HIGHWAYS AGENCY

Post Opening Project Evaluation

M25 Junction 16-23 Widening

One Year After Study

October 2014

An executive agency of the Department for Transport

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Executive Summary

Scheme Description

The M25 junctions 16 to 23 widening scheme is a Highway's Agency major project which was completed in May 2012. The scheme widened the M25 from three to four lanes in both directions on the sections of the motorway between junction 16 at Iver Heath near Uxbridge and junction 23 near South Mimms.

This section of the M25 suffered from increasing congestion levels and unpredictability of journey times. This widening scheme is part of an overall strategy for the M25 comprising a series of widening and smart motorway schemes.

In addition to widening, gantries were erected along the M25 between junctions 16 and 23. This part of the M25 now has the capacity to operate as a controlled motorway. At the time of this study, signage on the gantries is only advisory and gantry messages are manually inputted as the system does not currently respond automatically to changes in flow. Operation of the controlled motorway commenced in March 2014.

Scheme Objectives

Objective	Objective Achieved?
Improve Reliability	✓
Improve Safety	Too early to draw conclusions
Reduce Congestion	✓
To minimise adverse environmental impacts of the upgraded section	Too early to draw conclusions
Improve Driver Information	Too early to draw conclusions

Key Findings

- Average weekday traffic has increased along the scheme section post-opening compared to pre-scheme with reduced flows observed on alternative routes in the vicinity of the scheme.
- The scheme appraisal overestimated traffic volumes using the corridor in the opening year. This is largely due to the forecast growth being higher than has been realised, possibly as a result of the economic recession.
- Average journey times along the M25 scheme section have reduced post scheme opening along with improved journey time reliability and reduced congestion. Observed journey time savings in the opening year are higher than forecast, this is probably in part due to traffic volumes being lower than forecast.
- It is too early to conclude about the scheme's impact on safety at this One Year After (OYA) stage.
- Economic benefits are higher than expected, with the Benefit to Cost Ratio (BCR) from this OYA evaluation being 5.7 compared to a forecast BCR of 3.4. This is primarily due to higher than expected journey time savings, a major contributor to scheme benefits.
- The long term scheme impacts are likely to be affected by the completion of the ongoing schemes in the vicinity and the controlled motorway being implemented along the scheme section.
- Design development changes including reduction in length of retaining features (such as sheet pile walls) and the inclusion of additional ponds and landscape (screening) bunds have resulted in an improvement of habitat and planting in some areas whilst having a slight negative impact (such as loss of existing vegetation and habitat) in others. In balance, the design changes are seen as positive.

Summary of Scheme Impacts

Traffic

- Traffic flows on the M25 along the length of the scheme have increased since scheme opening. In the clockwise direction, an increase of 4% to 6% is observed and in the anti-clockwise direction, on both ends of the scheme the change has been 0% to 2% with the middle section carrying 12% more traffic than pre-scheme. In comparison, traffic volumes on minor roads in the vicinity of scheme have seen a reduction in traffic flows. This is indicative of the reduction in rat-running on the local network around the scheme.
- Traffic flows on sections of the M25 beyond the scheme's extent have seen an increase in traffic, but less than the increase observed along the scheme section at OYA compared to before the scheme.
- From the analysis of hourly distribution of traffic, traffic growth on the scheme section post opening is concentrated in the morning and evening peak periods. The flow has remained nearly the same for offpeak period.
- The forecasts overestimated the traffic using the corridor in the opening year. The average increase along the scheme section was forecast to be approximately 14% in the AM peak and 18% in the PM peak, whereas the observed increase is 9% and 14% respectively.
- Following the scheme's completion, there has been a decrease in journey times despite an increase in traffic flow along the scheme. Observed proportionate decreases are between 7% and 22% in the clockwise direction for different time periods and between 17% and 24% in the anti-clockwise direction. This indicates that the extra capacity created by the scheme has catered for the increased traffic and meets the scheme's objective to reduce congestion. Observed journey time savings are higher than forecast.
- The scheme has resulted in improved journey time reliability. The variation in journey times has been reduced, with the greatest improvements seen in the peak periods.

Safety

- Analysis of data on collisions which resulted in injury before and after the scheme was built has shown that the annual average number of collisions on the scheme key links, i.e. M25 between junction 16 and junction 23, has seen a small increase at the OYA stage when accounting for the background trend in collision reduction. However this is based on only seven months of post opening data and a clearer picture will be available at FYA.
- Analysis of collision data for the wider study area shows a similar trend to that seen on the key links and there is a marginal increase in the number of collisions at OYA.
- Since the scheme completion, there has been a large reduction in the number of slight collisions compared to the before scenario (from an annual average of 242 slight collisions per year in the pre-scheme to 163 in the post-opening).
- Collision rates taking into account changes in traffic flows along the M25 have increased slightly post opening, suggesting that the scheme has had a beneficial impact for safety along its key links. It should be noted that this does not reflect changes in the wider study area for which results were inconclusive at this stage.

Environment

- The increase in traffic flow observed is lower than that predicted in the Environmental Statement (ES), however, there is an observed increase in traffic speeds during the inter peak and evening peak times. Speeds in the morning peak vary, with slower speeds seen along some sections. Roadside noise levels are based on flow, speed and percentage of heavy goods vehicles (HGV)for each case. Purely on the basis of changes in traffic, the noise on the motorway is lower than predicted although not sufficient to affect an 'as expected' assessment for noise.
- The scheme has had a better than expected impact on greenhouse gases, as the outturn emission with the scheme is less than forecast. This is primarily due to traffic flows being lower than expected.
- Land purchase areas outside the original scheme boundary have required additional clearing of existing vegetation in some instances and presented opportunities to plant shrubbery in new areas. This additional clearance has allowed for an increase in soft landscaping within

the highway boundary, replacing retaining features which would have been a permanent artificial feature in the landscape.

- Soil preparation issues noted during construction, including compaction and insufficient depths of topsoil may impact on growth targets for mitigation measures.
- Overall loss of habitat to the widening was reduced compared to the ES forecast. However, there had been some loss of habitat (arable land or species-poor pasture) outside the highway boundary for new attenuation ponds and environmental (screening) bund sites. Mitigation for these impacts includes new habitat creation of woodland or species-rich grassland. New habitats are considered to be of higher quality than those lost, and to provide improved habitat connectivity.

Accessibility and Integration

- The scheme's impact on the Option Values, Severance and Access to the Transport System sub-objectives of neutral is consistent in the forecast and the outturn evaluation.
- This scheme is compatible with regional and national transport polices and most local policies.

Summary of Scheme Economic Performance

All monetary figures in 2002 Prices and values	Forecast	Outturn Re-forecast
Journey Time Benefits	£1,415.7m	£2,208.5m
Vehicle Operating Costs[1]	-£115.2m	-£55.7m
TEE impacts during construction	£15.9m	
TEