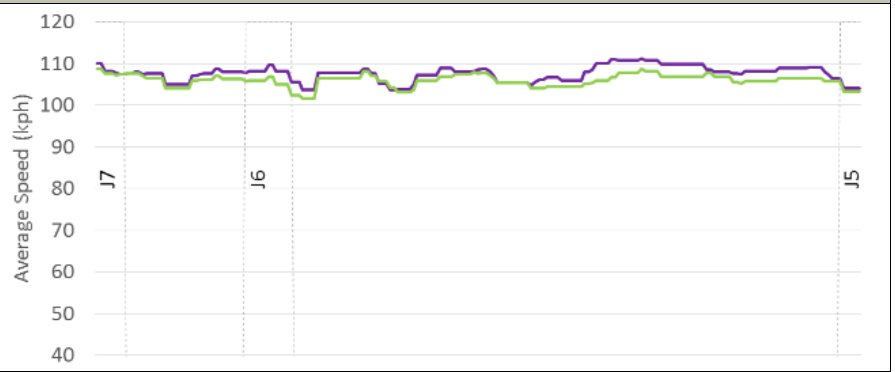
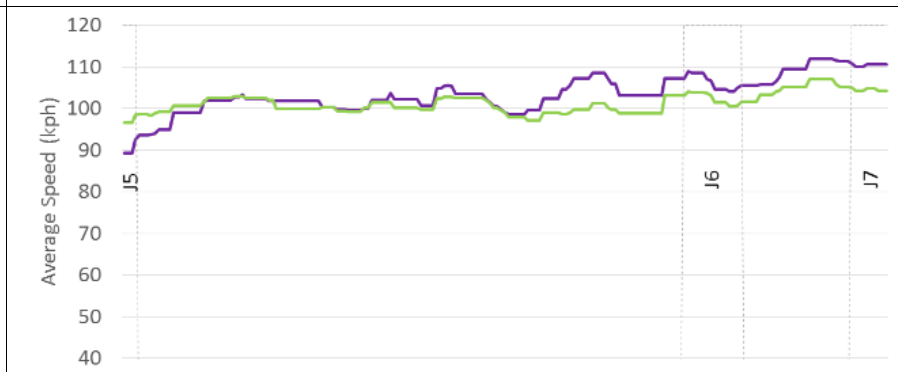
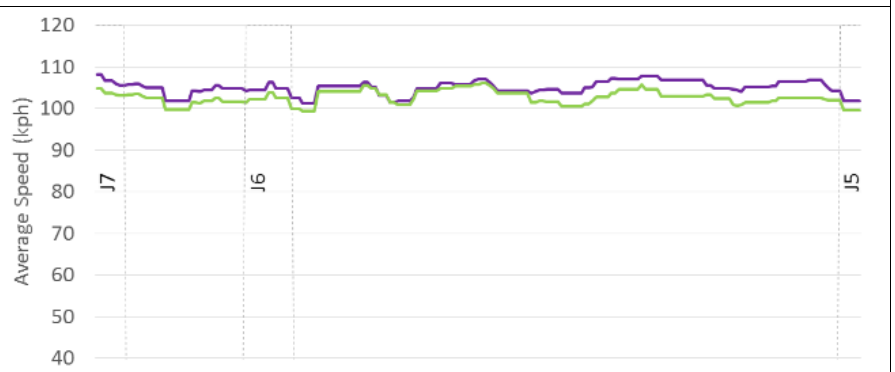
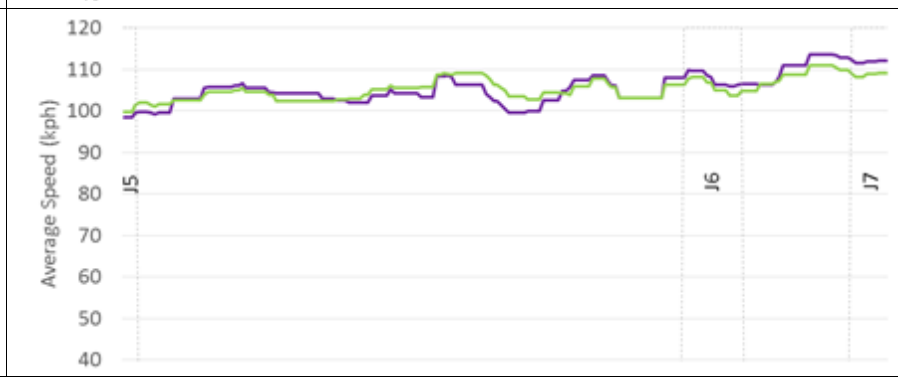
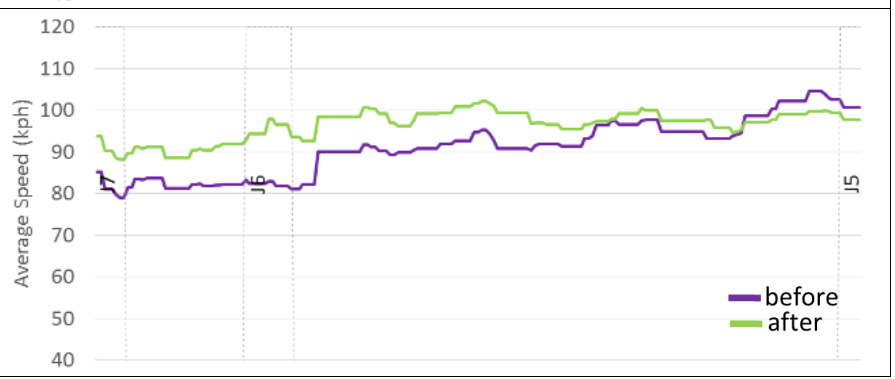
	Clockwise	Anticlockwise
AM		
IP		
PM		

Table 2-5 Speed over Distance before and after M25 J5-7: Fridays

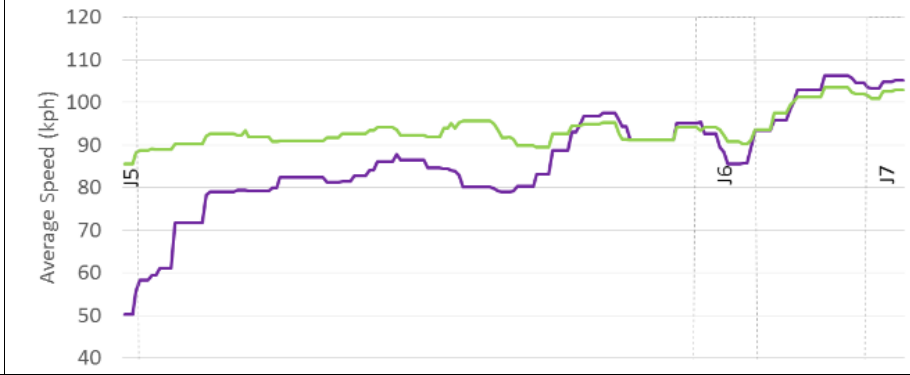
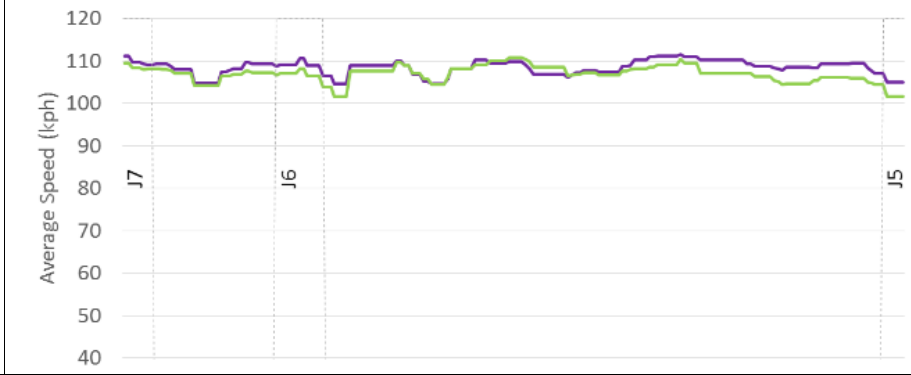
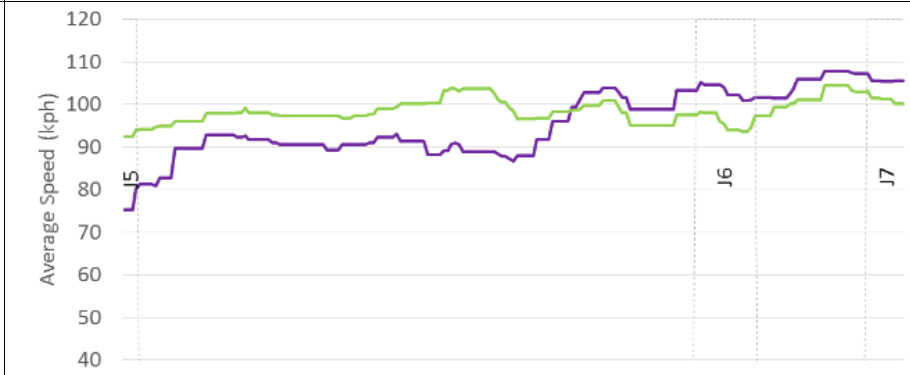
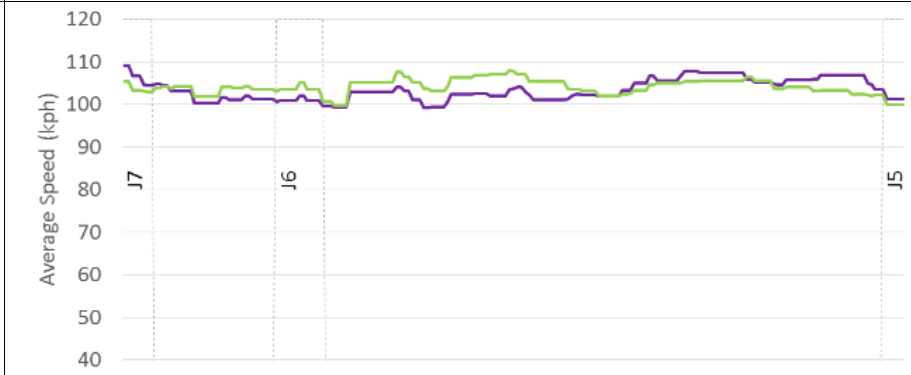
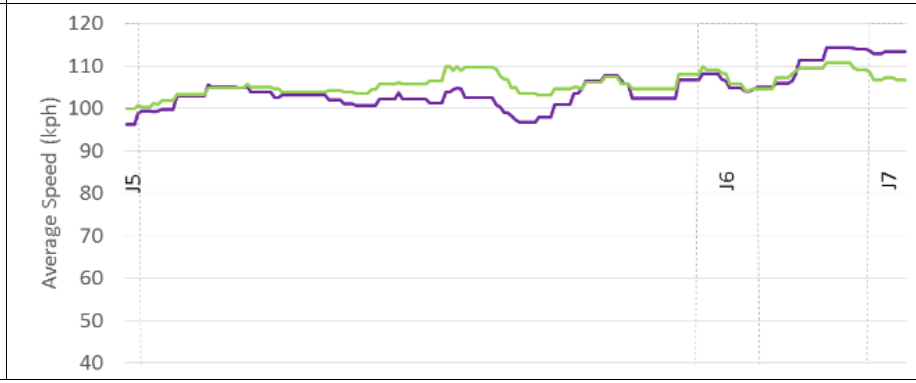
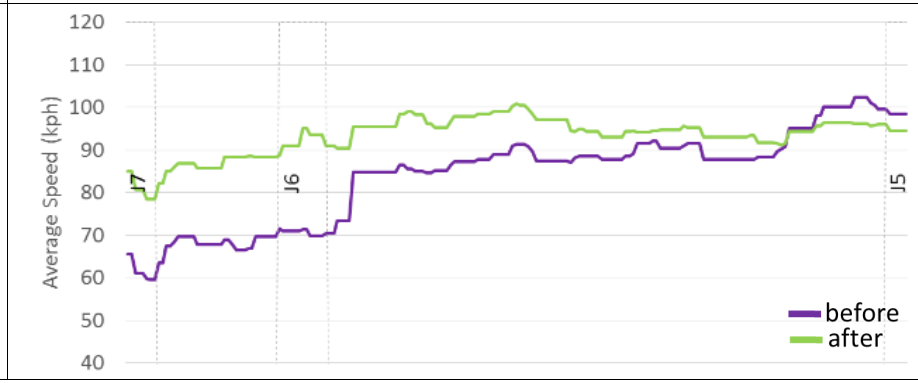
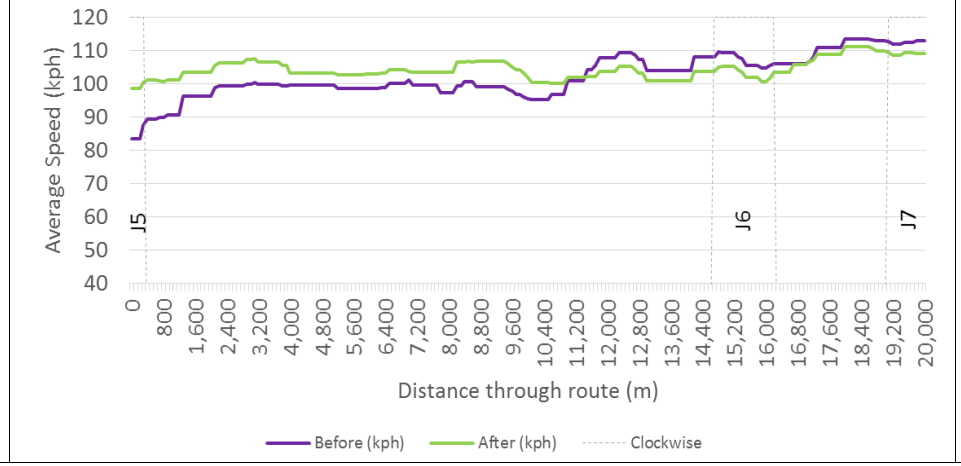
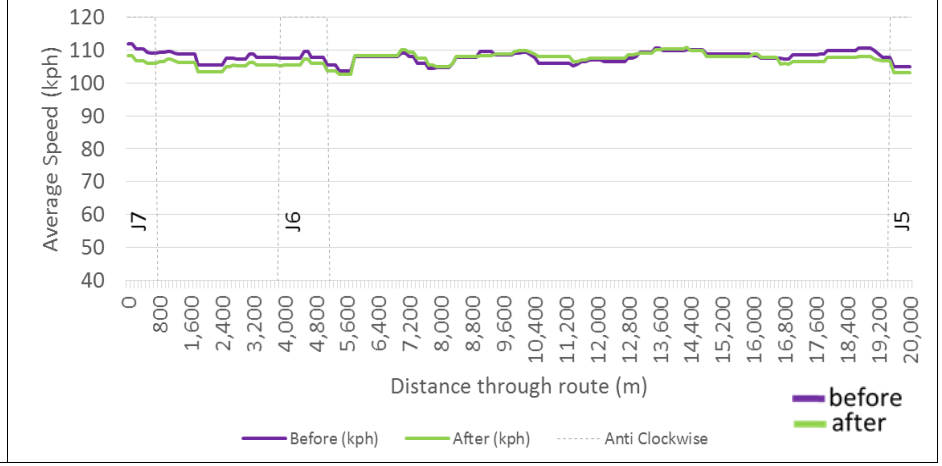
	Clockwise	Anticlockwise
AM		
IP		
PM		

Table 2-6 Speed over Distance before and after M25 J5-7: Saturday and Sunday

	Clockwise	Anticlockwise
		

2.40. The key findings shown by the weekday speeds over distance plots in ***Table 2-4*** and ***Table 2-5*** **clockwise** are:

- In the weekday AM, Friday inter peak and weekend periods, the after speeds are higher on the (eastern) first half of the J5 to J6 link. Approaching J6, speeds are more similar or in some periods before speeds are higher than after.
- Before, the speeds are generally low around J5, showing signs of delay. This may be caused by the merge arrangements around J5 where first the M26 merges and then shortly after the A21 merges. In the after period speeds are more consistent through J5, perhaps due to the new lane gain.
- From around 10km into the scheme the before line starts to match or show faster speeds than the after line. A likely explanation is that there was little congestion in the before and in the after there is better compliance with the national speed limit and VMSLs.

2.41. In summary, the clockwise benefits are largely accrued around the junction 5 merge, which previously involved a succession of merges and now involves a lane gain layout which provides more capacity and fewer lane change movements.

2.42. The key findings for the speeds **anticlockwise** are:

- Speeds along the length of the scheme are very similar between the before and after periods.
- Weekday PM peak shows higher speeds in the after period between J7 and J6.
- For the J7 to J6 link there is no significant change to the road layout but the J6 on-slip has a new lane gain which may have reduced upstream congestion in the after period.

2.43. In summary, in the PM peak time periods the main benefits are only experienced between J7 and J6. This could be due to layout changes at the J6 on-slip.

Congestion plots

2.44. Further illustration of the average speeds along the motorway through the scheme, again based on the sat-nav data is given in the congestion plots in ***Figure 2-5*** and ***Figure 2-6*** for the AM peak period by direction.

Figure 2-5 M25 J5 – 7 AM Peak Before

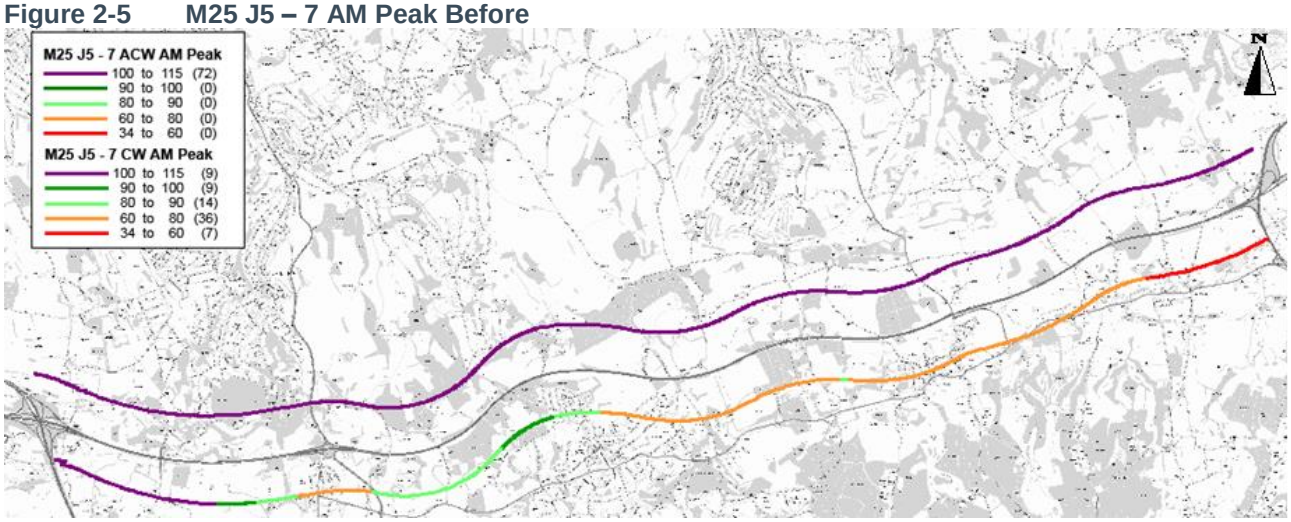
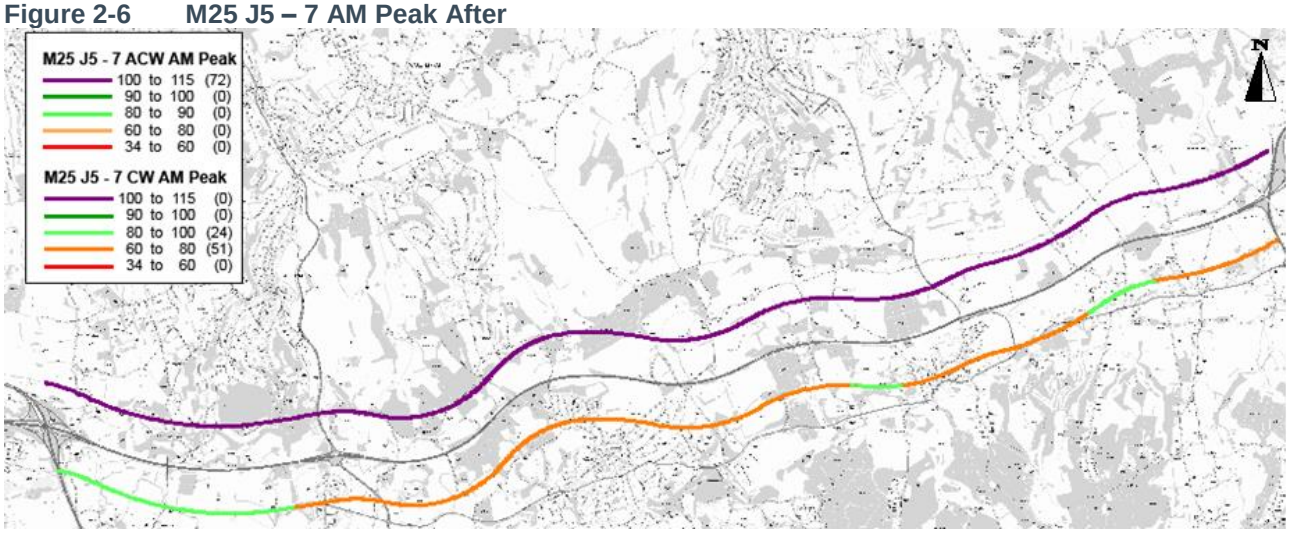


Figure 2-6 M25 J5 – 7 AM Peak After



2.45. These plots of the speed by bands show that:

- For the anti-clockwise flow, traffic was free-flowing both before and after.
- On the busier clockwise flow, congestion was most evident on certain parts of J5-6 before and after the ALR was completed, the speeds are more consistent along the link, with less congestion.

Journey Time forecasting accuracy

2.46. The TFR included details of the forecast speeds on sections of the M25 within the scheme by time period for the modelled years and DM and DS scenarios. The time periods were weekdays as follows:

- AM: 08:00-09:00
- IP: 10:00-16:00
- PM: 17:00-18:00

2.47. It is noted that the forecasts do not directly align with weekday time periods of the observed data (as set out in paragraph 2.30), which has much wider peak periods and treated Fridays separately. Thus direct comparison of forecast and observed data for journeys and speeds can only be approximate. Comparison here has been done by calculating forecast journey times from the forecast speeds then working out the net difference as shown in ***Table 2-7***.

Table 2-7 Journey Time Forecasting accuracy: net saving (seconds)

Net change (seconds) Green is saving, red is worsening		AM		IP		PM	
		Forecast AM peak 08-09:00	Observed	Forecast Inter-peak 10-16:00	Observed	Forecast PM peak 17-18:00	Observed
CW	J5 to J6	62	53	42	1	46	5
	J6 to J7	2	-12	-2	-7	-4	-3
ACW	J5 to J6	52	-8	56	-9	52	31
	J6 to J7	-2	-2	-2	-3	-2	28
Total	CW	64	41	41	-6	42	2
	ACW	50	-10	54	-12	50	59

2.48. The key points on journey time forecasting accuracy shown in ***Table 2-7*** are:

- Journey time savings were forecast between J5 and J7 in all of the modelled time periods in both directions of between 41 and 64 seconds, and this was almost all due to savings on the ALR section between J5 and J6.
- Journeys in the clockwise direction in the AM peak and anticlockwise in the PM peak showed large actual journey time savings of 41 and 59 seconds which is close to the forecast savings, but other time periods fail to show any savings close to those predicted.
- Traffic flows are lower than predicted (as noted earlier in ***Table 2-2***), which should have reduced congestion during the peak periods, but as this applies to both the before and after periods, only limited conclusions can be inferred about the net time saving compared with the forecast in which the extra lane would have provided greater benefit for the higher traffic level.

Operation of the Smart Motorway

2.49. We now present a summary of how the smart motorway is operating based on data as recorded in HALOGEN data (Highways England Logging Environment).

HALOGEN Operation Data Analysis

2.50. Analysis of this data has been undertaken for March 2015, to be consistent with the flow and speed data above. Note that this is a record of the smart motorway settings as installed by this scheme, and therefore there is no equivalent pre-scheme data shown here. Analysis of HALOGEN data has been used to determine how much, on average, different speed limits were in place during the peak periods.

2.51. The time periods used in this analysis are 07:00-10:00, 10:00-16:00 and 16:00-19:00 for the AM, inter-peak and PM peaks respectively.

- Monday – Thursday:

- AM: 06:00-10:00
- IP: 10:00 – 15:00
- PM: 15:00 – 20:00

- Friday:
  - AM: 06:00 – 09:00
  - IP: 09:00 – 13:00
  - PM: 13:00 – 20:00
- Saturday and Sunday:
  - Peak: 08:00 – 20:00

2.52. The smart motorway includes capability to use variable mandatory speed limits (VMSL) along the full length of J5-7. This means that when it is deemed necessary to reduce the speed limit below the national speed limit (70mph), the VMSL is activated and the gantries on the relevant part of the motorway show the speed limit setting. When 70mph applies the gantries do not show the speed limit.

2.53. HALOGEN data has been analysed for several points though the scheme as the speed limits setting by the variable mandatory speed limits (VMSL) can vary along a section of carriageway. ***Figure 2-7*** and ***Figure 2-8*** show this for all sections in the scheme including east and west of the Clacket Lane motorway service area (MSA).

Figure 2-7 VMSL active setting by time period (Monday – Thursday)

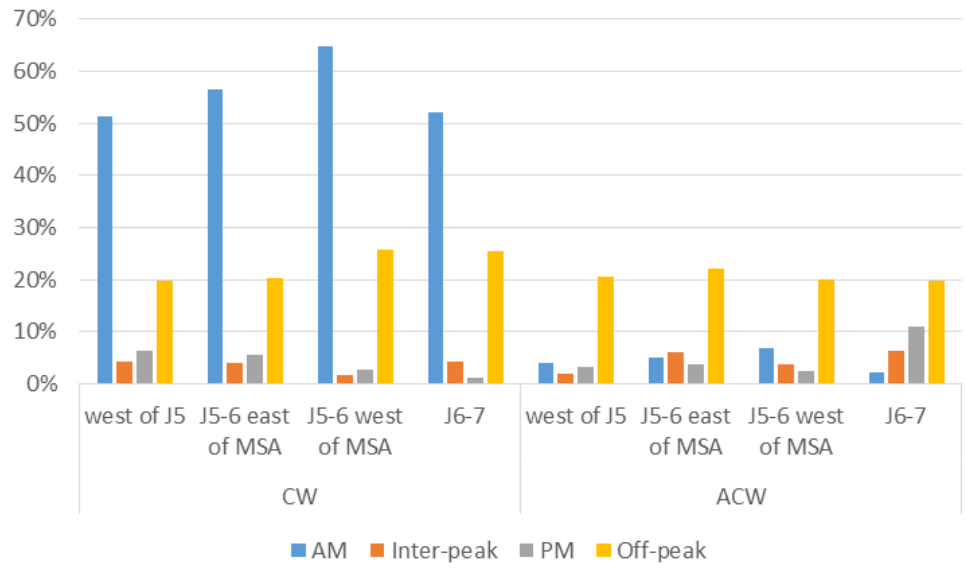
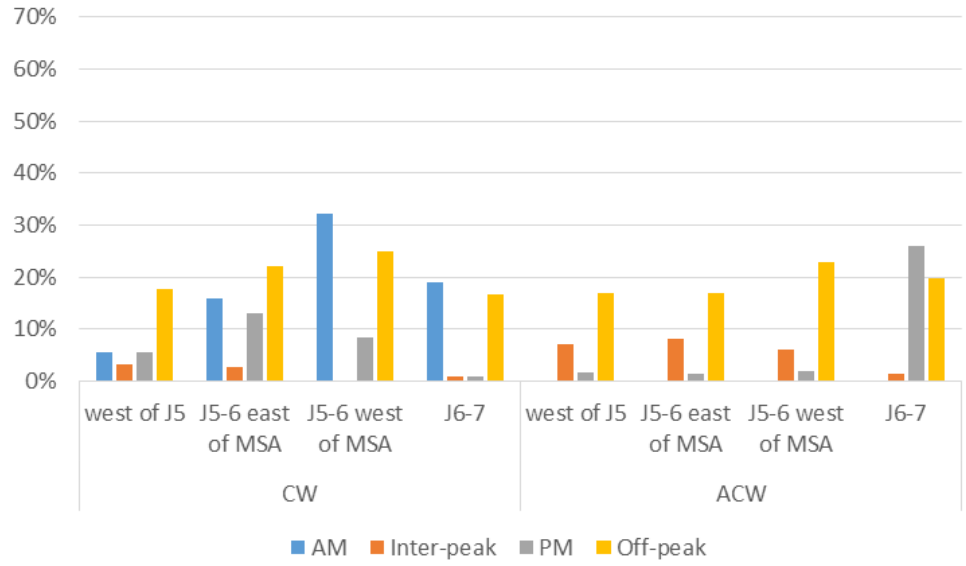


Figure 2-8 VMSL active setting by time period (Friday)

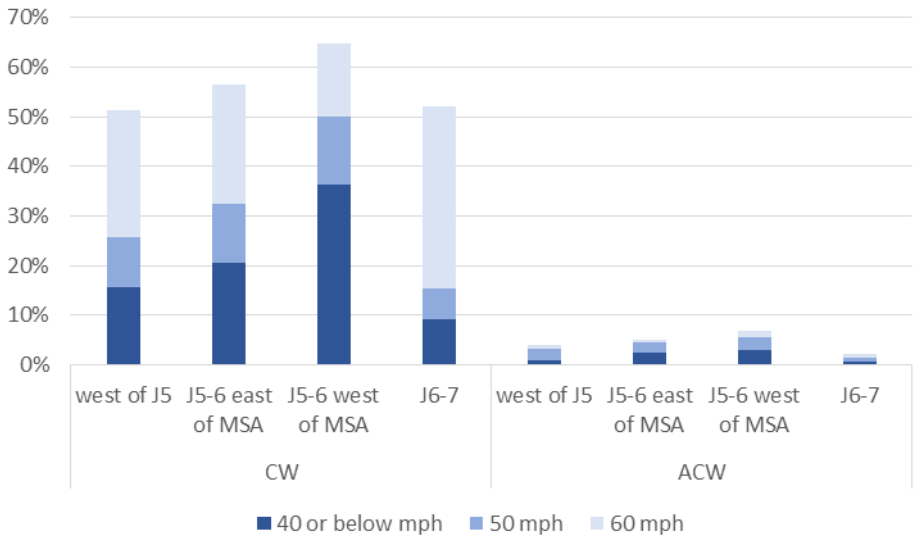


2.54. The key points shown by these plots of the average proportions of the time periods that the VMSL is active are:

- AM clockwise sees the highest level of use of the VMSL on Monday-Thursdays, ranging between 50% and 65%.
- Inter-peak and PM peaks see VMSL use less than 10% of the time on Monday-Thursdays.
- Fridays show much lower use of VMSL in the AM than other weekdays, but slightly higher use in the IP and PM periods.
- It should be noted that the off-peak use of the VMSL represents its use for overnight roadworks.

2.55. Further analysis of the VMSL setting in the most used period, the AM peak are shown by speed in ***Figure 2-9***. As 30mph or below is only rarely used, it is included within the 40mph band.

Figure 2-9 VMSL Speed settings as proportion of AM peak (Monday – Thursday)



2.56. This shows the following key points regarding speed limit settings in the AM peak:

- Speed limits regularly set by VMSL in the AM peak clockwise within the scheme are split between the 40,50 and 60mph settings.

- 40mph setting is most commonly used on the short section J6-7 where there is likely to be much lane changing and consequent peak period congestion.

2.57. The figures for the proportions of all the time periods, including the weekend peaks are detailed in ***Table 2-10***.

Table 2-8 Activation of VMSL by time period

% of time period that VMSL is set		Monday-Thursday				Friday				weekend peaks
		AM	Inter-peak	PM	Off-peak	AM	Inter-peak	PM	Off-peak	
CW	west of J5	51%	4%	6%	20%	6%	3%	6%	18%	3%
	J5-6 east of MSA	56%	4%	6%	20%	16%	3%	13%	22%	4%
	J5-6 west of MSA	65%	2%	3%	26%	32%	0%	8%	25%	5%
	J6-7	52%	4%	1%	26%	19%	1%	1%	17%	5%
ACW	west of J5	4%	2%	3%	21%	0%	7%	2%	17%	5%
	J5-6 east of MSA	5%	6%	4%	22%	0%	8%	1%	17%	3%
	J5-6 west of MSA	7%	4%	2%	20%	0%	6%	2%	23%	5%
	J6-7	2%	6%	11%	20%	0%	1%	26%	20%	2%

Flows and Speeds by Lane

2.58. In addition to the traffic flow and journey time analysis presented earlier in this chapter, additional analysis has been completed using MIDAS data focusing on the main peak period flows, namely AM peak in the clockwise direction and the PM peak in the anticlockwise direction. Unlike the sat-nav data, MIDAS data includes a breakdown by lane.

2.59. The graphs presented in the remainder of this section show the lane-by-lane traffic flows and speeds on the All Lane Running section between J5 and J6. Data for J6 – 7 is not shown as it is only short with relatively few MIDAS monitoring sites and there is extensive lane movement with the on and off slips of the two junctions being relatively close.

2.60. The analysis here is for an average Monday to Thursday March 2015. This is the same month that has been used for post-opening traffic flow. In each figure, the different coloured lines represent the different lanes as shown in the key. The distance on the x-axis is the distance in metres from within J6 in the anticlockwise direction and within J5 in the clockwise direction. All analysis has been completed on the mainline MIDAS sites at 32 locations on each carriageway.

2.61. Time periods are the same as the journey time data as detailed on page 20.

2.62. ***Table 2-9*** shows the flows and speeds in the AM peak on the busiest direction, clockwise and ***Table 2-10*** shows the anticlockwise flow and speeds in the PM peak period.

Table 2-9 Flows and Speeds by Lane on J5 – 6: Mon – Thurs AM peak (05:30- 10:30) Clockwise

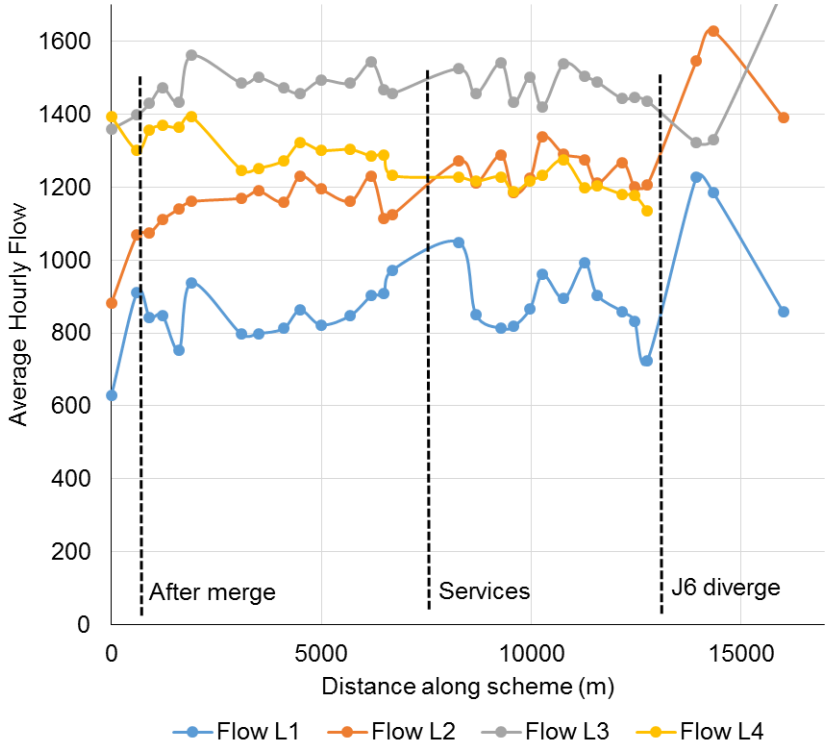
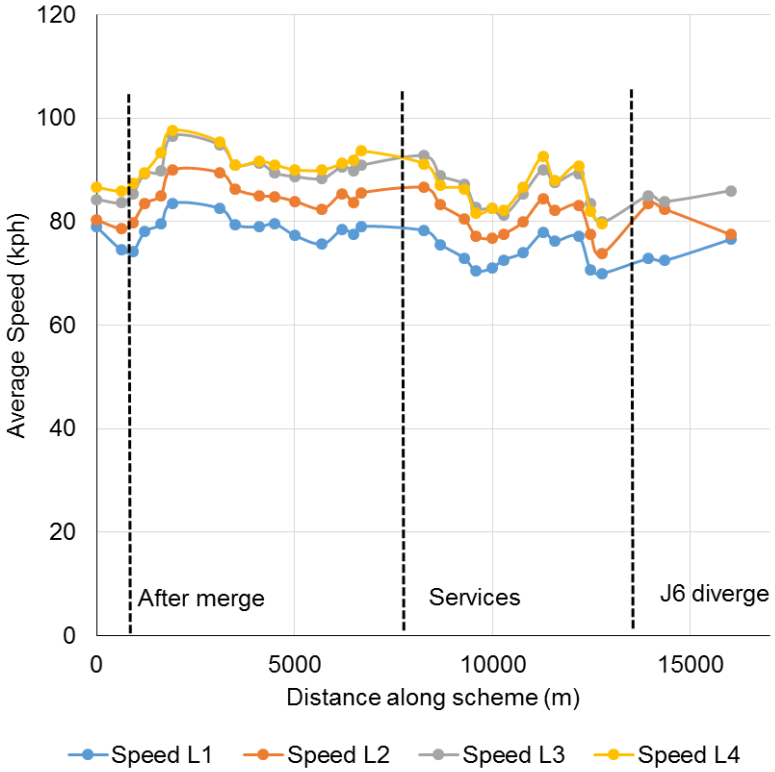
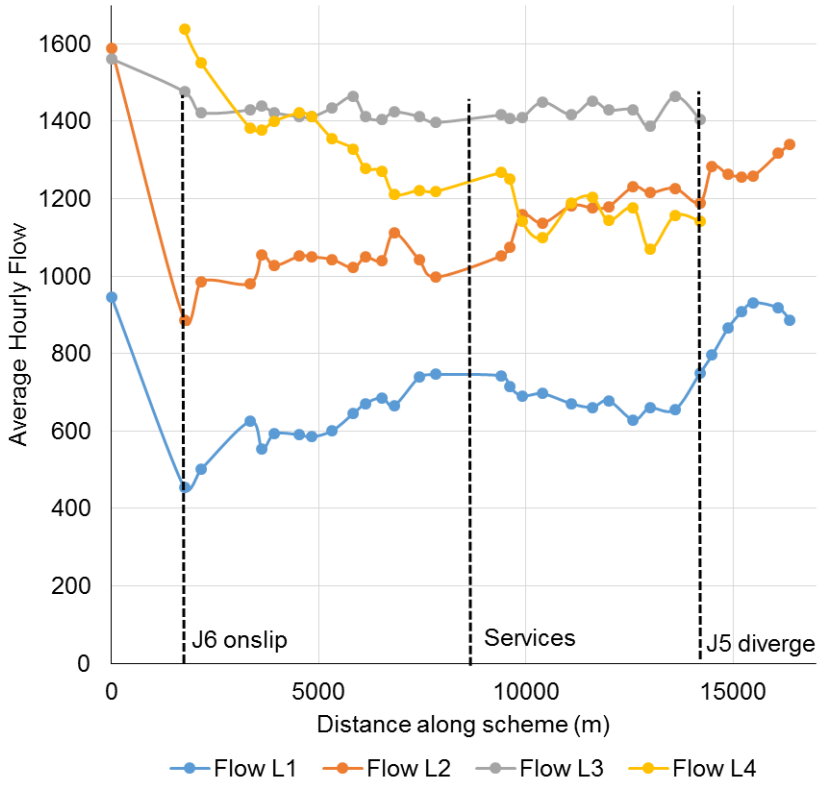
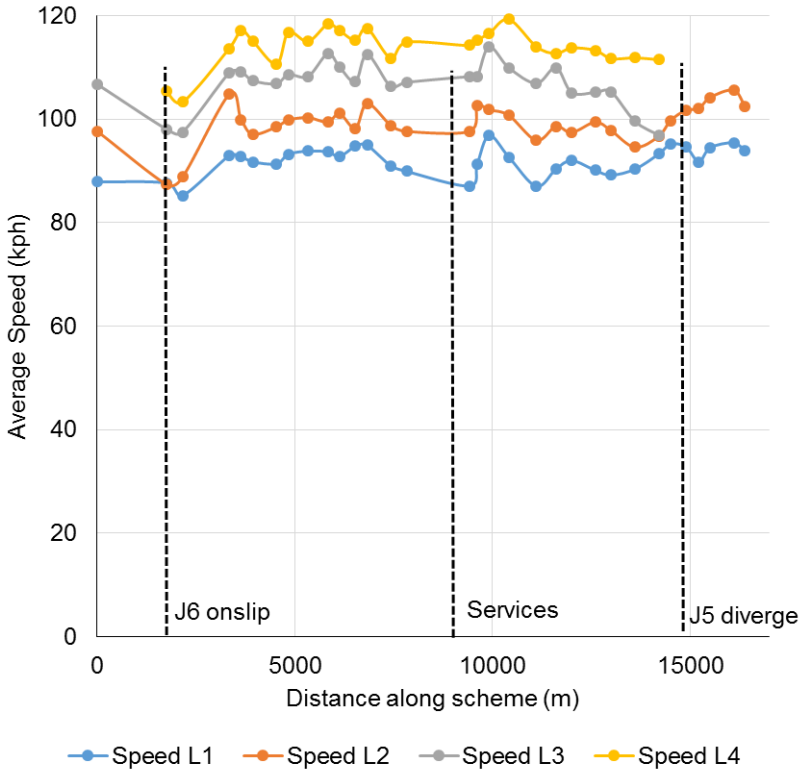
	Flows by Lane	Speeds by Lane
AM peak		
Comment	• Comparing the flows by lane shows that Lanes 1 to 3 show increasing levels of use, and flow in lane 4 is similar to lane 2. This usage pattern shows that the scheme has successfully increased the used capacity on this section. • Lane 1 was formerly the hard shoulder and has the lowest level of use. It only includes 16% of traffic halfway along the link. As the majority of HGVs will be in this lane for much of the time, this lower level of use is a reasonable proportion across a 4-lane motorway.	• In this time period, traffic speeds are generally below 96 kph (60mph), this is a result of the setting of the speed limit to 60 or below for a relatively high proportion of the time, as shown in ***Figure 2-7***. • Speeds are very similar across all four lanes at all points through this section of the motorway, especially lanes 3 and 4, making lane change easier. • Lane 1 has the lowest flow and the lowest speed again likely to be reflecting the higher proportion of HGVs in this lane.

Table 2-10 Flows and Speeds by Lane on J5 – 6: Mon – Thurs PM peak (15:00 – 20:00) Anticlockwise

	Flows by Lane	Speeds by Lane
PM peak		
Comment	• There are lower levels of lane 1 flows than in the AM peak in the opposite direction as shown in ***Table 2-9*** with the proportion of flow in lane <15%. Lane 1 also shows lower speed and a greater speed differential between this lane and the faster lanes 2 to 4. • The through junction running of the lanes by the motorway services is successfully maintaining best use of the capacity.	• Average speeds in the PM peak are higher in all lanes than in the AM period. • There is a greater spread of average speeds by lane, with an average difference of 22kph (14 mph) between lanes 1 and 4.

Reliability

2.63. The reliability sub-objective of this scheme was appraised using the HSR INCA (Incident Cost Benefit Appraisal) which forecast a benefit over 60 years of £413m (2010 prices). This included high benefits for day-to-day travel time variability (TTV) but a small disbenefit for delay reliability (due to accidents and incidents) arising from the impact of the loss of the hard shoulder.

2.64. It is not possible to evaluate reliability using data on observed incidents before and after the scheme was built because the nature of the smart motorway means that recording of incidents has much improved. Clearly a basic assessment of the data would show more incidents being recorded through the smart motorway technology than that recorded by more manual means before opening.

2.65. The alternative approach to the evaluation of reliability impact is to study the impact that the scheme has had on the variability of journey times.

2.66. Variability is the extent to which journey times vary from the expected average journey time on a particular day of the week at the time of day in question. The distribution of journey times is considered to be a good indication of how much journey times vary.

2.67. The satellite navigation data was used to determine the average journey time along the route also provides the distribution of journey times by percentile ranges. ***Figure 2-11*** and ***Figure 2-12*** present the variability in journey times for the different peak periods. The analysis presented is for the route as a whole (J5 – 7). The nature of traffic flows and congestion issues vary by peak and direction depending on the section of the scheme so, in turn, the variability is greater for individual sections of the scheme.

2.68. Four metrics of the distribution of journey times through the scheme have been used:

- 5th Percentile – One in 20 vehicles are completing the journey faster than this, so it is a good measure of the best time achievable.
- 25th Percentile – One in four vehicles are completing the journey faster than this and it is known as the lower quartile. The further this value from 5th percentile the more variability in the fastest journeys, it is an indicator that delays are experienced by a high proportion of all users
- 75th Percentile – Three quarters of vehicles complete the journey faster than this and it is a good measure of general variability from day to day of in journey times.
- 95th Percentile – 95% of vehicles complete the journey faster than this, the remaining journeys are likely to be affected by incidents or heavy congestion. The further the 95th percentile journey time is from the 75th percentile the more heavily congested a journey is, this is an indication of incident related variability.

2.69. These four metrics are shown below in ***Figure 2-10*** and ***Figure 2-11*** as box-and-whisker diagrams for each time period, before and after. The 75th percentile and 95th percentile journey times are annotated on the plots.

Figure 2-10 Clockwise Journey Time Reliability Analysis

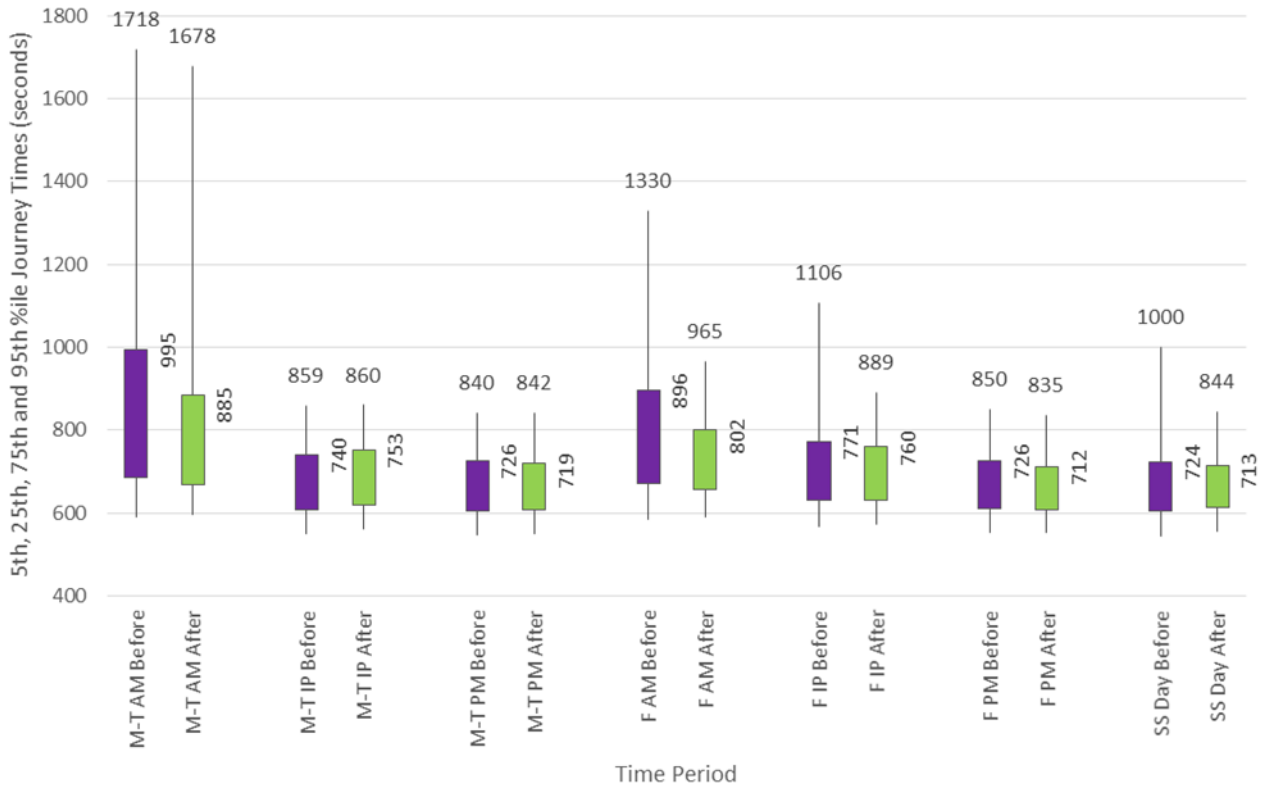
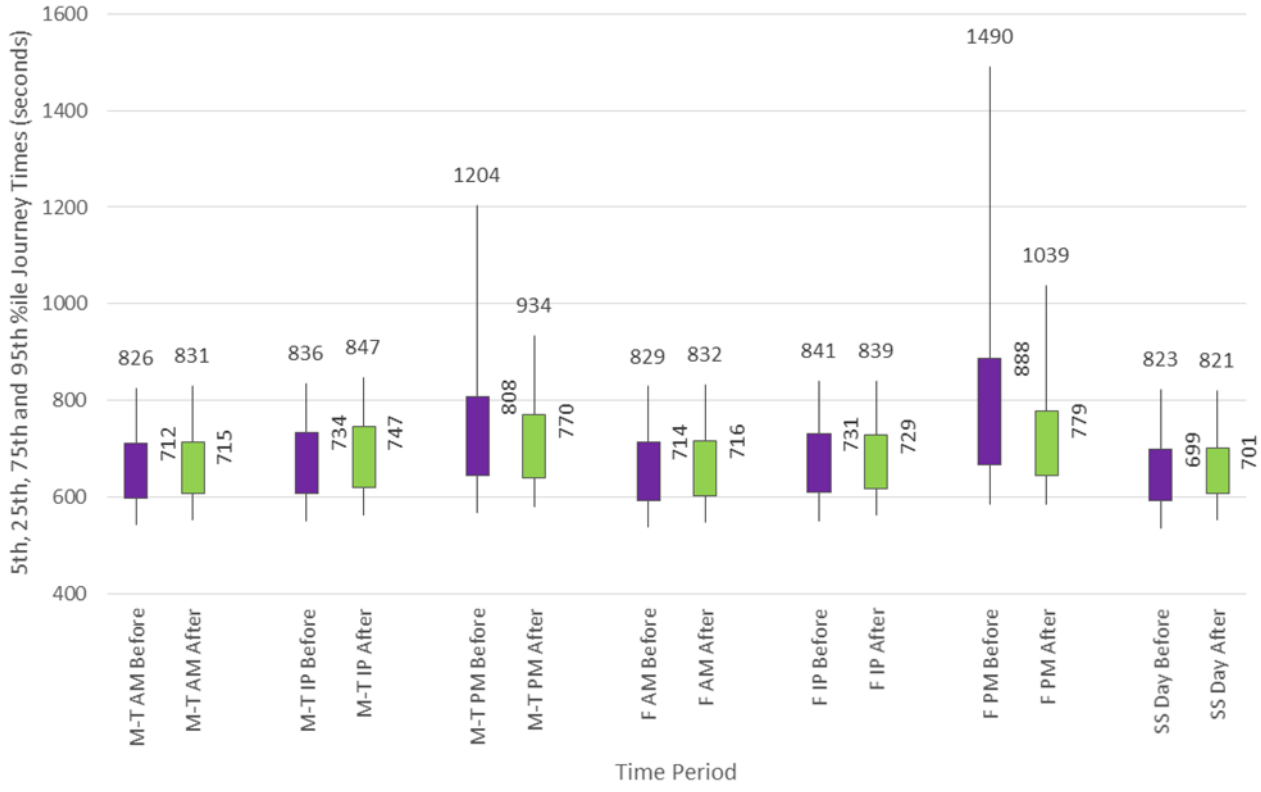


Figure 2-11 Anticlockwise Journey Time Reliability Analysis



2.70. The results show that reliability is improved in some time periods but remains similar in others.

2.71. Observations on Clockwise journey time reliability shown in ***Figure 2-10*** include:

- The most unreliable journey times are in the AM peaks, Friday AM and at weekends. These periods all saw improvements in the 75th percentile journey time which shows there has been an improvement in day-to-day variability.
- The less congested time periods have similar results before and after.

2.72. Observations on anticlockwise journey time reliability shown in ***Figure 2-11*** include:

- The most unreliable journey times are in the weekday (Monday – Thursday, and Friday) PM peaks.
- The benefits in journey time reliability are gained in the two most unreliable time periods.
- The less congested time periods have similar results before and after.

2.73. Reliability is monetised in the Economy chapter later in this report (page 57).

Planning Time Index

2.74. The Planning Time Index (PTI) is a relatively new metric by which reliability is measured. As set out in Highways England's Operation Metrics Manual, this measure is designed to indicate how much additional time road users need to allow to ensure they arrive on time. It highlights roads where very slow journeys are encountered. This measure is the ratio of the 95%ile journey time to the free-flow journey time, where free-flow time is the maximum of the journey time and 15%ile journey time (i.e. that when taken at the 85%ile speed) and the journey time taken at the 70mph motorway speed limit.

2.75. Table 2-11 below shows the PTI for the before and after periods for the anti-clockwise journeys based on the sat-nav journey time data, weighted by flows in the individual time periods.

Table 2-11 Flow-weighted PTI

	Before	After
Clockwise journeys J5 – J7	1.77	**1.67**
Anticlockwise journeys J7 – J5	1.54	**1.38**

2.76. The PTI figures show that the reliability has improved in the post opening period in both directions, as indicated by the lower PTI values.

Traffic Impacts – Key Points

Flows

- Weekday traffic on the ALR section of the scheme (J5 – J6) is 141,500 vehicles per day (vpd), an increase of 7% from that before scheme was built. This growth is likely to be partly due to the increased capacity provided by the additional lane provided by the ALR.
- The scheme has experienced traffic growth of only 1% between J6 – J7, which was not previously at capacity before the scheme was implemented and the scheme provides no additional capacity on this section, only controlled motorway; this is in line with regional growth trends.
- The proportion of traffic which is made up of HGVs has increased by about 3% on weekdays.

Journey Times

- Overall journey times have reduced in both directions. Clockwise has experienced a 3% overall reduction, but this varies from a 5% reduction between J5 and J6 to a 3% increase between J6 and J7. Anticlockwise journey times have reduced by 2% overall.

- Journey times have reduced most significantly where they were most affected by delays in the before period, the AM peak clockwise and the PM peak anticlockwise. The journey time increase between J6 and J7 is likely to be due to drivers being more compliant with the national speed limit and any Variable Mandatory Speed Limits (VMSLs) displayed.

- Speeds have increased predominantly around the J5 clockwise merge and between J6 – J7 anticlockwise, most likely as a result of road layout changes at these locations.

- Speeds have reduced in the downstream part of J5 – J6 on the clockwise carriageway, probably due to better compliance with speed limits.

Forecast vs. Outturn Flows and journey time impacts

- Post opening traffic flows are significantly lower than expected (with the scheme in place) by between 7% and 15% within the scheme length, averaging 12% lower. Sections of the M25 up- and downstream of the scheme show even greater the differences from forecast.

- Traffic flows in 2012, before the start of construction were also lower than modelled which is linked to the economic downturn's impact of traffic in preceding years.

- Growth of traffic on the M25 between J5 – 7 was forecast to be between 8% and 11% due to the scheme and background trends but observed growth has been much lower except for J5 – J6 clockwise suggesting there has been lower levels of reassignment from other roads than expected.

- Journey time savings were forecast between J5 – J7 in all of the modelled time periods in both directions of between 41 and 64 seconds, and this was almost all due to savings on the ALR section between J5 – J6.

- Journey time savings in the busiest periods, clockwise in the AM peak and anticlockwise in the PM peak, are close to the forecast savings, but other time periods fail to show any savings close to those predicted.

Operation of Smart Motorway

- Smart motorway setting of the speed limit to 60mph or below is most used in the in the AM peak clockwise (up to 65% of the period). This is shown to result in the average speeds in all 4 lanes being similar in this period, making lane change easier for all.

- Speed limits are only set for a minority of the time at other time periods

- Analysis of traffic flows by lane shows a reasonable level of usage in all 4 lanes of the ALR section, albeit with slightly lower flows on the former hard shoulder probably due to HGV usage.

Reliability

- The biggest journey time reliability improvements relate to the times when journey times were most unreliable in the before period, i.e. the clockwise AM peaks and the anticlockwise PM peaks. At less congested times the journey time reliability has not significantly changed.

3. Safety Evaluation

Introduction

3.1. This section of the report considers the impact of the scheme in terms of the level of success in addressing the objective of reducing collisions.

3.2. The Client Scheme Requirements (CSR) document notes that one of the scheme objectives was:

> *To achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.*

3.3. In order to assess the impact of the scheme on collisions, personal injury collisions (PICs) occurring in the pre-construction period, and the available post opening period have been analysed. Evaluation of the schemes impact on personal security has been undertaken through the use of observations made during a site visit.

3.4. This section of the study concerns collision numbers; the economic impact of the change in collisions is evaluated later in the Economy section of this report.

Sources

3.5. The sources used in this section are:

- AST
- Economic Appraisal Report (EAR)
- Recorded Collision data for the DfT and the DBFO operator
- Monitoring Evaluation Report (2015)
- COBA (Cost Benefit Analysis) model

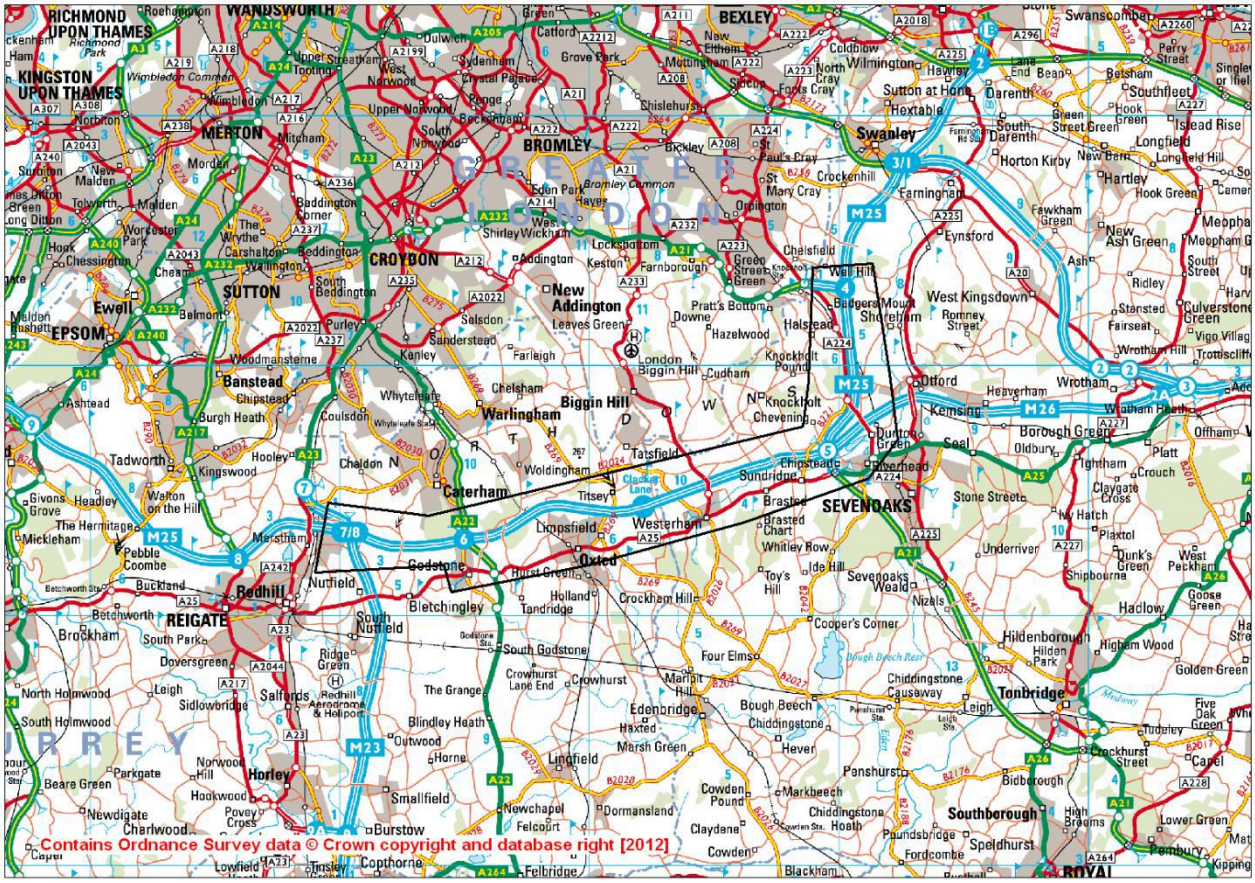
3.6. The area covered in the original appraisal that part of the model network expected to be most affected by the scheme, in terms of Annual Average Daily Traffic flow.

Forecast sources

3.7. The EAR stated that the scheme would result in lower accident rates on those sections of the M25 where ALR would be implemented due to various factors including the introduction of MIDAS and associated queue protection. An 11% reduction in the collision rate on all the affected sections of the M25 was modelled (including the CM). Over the whole modelled area, the 60 year impact was forecast to be a reduction of 198 collisions (0.67%), despite the higher level of traffic expected with the scheme.

3.8. In order to ensure like for like comparison between the predicted and observed collision changes, the overall geographical area of analysis used for this study is the same area, as shown in ***Figure 3-1*** including the local roads.

Figure 3-1 Area of Roads modelled for Collision Impact Appraisal



Observed data sources

3.9. Collisions by their nature include a random element and are somewhat unpredictable events. Therefore, to ensure that the scheme is the main change in the immediate area, and therefore the observed changes are likely to be linked to the scheme, the following approach has been taken.

3.10. Collision data has been obtained from the DfT database for the area shown in ***Figure 3-1*** covering the following time periods:

- Pre Scheme:1 Sept 2007 – 31 August 2012 (five years)
- Post Construction: 1 May 2014 – 31 March 2015 (11 months)

3.11. The collision data is based on the records of Personal Injury Collisions (PICs) that are recorded in the STATS19 database as collected by police when attending collisions. Collisions that do not result in injury are not included in this dataset, and are therefore not included in this evaluation.

3.12. Collision analysis is normally undertaken with three full years of data, so the emerging trends identified in a one year after POPE, should be treated with some caution.

3.13. Additionally, more detailed data has been obtained from the DBFO operator for the motorway within the scheme itself. This data has also been used in monitoring studies, thus for consistency this data covers the following time periods:

- Pre Scheme:1 Sept 2009 – 31 August 2012 (three years)
- Post Construction: 1 May 2014 – 30 April 2015 (12 months)

3.14. It should also be noted that at this stage, the collision data used here may not all have 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. It is not anticipated that this would be significant in terms of the analysis of collision numbers presented in this report.

Analysis of Collision Numbers

3.15. This section analyses the observed changes in PICs following the implementation of the scheme. This section includes an investigation into the changes in the number of collisions and associated casualties as well as whether there has been any change in the relative severity of recorded collisions.

Background Collision Reduction

3.16. It is widely recognised that, over a decade, there has been a year on year reduction in the number of personal injury collisions on the roads, even against a trend of increasing traffic volumes over much of that period. The reasons for the reduction are considered to be wide ranging and include improved safety measures in vehicles and reduced numbers of younger drivers. This background trend needs to be considered when looking at the changes in collision numbers in the scheme area in the before and after periods. If the scheme had not been built, collision numbers in the area are still likely to have been influenced by wider trends and reduced.

3.17. When the number of collisions in the area in the years before and after the scheme was built are compared, and the net change associated to be primarily due to the scheme, the background reduction needs to be taken 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 in the modelled area here would have dropped at the same rate as they did nationally during the same time period. This gives what is known as a counterfactual 'without scheme' scenario on a like for like basis with the observed post opening data which is the 'with scheme' scenario.

3.18. 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.

Evaluation of Collision Numbers and Severity in the Scheme Modelled Area

3.19. The evaluation of the before and after collision numbers by year for the scheme modelled area (as shown in ***Figure 3-1***) and the counterfactual number of collisions which could have been expected in the opening year had the scheme not been built, is shown in ***Figure 3-2*** and ***Table 3-1***. The severity of a collision is defined by the most serious injury incurred. Note that the after period data covers only 11 months, so the graph additionally shows the total extrapolated to 12 months.

Figure 3-2 Number of Collisions on Year by Year Basis for Scheme Modelled Area

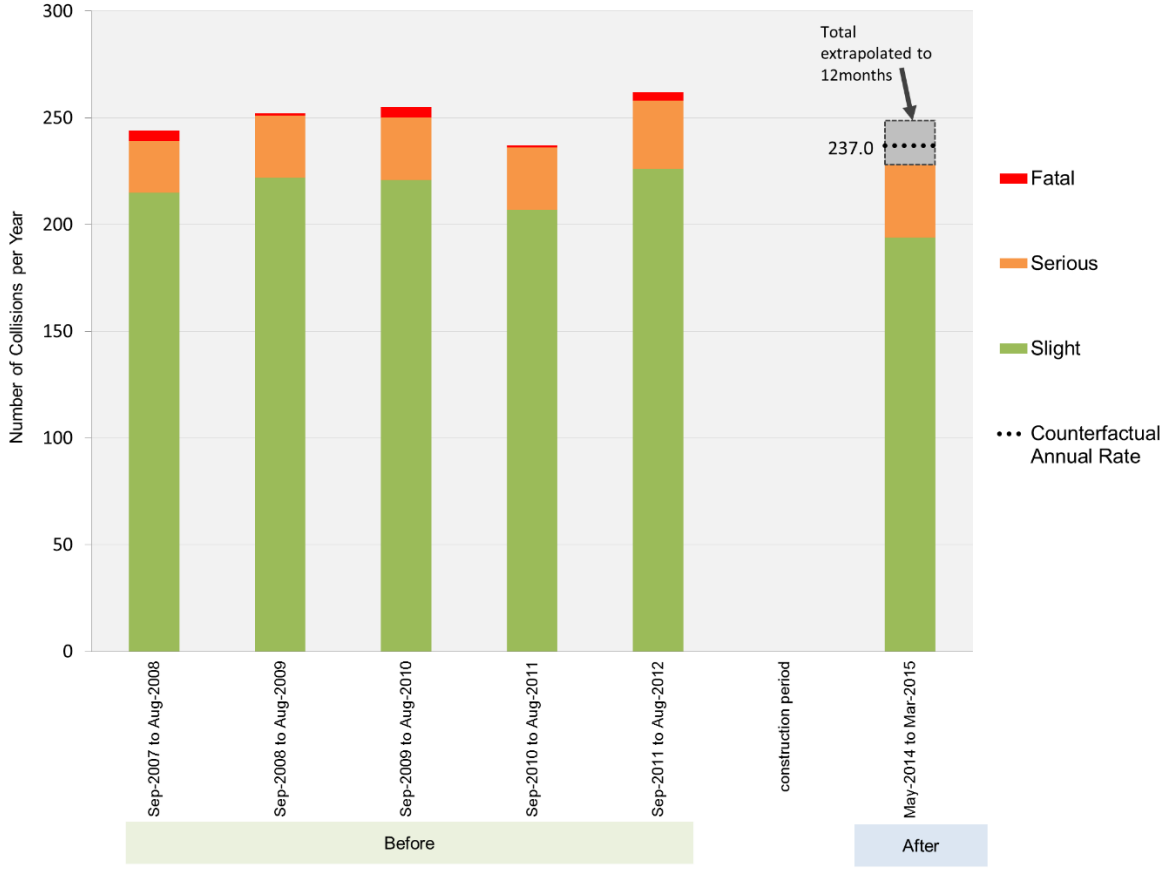


Table 3-1 Annual Average Number of Collisions by severity in Modelled Area

	Five years Before	11 months After	Difference	% Difference
Fatal	3.2	0.0	-3.2	-100%
Serious	28.6	37.1	+8.5	+29.6%
Slight	218.3	211.6	-6.7	-3.1%
Total	250.1	248.7	-1.4	-0.6%
Total Adjusted counterfactual*	237.0		+11.7	+4.9%

*Adjusted figure is the counterfactual annual average i.e. the estimated annual average if collisions risk due to the road layout was the same as observed before construction, reduced by the background trend observed nationally.

3.20. Collison data shown here for the modelled area shows that at this stage there is almost no change in annual average collision numbers in this area between the before and after periods, but a nearly 5% increase when post opening data is compared with expected number of collisions had the scheme not been built (the counterfactual scenario).

3.21. A statistical test[7] on the change in collisions numbers shows that this is not a statistically significant difference.

Evaluation of Collision Numbers and Severity on M25 J5 -7 through the scheme

3.22. This sub-section examines the numbers of collisions and rate occurring on the section of the M25 improved by the scheme. This has been previously evaluated as part of monitoring work for the

[7] Chi-square test with a 95% confidence interval.

smart motorway, so data presented here is taken from this work and uses a 3 year period prior to start of construction and a full year after opening.

Figure 3-3 Number of Collisions on Year by Year Basis for M25 J5-7

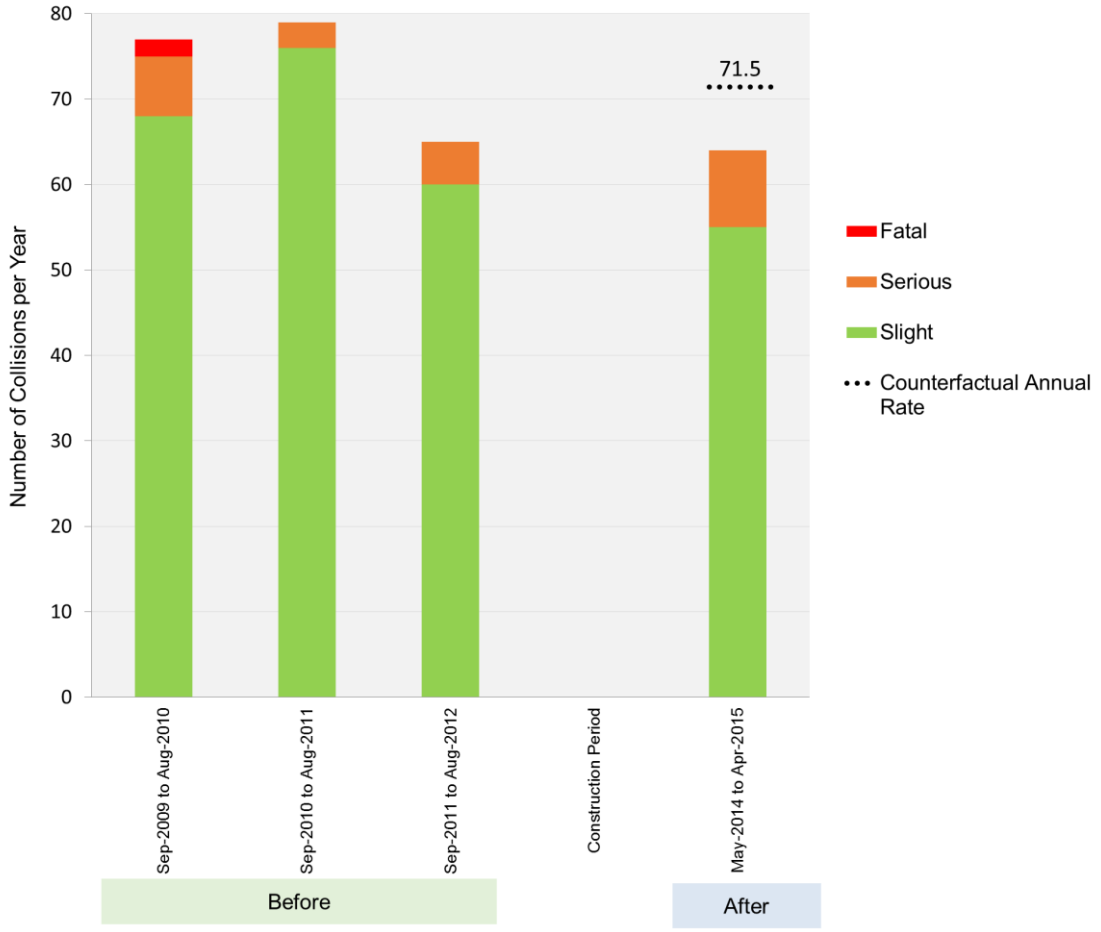


Table 3-2 Annual Average Number of Collisions by severity for M25 J5-7

	Three years Before	One Year After	Difference	% Difference
Fatal	0.7	0	-0.7	-100%
Serious	5.0	9	+4.0	+80%
Slight	68.0	55	-13.0	-19%
Total	73.7	64	-7.5	-10%
Total Adjusted counterfactual*	71.5			

*Adjusted figure is the counterfactual annual average i.e. the estimated annual average if collisions risk due to the road layout was the same as observed before construction, reduced by the background trend observed nationally.

3.23. This shows that, even allowing for the background trend, collision numbers fell by 7.5 (10%) on J5 – 7 of the M25 within the scheme. However, while this suggest that the scheme is having a beneficial impact on safety, at this stage with only one year's data the result shown above is not large enough to be statistically significant.

Evaluation of Collision Rates on M25 through the scheme

3.24. The number of collisions along a length of road in conjunction with its AADT can be used to calculate a collision rate (calculated as the number of collisions per million vehicle kilometres

travelled). By looking at the rate it is possible to identify the safety impact on the roads of interest whilst ignoring the impact of the change in traffic volumes.

3.25. These collision rates can also be compared against the expected rates used in the forecasts is shown in the EAR and COBA model. The forecast collision impact in the COBA model includes a predicted collision reduction over time. The POPE evaluation counterfactual rate as shown below is based on the observed national reduction in collisions on motorways from the Department for Transport national data between the before and after time periods.

Table 3-3 Collision rate on M25 J5 – 7

	Observed 3 years before	Counterfactual rate	Observed 12 months after	Difference
Personal Injury Collision per million vehicle kilometres (PIC/mvkm)	0.076	0.0707	0.063	-11%

3.26. The results show that the collision rate has decreased to 0.063 PICs/mvkm (11%) when compared to the before scheme opening counterfactual rate. This collision saving is not statistically significant at this stage when only one year's post opening data is available.

Collison severity

3.27. ***Table 3-4*** shows the comparison of results for the Severity Index which is calculated based on fatal and serious collisions as a proportion of all collisions. The results indicate an increase in the Severity Index; however this is based on a small sample size so no conclusions should be drawn at this stage.

Table 3-4 Severity Index of Collisions

Scope	Before	After
Modelled area	12.7%	14.9%
M25 mainline (scheme section only)	8.3%	16.4%

Forecast vs. Outturn Collision Numbers and Rates

3.28. Forecasting of the safety impact of this scheme was undertaken using the COBA (Cost Benefit Analysis) modelling software. This gave forecasts of the changes to collision numbers which is examined here and the associated monetary benefit which is evaluated in the next section of this report.

3.29. The extent of the network of roads included in the COBA modelling was defined as the part of the SATURN network most affected by the scheme in terms of traffic flows. This included the M25 from J4 to J8 and the adjacent motorways and some of the local road network, as shown in ***Figure 3-1***. Observed collision rates on the D3M sections of the M25 were used in the model. In accordance with MM-ALR assessment guidance[8] specifying the use of the Hazard Log for the section, the forecast change in collision rate with the scheme was an 11% reduction.

[8] IAN 161/13

Forecast vs. Outturn Collision Rates

3.30. Forecast and observed changes in collision rates are shown in ***Table 3-5***.

Table 3-5 Collision Rates on M25 J5-7 : Forecast and observed (PIC/mvkm)

Section	Forecast			Observed		
	Do Minimum	Do Something (with scheme)	% diff	Before (with counterfactual adjustment)	After	Diff
J5 – 6 (D3M to D4 ALR)	0.175	0.156	-11%	0.0707	0.063	-0.006 (-11%)
J6 – 7 (D3M D4 ALR	0.175	0.156				
J6 – 7 (D4M)	0.098	0.087				

3.31. The key points on collision rates shown here are:

- The decrease in the collision rate of 11% (including adjustment for counterfactual) is the same as forecast.
- Collision rate on the M25 here in the before period (adjusted for counterfactual) was much lower than the Do Minimum in the model reflecting the lower flows that were observed, which reduced the potential for rate reduction.

Forecast vs. Outturn Collision Numbers

3.32. ***Table 3-6*** shows the forecast saving in terms of collision numbers has been extracted from the COBA model, and the numbers are compared with the observed data on savings from ***Table 3-1*** and ***Table 3-2***.

Table 3-6 Collision numbers: Forecast and Observed

Scope	Forecast		Observed	
	Saving	%	Saving	%
M25 J5 – 7	7.1	3.9%	7.5	10%
Modelled area	2.8	0.6%	-11.7	-4.9%

3.33. The key points on number of collisions saving forecast are:

- Savings on J5 – 7 is as forecast at just over seven, although the proportional saving is greater due to lower traffic volumes and therefore lower collision rates (as noted in ***Table 3-5***).
- Over the wider modelled area, the forecast saving was below 1% and it is noteworthy here that the benefits on J5 – 7 were forecast to be partially outweighed by increases in collisions elsewhere on the network.
- The increase in collisions in the modelled area are not statistically significant at this stage.

Casualties and Fatal Weighted Injury (FWI)

3.34. Fatal and weighted injury (FWI) casualties and the rate of FWI casualties per billion vehicle miles per annum are metrics used in the objectives of the smart motorway as set out in the Interim Advice Note IAN 161[9]. ***Table 3-7*** shows the number of casualties and the FWI for the before and after periods. This is calculated based on the numbers of fatal, serious and slight casualties as weighted proportions, to adjust for the severity. Note that no adjustment has been made here for the background reduction in casualties as in the approach for the collision counterfactual assessment above.

3.35. FWI is defined as: (number of fatalities) + 0.1 x (number of serious casualties) + 0.01 x (number of slight casualties).

[9] FWI is defined as: (number of fatalities) + 0.1 x (number of serious casualties) + 0.01 x (number of slight casualties).

3.36. The FWI per billion vehicle kilometres (FWI / bvkm) or hundred million vehicle miles (FWI / hmvm) allows a comparison between road sections with different flows and lengths.

3.37. The reduction of FWI by distance travelled is attributable to the smaller number of fatal and serious casualties being recorded in the after period, but this is based on a small sample size.

Table 3-7 Casualties and FWI

		Before		After	Difference
		36 months	Annual average	12 months	
Severity	Fatal	2	0.67	0	
	Serious	16	5.33	9	
	Slight	368	122.67	87	
	Total	386	128.67	96	
FWI		7.28	2.43	1.77	-27%
Distance Travelled	bvkm	2.91	0.97	1.02	
	hmvm	18.0	6.0	0.63	
FWI / bvkm		2.51		1.79	-28%
FWI / hmvm		0.40		0.29	

3.38. The key points show here are :

- Number of casualties has fallen by 27%, not including any background trend; and the rate by distance travelled has fallen similarly.
- This change is better than the smart motorway objective as set out in IAN 161 of not causing any increase in the FWI.

Security

Forecast

3.39. The AST stated that this sub-objective was not relevant to this scheme and it was not appraised.

Evaluation

3.40. Smart Motorway schemes can be beneficial to security because they include permanent surveillance of the motorway with CCTV, however, this was already installed on this section of the M25. Therefore, the OYA assessment of the security impact is neutral.

Safety Impact – Key Points

Collisions

- Analysis of observed collision data for the M25 J5 – 7 within the scheme shows a decrease (when compared to the counterfactual) of 7.5 collisions (10%) one year after opening, indicating that the scheme has had a beneficial impact on safety. Conversely, in the wider area as used in the original model, there has been a net increase in collisions compared with the counterfactual.
- At this stage it is too early to draw firm conclusions as the net changes are not statistically significant.
- When traffic flow changes are taken into account, the collision rate for the scheme section J5 – 7 has decreased by 11% even taking into account the background trend in collision reduction on motorways. This change is also not statistically significant.
- Collision severity as a proportion of all collisions has increased marginally over the scheme, although this is mainly due to the large decrease in the number of slight collisions, rather than the increase in serious collisions.

Casualties

- Numbers of casualties on this section on the M25 have fallen by 25%, not including the wider trend of casualty reduction.
- The Fatal and Weighted Index (FWI) per hundred million vehicle miles has fallen.

Forecast vs. Outturn Collision Rate Savings

- Collision saving on the M25 J5 – 7 and the reduction in the collision rate of 11% are in line with that forecast.

Security

- The impact is neutral, as forecast.

4. Economic Evaluation

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 achieve good value for money

4.2. The sub-objectives for economy are as follows:

- To achieve 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; and
- 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); and
- Costs to users due to delays during construction and future maintenance periods.

4.4. This section provides a comparison between the outturn costs and benefits and the forecast economic impact, as well as evaluating reliability and the scheme's wider economic impacts.

Sources

4.5. The economic forecasts presented in this section are based upon:

- Benefits as presented in the M25 DBFO LUS Economic Appraisal Report S2, November 2012 (EAR);
- Forecast costs of the scheme as in the October 2012 LUS estimates;
- AST (July 2012);
- Economic model outputs from:
  - Transport Users Benefit Appraisal (TUBA): Transport Economic Efficiency, Indirect Tax Impact;
  - Incident Cost-benefit Analysis (INCA): Journey Time reliability (including incident related delay); and
  - Cost Benefit Analysis (COBA): Safety impact.

4.6. The outturn results are based on the following sources:

- Outturn costs from the Regional Finance Manager in March 2015;
- Benefits are based on the observed findings of the impacts on the traffic and numbers of collisions as detailed in the preceding traffic and safety sections of this report monetised to create re-forecasts of the long term impacts;
- WebTAG guidance: Carbon impact, Fuel consumption; and
- PAR 6.3 guidance[10].

4.7. The appraisal report provides forecasts of the benefits for a 60 year appraisal period. All costs presented in the EAR and this chapter are in 2010 prices discounted to 2010 unless otherwise stated. This is in line with the price base as used in the EAR.

[10] Project Appraisal Report (PAR) is Highways England's standard approach to appraisal typically used for smaller schemes based on webTAG guidance on economic assessment. It provides a basis for POPE evaluations where is not appropriate to re-run full models.

Present Value Benefits

4.8. The appraisal considered the economic benefits of this scheme expressed in terms of present value (present value benefits – PVB) for the aspects set out in ***Table 4-1***. This table also sets out the approach taken in this post opening evaluation to the reforecasting based on the observed data at this stage, and those which have not been evaluated and have been assumed as forecast. A 'yes' indicates that the element of benefits is considered as part of this evaluation. A 'no' indicates that the forecast impact from the appraisal will be used in place of a full evaluation at this stage.

Table 4-1 Economic Benefits of Scheme (2010 prices and values)

Benefits in £m 2010 market prices, discounted	Forecast £m (EAR)	Evaluate ?	Evaluation Approach
Journey Time (TEE business and consumer users)	564.160	Yes	Outturn journey time impacts in opening year can be calculated from observed data and forecasts.
Vehicle Operating Costs (VOC)	-127.947	Yes	Net change in fuel consumption monetised to calculate a proxy outturn reforecast value of VOC.
Construction period & Future maintenance periods: Journey time and VOC impacts	-57.225	No	Not known at this stage and not within the remit of POPE to evaluate.
Safety Benefits	11.908	Yes	Based on reduction in collision numbers, if this is statistically significant
Carbon Benefits	-161.488	Yes	Ratio between forecast and outturn opening year carbon impact used to calculate 60 year reforecast
Noise Benefits	-0.894	No	Small proportion of the overall scheme impacts.
Air Quality	0.013	No	Small proportion of the overall scheme impacts.
Indirect tax impact as a benefit	160.333	Yes	Calculate outturn change in fuel consumption and use ratio against forecast change to reforecast 60 year benefit
Total PVB	388.860		
Reliability	412.840	Yes	Re-run INCA model with observed opening year traffic flow data
Total including Reliability	801.700		

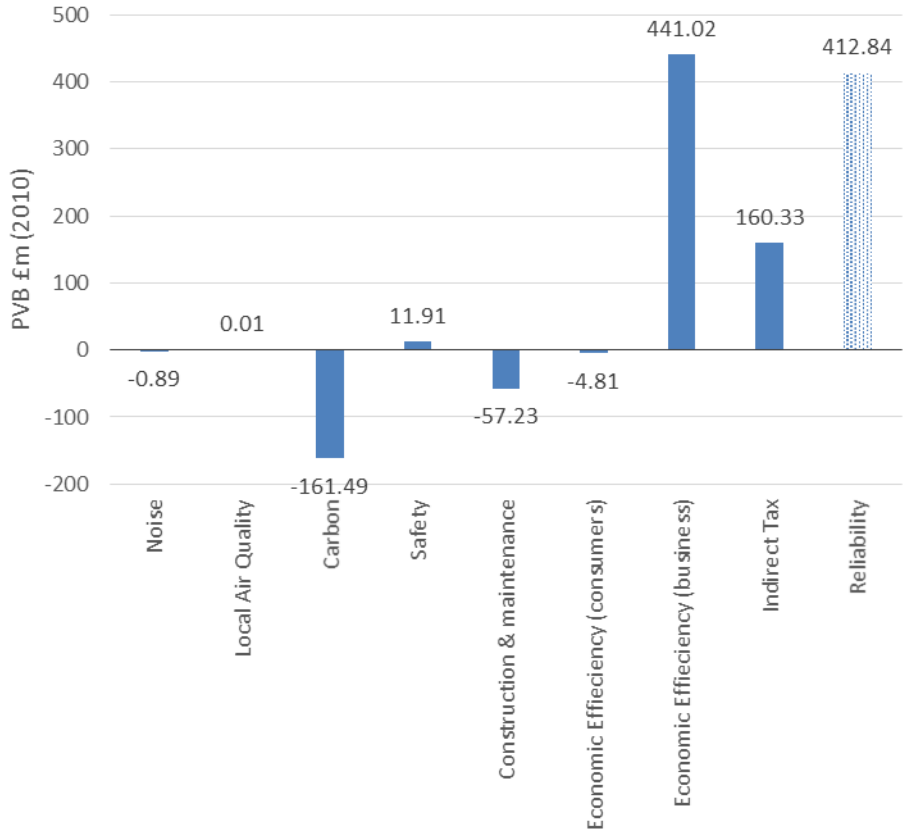
4.9. It is noted that although reliability benefit was forecast in the EAR, it was not included in the overall benefits as set out in the Analysis of Monetised Costs and Benefits (AMCB) table in the EAR.

4.10. Economic modelling was primarily for a core scenario, with low and high growth extrapolated in line with webTAG guidance on Forecasting and Sensitivity (TAG Unit 3.15.3). The forecasts presented above are all from the core scenario, as are the results shown in the rest of this section.

How are the forecast benefits made up?

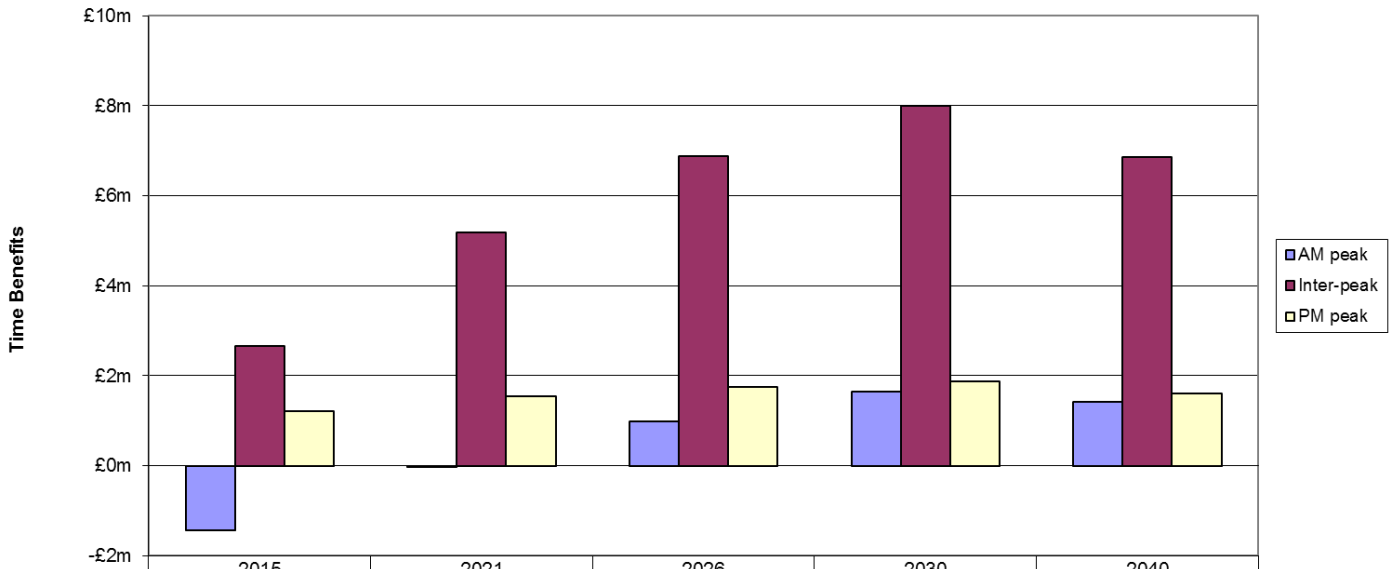
4.11. Benefits as listed in ***Table 4-1*** are shown graphically in ***Figure 4-1*** emphasizing the relative importance of the component parts.

Figure 4-1 Forecast 60 year Benefits by type



4.12. Supplementary analysis of the TUBA forecasts detailed how the journey time benefits were split between time periods over five modelled years. These graphs are shown in ***Figure 4-2*** and ***Figure 4-3***.

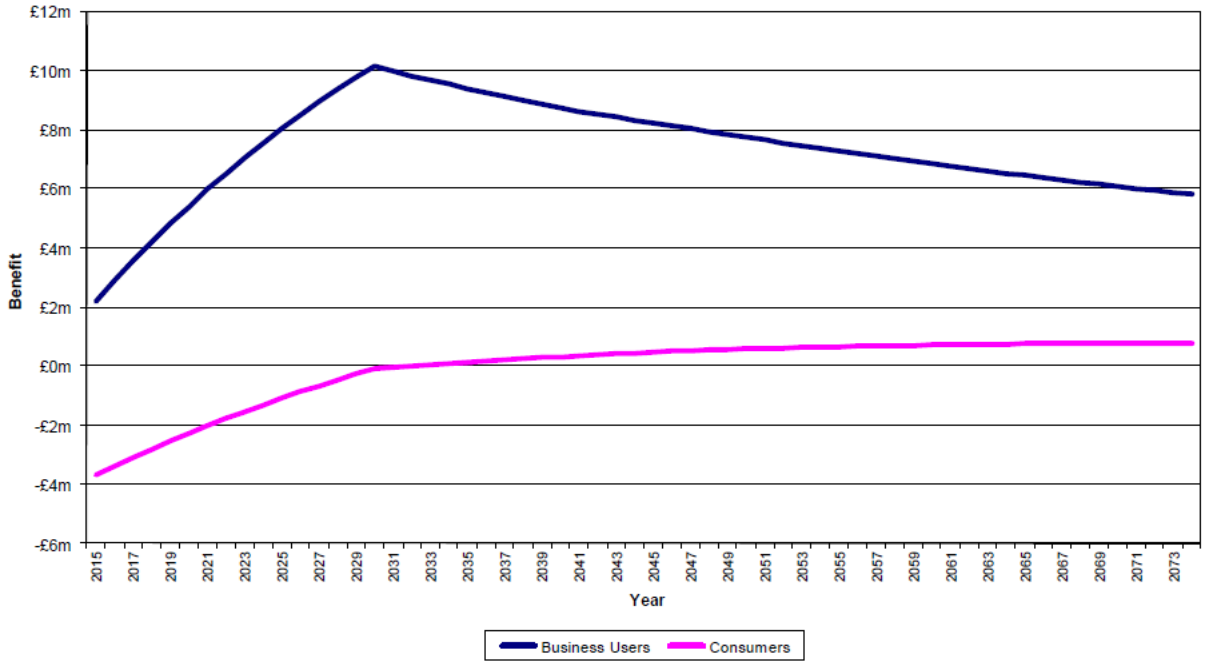
Figure 4-2 Forecast Journey Time Benefits spread by time period and modelled years (£m)



	2015	2021	2026	2030	2040
AM peak	-£1.439m	-£0.005m	£0.975m	£1.638m	£1.418m
Inter-peak	£2.658m	£5.193m	£6.872m	£7.989m	£6.854m
PM peak	£1.222m	£1.542m	£1.747m	£1.881m	£1.615m

Modelled Year

Figure 4-3 Forecast Benefits spread over 60 years (£m)



4.13. The graphs of the spread of the benefits and analysis of the TUBA model output shows:

- Only 0.5% of the journey time benefits were forecast to be achieved in the opening year (2015).
- Further analysis of the TUBA model shows that the inter-peak period was expected to provide most of the benefits, both in the opening year and in the long term. As business users gain the most from inter-peak travel time benefits and have higher personal values of time, this explains why they have the higher benefits.
- The EAR stated that the benefits were expected to increase to 2030, the design year, after which business users' benefits would start to decline due to the impact of discounting. The relatively better long term performance for consumers is due to the growth in the value of time being greater for them than business users.

4.14. The low level of benefits expected in the opening year as shown in ***Figure 4-2*** and ***Figure 4-3*** is important to the POPE assessment of the outturn benefits as detailed later in this chapter.

Transport Economic Efficiency (TEE) benefits

4.15. TUBA was used to appraise the TEE benefits of the scheme compared to just having the existing D3M on J5-6 compared against 4 lanes ALR, including through Clacket Lane Motorway Service Area (MSA).

4.16. Modelling assumed that the 4 lanes ALR would operate in the same way as D4M. The time periods used were weekdays as follows:

- AM: 4 hours
- Inter-peak: 6 hours
- PM: 3 hours
- Weekend AM peak: 5 hours
- Weekend PM peak: 9 hours

4.17. TUBA analysis did not cover off-peak periods as the scheme was not expected to generate benefits in this period as there were only low congestion levels.

4.18. TEE benefits assessed in TUBA include journey time benefits and vehicle operating costs (VOC), in addition to indirect tax revenue impact.

Evaluation of Journey Time Benefits

4.19. The standard POPE methodology for evaluating the economic value of benefits arising from journey time benefits is based upon comparing the observed vehicle hour savings in the opening year against a forecast of the savings. It is then assumed that the ratio between these at OYA is indicative of the long term trend, hence the 60 year outturn monetised benefits can be derived from the forecast 60 year benefits.

4.20. In the case of this scheme, this approach was not possible due to the lack of sufficient like-for-like information to be able to re-create a reforecast of the opening year vehicle hours saving. The alternative approach used in POPE studies is to base the monetisation of journey time savings on M25 J5 – 7 on the PAR approach.[11] For this scheme however, the suitability of the PAR method is compromised by the necessary assumption that the opening year can be used as a strong indicator of the long term trend. Analysis of the benefits profile over time for this scheme (as shown in Figure 4-3) shows that in the opening year, and to a lesser extent the first few subsequent years, the benefits are atypical of the long term. Therefore, the approaches to evaluation of the journey time used here are based on the monetisation of journey time savings on J5 – 7 in the opening year based on PAR guidance but showing two alternatives for how this is extrapolated to 60 years of benefits (i.e. the capitalisation factor).

4.21. Calculating the vehicle hour benefits in the first year attributable to the scheme is not a straightforward calculation. Many logical assumptions were therefore required, and these are summarised below:

- The traffic already using the routes included in the assessment (in the before period) receives the full journey time benefit observed at this one year after stage;
- Any additional traffic receives half of the journey time benefits. This concept is known as the 'rule-of-a-half' and is the standard approach for dealing with extra traffic; and
- Off-peak periods are omitted as no forecasts were provided for these time periods and it is assumed that the motorway has spare capacity in these periods, even without the improvement.

4.22. Capitalisation of the opening year benefits to get the full 60 years has been done in two ways:

- Use of standard factor for a motorway, assuming traffic growth as predicted on NTEM, as given in PAR guidance.
- Assuming that the benefits profile in future years follows the same trend as modelled in TUBA Using a factor calculated from the ratio between the opening year benefits and the 60 year benefits.

4.23. The monetisation of the opening year savings is shown in ***Table 4–2***.

[11] The Project Appraisal Report (PAR) 6.3 is normally used by Highways England for the appraisal of smaller scheme and therefore only provides an estimate of the economic benefit of the scheme.

Table 4-2 Journey Time Benefits

					Outturn
Opening year observed vehicle hours saved on M25 J5-7				(a)	165,173
Value Of Time per hour for opening year, at 2010 market prices £				(b)	£14.18
Annual Time Saving at 2010 prices £m				(c)=(a)*(b)	£2.34m
	PAR method		**TUBA profile method**		
60-Year Capitalisation Factor (NTM Traffic Growth)	(d)	54.811	Proportion of 60 year benefits in opening year	(d)	0.49%
Discount factor	(e)	0.871			
Total 60 year benefits £m	(f)=(d)*(e)	£111.8m		(f) = (c) / (d)	£478.0m

4.24. It can be seen from this assessment of the 60 year benefits, that assuming only a standard rate of capitalising the opening year benefits to 60 years, gives low benefits. This is due to standard capitalisation factor (d) above, not being representative of the low level of significance attached to the opening year impact. When the 60 year benefits are reforecast using measured opening year impact combined with the assumption of the same long term trend as in the original TUBA forecasting as noted in ***Figure 4-2,*** the benefits are substantially higher at £478.0m.

Further Journey Time Benefits Evaluation - All Lane Running (ALR)

4.25. The economic impacts of the conversion of a motorway to ALR are of particular interest to Highways England, therefore this study has additionally examined what the benefits are accruing from the ALR part of this scheme alone, J5 – 6. 97% of the total opening year vehicle hours saving shown in (a) above is derived from the ALR section and only 3% from the J6 – 7 controlled motorway, hence the 60 year benefits of ALR are reforecast to be £464.1m.

Vehicle Operating Costs (VOC)

4.26. WebTAG guidance states that the use of the road system by private cars and lorries gives rise to operating costs for the user. These are fuel and non-fuel costs, where fuel is the majority net impact of conventional highways schemes.

4.27. In the case of this scheme, the forecast VOC impact in the EAR was from the TUBA model. This forecast that VOC impact of the scheme would be a net disbenefit. This disbenefit would be mainly for consumer users, and this was largely due to the expected diversion of some consumer traffic from local roads onto the M25, which would have more capacity due to the ALR provided by the scheme. This would result in drivers travelling further to reach their destinations, but doing so in less time. As a result of the rerouting they were forecast to use more fuel (and non-fuel resources), thus increasing their operating costs. Business users see less impact as business traffic generally uses strategic roads and hence was forecast to only have a small disbenefit VOC, due to the increase in speeds slightly increasing the fuel costs.

4.28. As with journey time benefits, the TUBA model cannot be rerun to evaluate the impact. The alternative approach adopted here is based on using observed changes in traffic at OYA combined with guidance in webTAG and PAR to calculate a re-forecast 60 year impact. This approach consists of the following steps:

- Estimating changes in fuel consumption one year after opening on the M25 using observed data for flows and speeds by time period and based on VOC guidance on calculations given in webTAG.
- Monetising the value of change in litres of fuel in the opening year based on webTAG.
- Capitalising the OYA monetary impact to 60 years using the PAR 6.3 approach for VOC.

4.29. This evaluation approach is based on the assumptions:

- Fuel consumption is the majority of the VOC impact.

- Changes on the key links J5 – 7 are indicative of the changes overall.

4.30. The evaluation of the outturn impact based on the observations in the opening year is shown in ***Table 4-3*** compared with the forecast from the EAR.

Table 4-3 Vehicle Operating Costs (VOC)

£m	Forecast (whole area)	Outturn reforecast (M25 J5-7 only)	
		0% growth	NTM growth
60 year impact £m	-127.9	-163.58	-227.21

4.31. This shows that the outturn assessment shows higher VOC disbenefits than was forecast. This result however, needs to be taken with caution, as EAR stated that the magnitude of the disbenefit forecast was largely due to consumer users travelling longer distances to use the improved capacity M25. It was not possible to identify the VOC disbenefit for this traffic from observed data as no detailed forecast of the impact on local roads was included in the TFR and the impacts over a wide network of roads is likely to be proportionately minor compared with other traffic changes between the before and after periods occurring in this wide area over the same period. The outturn disbenefit evaluated here measures the change due to increased fuel consumption on the M25 and is not therefore comparable on a like-for-like basis with the forecast.

Monetised Safety benefits

4.32. As set out in the EAR and in the preceding safety section of this report, the safety benefits were forecast using the COBA (Cost Benefits Analysis) modelling software. This also forecast the monetised value of the safety impact at £11.908m over 60 years.

4.33. As shown in ***Table 3-6*** in the safety section of this report; the predicted saving for the opening year was 9.7 PICs in the central case. The EAR stated that the level of saving for the corridor alone was £3.5million.

4.34. The POPE methodology for evaluating safety benefit, is based on the difference between the forecast and observed number of collisions, the PAR method for monetising injury collisions, and the forecast 60 year monetary savings. How these combine to produce and outturn monetary benefit is set out in ***Table 4-4***.

Table 4-4 Monetisation of Outturn Safety Impact

Forecast		Outturn	
COBA forecast opening year collision saving on key links J5 – 7	7.1	Observed annual average saving in first year on key links J5 – 7	7.5
		Net difference from forecast	0.4
		PAR based monetisation of net difference in first year	£0.037m
Forecast Monetary benefit for whole area (60 years)	£11.908m	60 monetisation of net difference in collision numbers on the M25 J5-7 key links	£1.892m
		Total safety PVB whole area (60 years)	£13.800m

4.35. This evaluation of the re-forecast 60 years safety impact shows the benefits to be £13.8m, which is above that forecast. However this figure outturn result should be taken with caution as the collision savings at this stage are not statistically significant. Hence the outturn saving is not included in the total benefits of the scheme in accord with the POPE methodology.

Indirect Tax Revenue

4.36. Indirect tax revenue impact in the context of scheme appraisal means the changes to the revenue raised by central Government. For highway schemes this primarily means the revenue from fuel

duty for all users and, for consumers, from VAT which will change if the scheme impacts the amount of fuel used by road users. Fuel usage changes are from the following:

- Changes in speeds which mean that vehicles are travelling at a greater or worse fuel efficiency;
- Changes to the amount of traffic; and
- Change to the journey lengths.

4.37. When this scheme was appraised, the impact of the scheme on net indirect tax revenue raised by central Government over the 60 year appraisal period was included as part of the benefits, rather than as part of the costs as had previously been the approach.

4.38. As indirect tax revenue for Government as a benefit is of similar magnitude, although in reverse, to the Vehicle Operating Costs (VOC) paid by users, the approach to evaluate the outturn impact is the use the ratio between the forecast and outturn VOC benefits to calculate the outturn reforecast of the 60 years Indirect Tax impact, as shown in ***Table 4-5***.

Table 4-5 Indirect Tax Impact of scheme as a benefit (60 years, £million, 2010 prices and values)

£m	Forecast (whole area)	Outturn reforecast (M25 J5-7 only)
60 year impact based on NTM traffic growth	160.3	284.7

4.39. This shows that the indirect tax was forecast to be a large benefit of the scheme and that the outturn results is higher than forecast. It should be noted that, as for the VOC disbenefit, the outturn evaluation does not cover the wide area as covered by the forecast, therefore it does not include the impacts on all-purpose roads which are likely to increase these benefits further.

Greenhouse Gas (Carbon) Benefits

4.40. The monetised Carbon impact of the scheme was undertaken in accordance with TAG Unit 3.3.5 with the value of carbon from Department for Energy and Climate Change (DECC) 'Valuation of Energy Usage and Greenhouse Gas Emissions for Appraisal and Evaluation' published in June 2010. This was used as more appropriate than the TUBA model output.

4.41. The carbon modelling based on an area called the Traffic Model Reliability Area and assumed background traffic growth from 2015-2030 then zero growth. This area extended around the south of the M25 from north of J16 (M40) at Chalfont St Peter in the west to J30 in the east at Grays (A13), including sections of all radial routes, M40, M4, M3, A3, A24, A22, A23, M23, A21, M26 and A2. It also extends along the M20 corridor to J8, and includes the M2 between J1 and J5.

4.42. The forecast was a large disbenefit of -£161m which is the mid-point between the low and high estimates of the impact in the core scenario.

4.43. WebTAG states that for highway schemes, greenhouse gas emissions are assumed to be proportionate to the number of litres of fuel burnt. The evaluation of the fuel consumption undertaken in the VOC analysis showed that the total petrol and diesel consumption between J5 and 7 had increased by 5.9%, mostly due to increased flows.

4.44. Therefore, the POPE outturn evaluation is based on calculating the opening year net carbon emissions then using the ratio method to calculate the monetised impact. The evaluation of the carbon emissions is detailed later in this report (page 71).

4.45. ***Table 4-6*** summarises the evaluation of the monetary impact.

Table 4-6 Carbon Benefit (£m)

Carbon	Forecast (core traffic growth)			Outturn
Net change in carbon tonnes within scheme links in 2015	15% increase			6% increase
Monetised impact	**lower estimate**	**upper estimate**	**mid-point**	
60 years net change £m	-£76.5m	-£246.5m	-£161.5m	-£59.8m

4.46. The result of the evaluation of the carbon impact is a net increase in carbon emissions, but this is much lower than forecast hence the level of the disbenefits of proportionately lower at -£59.8m over 60 years.

Other benefits: Noise, Air Quality, Impact of Construction period and future maintenance

4.47. Noise and Air Quality impacts of this scheme form –0.23% and 0.003% of the monetised benefits of this scheme respectively. Although the traffic flows have been slightly lower than predicted (as shown in ***Table 2-3***), as the importance of the monetary impact is so low, the monetised impacts have assumed to be as forecast for both.

4.48. During the construction period, there was forecast to be disbenefits, largely due to delays caused to M25 journey times. The impact of future maintenance was also considered and the total net impact was -£57.2m. The EAR states that this includes the replacement of the steel safety barrier in the central reserve with a rigid concrete barrier (RCB) with no further requirement for maintenance or replacement within the 60 year appraisal period. It is not part of the POPE process to evaluate the impacts during the construction period and at this point, it can be assumed that the future maintenance of the scheme will be as expected, therefore the OYA assessment of the impact of the construction period and future maintenance is as forecast at £57.2m.

Reliability impact

4.49. The scheme appraisal estimated the reliability benefits for the scheme. The monetised reliability benefit was not included in the overall monetised benefits in the EAR. The reliability sub-objective includes the impact of the scheme on incidents and day-to-day journey time variability.

4.50. Benefits of delays and travel time variability costs relating to incidents were examined using INCA. The appraisal used INCA (INcident Cost Benefit Assessment) version 4.1 for estimating the benefits of reduced delay and travel time variability (TTV) caused by unforeseen incidents that reduce capacity, such as collisions, breakdowns, debris on the carriageway and major disruptions such as fire, load shedding or spillage. The combined impact on variability and delay are known as reliability. The forecast INCA benefit was not however included in the overall benefits for the purpose of calculating the BCR. This is in line with the webTAG guidance which states that the monetised reliability benefits should not be included in the overall Analysis of Monetised Costs and Benefits (AMCB).

4.51. INCA modelling was based on two modelled years (2015 and 2030) from which the INCA software extrapolates the 60 year benefits. ***Table 4-7*** shows the forecasts as stated in the EAR and from a rerun of the INCA model obtained for this study.

Table 4-7 Reliability Benefits from INCA (£m)

	Forecast (EAR)	Re-run forecast using original INCA model	Outturn Reforecast using INCA model with observed data for 2015, and as forecast for 2030 onwards	%diff
60 years net impact £m	412.8	422.0	399.0	-5%

4.52. The re-forecast reliability impact is 5% lower and this is due to the observed traffic flows being lower than forecast which gives slightly lower benefits for day-to-day variability and from the impacts of collisions. As most the years in the re-forecast are still based on the original model from

2030 onwards there is still considerable uncertainty in terms of whether the scheme is likely to achieve the forecast monetary benefit for reliability.

4.53. It is further noted that the INCA assessment is based on the observed data on incidents on the motorway. Although this data does exist for the M25 before and after the scheme was built, the data cannot be compared on a like-for-like basis as once a smart motorway is fully operational, the additional technology means that far more incidents are automatically being detected and hence recorded, than was the case with all manual recording before the scheme was in place.

Summary of Total Present Value Benefits

4.54. The total benefits as forecast and the outturn reforecast of the 60 year benefits are shown in ***Table 4-8***.

Table 4-8 Present Value Benefits summary (£m)

Costs in £m 2010 market prices, discounted	Forecast	Outturn	
Journey Time	564.2	111.8	478.0*
Vehicle Operating Costs (VOC)	-127.9	-227.2	
Construction period & Future maintenance periods: Journey time and VOC impacts	-57.2	-57.2	
Safety Benefits	11.9	**	
Carbon Benefits	-161.5	-59.8	
Noise Benefits	-0.9	-0.9	
Air Quality	0.0	0.0	
Indirect tax impact as a benefit	160.3	284.7	
Total	388.9	51.4	417.6*

* Based on trend of increasing congestion in future years long term as forecast by TUBA
**Safety benefits not included as not statistically significant at this stage

4.55. This summary of the total benefits shows that based on the POPE approach of using the PAR guidance for the journey time benefits evaluation, the benefits are much lower than forecast. This is due to several factors, including lower traffic flows than predicted but the key one is that the benefits in the opening year were expected to be low. The alternative approach for evaluating the journey time benefits in which opening year benefits are only 0.49% of the benefits and the 60 year impact includes forecasting of future congestion in the Do Minimum scenario using the trend predicted by TUBA, has much higher benefits such that the total outturn benefits are similar to those forecast, despite the lower than forecast traffic flows the M25.

Scheme costs

4.56. 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. Investment costs are considered in terms of a common price base of 2010 for comparison with forecast. For comparison with the benefits, overall costs are expressed in terms of present value, termed Present Value Cost (PVC).

Present Value Costs (PVC)

4.57. 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.

4.58. Following current Treasury Green Book guidance, calculation of the present value entails the conversion to market prices, then discounting by year. This uses a rate of 3.5% for the first 30 years and 3% thereafter. Note that the base year used here is 2010, as used in the scheme forecasts and as in current guidance.

4.59. Appraisal of this scheme included the following types of cost:

- Investment costs: before and during construction; and
- Operational costs of the smart motorway during the 60 years after opening.

4.60. Note that when this scheme was appraised, the impact on Indirect Tax revenues during the 60 years after opening was included as part of the benefits in accord with then current guidance, rather than as part of the costs. It has likewise been treated as a benefit in this report.

Investment Cost

4.61. The investment cost is the cost to Highways England of the following:

- Costs of construction;
- Land and property costs;
- Preparation and supervision costs; and
- Allowance for risk and optimism bias.

4.62. For the purpose of this evaluation, we have determined the forecast scheme cost based on data presented in the M25 Later Upgraded Sections (estimate of 11/10/12) which was an update on the figures presented in the EAR. This gave a total cost for Highways England Major Projects of £129.1m.

4.63. No Do Minimum costs were detailed in the EAR. It stated that cost of upgrading the steel safety barrier to rigid concrete barrier (RCB) as a necessary part of the conversion of J5-6 to ALR was excluded from the forecast cost of the Do Something scheme as it was also a necessary cost for the Do Minimum scenario. The cost of the RCB was not given.

4.64. For comparison with the outturn costs on an equivalent basis, the investment part of the PVC was calculated assuming the same spend profile by year as the forecast spend by milestone, and adjusted to 2010 prices (without discounting), as presented in ***Table 4–8***. This has been confirmed by Highways England's MP Portfolio Office.

4.65. The outturn investment costs as of September 2015 for building this scheme have been obtained from the Regional Finance Manager at Highways England covering the period 2008 – 2015. For the purpose of comparison between forecast and actual, and with other major schemes, prices have been converted to 2010 prices. This figure can then be compared with the forecast cost on a comparable basis. These figures are shown below in ***Table 4-9***.

Table 4-9 Investment Cost of Scheme (£million, 2010 prices, not discounted)

Forecast	Outturn	Difference
124.4	102.8	21%

4.66. This shows that the outturn cost was 21% lower than forecast. It is understood that this saving was achieved through value engineering.

Operational Costs

4.67. Operational costs of the scheme were assessed in the EAR in line with guidance in IAN 164/12. It covers expenditures relating to the following aspects of the smart motorway:

- Day-to-day running and operation of the smart motorway;
- Enforcement costs including police; and
- Capital costs of renewal. This is the costs over 60 years of the maintenance and renewal of the technology and associated infrastructure. Note that this is distinct from Vehicle Operating Costs (VOC) which is the impact on the costs to road users, and is considered as part of the benefits assessment above.

4.68. No reassessment of the operating costs has been made as at this stage; the assumptions made in the appraisal are still considered to hold true.[12]

Summary of Present Value Cost (PVC)

4.69. ***Table 4-10*** shows the total of the costs expressed in terms of present value.

Table 4-10 Present Value Costs Summary (£m)

Costs in £m 2010 market prices, discounted	Forecast	Outturn
Investment cost	134.6	113.7
Operational costs	20.9	20.9
Total PVC	155.6	134.6

4.70. It should be noted that there are no Do minimum costs included in this summary. The EAR stated that the capital cost of regular maintenance (other than for the smart motorway) would be similar in Do-minimum and Do-Something scenarios. Capital cost of the smart motorway technology renewal is covered within the operating costs[13].

4.71. A major cost which would still have been required had the scheme not been built is that of converting in the central reserve to Rigid Concrete Barrier. The impact of the construction of this was included as a disbenefit in the future maintenance periods appraisal as detailed in the benefits section, but the construction costs were not detailed in the forecast in the EAR and cannot be accurately predicted now as the timescale for the when the works would have happened is unknown, but the costs are likely to have been in the £20 – 40m range. This means that the total PVC figures both forecast and outturn are over estimates.

4.72. With these costs expressed in Present Value on the same basis as the benefits (PVB), we can now assess the benefit cost ratio.

Benefit Cost Ratio

4.73. 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 scheme 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.

4.74. ***Table 4-11*** shows the calculation of the BCR using the costs and benefits presented earlier in ***Table 4-10*** and ***Table 4-8***.

Table 4-11 Benefit Cost Ratio (£m)

[12] It is understood the costs so far have been higher than expected, but no figure was available for the additional costs in the long term.
[13] In line with guidance in Interim Advice Note 164/12 – The economic assessment of Managed Motorways – All lanes running

Monetary values in £m 2010 market prices, discounted	Forecast	Outturn (std. method)	Outturn (including increasing congestion in future years)
Present Value Benefits (PVB)	£388.9m	£51.4m	£417.6m
Present Value Costs (PVC)	£155.6m	£134.6m	
Benefit Cost Ratio (BCR)	2.5	0.4	3.1

4.75. The key points regarding the BCR assessments are:

- The original forecast was 2.5 meaning than over £2 of benefits were expected for every £1 spent.
- Using the standard POPE method including PAR capitalisation of the benefits over the long term, at OYA, the outturn evaluation BCR is only 0.4, despite the lower costs, due to the much lower benefits. Taking the alternative approach more suited to smart motorways, of considering the increasing congestion in future years by taking the benefit profile trend as forecast for the smart motorway to capitalise the opening year benefits for the long term, then the outturn BCR is 3.1.
- Uncertainty over predicting the long term trend of journey time saving based on only the first year for a scheme of this type means that the outturn BCR has a wide range of outcomes resulting in the value for money scoring ranging from poor to very high.

4.76. Reliability benefits (as shown in ***Table 4-7***) are not included in this BCR assessment, in line with the original appraisal. If they are included then the forecast BCR rises to 6.2. For the outturn, if we take the rerun reliability benefit (***Table 4-6***) and on the grounds that journey time reliability has been observed to improve (as shown in ***Figure 2-10*** and ***Figure 2-11***), then the outturn BCR at OYA is 3.3 with the PAR approach and 6.1 with the increasing congestion capitalisation method.

4.77. 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 considered but are not monetised.

4.78. The evaluation of the environmental and social objectives is covered in the following sections.

Further BCR Evaluation - All Lane Running

4.79. Following the evaluation of the ALR-only benefits as set out on page 54, we now look at the BCR for this section alone. This can only be approximate as the scheme costs are only reported for the full length of the scheme, not broken down by section and the evaluation of all benefits has not been split by junction.

Table 4-12 Benefit Cost Ratio: estimate for J5 – 6 ALR only (£m)

Monetary values in £m 2010 market prices, discounted	Outturn
Present Value Benefits (PVB) (including increasing congestion levels in future years)	£403.7m
Present Value Costs (PVC) (based on assumption that costs of ALR section alone is 90% of the total for J5-7)	£123.3m
Benefit Cost Ratio (BCR)	3.3

4.80. The key point shown by this estimate of the BCR for the ALR only, based on increasing congestion in future years without the scheme leading to greater long term benefits, is clearly high value for money.

Regeneration, Wider Economic Benefits

4.81. The AST stated that as the scheme was not in a regeneration area, Regeneration Impacts were not assessed. Likewise, no Wider Economic impacts were assessed.

4.82. The EAR noted that at the scheme's PCF stages 2 and 3, it was deemed that a Regeneration Impacts Report would not be required for this scheme.

4.83. At OYA, there has been no change to regeneration area designation. No evaluation of Regeneration or Wider Economic Benefits has been undertaken.

Economic Impacts – Key Points

Benefits

- Benefits from journey time savings were forecast to be large and provide the majority of the monetised benefits. Evaluating the outturn long term benefits is however difficult, based on the observed opening year impacts of this scheme, due to the forecast of only low benefits in the first year rising rapidly over the years to substantial benefits throughout the day by 2031. At this stage it is too early to be very confident about the trend in coming years, however the evidence suggests that the outturn benefits in the first year were similar to those forecast although focused in the peak hours rather than in the inter-peak period in the forecasts.

- The alternative approach for evaluating the journey time benefits in which opening year benefits are only 0.49% of the benefits and the 60 year impact includes forecasting of future congestion in the Do Minimum scenario using the trend predicted by TUBA, has much higher benefits such that the total outturn benefits are similar to those forecast, despite the lower than forecast traffic flows the M25

- A calculation of the economic benefits of the ALR section (J5 – J6) in isolation shows £464.1 million of journey time benefits in the long term, based on predicted future congestion without the ALR.

- The monetary benefits of the savings in the number of injury collisions has been evaluated as £13.8million over 60 years, higher than forecast despite excluding the impact of background reduction in collisions over this period from the benefits. This has not been included in the total benefits at this stage as the result is not statistically significant.

- Disbenefits from the delay during construction period and maintenance of the technology in future years are £57.2million however this is a forecast benefit and has not been recalculated.

- The monetisation of the Carbon impact of the scheme was forecast to be a large disbenefit (-£161million) due to the increase in emissions, but the outturn evaluation is significantly less negative at -£59.8million.

- Vehicle Operating Costs (VOC) which were forecast to be a disbenefits for road users and Indirect tax which was expected to be a benefit for the Government have both been evaluated to be of greater magnitude than forecast.

- Other monetised benefits are roughly as expected.

- Reliability benefits from the reduction in incidents related delay and improved travel time variability were significant in the appraisal. Based on the information currently available to POPE journey time variability has improved, and a rerun of the reliability modelled with observed traffic flows suggest the benefits could be close to that forecast at almost £400 million over the 60 year appraisal period.

Cost

- The investment cost of building the scheme was £102 million (in 2010 prices), which was 21% lower than forecast.

- Long term costs of operating the smart motorway are assumed to be as forecast at £20.9million.

Benefit Cost Ratio

- An outturn BCR has not been calculated due to the difficulty in evaluating the journey time benefits at the OYA stage.

- A simple calculation of the BCR of the ALR section in isolation, with increasing congestion in future years had the scheme not been built, suggests that in the long term benefits will be over three times greater than the costs with a BCR of 3.3.

- If monetised reliability benefits were achieved in line with the rerun figures, and were included in this assessment, the outturn BCR is 3.3, meaning the scheme would be high value for money.

5. Environmental Evaluation

Introduction

Background

Assessment

5.1. An environmental assessment for the scheme was undertaken and reported in an Environmental Assessment Report (EAR), which notes that the objectives of the scheme were:

- To make best use of existing infrastructure providing additional capacity within the existing highway boundary, other than in exceptional circumstances;
- To improve on the AST assessment results produced during the Stage 3 EAR Phase where possible within the constraints of affordability; and
- To minimise the detrimental environmental effects of the scheme and offset by mitigation measures where technically feasible and economic to do so, taking account of costs, availability of funding, and statutory obligations.
-

5.2. For each of the environmental sub-objectives considered by the EAR, the evaluation in this chapter assesses the environmental impacts predicted in the Scheme's Appraisal Summary Table (AST) and EAR against those observed one year after opening.

5.3. In the context of the AST and EAR forecasts and using evidence collected one year after (OYA) opening, this chapter presents:

- A record of any significant changes to the scheme that have taken place since the EAR;
- An evaluation of the effectiveness of the mitigation measures implemented as part of the scheme; and
- A summary of key impacts against all of the ten environmental WebTAG sub-objectives.

Data Collection

5.4. The following documents/ data have been used in the compilation of this environmental chapter of the OYA report:

- Design Input Statement, Drainage (June 2011);
- Appraisal Summary Table Report (July 2012);
- Stage 3 Preliminary Design, Environmental Assessment Report (July 2012);
- Lighting of ADS Signs at J6 Approach, Environmental Assessment Report Addendum (August 2013);
- Detailed Design, Scheme Visual Impact Assessment Review (November 2013);
- 'As Built' Landscape and Ecology Design drawings (April 2014);
- Detailed Design, Landscape and Ecology Summary Report (June 2014);
- Detailed Design, Draft Environmental Management Plan (June 2014);
- Final Use Assessment – Noise Insulation Regulations Assessment (July 2014);
- Noise Assessment at Flint Hall Cottage, Flower Lane (August 2015); and
- Web based scheme information.

5.5. A list of the background information specifically requested and received to help with the compilation of this report is included in ***Appendix B***.

Alternative Design Proposals and Design Development Changes

5.6. During design development, alternative design proposals were assessed for approval. Several alternative proposals relating to lighting, infrastructure, and earthworks were made due to changes throughout the design process, originating either from design development or from addressing on-

site constraints found during construction. One of these alternative design proposals[14] utilised private land outside the highway boundary under a General Permitted Development Order.

5.7. Alternative Design Proposals which were built (and detailed further in the relevant sub-objective sections, below) include;

- Lighting of Advance Distance Signs (ADS) on three gantries on the approach to Junction 6 of the clockwise carriageway;
- Changes to locations and types of highway infrastructure (gantries); and
- An additional bund at Clacket Lane.

Site Visit

5.8. As part of the OYA evaluation, a site visit was undertaken in early September 2015. The visit included the taking of photographs to provide a photographic record of the scheme. Where appropriate, these photographs have been included within the text of this document; no photographs were contained in the EAR, so no comparison photographs were able to be taken.

Consultation

5.9. Statutory environmental organisations, stakeholders, District/ Borough/ County councils, and relevant organisations that were consulted prior to the final publication of the EAR were contacted as part of the OYA evaluation regarding their views on the impacts they perceive the scheme has had on the environment are shown in ***Table 5-1***, below.

Table 5-1 Summary of Environmental Consultation Responses

Organisation	Field of Interest	Comments at OYA
Natural England	Biodiversity & Landscape	**Had no comments to make.**
Historic England	Heritage	Did not respond to the invitation to provide feedback.
Environment Agency	Water	Did not respond to the invitation to provide feedback.
Tandridge District Council	General	Did not respond to the invitation to provide feedback.
Sevenoaks District Council	General	Did not respond to the invitation to provide feedback.
Kent County Council	General	Did not respond to the invitation to provide feedback.
Surrey County Council	General	Did not respond to the invitation to provide feedback.
Kent Downs AONB[15] Unit	Landscape	Did not respond to the invitation to provide feedback.
Surrey Hills AONB Office	Landscape	**Commented on Landscape, Biodiversity, and Journey Quality.**
Kent Wildlife Trust	Biodiversity	Did not respond to the invitation to provide feedback.
Surrey Wildlife Trust	Biodiversity	Did not respond to the invitation to provide feedback.
Oxted Parish Council	General	Did not respond to the invitation to provide feedback.
Brasted Parish Council	General	Did not respond to the invitation to provide feedback.
Chevening Parish Council	General	Did not respond to the invitation to provide feedback.
Sundridge & Idle Hill Parish Council	General	Did not respond to the invitation to provide feedback.
Westerham Parish Council	General	Did not respond to the invitation to provide feedback.
Limpsfield Parish Council	General	Did not respond to the invitation to provide feedback.

[14] An environmental bund at Clacket Lane.
[15] AONB: Area of Outstanding Natural Beauty

Animal Mortality

5.10. The Managing Agent has also been consulted with regard to animal mortality figures which have been made available for the M25 route corridor between Junction 5 and Junction 7 for the approximate 6 year period from 2010 to 2015 inclusive. These figures are discussed in the biodiversity sub-section.

Awards

5.11. See ***Appendix B***, *Information Requested for Environmental Evaluation*, for further details.

Traffic Forecast Evaluation

5.12. 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 POPE and an assumption is made that the level of traffic and the level of traffic noise and standard of local air quality are related.

5.13. ***Table 5-2*** below, shows the accuracy of the traffic modelling before and after construction for the M25 within both the scheme (emphasised in grey) and adjacent sections. The traffic forecasts presented in the traffic chapter of this report correspond to this data, and the Environmental evaluations are consistent with this. It should be noted that rounded values (to the nearest 100) are presented.

Table 5-2 Traffic flow (AADT) on M25: Forecast and Observed

Location	Dir	Without scheme 2012			With Scheme 2015			Increase with scheme*	
		DM F'cast	Obsv'd	% diff	DS F'cast	Obsv'd	% diff	F'cast	Obsv'd
M25 J7-8	CW	84,400	74,800	-11%	89,000	78,000	-12%	5%	4%
	ACW	89,800	76,300	-15%	93,200	79,600	-15%	4%	4%
M25 J6-7	CW	75,100	70,500	-6%	81,600	71,700	-12%	9%	2%
	ACW	77,000	69,200	-10%	82,800	70,800	-15%	8%	2%
M25 J5-6	CW	69,100	63,000	-9%	76,500	71,000	-7%	11%	13%
	ACW	70,400	64,200	-9%	77,600	66,000	-15%	10%	3%
M25 J4-5	CW	55,500	48,700	-12%	59,300	50,200	-15%	7%	3%
	ACW	57,300	48,100	-16%	60,900	49,400	-19%	6%	3%

* Difference between the 2012 Do Minimum (DM) and 2015 Do Something (DS) scenarios, including the net impact of the scheme and wider trends regarding traffic growth.

5.14. In order to provide a context for the following review and evaluation of environmental topics, the key points regarding the accuracy of the traffic forecasts for the scheme and the adjacent sections of the M25 are summarised as follows:

- Observed post-opening traffic flows are lower than expected (between 7% and 15% between junctions 5 and 7), the average being 12% lower. Adjacent sections of the M25 to both the east and west show the difference from forecast is even greater.
- Traffic flows in 2012, before the start of construction, are also lower than expected (between 6% and 10% between junctions 5 and 7) with the average being 8% lower. This may partially explain why the observed post-opening flows are lower than forecast. The inaccuracy of the DM forecasts reflect that the modelling of the traffic growth from the base years of 2004 and 2012 did not include the impact of the recession.
- Traffic was forecast to increase between junctions 5 and 7 by between 8% and 11%, which were higher that the rates on the adjacent sections; what has been observed is that growth is in line which that seen on the other sections except for the higher growth of 13% on the clockwise ALR (J5-6) which suggests that additional traffic has been attracted to this part of the M25.

5.15. Analysis of HGV levels is through vehicle classification by length, in which an HGV is classed as a vehicle over 6.6m in length. No comparisons between HGV/ speed data have been made and due

to technical limitations of the traffic counting at sites through the scheme, only J6-7 anticlockwise could be analysed. Results by time period are shown in ***Table 5-3***, below.

Table 5-3 Percentages of HGVs between J6 and J7 Anticlockwise

Location	Value	Mon-Thurs			Friday			Saturday-Sunday
		AM Peak	Inter-peak	PM Peak	AM Peak	Inter-peak	PM Peak	
J6 – J7	Before	13%	18%	10%	14%	16%	10%	5%
	After	16%	22%	13%	17%	18%	13%	6%
	Change (% points)	+3	+4	+3	+3	+3	+3	+1

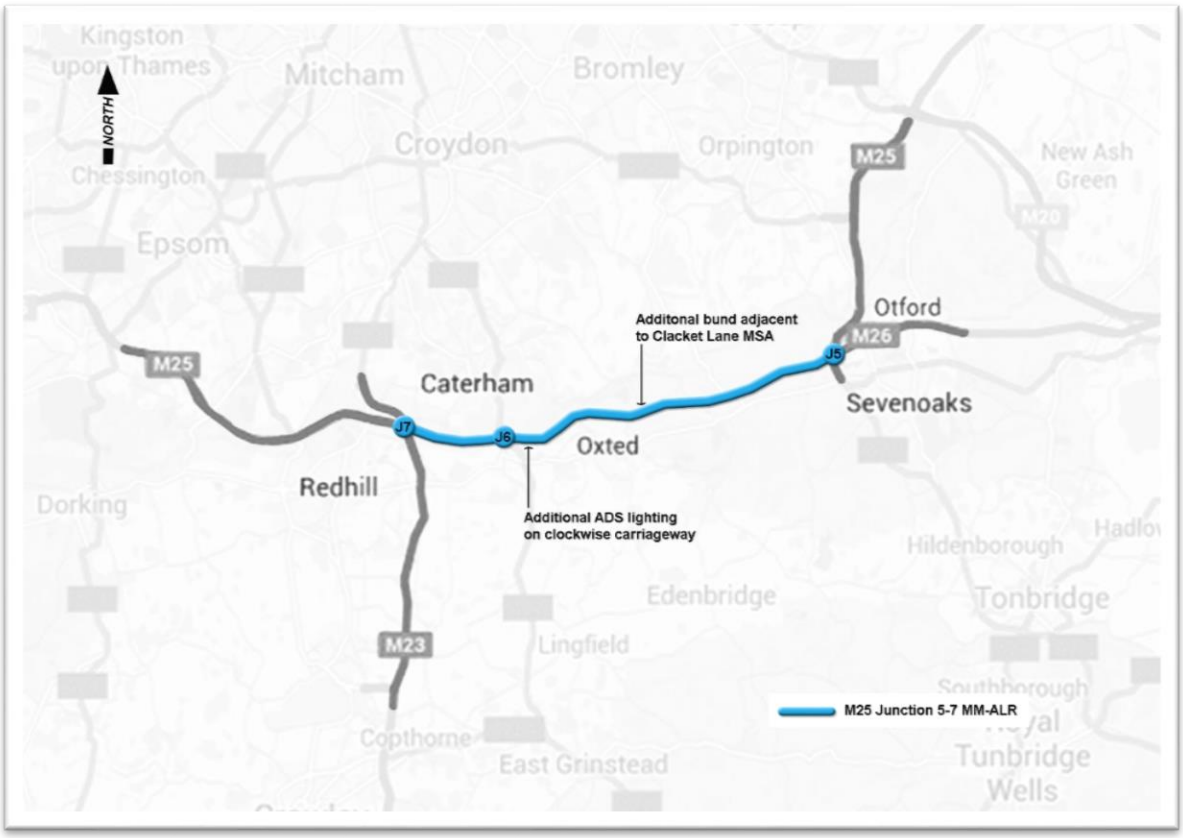
5.16. It can be seen that there has been an increase in the percentage of HGVs across all time periods in the anticlockwise direction between J7 and J6. It is expected that this would be mirrored throughout the rest of the scheme.

One Year After Environmental Assessment

5.17. Included in this section is a brief summary of statements from the AST and EAR evaluations which have been included to provide the context for the OYA evaluation.

5.18. The key environmental features that are discussed in this chapter are shown in ***Figure 5-1***, below.

Figure 5-1 Key Environmental Features



Noise

Forecast

Appraisal Summary Table

5.19. The AST stated that 2,123 dwellings and 17 other noise sensitive receptors were considered in the detailed study area, and that:

- On opening: 10 dwellings were predicted to experience a minor increase in noise, with all other changes being negligible or no change;
- Over the design period: 3 dwellings were predicted to experience a minor increase and 2 dwellings a minor decrease in noise, with all other changes being negligible or no change; and
- There were no distributional impacts on the most deprived and two least deprived income quintiles, and only a slight adverse impact on the two remaining middle income quintiles.

5.20. Overall, the AST concluded was that there would be 17 more people annoyed by the scheme than would be without the scheme, and that the effect of the scheme on the noise climate would be slight adverse.

Environmental Assessment Report

5.21. The EAR contained calculations for the detailed study area which predicted that:

- On opening: 10 dwellings (4 at Madan Road, Westerham, 1 at Brasted, and 5 at Sundridge) would experience a minor increase in noise greater than 1dB(A)[16]. All other receptors were expected to experience negligible, or no change, in noise.
- By the design year: 3 dwellings in Chevening were predicted to experience a minor increase in noise, whilst 2 dwellings in Bletchingly were predicted to experience a minor decrease in noise (attributable to traffic growth and resurfacing, which would occur irrespective of the scheme being implemented or not).
- Decreases in noise at Bletchingly (2 properties), Brasted (2 properties) and Sundridge (11 properties) due to resurfacing if the scheme were not built would not be realised if the scheme were built due to changes in traffic speed and volume.

5.22. The EAR considered that no mitigation for the scheme would be required for the purposes of noise impact remediation.

5.23. Increases in noise were predicted on some routes within the wider area, however these increases were predicted to occur both with and without the scheme, and therefore were not considered to be direct impacts of the scheme.

5.24. The EAR considered that the construction works required for the scheme could give rise to short term temporary significant adverse impacts, particularly for works near residential properties (within 80m of works), or for works taking place at night (up to 200m from works). These impacts were expected to be limited by the use of Best Practicable Means, although it was caveated that the assessment was indicative, since the details of the full construction programme and methods were not known when the EAR was produced.

5.25. The EAR concluded that the impact of the scheme on the noise climate would likely be **neutral** overall.

Consultation

5.26. No responses to consultation requests were received for this sub-objective.

Evaluation

5.27. It has been confirmed to POPE that the road surface of the M25 between junctions 5-7 is now all Low Noise Surfacing (LNS) as a result of the scheme, whereas LNS was only partly installed

[16] A-weighted decibel ($dB_{(A)}$): This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. “A” weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

between junctions 5-7 prior to construction. It was also confirmed that had the scheme not been implemented, LNS would have been installed between junctions 5-7 over the coming years, so the scheme has effectively brought this forward.

5.28. The Final Use Noise Regulations Assessment calculated the prevailing and relevant road traffic noise levels at a sufficient number of representative receptors[17], and concluded that the east façades of two properties in Oxted were shown to qualify for noise insulation, and that the increase in noise was primarily due to traffic changes on Chalkpit Lane which was shown to rise from an 18hour AAWT[18] flow of approximately 3,600 in 2015 to a flow of approximately 4,700 in 2030. The flow at Chalkpit Lane in 2030 was expected to occur either with or without the scheme.

5.29. Since the scheme was completed, a resident of a property off Flower Hill Lane has voiced concerns about noise levels from the M25. Significant changes in noise were not predicted at this property by the EAR and in order to investigate these concerns, an ambient noise survey was undertaken to ascertain the noise levels in this area now that the scheme is operational. The results of the survey indicate that the current noise levels are similar to those previously measured for the EAR, and the report that accompanied the ambient noise survey concluded that there had been a negligible change in noise and overall, noise levels had not significantly increased at this location as a result of the scheme.

5.30. 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 in ***Table 5-2*****,** above, the data indicates that the observed AADT Traffic Flows are between 7% and 15% lower than forecast at all locations and as such, these figures are within the tolerances prescribed by POPE.

5.31. Although POPE methodology would normally take HGV/ speed data into account when evaluating the noise climate, no comparisons between HGV/ speed data have been made due to technical limitations of the traffic counting at sites through the scheme.

5.32. Based on the available information, it is therefore concluded that the effects of the scheme on the noise climate are likely to be **as expected**.

Table 5-4 Evaluation Summary: Noise

Sub-Objective	AST	OYA
Noise	Population annoyed without Scheme: 483. Population annoyed with Scheme: 500. Net change: 17 more people annoyed.	As expected.

Air Quality

Forecast

Appraisal Summary Table

5.33. The AST stated that with the scheme, there would be an overall slight improvement in Nitrogen dioxide (NO_2) and Particulate Matter (PM_{10}) concentrations, and that:

- In terms of local air quality, there were 4 Air Quality Management Areas (AQMAs) for annual average NO_2, and 2 AQMAs for 24 hour PM_{10} within 200m of the affected road network;
- There would not be any exceedances of annual average NO_2 concentrations 20m from the road in the opening year (2015), with expected changes in NO_2 concentrations being between -0.1 µg/ m^3 to +1.9 µg/ m^3 at the same location; and

[17] Using the methodology detailed in the DoT technical memorandum Calculation of Road Traffic Noise (CRTN). CRTN is the methodology used to determine entitlement under the Noise Insulation Regulations 1975 (as amended 1988) (NIR) and is the accepted method for the prediction of traffic noise in the UK.
[18] AAWT: Average of 24 hour flows, seven days a week, for all days within the year.

- All quintiles were expected to experience a beneficial distributional impact (including the most deprived quintile) of between 2 and 67% (large beneficial) with the exception of quintile 2 (the second most deprived), which was predicted to demonstrate a 6% worsening.

5.34. Overall, the AST concluded that the impact of the scheme on air quality would be **moderate beneficial**, quantified as follows:

- In terms of changes in NO_2 concentrations: 2,003 properties would experience improvement, 688 would experience deterioration, and 193 would experience no change; and
- In terms of changes in PM_{10} concentrations: 2,077 properties would experience improvement, 360 would experience deterioration, and 447 would experience no change.

Environmental Assessment Report

5.35. The EAR stated that an air quality assessment of the scheme had been undertaken in accordance with the DMRB HA207/0719, and that the assessment included consideration of:

- Local air quality impacts at representative receptors, in terms of human health and designated sites with ecologically sensitive features, as a consequence of the scheme in 2015 (the first full year after scheme opening);
- Regional air quality impacts, in terms of changes in emissions as a consequence of the scheme in 2015 and 2030 (the design year); and
- Construction dust impacts, in terms of relevant sensitive receptors within 200m of the scheme.

5.36. The Local Air Quality Assessment illustrated that there were no predicted modelled exceedances of the annual mean NO_2 European Union (EU) Limit Value in the Do-Something (DS) or the Do-Minimum (DM) scenarios. The local air quality assessment also illustrated that there would be no predicted modelled exceedances of the annual average PM_{10} EU Limit Value or permitted number of 24-hour mean exceedances in the DS scenario. Changes in concentrations with the scheme were found to be small.

5.37. The Designated Site Assessment indicated that the scheme would increase concentrations of oxides of Nitrogen (NOx) at transects (especially north of the M25) and the critical level for NOx would be exceeded at some of the closest receptors within four of the five designated sites both with and without the scheme. Assessment of the changes in total Nitrogen (N) deposition as a result of the scheme indicated that deposition rates at three sites were elevated due to the scheme, however the maximum increase in the road increment contribution to the total N deposition rate was 1% compared to the DM scenario.

5.38. For local air quality (human health and Designated Sites), supplementary information was provided on:

- A gap analysis[20] of long term trends in NO_2, to help understand the implications of DEFRA's note[21] on projecting NO_2, issued after the assessment was complete; and
- A sensitivity test for worst case locations demonstrating that use of Road Transport Forecasts for 2011 (RTF11) national transport model factors would not materially change the findings presented under RTF09.

5.39. For the Regional Assessment, the affected road network was very small and did not include the scheme extent. The Regional Assessment indicated that there would be little change in absolute emissions with the scheme in 2015 and 2030 when compared to the DM scenario.

5.40. In terms of construction, with mitigation measures in place, implemented on the construction site and not at individual receptors, the risk during construction was stated as be low, and construction was therefore considered be unlikely to cause a statutory nuisance.

[19] DMRB: Design Manual for Roads and Bridges, a series of 15 volumes that provide standards, advice notes and other documents relating to the design, assessment, and operation of trunk roads, including motorways in the United Kingdom. HA207/07 deals with Air Quality Assessment.

[20] The process of comparing actual performance to expected performance in order to determine whether expectations are being met.

[21] "Projecting NO_2 Concentrations", April 2012.

5.41. The overall effect of the scheme was determined by the Local and Regional assessments, all of which indicated a negligible effect on air quality, with no exceedances of the EU Limit Values for NO_2 and PM_{10} with the scheme.

5.42. The assessment concluded that the effects on air quality would be **insignificant**.

Consultation

5.43. No responses to consultation requests were received for this sub-objective.

Evaluation

5.44. An assumption is made by POPE methodology that local 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 5-2***, above, the data indicates that the observed post-opening traffic flows are lower than expected by between 7% and 15% between junctions 5 and 7.

5.45. Where the tolerances assumed by POPE are exceeded and in terms of the shortfall between the absolute number of vehicles and the predicted figures, traffic flows are less than predicted by between 9,900 and 12,000 AADT and being greater than 1,000 AADT, the percentage differences between the predicted and observed flows are considered likely to be significant.

5.46. Where the tolerances assumed by POPE have not been exceeded (clockwise between junctions 5-6), in terms of the shortfall between the absolute number of vehicles and the predicted figures, traffic flows are less than predicted by 5,500 AADT and being greater than 1,000 AADT, the percentage difference between the predicted and observed flows are also considered likely to be significant.

5.47. Although POPE methodology would normally take HGV/ speed data into account when evaluating air quality, no comparisons between HGV/ speed data have been made due to technical limitations of the traffic counting at sites through the scheme.

5.48. Based on the information presented in this evaluation, it is therefore concluded that the effects of the scheme in terms of local air quality are likely to be **better than expected**.

Table 5-5 Evaluation Summary: Air Quality

Sub-Objective	AST	OYA
Air Quality	NO_2 Overall Assessment Score: -8. Properties with improvement 2,003, deterioration 688, no change 193. PM_{10} Overall Assessment Score: -6. Properties with improvement 2,077, deterioration 360, no change 477.	Likely to be better than expected.

Greenhouse Gases

5.49. For transport, Carbon Dioxide (CO2) is considered the most important greenhouse gas therefore it has been used as the key indicator for the purposes of assessing the impacts of a road scheme on climate change. Changes in CO2 levels are considered in terms of equivalent tonnes of Carbon released as a result of the scheme under evaluation.

5.50. The AST forecast that carbon emissions would increase with the scheme due to the increase in vehicle kilometres travelled. This was assessed for the opening year and for 60years using a non-TUBA method. The 2015 emissions were forecast to be a net increase of 0.037 MtCO2e (Million metric tons of carbon dioxide equivalent), which is 10,091 tonnes of carbon.

5.51. In the ES, the Regional Air Quality Impacts, which include carbon emissions, were assessed based on total emissions from roads included in the regional air quality ARN (based on selection of roads where significant change was forecast). These were slip roads of the M25 and several minor roads

in Godstone, Oxted, Tatsfield, and Waddingham. The forecast impact on these links was a net increase of only 110 tonnes (6%). This is much lower than the forecast in the AST, reflecting the narrow area modelled.

5.52. The POPE approach to the evaluation has been to measure the net carbon impact in the opening year for the sections of the M25 within the scheme only. For the purpose of meaningful comparisons, a forecast has been created for the same links based on published traffic flow and speed forecasts. Carbon calculations have been undertaken using the DMRB regional air quality spreadsheet.

Table 5-6 Forecast and Outturn opening year carbon impact (tonnes carbon)

	Forecast	Outturn
Do Minimum/ Without scheme	62,834	58,990
Do Something / with scheme	72,240	62,261
Net impact	9,406 (+15%)	3,271 (+6%)

5.53. This evaluation shows a much lower carbon increase on the M25 through the scheme than forecast which is largely due to there being lower than forecast traffic flows.

Landscape

Forecast

Appraisal Summary Table

5.54. The AST stated that the scheme is located within an AONB and an Area of Great Landscape Value (AGLV), and that landscape and visual impacts were to be expected due to the presence of new infrastructure and the removal of vegetation required to accommodate the ERAs and associated retaining structures. 38 properties were expected to experience a slight adverse visual impact and 12 properties a **moderate adverse** visual impact in the opening year (2015), and the effects of the scheme on local landscape character areas were predicted to be slight adverse.

5.55. Overall, the landscape impact of the scheme was predicted by the AST to be **slight adverse**.

Environmental Assessment Report

5.56. The EAR assessed the landscape and visual effects of the scheme at Year 1 and Year 15:

- Landscape: The frequency, scale and appearance of the new structures along the M25 in a highly sensitive landscape was considered by the EAR to have an urbanising influence to the east of Junction 6, on the relatively open rural scarp landscape south of Beech Plantation, and on the setting on the north west edge of Brasted Church. However, the EAR also considered that the scheme would have a limited effect on the existing highway planting, previously implemented to tie-in with the landscape infrastructure of woodlands, shaws,[22] and hedgerows in the immediate area alongside the M25 (and a feature of the landscape character area). Overall, the EAR assessed the effect of the scheme on landscape as **slight adverse**.
- Visual Amenity: The EAR considered that while the large majority of the 309 visual receptors would experience **neutral** or only slight adverse effects, 11 properties on the edge of Brasted (where new, noticeable, and discordant features introduced to the view would be exacerbated by traffic using the hard-shoulder) would experience moderate adverse visual effects. It was considered that new planting to reinforce and supplement the existing would help to mitigate this effect, and consequently, the overall impact of the scheme on visual amenity was assessed as **slight adverse**.

5.57. A total of 4 open space and Public Right of Way (PRoW) receptors to south of the National Trust Land at Beech Plantation were also predicted to be affected by the scheme as a result of the visual effects of a single gantry and 3 MS4 cantilever signs between chainage 13010 and 11600.

[22] Shaw: A small wood, thicket, or copse.

5.58. Due to the location of the proposed works within the existing M25 highway boundary and the restricted nature of the works, the effects of the scheme in terms of landscape character and visual amenity on the majority of landscape/ visual receptors were considered to be generally **neutral** or **slight adverse**. However, the implementation of the scheme was predicted to result in an increase in visual intrusion, an increase in the perception of the motorway and traffic, and a detraction from the sense of place (resulting from the loss of existing planting within the highway boundary).

5.59. Overall therefore, the EAR concluded that the scheme would have a **slight adverse** effect on landscape and visual amenity.

Environmental Assessment Report Addendum

5.60. While the EAR proposed no additional lighting along the length of the scheme, the EAR Addendum (Lighting of ADS Signs at J6 Approach) explained that lighting was required for visibility reasons for the ADS on three gantries on the approach to Junction 6 of the clockwise carriageway, and reviewed the changed design and assessed the possible impacts on Landscape and Visual receptors.

5.61. In terms of mitigation, it was stated that the lighting of the ADS would be designed to prevent light spill and light pollution; lighting units on the cantilever gantries for a mile and half mile would be mounted above the signs to direct the light downwards and reduce sky glow, and the lights would be fitted with baffles to prevent light spill away from the signs. No new planting was proposed as part of this design change.

5.62. The EAR Addendum concluded that with any physical changes to local landscape character being seen in the context of existing highway infrastructure during both construction and operation, the significance of effect for landscape would remain as **slight adverse**.

5.63. In terms of visual impact, although the introduction of lighting was to be within an area of motorway previously unlit and static, it was concluded that the changes would largely be seen in the context of lighting from passing vehicles and would result in an increase from **neutral** to **slight adverse** significance of effect for only two visual receptors.

Scheme Visual Impact Assessment Review

5.64. As a result of design development, some of the infrastructure (i.e. gantries) implemented to support the scheme were located differently than had been proposed by the EAR, and different infrastructure was proposed and some infrastructure was deleted. The intention was to make the scheme work more efficiently and to minimise cost, whilst maintaining or reducing adverse environmental effects.

5.65. The Scheme Visual Impact Assessment Review (SVIAR) report was prepared to compare the scheme prepared for the EAR with the later detailed design proposals, and to identify if there were any significant changes in relation to the visual impact of the schemes.

5.66. ***Table 5-7*** and ***Table 5-8***, below, summarise the changes in the quantity of infrastructure that was altered between the Preliminary (EAR) and Detailed Design stages. The quantities at the detail design stage match those as built.

Table 5-7 Gantry Quantities at Preliminary Design/ EAR

Gantry Type	A C'way	B C'way	Total
Existing overhead Gantries	6	11	17
Existing Cantilever MS3's	0	2	2
Existing Super-span Gantries retained	0	0	0
New Single Span Gantries	0	0	0
New Cantilever MS4's	9	8	17
New Super-span Gantries	17	17	17*
Existing Gantries retained	6	10	16
New ADS Cantilevers	1	1	2
Existing Cantilever MS3's retained	0	2	2
New Cantilever MS3's	2	0	2
TOTAL	**35**	**38**	**56**

* Super-span gantries are only counted once

Table 5-8 Gantry Quantities at Detailed Design

Gantry Type	A C'way	B C'way	Total
Existing overhead Gantries	7	11	18
Existing Cantilever MS3's	0	2	2
Existing Super-span Gantries retained	0	0	0
New Single Span Gantries	0	0	0
New Cantilever MS4's	9	10	19
New Super-span Gantries	9	9	9*
Existing Gantries retained	6	8	14
New ADS Cantilevers	2	0	2
Existing Cantilever MS3's retained	0	0	0
New Cantilever MS3's	0	2	2
TOTAL	**26**	**29**	**46**

* Super-span gantries are only counted once.

5.67. The tables show that there has been a reduction of 17.8% in the infrastructure needed between the Preliminary Design scheme assessed in the EAR and the Detailed Design. Overall, the number of individual elements has been reduced between EAR stage and detailed design stage from 56 to 46, with the number of super-span gantries (the most visually intrusive) being reduced from 17 to 9.

5.68. In several areas, the SVIAR noted that the relocation of gantries reduced the visual impact for some receptors, but noted that there was only one area where the adverse visual impact of the Detailed Design would be slightly greater than the preliminary design, where two of the three cantilever gantries proposed by the EAR on the anticlockwise carriageway at chainage 3680 (where the M25 is on embankment) were replaced by a Super-span gantry; it was considered that a cluster of houses on Brasted Hill Road and Station Road could have views to the Super-span gantry, despite benefitting from a degree of screening vegetation to the rear of the properties.

Landscape and Ecology Summary Report

5.69. The Landscape and Ecology Summary Report (LESR) provided a record of the process by which the landscape and ecology design was developed and implemented, and a framework for monitoring environmental performance to ensure that performance targets were achieved. The key points noted in the LESR are:

- That Landscape and Ecology Design drawings were prepared early in the detailed design phase when the full extent of the works required was not fixed and changes to the design were

foreseen. For this reason the extent of the planting shown on the EAR drawings extended over a slightly greater area than might be required to allow for any changes in design. It was anticipated that the eventual extent of the planting would vary from that shown on the original drawings and a note to that effect was included on the drawings;

- The planting areas were set out based on the final extent of earthworks and site clearance required to construct the works, and took account of the presence of underground services and of the requirements setbacks from the edge of the carriageway and crash barriers which were not known at the time of the planting design. As expected, this led to some differences between the areas shown on the original design drawings and those to be planted on the ground. Alterations were made to the plant numbers and spacing within each plot as necessary to fit the design to the site situation;
- In some areas, it was not possible or necessary to carry out the planting due to the presence of services or reductions in site clearance, and 11 plots were deleted from the scheme. 26 additional areas were identified for planting where new works had been carried out that were not identified during the initial design phase, or where additional site clearance had taken place. These areas of additional planting used surplus plant material from the altered or deleted plots;
- During the first stages of implementation, a site inspection of the completed planting revealed that insufficient topsoil had been spread in some planting plots. The specification requirement was for 300mm in all new areas of planting where new earthworks were implemented, but it was found that less than 300mm of topsoil had been spread at 14 locations. As planting had already taken place in these plots it was agreed that these plots would be monitored during the first year and if growth was insufficient, then the planting would be removed, further topsoil placed, and replacement planting carried out. The remaining planting plots were checked and topsoil levels were made up to 300mm in all locations where necessary. In all other respects, planting was carried out in accordance with the specification.
- After the original design had been completed, an area adjacent to the site near Clacket Lane was identified for the disposal of surplus fill material in the form of a bund. This was subsequently subject to an Alternative Design Report, which included the necessary landscape mitigation proposals to integrate the bund with the overall scheme design. These additional areas of planting were included in the planting carried out on site and were included in the scheme's as-built drawings. However, as the final topsoiling of the bund was not completed until May 2014 it was not possible to complete the planting at that time. The LESR also noted that the planting was scheduled to be completed in the autumn of 2014); and
- Other than at the bund near Clacket Lane, planting works were completed in March 2014 and aftercare operations were scheduled to begin and to last for 5 years. Unlike traditional motorway schemes (where maintenance access can be gained from the hard shoulder), the difficulties associated with access between Junctions 5-7 led to proposals for the maintenance of the planting areas to be handed over to the Managing Agent ahead of the end of the 5 year aftercare period.

Consultation

5.70. Natural England responded to the consultation request, but had no comments to make.

5.71. Surrey Hills AONB Office commented that:

- The quantity and form of the structures is detrimental to the Surrey Hills AONB, and the wrong balance has been struck between the recognised need to promote safety and provide information for motorway users and to respect the sensitive, nationally important designated landscape through which the motorway passes;
- The design of gantries could be more graceful. Even if more expensive, more graceful gantries should at least be introduced when they are required in sensitive landscapes such as AONBs; and
- Landscape mitigation measures, including landscape management and maintenance, are not apparent.

Evaluation

Effects of Design Changes

5.72. Regarding the lighting of the ADS on three gantries on the approach to Junction 6 of the clockwise carriageway that was not proposed by the Preliminary/ EAR design but implemented as part of the Detailed Design, the changes have been reviewed by a combination of desktop studies and a site visit, and it is considered by POPE that there is no reason to consider that the assessment of the changes noted by the EAR Addendum are anything other than valid. It is therefore considered that despite the increase in significance of effect from **neutral** to **slight adverse** for two visual receptors, the landscape and visual amenity impact of the scheme has not significantly been altered by this design change from the original AST and EAR assessments of slight adverse.

5.73. In terms of the comments received from the Surrey Hills AONB Office regarding the quantity and form of highways infrastructure, there has been a significant reduction in the number of gantries proposed by the Preliminary/ EAR design and that which has been implemented as part of the Detailed Design. These changes to infrastructure have been reviewed by a combination of desk studies and a site visit, and it is considered by POPE that there is no reason to consider the SVIAR assessment of the changes to be anything other than valid. In general, any reduction in highway infrastructure is considered to be beneficial as it has the potential to reduce the landscape and visual effects of a scheme and while the relocation of gantries slightly reduces the effect on some receptors and slightly increases it on others, there is only one area where the Detailed Design would have an overall slight worsening effect on receptors (Brasted Hill to Station Road, lying outside the Surrey Hills AONB). While the Detailed Design may therefore be considered to be generally better than the Preliminary EAR Design in terms of the effects of highway infrastructure on the landscape and for the majority of visual receptors, it is considered that the frequency, scale, and appearance of the 46 new structures along the M25 would have resulted in the increased visual intrusion and increased perception of urbanisation of the countryside as predicted by the EAR. As such, the reduction in infrastructure from the Preliminary/ EAR Design is considered unlikely to have significantly altered the predicted slight adverse impact of the scheme overall.

5.74. Other than the additional lighting on the three gantries on the approach to Junction 6 as discussed above, POPE is unaware of any design changes to the form of the gantries outlined by the Preliminary/ EAR design.

5.75. The LESR noted that after the Preliminary/ EAR design had been completed, an area adjacent to the site near Clacket Lane was identified for the disposal of surplus fill material, utilising private land outside the highway boundary under a General Permitted Development Order. Although the Alternative Design Report for the identified site near Clacket Lane was not available to POPE for the purposes of this evaluation, the as-built drawings indicate that the intent of the mitigation (planting) proposals was to integrate it within the overall scheme design and the wider landscape context, and to augment the visual screening function of the planting proposed by the Detailed Design. These functions are illustrated by ***Figure 5-2***. Given the form of the bund, the quantity of associated mitigation planting, and the context in which it is located, it is considered that the landscape and visual effects of the scheme are likely to be less, i.e. better, than expected at this location due to the increased visual screening and landscape integration afforded by the bund and associated planting at this location.

Figure 5-2 The environmental functions of the bund near Clacket Lane are visual screening and landscape integration.

Implementation of Planting Proposals

5.76. The intention of the planting was to minimise the visual impact of the infrastructure associated with the scheme and replace vegetation lost during the construction. The nature of the scheme meant that the planting was in discrete packages associated with specific items of highway infrastructure such as gantries, signs, or ERAs.

5.77. Although in draft status at the time of the OYA evaluation, it was stated in the Handover Environmental Management Plan (HEMP) that species mixes were based on indigenous species which were surveyed as part of the Existing Vegetation Design with the intention of integrating the new scheme into the existing landscape design and maintaining the (unstated) environmental design aims of the original M25 planting.

5.78. The draft HEMP confirmed that percentages of trees and shrubs comprising each planting mix were based on the required Environmental Element i.e.:

- Woodland: 40% trees, 60% shrubs
- Woodland Edge: 20% trees, 80% shrubs
- Scattered Trees: 100% trees
- Linear Belts of Trees: 35% trees, 65% shrubs
- Shrubs with Intermittent Trees: 20% trees, 80% shrubs

5.79. Plant spacing was stated in the draft HEMP as generally at 2m centres giving a planting density of 0.25 plants/ m^2, and plants within planting plots were stated as comprising transplants (typically sized 40-60cm or 60-80cm) and feathered trees (typically sized 175-200cm). A single seed mix was specified for all areas of disturbed ground, including planting areas, and this was stated as a tussock forming grass/ herb mix (sown at a rate of 4g/ m^2).

5.80. The draft HEMP confirmed that the tussock seed mixture was used in the original locations as shown on the (unspecified) drawings, but noted that a low growing/ low maintenance seed mix was used in some (unspecified) areas.

5.81. Despite comments received from the Surrey Hills AONB Office regarding landscape mitigation measures not being apparent, where planting plots were able to be accessed, the OYA site visit observed that the tree and shrub planting/ grassland plots comprising the landscape mitigation measures generally appeared to have been implemented in line with the EAR, with plant spacing and plant sizes appearing to be broadly as indicated by the draft HEMP. However, the density of weeds within the plots at the time of the site visit made the identification of the planted stock almost impossible at most of the locations accessed; please refer to ***Figure 5-3***, below.

5.82. As can be seen in ***Figure 5-2***, above, the new planting associated with the bund near Clacket Lane has been completed.

5.83. Regarding the 14 areas noted by the LESR as having less than 300mm of topsoil at the time of planting implementation, no information regarding the first year monitoring reports noted in the LESR were available to POPE for evaluation, and so it cannot be confirmed whether the plant stock

performed satisfactorily as originally planted in less than 300mm of topsoil, or whether the areas having less than 300mm of topsoil were cleared of planting, had had further topsoil placed, and were subsequently replanted.

5.84. As far as could be ascertained at OYA, plant species appeared to be broadly as specified and set out as expected; plant shelters generally remain in place throughout planted areas.

5.85. In terms the planting that was proposed by the Preliminary/ EAR design and that which was implemented as part of the Detailed Design, it is considered that that some areas will experience slightly beneficial effects and other areas will experience slightly worse effects, i.e. there will be some slight variation in the effects expected at a local level. However, it is thought that the changes to the planting proposals as a result of Detailed Design have likely not materially altered the landscape and visual effects of the scheme from the slight adverse impact that was predicted by the AST and EAR.

Establishment and Condition of Planting Proposals

5.86. The contract Aftercare Period for the scheme was originally 5 years but the draft HEMP stated that this had been reduced to 1 year following discussions with the Managing Agent. Aftercare Operations stated in the draft HEMP are presented in ***Table 5-9***, below.

Table 5-9 Aftercare Operations as stated in the Draft HEMP

Operation		Times per year	Timing
Relevant to OYA	Weed control (planting stations)	4	March, May, July, September
	Plant replacement	1	November
	Cutting of vegetation	2	May, September
	Spot weed control	3	Each month
	Weed control (planting stations)	4	March, May, July, September
	Aftercare Inspection Reports	4	March, June, October, December
	Removal of tree stakes	1	Feb in Year 5
	Removal of shelters/guards	1	Feb in Year 5

5.87. The draft HEMP further stated that at the time of writing (June 2014), no significant issues had been identified and no other problems were anticipated to arise during (the remainder) of the Aftercare Period; it has therefore been assumed by POPE that the responsibility for undertaking Aftercare Operations for the remainder of the Aftercare Period has passed from the Contractor to the Managing Agent.

5.88. No records of maintenance operations or specific issues arising were documented in the draft HEMP, and the quarterly Aftercare Inspection Reports were not available to POPE for the purposes of this evaluation.

5.89. The site visit observed little evidence of any recent vegetation management within the planting plots in line with the Aftercare Operations stated in the draft HEMP, and that throughout the vast majority of planting plots, excessive weed growth was a problem. Although many plots were unable to be accessed fully during the site visit, as illustrated in ***Figure 5-3***, are generally illustrative of the excessive weed growth encountered.

Figure 5-3 Excessive weed growth observed within the representative sample of planting plots that were able to be accessed.

5.90. The abundance of weeds and subsequent competition for resources in almost all planting plots is considered to suggest that the majority of the planted stock may not have established and progressed as well as would have been reasonably expected at OYA. The action required to remedy this situation would be to undertake weed control operations to eliminate all competing vegetation within a 300mm radius of all plant stations as proscribed in the draft HEMP; the annual (November) replacement of any dead and defective plants should also be considered (as also indicated by the draft HEMP).

5.91. The As-built Landscape and Ecology Design (LED) drawings did not indicate areas that were to be seeded as grassland, but did indicate areas of *Natural Regeneration of Habitat following Construction*; although it has not been confirmed, it is considered likely that these areas equate to the areas of disturbed ground noted as being seeded by the draft HEMP following the cessation of construction activities.

5.92. Although POPE is unable to confirm whether seeding has been undertaken in the disturbed areas, the site visit was able to confirm that the areas consistent with the LED drawings are regenerating naturally as illustrated by ***Figure 5-4***, below; it should be noted that the quarterly Aftercare Inspection Reports referred to by the draft HEMP should be available at the FYA stage, and these may inform the FYA evaluation as to whether the disturbed areas were seeded or not.

5.93. The site visit also observed that the maintenance of grassland swards on the verges near and around structures for visibility purposes has been undertaken (also illustrated by ***Figure 5-4***, below), and that maintenance appeared to be consistent with the Aftercare Operations as specified by the draft HEMP.

Figure 5-4 Areas of grassland management around structures (left), and of natural regeneration along the verge (right).

5.94. Given the timing of the site visit (early September) and the timing of the Aftercare maintenance items as indicated in the draft HEMP (May and September), while it is possible that September vegetation clearance operations may not have yet been undertaken at the time of the site visit, the

condition of the planting plots suggests that vegetation may not have been cut in May, and that weed maintenance operations have not been adhered to during the last growing season.

5.95. It is therefore considered that unless the Aftercare Operations as detailed in the draft HEMP are adhered to, it is unlikely that the planting proposals will achieve their full potential in the long term. However, it is also considered that it is too early for any meaningful assessment of the environmental functions of the planting proposals to be made at this OYA stage, but that a more accurate assessment should be possible at FYA.

Long term Landscape Management

5.96. It was stated in the draft HEMP that the longer term objectives of landscape management were to:

- Maintain dense screening where required;
- Maintain working access to plots and roadside equipment;
- Vary the age of planting individually or in blocks by thinning and coppicing;
- Encourage multi-stem re-growth from coppicing;
- Promote ecologically sound habitats/ habitat diversity; and,
- Maintain the safety of the travelling public.

5.97. The draft HEMP outlined strategies for regular maintenance and stated that in line with best practice, the developing landscape planting would require ongoing monitoring to review the interval, scope, and extent of management interventions to ensure that the landscape objectives would be met, and that any monitoring should include identification of problems that could potentially prevent the landscape objectives from being realised.

5.98. In light of the draft HEMP's acknowledgement of the objectives of the detailed landscape design and the subsequent maintenance thereof, it is considered that the establishment and maintenance of the landscape proposals can be considered further at FYA when the final version of the HEMP is available.

Visual Effects at Night

5.99. Although a full night time evaluation of the effects of the scheme has not been undertaken for this study, there is no information available to POPE that would suggest that the effects of the illuminated ADS on the three gantries on the approach to junction 6 (and the control of light spillage therefrom) are likely to be significantly different from those predicted by the EAR Addendum; as such, the adverse night time effects of the scheme are considered likely to be broadly **as expected**.

Summary

5.100. Overall, the changes brought about by the final design, including changes to the proposed planting design and the type and location of highways infrastructure, are evident along the length of the scheme.

5.101. Although there has been a significant reduction in the quantity of infrastructure proposed by the Preliminary/ EAR design, it is considered that these design changes have not significantly altered the overall slight adverse impact of the scheme on landscape and visual amenity as predicted by the AST/ EAR and as such, the impacts are considered likely to be as expected.

5.102. Despite there being local variations in the effects expected, there is no reason to assume that the design changes in the form of the additional lighting of the ADS on three gantries on the approach to Junction 6 of the clockwise carriageway and the implementation of the bund near Clacket Lane have materially changed the expected landscape or visual amenity effects of the scheme overall.

5.103. Similarly, landscape mitigation measures in the form planting proposals appear to have been broadly implemented as anticipated and any local variations in the effects expected are considered unlikely to have materially changed the predicted landscape or visual amenity effects of the scheme.

5.104. However, in terms of effective establishment and maintenance of the plant stock, while the excessive weed growth noted at the time of the OYA site visit suggests that the environmental functions of the mitigation measures may not be developing to their full potential at this stage, it is

too early for any evaluation of the plant stock to be meaningful at OYA and a more meaningful assessment of the environmental functions of the planting proposals could be possible at the FYA stage.

5.105. It is therefore considered that the landscape and visual amenity effects of the scheme are likely to be generally **as expected**, although consideration could be given to adjusting the maintenance regime to ensure that the planting plots develop their intended environmental functions by Design Year.

Table 5-10 Evaluation Summary: Landscape

Sub-Objective	AST	OYA
Landscape	Slight Adverse	As Expected

Townscape

Forecast

Appraisal Summary Table

5.106. The AST stated that although townscape was considered in the assessment, as the scheme did not pass through urban areas and was located in agricultural land, townscape impacts were considered under the landscape sub-objective. Overall, the impact of the scheme on townscape was considered to be **neutral**.

Environmental Assessment Report

5.107. No Townscape specific assessment was undertaken by the EAR.

Consultation

5.108. No responses to consultation requests were received for this sub-objective.

Evaluation

5.109. No changes from the AST regarding Townscape were identified during the site visit, and settlements remain well separated from the road by embankments and vegetation; it is therefore considered unlikely that any townscape feature would have been affected by the scheme.

5.110. No further evaluation has been undertaken, as no changes from the AST regarding Townscape were identified during the site visits.

5.111. It is therefore concluded that the effects of the scheme on Townscape are **neutral**, **as expected**.

Table 5-11 Evaluation Summary: Townscape

Sub-Objective	AST	OYA
Townscape	Neutral	As Expected

Heritage and Historic Resources

Forecast

Appraisal Summary Table

5.112. The AST stated that slight adverse impacts to the historic settings of 2 Registered Historic Parks and Gardens (Combe Bank and Titsey Place) were expected, along with a slight adverse impact on the settings of 2 Listed Buildings and 1 Conservation Area within the study area; overall, the AST assessed the impact of the scheme on the heritage resource as **slight adverse**.

Environmental Assessment Report

5.113. Guidance contained in Section 5 of the Interim Advice Note 111/09 for Managed Motorways Implementation Guidance - Hard Shoulder Running (Highways Agency, November 2009) states that as most projects are contained within the "*disturbed*" highway boundary, impacts on buried archaeology are considered to be unlikely. Any potential impacts are therefore likely to be limited to receptors off site such as the effects on the setting of heritage assets. The EAR assessment was therefore concerned with the potential visual and aural impacts of the proposed scheme on the setting of designated heritage assets only.

5.114. The EAR predicted that the scheme would have a slight adverse effect on a small number designated sites, resulting from changes to their setting during both the construction and operational phases.

5.115. Overall, the EAR stated that the scheme would not affect the vast majority of approximately 29 designated heritage assets within the study area, but noted that there would be slight adverse effects on the following:

- Park Hill Farmhouse (Grade II Listed Building);
- Church of St Martin (Grade II* Listed Building);
- Brasted Church (Conservation Area);
- Titsey Place (Grade II Registered Park and Garden); and
- Combe Bank (Grade II* Registered Park and Garden).

5.116. Taking into account mitigation measures designed to minimise any impact (summarised as minimising tree removal and providing additional (screen) planting at specific locations), the EAR considered that there would be no significant effects on any designated heritage asset as a result of the scheme, and concluded that the impact of the scheme would be **slight adverse**.

Consultation

5.117. No responses to consultation requests were received for this sub-objective.

Evaluation

5.118. As noted in the Landscape sub-objective, above, there has been a significant reduction in the quantity of infrastructure (i.e. gantries) proposed by the Preliminary/ EAR design and that which was implemented as part of the Detailed Design. Although any reduction in highway infrastructure is considered beneficial, there is only one area where the Detailed Design would have an overall slight worsening effect on receptors, noted in the SVIAR as the cluster of residential properties on Brasted Hill and Station Road. It is therefore considered that these design changes have not significantly altered the overall slight adverse impact of the proposals on the landscape setting of the designated heritage assets as predicted by the AST/ EAR and as such, the impact of the scheme may also be considered to be broadly as expected overall.

5.119. Regarding mitigation planting, it is considered that although planting has been implemented broadly as expected, it is too early for any evaluation of the plant stock to be meaningful at OYA, and that the screening and integration functions of the planting proposals with respect to heritage assets are likely to be more apparent at the FYA stage.

5.120. No further evaluation has been undertaken as there were no outstanding issues highlighted by the information received as part of this study, or raised during the site visit.

5.121. It is therefore considered that based on the information presented above, the effects of the scheme on the heritage resource are likely to be generally **as expected**.

Table 5-12 Evaluation Summary: Heritage and Historic Resources

Sub-Objective	AST	OYA
Heritage and Historic Resources	Slight Adverse	As Expected.

Biodiversity

Forecast

Appraisal Summary Table

5.122. The AST stated that construction phase impacts of the scheme were considered to be sight adverse with respect to dormice and great crested newts, and **neutral** with respect to habitats of lower value within the soft estate (and their associated protected species). Although no long term impacts on the 7 statutory (and 1 internationally) designated sites present within the study area were expected, the AST did highlight that there were risks of slight adverse impacts on 11 non-statutory sites, including Wet Wood Site of Nature Conservation Interest (SNCI).

5.123. Overall, the scheme was considered to have a **slight adverse** impact on ecological resources, arising from a reduction in the buffering of adjacent designated sites and loss and severance of habitat within Highways England soft estate that, although itself of lower value, contributes to the habitat of protected species.

Environmental Assessment Report

5.124. During the construction phase within the highway boundary, the EAR predicted that there would be a **neutral** effect on habitat, as the habitat concerned was of negligible or local value only for protected and/ or notable species.

5.125. In terms of designated habitat, the EAR stated that as a part of Titsey Wood Site of Special Scientific Interest (SSSI)/ Ancient Woodland extended on to the soft estate where clearance would be required, there would potentially be some permanent habitat loss within the SSSI/ Ancient Woodland boundary that would require consent from Natural England. Additional buffer habitat[23] was predicted to be lost in small areas adjacent to Westerham Woods SSSI and although the EAR considered that there was a risk of a slight adverse impact, this risk was not considered to be significant. No other direct impacts on national or internationally designated sites were considered likely. The risk of slight adverse effects was predicted for all non-statutory sites adjacent to the scheme (including Wet Wood SNCI where the SNCI boundary extends on to the soft estate), but again, these risks were not considered to be significant.

5.126. Measures to mitigate the required vegetation/ habitat loss were stated in the EAR as minimising the clearance as far as possible, with care being taken to reduce the possibility of habitat fragmentation. It was further stated that provided any loss of buffering habitat was restricted to lower value scrub habitat that could be adequately compensated for through habitat enhancement/ replanting, any small scale loss of this habitat was considered to be a slight adverse impact and as such, not significant.

5.127. In terms of protected species, the EAR stated that any construction phase impacts of the scheme on dormice and great crested newts (GCN) were considered to be sight adverse, and not significant provided the outlined mitigation measures, which included European Protected Species (EPS) licensing, seasonally timed construction works, species translocation, ecological watching briefs, and habitat enhancement/ creation, were implemented.

5.128. Overall, the scheme was considered to have a **slight adverse** effect on ecological resources, but the effects were not considered significant.

Environmental Assessment Report Addendum

5.129. As noted in the Landscape sub-objective, above, while the EAR proposed no additional lighting along the length of the scheme, the EAR Addendum explained that lighting was required for the ADS on three gantries on the approach to Junction 6 of the clockwise carriageway.

5.130. In summary, the EAR Addendum stated this lighting would not result in any further land take across the scheme, and would result in negligible additional construction activities. The addition of lighting in just three locations was stated as providing a negligible increase to the existing operational

[23] Buffer habitat: Habitat between the carriageway and the highway boundary, buffering the M25 from surrounding habitats.

lighting levels across the scheme, but it was noted that as the area was currently unlit, the additional lighting could potentially cause disruption to movements of animals along the verge (particularly bats).

5.131. The addendum concluded that provided the detailed design minimised light spill from the three lamps, the significance of effects on ecological receptors would be altered from **neutral** to **slight adverse** for only two ecological receptors: bats using the (former) Highways Agency land, and the Westerham Wood SSSI), although this change was not considered significant. The significance of the effects on all other identified ecological receptors was stated to remain unchanged and as described in the EAR.

Landscape and Ecology Summary Report

5.132. As noted in the Landscape sub-objective, above, the full extent of the works required was not fixed at the time of the EAR and changes to the design were foreseen. The Advance Ecological Design (AED) drawings showing extents of protected species mitigation methods across the scheme were based on the designs at the initial issue of the EAR, but in a format to allow adjustment as design developed. The key ecological points noted by the LESR are:

- The AED included a number of mitigation methods to protect species on site based on the results of survey work undertaken for the EAR. This included works carried out under a Precautionary Method of Working where risks to individuals of each species were considered low, and also included works to trap and translocate newts and reptiles from the working area.
- It was necessary to apply for licences to undertake work in relation to dormice, GCN, and Roman snails[24] along the length of the scheme, and works relating to the licences were timed to take place and at an appropriate time of year within the scheme timetable. Although it was necessary to amend the dormouse licence in relation to works at Clacket Lane Bund, the GCN licence did not require revision. The Roman snail licence was renewed annually as a requirement of the licence.
- During construction, detailed site work including watching briefs during vegetation clearance, exclusion fence installation and destructive searches, and trapping and translocation of newts and reptiles was undertaken. The licence holder named within the licence documents was consulted where necessary on any measures required under the licences, and on any other work carried out across the scheme.
- In terms of aftercare, the LESR stated that general maintenance and management of habitats should take into account the presence of protected species across the scheme, particularly nesting birds, dormice and GCN. Regular management was stated as ensuring that it would not be necessary to remove large blocks of vegetation at any one time, and the Managing Agent should be provided with the information in the EAR to ensure awareness of the areas where protected species had been encountered.
- As a requirement of the dormouse licence, the hedgerow at Clacket Lane bund must be monitored for establishment over the five year period, along with the dormouse boxes which have been installed in woodland habitat. Another requirement of the dormouse licence was to undertake a dormouse survey of the boxes provided as part of mitigation to be undertaken in May and September 2016 (two years from completion of the scheme). Following this monitoring, it was expected that the licence could be closed. No specific monitoring, other than that which covers establishment of planting, was proposed in relation to the GCN or Roman snail licences.

Consultation

5.133. Natural England responded to the consultation request, but had no comments to make.

5.134. Surrey Hills AONB Office commented that the effects of the scheme on biodiversity were not known, but were likely to be negligible.

Evaluation

Species

5.135. No information has been received by POPE regarding the detailed lighting design of the ADS on three gantries on the approach to Junction 6 of the clockwise carriageway, and as such it cannot

[24] As noted in the EAR, Roman Snails are protected under Schedule 5 of the Wildlife and Countryside Act 1982 (as amended).

be verified as to whether the mitigation measures to minimise light spill proposed by the EAR Addendum have been implemented. Any change in the significance of effect on bats using the soft estate cannot therefore be confirmed, although there is no reason to suppose that the ecological impacts on this species differ significantly from the slight adverse impacts predicted by the EAR Addendum.

5.136. The LESR confirmed that the AED defined the approach to the ecological mitigation measures adopted during the construction phase, and included seasonally timed construction works, species translocation of newts and reptiles, ecological watching briefs, and incorporation of enhancement measures. The LESR also confirmed that this mitigation also included obtaining protected species licences where appropriate, and that the licence holder was consulted where necessary on any measures required under the licence. It is therefore considered that construction phase impacts of the scheme on dormice and GCN are unlikely to have been significant, as the mitigation measures outlined in the EAR have been implemented.

5.137. No monitoring reports were available at this stage. Dormouse box monitoring and Dormouse box survey required as part of the dormice licence are scheduled to take place in May and September 2016. Thus the operational impact of the scheme on species, protected or otherwise, cannot be confirmed.

Habitat

5.138. As noted under the *Species* sub-section above, no information has been received by POPE regarding the detailed lighting design of the ADS on three gantries on the approach to Junction 6 of the clockwise carriageway; any change in the significance of effect on the Westerham Wood SSSI cannot therefore be confirmed, although there is no reason to suppose that the ecological impacts on this habitat differ significantly from the slight adverse impacts predicted by the EAR Addendum.

5.139. As noted in the landscape section, also above, the OYA site visit found that the planting proposals appear to have been implemented broadly as expected, and changes in vegetation clearance and proposed planting brought about by the Detailed Design are evident along the length of the scheme; however, it is considered that any local variations in the effects expected are unlikely to have materially changed the predicted effects of the scheme on habitat overall. However, it is also considered that it is too early for any meaningful assessment of the planting proposals in terms of habitat to be made at this OYA stage, but that a more accurate assessment could be possible at FYA.

5.140. The key of the As-built LED drawings indicates that specific habitat enhancement measures were proposed along the scheme extents, and these comprised a combination of dormice boxes, hibernacula, log piles, and Roman Snail enhancement areas.

5.141. No Dormouse boxes were indicated on the As-built drawings (despite being noted in the key), and none were noted during the site visit. Log piles, indicated on the as-built drawings, were also not observed during the site visit. Hibernacula were noted during the OYA site visit, although one was observed to be broadly located where a log pile was specified by the LED drawings; this particular hibernaculum is illustrated by ***Figure 5-5*** below.

Figure 5-5 Habitat mitigation in the form of hibernacula, rather than a log pile.

5.142. The EAR confirmed the presence of Roman snails at several locations along the scheme extents, including along the southern verges between Junction 6 and North Park Lane over bridge in the woodland and grassland habitats. This area was indicated as a Roman Snail Enhancement Area on the As-built LED drawings, and is illustrated by ***Figure 5-6*** below.

Figure 5-6 Roman Snail Enhancement Area, directly south of the clockwise entry slip-road (right) at junction 6.

5.143. In terms of Roman Snail habitat mitigation during construction, the draft HEMP noted that vegetation clearance should be kept to a minimum at all times and that where it had been necessary to track machinery or store items on the soft estate, measures should be taken to reduce compaction of the soil at these locations following completion of works. As part of the conditions of the Roman Snail EPS licence, the draft HEMP also stated that although no monitoring was required, the presence of Roman Snails on road verges should be taken into account for all management/ maintenance and any future works on the road verge; however, these future management and maintenance operations were not specifically indicated.

5.144. The quarterly Aftercare Inspections and Reports as noted in the draft HEMP were unavailable for the purposes of this evaluation, and POPE is unaware of any other information regarding habitat; as such, it is considered that a full evaluation the impact of the scheme on habitat, including the establishment of the hedgerow at Clacket Lane and the installation of the dormouse boxes, is not possible at this stage of the POPE process, but could be considered further at FYA when the quarterly Aftercare Inspections and Reports are likely to be available.

Animal Mortality

5.145. Animal mortality figures have been received for the period between 2010 and 2015 (inclusive), and these are shown in ***Table 5-13*** below. It can be seen that animal mortality numbers are generally low and are relatively consistent and as such, it is considered that animal mortality does not appear to have altered significantly as a result of the scheme. This aspect could be reconsidered when additional post-opening data should be available.

Table 5-13 Animal Mortality Data, 2010-2015

Animal	2010	2011	2012	2013	2014*	2015
Badgers	2	1	2	1	1	1
Deer	4	6	3	-	1	4
Foxes	3	2	4	3	5	1
Dogs	-	-	-	-	2	-
Unspecified	-	1	2	1	2	-
TOTALS	**9**	**10**	**11**	**5**	**11**	**6**

* Scheme opening

Long term Ecological Management

5.146. The draft HEMP stated that all future maintenance work on the soft estate should be carried out in such a way so as to avoid harm to protected species, also noting that:

- Should any future maintenance or repair works that have potential to effect protected species that may be found on site be proposed, the appropriate mitigation methodology will need to be put in place and the relevant licence applied for; and
- A number of designated sites are present adjacent to the soft estate. If any works is likely to affect a SSSI, approval for the works should be obtained from Natural England in advance of any activity.

5.147. In light of the draft HEMP's acknowledgement of the above and the requirement of the dormouse EPS licence for establishment monitoring of the hedgerow at the bund near Clacket Lane, monitoring of the dormice boxes, and the dormouse survey, it is considered that these aspects could be considered further at FYA when the results of monitoring and surveys should be available for evaluation.

Summary

5.148. Construction phase impacts of the scheme on species, protected or otherwise, are unlikely to have been significant as the mitigation measures outlined in the EAR have been implemented as confirmed by the LESR, and it is considered that any changes in vegetation clearance and proposed planting brought about by the Detailed Design are unlikely to have materially changed the predicted effects of the scheme on Habitat.

5.149. In the absence of post-opening information, it is not considered possible to fully evaluate the effects of the scheme on species or habitat at this stage of the POPE process, but that these aspects could be considered further at FYA when the quarterly Aftercare Inspections and Reports are likely to be available.

5.150. It is therefore considered that the impact of the scheme on biodiversity at OYA is likely to be **as expected**, i.e. **slight adverse**, but more information is required to confirm this.

Table 5-14 Evaluation Summary: Biodiversity

Sub-Objective	AST	OYA
Biodiversity	Slight Adverse.	Likely to be as expected.

Water Environment

Forecast

Appraisal Summary Table

5.151. The AST stated that although there was the potential for accidental spillages to have an impact on surface and ground waters during construction, mitigation in the form of best practice would ensure that any such impact would be insignificant, and concluded that the scheme would have a **neutral** impact on the water environment overall.

Environmental Assessment Report

5.152. The EAR stated that the operational impacts of ERAs and slip-road widening were scoped out of the assessment due to mitigation measures being included in the scheme design; as the assessment was therefore limited to construction phase impacts only, it followed that the relevant criteria from DMRB (HD45/09)[25] were not able to be used. Consequently, professional judgement was used to assess the impacts of the scheme, as the overall assessment and water quality

[25] Part HD45/09 of the DMRB provides guidance on the assessment and management of the impacts of routine run-off on surface and groundwater, pollution impacts from spillages, and assessing flood impacts.

mitigation measures required for the section of road were to be considered as part of the Priority Outfalls Investigation[26].

5.153. The EAR considered that the most significant construction effects impacts on surface water were likely to occur where construction was to take place in close proximity to waterbodies with good water quality:

- The ERA at chainage 3850-3950 on the clockwise carriageway; and
- ERAs at chainages 3450-3550 and 4175-4275 on the anti-clockwise carriageway.

5.154. The majority of construction was stated as not taking place in close proximity (within 100m) to protected groundwater and therefore for the majority of the construction, no effect on groundwater was predicted. In a few locations however, where construction was to take place slightly closer to protected groundwater, the effect would be low:

- The ERA at chainage 11150-11250 on the clockwise carriageway; and
- ERAs at chainages 11550-11650 and 14100-14200 on the anti-clockwise carriageway.

5.155. No construction was to take place in Flood Zone 2 or 3, therefore the EAR considered that there would be no effect of construction on the floodplain.

5.156. The EAR considered that potential construction impacts on surface and ground waters could be addressed by following relevant Pollution Prevention Guidance at all times during construction, specifically, and as advised in DMRB (HD45/09), it was considered that action should be taken on:

- Bunding;
- Routes of temporary traffic diversions;
- Storage of hazardous wastes and materials;
- Procedures for concreting; and
- Wash down areas and disposal of surface water run-off from excavations during construction.

5.157. With the mitigation measures in place, the EAR considered that the overall construction effects of the scheme on water and drainage should be **neutral**; operational effects were also considered to be **neutral** as mitigation had been included in the design of the ERAs and widened slip-roads.

Consultation

5.158. No responses to consultation requests were received for this sub-objective.

Evaluation

5.159. The Construction Environmental Management Plan (CEMP) was not available to POPE for the purposes of tis evaluation and as such, any construction impacts of the scheme on the water environment cannot be confirmed.

5.160. No as-built drainage drawings were available for this evaluation, and no information indicating whether any incidents that may have affected the drainage system during construction activities or post opening have been received by POPE.

5.161. All drainage facilities noted during the OYA site visit appeared to be generally clear of vegetation/ litter/ detritus, with no evidence to suggest that the facilities are unable to function in any way other than as expected.

5.162. Based on the site visit and the information provided by the EAR, it is concluded that the overall, direct effect of the scheme on water quality and drainage is likely to be **as expected** but further detail would be required to confirm.

Table 5-15 Evaluation Summary: Water Environment

[26] Priority Outfalls Investigation: one of a series of ongoing research projects commissioned by the former Highways Agency to develop a better understanding of the risks that the highway drainage asset presents to the travelling public and to the environment, whose aim is to identify priority outfalls on the drainage network that are at risk of polluting the surface water courses that they flow into, so that mitigation measures can be designed and installed.

Sub-Objective	AST	OYA
Water Environment	Neutral.	As expected.

Physical Activity

Forecast

Appraisal Summary Table

5.163. The AST stated that the scheme would have no effect on the activity duration of pedestrians, cyclists, or equestrians, as no direct changes to existing Non-Motorised User (NMU) facilities or routes were proposed; overall, the impact of the scheme on NMUs was assessed as **neutral**.

Environmental Assessment Report

5.164. Physical Activity was not considered by the EAR.

Consultation

5.165. No responses to consultation requests were received for this sub-objective.

Evaluation

5.166. The combination of desk studies and the site visit undertaken as part of POPE methodology has found no reason to suppose that there have been any significant changes to NMU facilities.

5.167. No NMU survey has been undertaken specifically for this study, and POPE is not aware of any NMU audits or Vulnerable User Studies undertaken for this scheme.

5.168. The sections of the PRoW network viewed during the OYA site visit appeared to be capable of performing generally as expected, although no direct evidence of PRoW use was observed.

5.169. It is concluded that the effects of the scheme on physical activity are likely to be as expected, as there has been no reduction or increase in the degree of severance of the PRoW network; the overall effect of the scheme on NMUs is therefore considered to be **as expected**.

Table 5-16 Evaluation Summary: Physical Activity

Sub-Objective	AST	OYA
Physical Activity	Neutral	As expected.

Journey Quality

Forecast

Appraisal Summary Table

5.170. The journey quality sub-objective considers traveller care (facilities and information), traveller views, and traveller stress (frustration, fear of potential accidents, and route uncertainty).

5.171. The AST stated that there would be no change in terms of traveller care, but that adverse effects on traveller views were expected as a result of the urbanising nature of the scheme. An overall improvement to driver stress was predicted, as the scheme would incorporate improved ADS which together with the gantry and cantilever message signs, would alleviate route uncertainty and improve driver comfort. Overall, the impact of the scheme on journey quality was assessed as **slight beneficial**.

Environmental Assessment Report

5.172. The effects of the scheme on non-motorised users and communities were scoped out of the EAR, which focussed instead on the effects of the scheme on vehicle travellers, including travellers' views, changes in amenity (traveller care), and driver stress which, in summary:

- Traveller Care: No additional facilities were proposed as part of the scheme. The existing facilities at the Clacket Lane Motorway Service Area (MSA), able to be accessed from both the clockwise and anticlockwise carriageways between Junctions 5 and 6, provides a dedicated rest area that includes a car park and petrol station, information centre, toilets, motel, archaeological display, catering facilities, and an outdoor seating area. The overall traveller care facilities were expected to remain the same with or without the scheme, although it was considered that the improved signage could prompt drivers to utilise the MSA; the overall effects of the scheme on traveller care were not considered to be significant (i.e. **neutral**).
- Traveller Views: The EAR recognised that there would be a number of additional gantry and cantilever signs which would be visible in views from the road. The scheme was expected to retain the existing open and intermittent views along the route, however taking into account the sensitivity of the landscape through which travellers would be moving and viewing, the overall urbanising effect of the of additional gantry and cantilever signs was considered to be **slight adverse**; and
- Traveller Stress: During construction, traveller stress was anticipated to be moderate adverse due to the number of drivers likely to be affected during the construction period, although this was stated to be temporary in nature. In the DS scenario, traffic data forecasts showed that traffic volumes were expected to increase in 2030, compared to the existing conditions and the DM scenario. In addition, the scheme would incorporate improved ADS (together with gantry and cantilever message signs) and the percentage of HGVs in 2030 was expected to reduce, both of which was expected to alleviate congestion and improve route certainty and driver comfort. As a result, the overall impact on driver stress resulting from the scheme was anticipated to be **slight beneficial**.

5.173. The overall EAR assessment of permanent effects on vehicle travellers in the long term, taking into account traveller care/ views/ stress as outlined above, was considered to be **neutral**.

Consultation

5.174. Surrey Hills AONB Office commented that in terms of Traveller Stress, the number of signs in practice seemed excessive and could be regarded as annoying to some motorway users, repeating the same message over and over again within a short distance. The following comments were also made regarding Traveller Views;

- The number and form of the structures has a great visual impact on users of the M25 during daylight hours;
- The effect of night time lighting would probably have a significant visual impact on users of the M25;
- The dark grey colour of the structures would probably result in structures being less noticeable during the hours of darkness, but seems to emphasise the form of the structures during daylight hours - a lighter grey may be a more appropriate colour, especially when structures are seen mostly against the sky (i.e. when viewed from the road); and
- The collective visual effect of the structures, particularly the character of the electrical signs by the side of the road, detracts from views to the AONB from the highway.

Evaluation

Traveller Care

5.175. No changes regarding traveller care were proposed as part of the final design, and none were identified during the OYA site visits; consequently, this aspect has not been evaluated further and the impact of the scheme on traveller care is considered to be as expected.

Traveller Views

5.176. Regarding the comments received at consultation from the Surrey Hills AONB Office, the reduction in highway '*clutter*' brought about by the decreased number of gantries (56 to 46) implemented as part of the Detailed Design was considered by the SVIAR to be better than predicted by the EAR,

but it is considered by POPE that signing is a part of the expected traveller experience and as such, the effects of the gantry amendments on Traveller Views are not significant as the frequency, scale, and appearance of the 46 new structures along the M25 would have resulted in the increased perception of urbanisation of the countryside as expected.

5.177. As noted in the landscape sub-objective, above, the landscape mitigation measures in the form planting proposals appear to have been broadly implemented as anticipated. It is considered that and any local variations in the effects expected are considered unlikely to have materially changed the predicted landscape or visual amenity effects of the scheme overall.

5.178. Route verges were observed to be generally tidy and litter-free at the time of the site visit.

5.179. Based on the information presented in this evaluation, it is considered that Traveller Views are likely to be as expected at this stage, due to the increased perception of urbanisation of the countryside.

Traveller Stress

5.180. Regarding the comments received at consultation concerning message repetition, it is considered by POPE that signing is a part of the expected traveller experience and as no information correlating the number of signs with the degree of driver annoyance has been made available to POPE, it cannot be confirmed whether the quantity of signs has had any effect on levels of Driver Stress.

5.181. The increased capacity of the M25 is considered likely to provide more opportunities for the safe overtaking of slower vehicles. Section 2 of this report notes that journey times in the peak periods have reduced and reliability has improved, both of which affect the drivers' ability to make good progress along a route and therefore reducing the levels Traveller Stress, experienced.

5.182. At the time of the site visit, the route appeared to be well signed (as illustrated in ***Figure 5-7*** below) with junctions (and routes) clearly indicated, and the junctions providing safe access and egress points to and from the M25.

Figure 5-7 Super-span gantry exhibiting clear, informative signage across all lanes

Summary

5.183. Based on the information presented in this evaluation, it is considered that the effects of the scheme on Journey Quality are likely to be **as expected** in terms of Traveller Care, Traveller Views, and Traveller Stress.

5.184. ***Table 5-17*** and ***Table 5-18*** summarise the evaluation of the scheme's impact on Traveller Factors and Journey Quality respectively.

Table 5-17 Evaluation Summary: Traveller Factors

Traveller Factor	AST	OYA
Care	No change	As Expected

Traveller Factor	AST	OYA
Views	Adverse	As Expected
Stress	Improvement	As Expected

Table 5-18 Evaluation Summary: Journey Quality

Sub-Objective	AST	OYA
Journey Quality	Slight Beneficial	As Expected

Key Points – Environment

Noise and Local Air Quality

- Traffic forecast data indicates that the observed post-opening AADT traffic flows are lower than expected by between 7% and 15% between junctions 5 and 7. Based on the information available:
  - The impact on the noise climate is considered likely to be as expected; and
  - The percentage differences between forecast and observed traffic flows are considered significant, and impacts on local air quality are likely to be better than expected.

Greenhouse Gases

- It was forecast that the scheme would result in a net increase in carbon emissions from M25 traffic. Due to lower than expected traffic the impact has been a much lower increase in opening year emissions than expected.

Landscape

- Changes brought about by the final design, including changes to the proposed planting design and the type and location of highways infrastructure, are evident along the length of the scheme;
- Although there are local variations in the effects expected, there is no reason to assume that the design changes have materially changed the expected landscape or visual amenity effects of the scheme overall; and
- Excessive weed growth within the planting plots suggests that the environmental functions of the mitigation measures may not be developing in line with their potential, and consideration could be given to adjusting the maintenance regime to ensure that the planting plots develop their intended environmental functions by Design Year.

Townscape

- It is considered unlikely that any townscape feature would have been affected by the scheme.

Heritage & Historic Resources

- The reduction in highway infrastructure is considered likely to have not significantly altered the overall slight adverse impact of the proposals on the landscape setting of the designated heritage assets as predicted.
- The screening and integration functions of the planting proposals with respect to heritage assets are likely to be more apparent at the FYA stage.

Biodiversity

- Construction phase impacts of the scheme on species, protected or otherwise, are unlikely to have been significant. Changes in vegetation clearance and proposed planting brought about by the Detailed Design are considered unlikely to have materially changed the predicted effects of the scheme on Habitat.
- In the absence of post-opening information, it is not considered possible to fully evaluate the effects of the scheme on species or habitat at this stage of the POPE process.

Water Environment

- There is no evidence to suggest that the facilities are unable to function in any way other than as expected, but further detail would be required to confirm.

Physical Activity

- As expected, as there has been no reduction or increase in the degree of severance of the PRoW network.

Journey Quality

- The effects of the scheme on Journey Quality are likely to be as expected in terms of Traveller Care, Traveller Views, and Traveller Stress.

6. Social Impacts Evaluation

Introduction

6.1. WebTAG guidance current when the scheme was appraised described Social impacts as covering the human experience of the transport system and its impact on social factors, not considered as part of economic or environmental impacts. This covered the following impacts:

- Accidents
- Physical Activity
- Security
- Severance
- Journey Quality
- Option and Non-Use Values
- Accessibility
- Personal Affordability

6.2. Accidents (collisions) and security were considered in section 3 of this report, and Physical Fitness and Journey Ambience in the environment chapter, this section here covers the remaining social impacts.

6.3. Output from the Social and Distributional Impacts (SDIs) assessment forms part of the revised Appraisal Summary Table.

Sources

6.4. Sources of the forecast social impacts of this scheme are:

- AST
- M25 LUS Section 2: Findings from Initial Screening and Scope for Full SDI Appraisal (Sept 2011)

Physical Activity

6.5. See environment section.

Journey Quality

6.6. See environment section.

Affordability

6.7. The SDI reported noted that the scheme would bring a net benefits for consumers as forecast by TUBA, but additional assessment of the impacts on lower income groups was needed. In the AST, it was stated that the scheme was forecast to increasing vehicle running costs for 81% of consumers in all income groups within the local area with the most deprived quintile and middle quintiles both experiencing a moderate adverse impact.

6.8. The outturn evaluation of vehicle operating costs impact showed it to be a disbenefits and this was greater than expected (***Table 4-3***) so the affordability impact has been assessed as moderate adverse.

Access to Services, Severance and Option Values

6.9. The AST stated that these sub-objectives were not relevant to this scheme thus they were not appraised. The SDI report noted that there would be no change to existing crossing routes used by pedestrians, cyclists or equestrians. There has been no change to the scheme as built which would alter impacts on these, thus they have likewise not been evaluated in this OYA.

7. Conclusions

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

7.2. ***Table 7.1*** presents an evaluation of the scheme's objectives using the evidence presented in this study.

Table 7-1 Summary of Success of Scheme Objectives at OYA

Objective	Has the objective been achieved?	
Reduce congestion and to develop solutions that provide additional capacity, increase journey time reliability and ensure the safe and economic operation of the motorway	Conversion of J5-6 from D3M to 4 lanes ALR has provided additional capacity	✓
Improve journey time reliability by improving and better managing traffic flow conditions	Journey time reliability improvements have been observed, mainly at the times when journey times were most unreliable in the before period, i.e. the clockwise AM peaks and the anticlockwise PM peaks. At less congested times the journey time reliability has not significantly changed	✓ but more data is required to be conclusive
Achieve a safety objective under which the "after" accident numbers (per annum) are no greater than those in the "before" and the severity ratio is not increased.	Initial results show reduction in collisions on M25 within the scheme, but an increase in severity. However it is too soon at this stage to be confident of the trend in numbers and to assess the severity impact.	✓ too early to determine any change in severity
Make best use of existing infrastructure providing additional capacity within the existing highway boundary, other than in exceptional circumstances	M25 provided with additional capacity within highway boundary	✓
Minimise detrimental environmental effects of the SM scheme by mitigation measures, taking account of costs, availability of funding and statutory obligations.	There has been a significant reduction in the quantity of infrastructure proposed by the Preliminary/ EAR design; the number of individual elements has been reduced between EAR stage and detailed design stage from 56 to 46, with the number of Super-span gantries (the most visually intrusive) being reduced from 17 to 9. Landscape mitigation measures in the form planting proposals appear to have been broadly implemented as anticipated and any local variations in the effects expected are considered unlikely to have materially changed the predicted environmental effects of the Scheme overall.	✓

Improve the currency and quality of information provided to drivers about the state of traffic flow on the motorway	Gantries provided by the scheme have improved driver information.	✓
Support the current role of the M25 as a major national and inter-urban regional transport artery.	M25 provided with additional capacity	✓

Appendix A. Appraisal Summary Table (AST) and Evaluation Summary Table (EST)

Table A.1 Appraisal Summary Table (July 2012)

M25 J5 to J7 Managed Motorway – All Lane Running						
	Impacts	**Summary of Key Impacts**	**QUANTITATIVE MEASURE**	**Qualitative**	**Monetary 3(NPV)**	**Distributional 7-pt scale/ vulnerable grp**
Economy	Business users & transport providers.	The scheme would provide journey time benefits and some vehicle operating cost savings for goods vehicle operators. This would be partly offset by vehicle operating cost disbenefits for business car users and also by delays to all business users during construction and future maintenance of the scheme.	Value of journey time changes(£) £269.4m Net journey time changes (£) 0 – 2 min £203.4m | 2-5 min £59.1m | >5min £6.9m	-	£225.0m	-
	Reliability impact on Business users	Incident-related reliability impacts have been assessed using the INCA program. The scheme would produce an overall benefit. Daily travel time variability (TTV) will improve due to the provision of additional capacity and variable speed limits. This would provide a benefit of £263.4m. Delay (due to accidents and incidents) would provide a dis-benefit of £45.8m reflecting the loss of the hard shoulder with the scheme.		-	£217.6m	
	Regeneration	The Project is not located within a regeneration area. The Regeneration Impacts have not been assessed.			-	
	Wider Impacts	The Wider Impacts (agglomeration, change in output in imperfectly competitive markets and labour market impacts) have not been assessed.			-	
Environment	Noise	2123 dwellings and 17 other noise sensitive receptors considered in the detailed study area. On opening 10 dwellings are predicted to experience a minor increase in noise, with all other changes negligible or no change. Over the design period 3 dwellings predicted to experience a minor increase and 2 dwellings a minor decrease, with all other changes negligible or no change. There are no distributional impacts on the most deprived and two least deprived income quintiles, and only a slight adverse impact on the two remaining middle income quintiles.	Population annoyed without scheme 483. Population annoyed with scheme 500. Net change 17 more people annoyed.	-	-£0.6m	Slight Adverse
	Local Air Quality	Overall slight improvement in NO_2 and PM_{10} concentrations. 4 AQMAs for annual average NO_2 and 2 AQMAs for 24 hour PM_{10} within 200 m of the local air quality affected road network. No exceedances of annual average NO2 at 20 m from the road in opening year 2015. Changes in NO2 concentrations of -0.1 µg/m^3 to +1.9 µg/m^3 at 20 m from the road. All quintiles experience a beneficial distributional impact (including the most deprived quintile) between 2 and 67% (large beneficial), with the exception of quintile 2 (second most deprived) which has a 6% worsening.	NO_2: Overall Assessment Score = -8 Properties with improvement 2003, deterioration 688, no change 193. PM_{10}: Overall Assessment Score = -6 Properties with improvement 2077, deterioration 360, no change 447	-	-	Moderate Beneficial
	Greenhouse Gases	Overall increase in carbon emissions with the scheme due to an increase of +16,587 million vehicle kilometres per day travelled over the 60 year appraisal period. Calculated using non-TUBA method. The non-traded carbon dioxide emissions in 2015 = +0.037 MtCO2e indicating an increase in CO2 emissions in opening year. Change in emissions in MtCO2e for 2013-2017 (actually 2015-2017) = +0.12, Change for 2018-2022 = +0.21	Change in non-traded carbon over 60y (CO2e) +3.14 MtCO2e Change in traded carbon over 60y (CO2e) Not applicable		-£91.2m	
	Landscape	The scheme is within an Area of Outstanding Natural Beauty and Area of Great Landscape Value. Landscape and visual impacts are likely as a result of the Project due to presence of new infrastructure, some loss of planting from ERAs and associated retaining structures where necessary. 38 properties would have a slight adverse effect and 12 properties a moderate adverse effect in the opening year. Effects on local landscape character areas would be slight adverse.	-	Slight Adverse	-	
	Townscape	Townscape considered in assessment but the Project does not pass through urban areas and is located in agricultural land so impacts are considered under the landscape objective	-	Neutral	-	
	Heritage of Historic resources	The Project would have a slight adverse impact on two Registered Historic Parks and Gardens (Combe Bank and Titsey Place) with regard to their historic settings. The Project would have a slight adverse impact on the historic settings of 2 listed buildings and 1 conservation area which are within the study area.	-	Slight Adverse	-	
	Biodiversity	There would be no long term impacts on the seven statutory designated sites (including one Internationally designated site) present. There are risks of a slight adverse effect on eleven adjacent non statutory sites, including Wet Wood SNCI. The construction phase impacts of the scheme are considered to be sight adverse on dormice and great crested newts. During the construction phase there would be a neutral effect on habitats of lower value within the soft estate and their associated protected species. Overall the Scheme is considered to have a 'slight adverse' effect on ecological resources resulting from reduction of buffering of adjacent designated sites and loss and severance of habitat within the Highways Agency soft estate that, although itself of lower value, contributes to the habitat of protected species, but this is not considered significant.	-	Slight Adverse	-	
	Water Environment	There is potential for accidental spillages to impact on surface and groundwater during construction, however, with best practice mitigation proposed, this impact is insignificant.	-	Neutral	-	
Social	Commuting and Other users	The scheme would provide journey time benefits. This would be offset by vehicle operating cost disbenefits for car users and also by delays during construction. All income quintiles receive an adverse distributional impact as a result of the scheme, with the second most deprived quintile and least deprived quintile both experiencing a large adverse impact.	Value of journey time changes(£) £82.9m Net journey time changes (£) 0-2 min £58.9m | 2-5min £19.8m | >5min £4.2m		-£43.0m	Moderate Adverse
	Reliability impact on Commuting and Other users	Incident-related reliability impacts have been quantified using the INCA program. The Project would produce positive benefits due to improvement in day to day variability in journey times.	Note: See Reliability Impact for Business Users			
	Physical Activity	The Project will have no effect on the activity duration of pedestrians, cyclists or equestrians because there are no direct changes to existing NMU facilities or routes.	n/a	Neutral		
	Journey Quality	Overall improvement to driver stress as the Project would incorporate improved ADS, together with gantry and cantilever message signs which would help alleviate uncertainty of route and improve driver comfort. No change to traveller care, although adverse effects on traveller views will be experienced as a result of the urbanising nature of the works.	n/a	Slight beneficial		
	Accidents	The Project would provide an overall reduction in accidents and casualties in all severity categories. This is partially offset by additional accidents during construction and future maintenance. Due to the small change in accidents as a result of the scheme (only two links with a higher than a +/-5% change in traffic flow and +/- 5% change in accident rates) the scheme has been deemed to have a neutral impact regardless of the number of casualties involving individuals from the identified vulnerable groups.	Accidents: -126.0 Fatal Casualties: -1.1 Serious Casualties: -5.6 Slight Casualties: -223.0	-	£2.3m	Neutral
	Security	No assessment undertaken	n/a			-
	Access to Services	No assessment undertaken	n/a			-
	Affordability	An overall assessment of moderate adverse is given for affordability. Around 81% of the population within the assessment area experience dis-benefits of the scheme, and only 13% experience affordability benefits. This is likely to be due to increased running costs of vehicles through travelling at higher speeds. All income quintiles receive an adverse distributional impact as a result of the scheme, with the most deprived quintile and middle quintiles both experiencing a moderate adverse impact.	n/a			Moderate Adverse
	Severance	Not applicable to this scheme	n/a			
	Option Values	No assessment undertaken	n/a			
Public Acco	Cost to Broad Transport Budget	The cost to the Broad Transport Budget would be scheme investment cost and the scheme operating cost. There would be no additional future maintenance cost.	The impact would be on Central Government only. There would be no impact on Local Government		£82.2m	
	indirect Tax Revenues	The Indirect Tax Revenue is a consequence of the additional fuel duty derived from the additional fuel used by car users.	The Indirect Tax Revenue is treated as a benefit to the scheme.		£102.3m	

Table A.2 Evaluation Summary Table

	M25 J5 to J7 Managed Motorway – All Lane Running						
	Impacts	**Summary of Key Impacts**	**QUANTITATIVE MEASURE**	**Qualitative**	**Monetary £(NPV)**	**Distributional 7-pt scale/ vulnerable grp**	**EST score**
Economy	Business users & transport providers.	Small opening year journey time benefits offset disbenefits for VOC, but long term trend unclear at OYA	Value of journey time changes(£) £111.8m Net journey time changes (£)	-	-£115.4m	-	
	Reliability impact on Business users	Improvements in day to day variability in journey times,		-	£399.0m		
	Regeneration	Not applicable to this scheme		-	-		n/a
	Wider Impacts	Not assessed in appraisal or this OYA		-	-		n/a
Environment	Noise			-	-£0.6m		As expected
	Local Air Quality			-	-		Likely to be better than expected
	Greenhouse Gases	Lower increase in opening year emissions than expected	Change in non-traded carbon over 60y (CO2e) - Change in traded carbon over 60y (CO2e) -	-	-£59.8m		Better than expected
	Landscape		-		-		As expected
	Townscape		-		-		As expected
	Heritage of Historic resources		-		-		As expected
	Biodiversity		-		-		Likely to be as expected
	Water Environment		-		-		As expected
Social	Commuting and Other users	As for business users above	Value of journey time changes(£) Net journey time changes (£)		Included with business		
	Reliability impact on Commuting and Other users	Improvements in day to day variability in journey times. Monetised benefits combined with business above			Included with business		
	Physical Activity	No change to PRoW		Neutral	-		As expected
	Journey Quality	Beneficial for traveller stress due to reduction in congestion and improved signage. Slight adverse effect on traveller views from the M25 of landscape		Slight beneficial	-		As expected
	Accidents	Analysis of observed collision data for the M25 J5 – 7 within scheme shows a decrease (when compared to the counterfactual) one year after opening but severity has worsened. Too soon for results to be statistically significant	7.5 collisions in opening year (10%)		£22.8m		
	Security	n/a	n/a		-		
	Access to Services	n/a	n/a		-		
	Affordability	Increased vehicle operating costs for consumers will adversely impact middle and lower income groups	n/a		-	Moderate Adverse	As expected
	Severance	No impact as a result of scheme.	n/a		-	Neutral	As expected
	Option Values	n/a	n/a		-		
Public	Cost to Broad Transport Budget	Investment cost was 21% lower than expected. Ongoing operating costs assumed as forecast			£134.6m		
	indirect Tax Revenues	Tax revenue as a benefits is higher than expected due to increased fuel on M25			£284.7m		

Appendix B. Environment

B.1. Sources

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

Requested Information	Response
Environmental Statement	Stage 3 Preliminary Design, Environmental Assessment Report (July 2012).
Environmental Assessment Report	Stage 3 Preliminary Design, Environmental Assessment Report (July 2012).
AST	Provided (July 2012).
Any amendments/ updates/addendums etc. to the EnAR or any further studies or reports relevant to environmental issues. Have there been any significant changes to the scheme since the EnAR.	Lighting of ADS Signs at J6 Approach, Environmental Assessment Report Addendum (August 2013). EAR Addendum (as noted above) detailing lighting and infrastructure changes, and Landscape and Ecology Summary Report detailing additional earthworks received
'As Built' drawings for landscape, ecological mitigation measures, drainage, fencing, earthworks etc. Preferably electronically or on CD.	'As Built' Landscape and Ecology Design drawings (April 2014).
Copies of the Landscape/Ecology Management Plan or Handover Environmental Management Plans	Detailed Design, Draft Environmental Management Plan (June 2014).
Contact names for consultation	Provided.
Archaeology – were there any finds etc. Have any Archaeological reports been written either popular or academic and if so are these available?	Not applicable.
Have any properties been eligible for noise insulation?	Not applicable.
Has any post opening survey or monitoring been carried out e.g. for ecology/biodiversity or water quality and if so would copies of the reports be available?	Provided as follows: • Design Input Statement, Drainage (June 2011) • Detailed Design, Scheme Visual Impact Assessment Review (November 2013; • Detailed Design, Landscape and Ecology Summary Report (June 2014); • Final Use Assessment – Noise Insulation Regulations Assessment (July 2014); and Noise Assessment at Flint Hall Cottage, Flower Lane (August 2015).
Animal Mortality Data	Provided by the Managing Agent.
Any publicity material/ Award information for the scheme.	The Skanska Balfour Beatty Joint Venture (SBBJV), involved in upgrading the M25 motorway between junctions 23-25 and 5-7, received three CEEQUAL (Civil Engineering Environmental Quality Assessment and Award Scheme) awards in May 2015. CEEQUAL is the evidence based sustainability assessment,

	rating, and awards scheme for civil engineering, infrastructure, landscaping, and the public realm, and celebrates the achievement of projects with high environmental and social performance. The SBBJV team picked up a "whole project" award with a score of 86%, rating Excellent, for the M25 Widening and Hatfield Tunnel Refurbishment
Pre scheme Non Motorised User (NMU) Audit or Vulnerable User Survey	Not applicable.
Copy of NMU post opening survey	Not applicable.
Employers Requirements Works Information – Environment sections	Not received.
Health and Safety File – Environment sections	Not received.
Construction Environment Management Plan (CEMP)	Detailed Design, Draft Environmental Management Plan (June 2014).
Landscape and Ecology Aftercare Plan (LEAP) and / or Landscape Management Plan (LMP)	Detailed Design, Draft Environmental Management Plan (June 2014).
Handover Environmental Management Plan (HEMP)	Detailed Design, Draft Environmental Management Plan (June 2014).

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Appendix D. Glossary

Term	Meaning
A carriageway, B carriageway	Directional labelling of carriageway in which the A carriageway is clockwise.
AADT	Average of 24 hour flows, seven days a week, for all days within the year.
ACW	Anticlockwise
ADS	Advanced Direction Sign
AED	Advance Ecological Design
ALR	**All Lane Running** is the type of smart motorway in which all lanes are open to traffic at all times. There is no lane which dynamically varies between operating as a hard shoulder or operating as a normal lane.
AQMA	Air Quality Management Area
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
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
CM	Controlled Motorway
CW	Clockwise
D3M, D4M	Dual 3 or 4 lane motorway
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 of 2010 was used in the appraisal and used in this report.
Do Minimum (DM)	In scheme modelling, this is the scenario which comprises only the existing road network and other committed schemes.
Do Something (DS)	In scheme modelling, this is the scenario detailing the planned scheme plus improvement schemes that have already been committed
EAR	Economic Assessment Report
EnAR	Environment Assessment Report
EIR	Economic Impact Report
ERA	Emergency Refuge Area
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.
FWI	Fatal & Weighted Injuries This figure is a combined measure of casualties based on the numbers of fatal, serious and slight casualties. It is weighted by severity of injuries, with fatalities having the highest weighting.
FWI/bvkm	FWI measure by volume of traffic
FYA	Five Years After
GCN	Great Created Newt
Halogen Data	**Halogen Data** is the record of the overhead gantry settings and message screens forming part of a smart motorway scheme over time.

HEMP	Handover Environmental Management Plan
INCA	**Incident Cost Benefit Assessment** can be used to estimate the benefits of reduce delay and travel time variability caused by unforeseen incidents that reduce capacity such as breakdowns, accidents and debris on the carriageway and major disruptions such as spillages.
KSI	Killed or Seriously Injured
LED	Landscape and Ecology Design
LESR	Landscape and Ecology Summary Report
LUS	**Later Upgraded Sections** Following plans in 2000 to examine widening of the M25, it was divided into a number of sections, of which the last two became known as the LUS. This is the study of LUS section 2.
MAC	Managing Agent Contractor
MIDAS Data	MIDAS data is held by Highways England which contains lane by lane traffic flows and speeds
MtCO2e	Million metric tons of carbon dioxide equivalent
NMU	Non-motorised User
OYA	One Year After
PIC	**Personal Injury Collision** Data on these is obtained from records of road collisions collected from by police officers attending accidents.
PIC/mvkm	Ratio of PIC to the level of travel measured in **million vehicle kilometres** (mvkm)
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.
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 Cost
RCB	Rigid Concrete Barrier
RSA	Road Safety Audit
Smart Motorway	Referred to previously as “managed motorways”: a motorway which uses technology to vary speed limits in response to driving conditions. These smart motorways make the hard shoulder available to traffic. This could be permanently or at particularly busy times of the day.
SNCI	**Site of Nature Conservation Interest** Designations used by local authorities in England for sites of substantive local nature conservation value
TFR	Traffic Forecasting Report
Traveller Care	In the context of journey ambiance, this covers aspects such as cleanliness, level of facilities, information and the general transport environment.
TTV	Travel Time Variability
VMSL	Variable Mandatory Speed Limit
WEBTAG	Department for Transport’s website for guidance on the conduct of transport studies at http://www.webtag.org.uk/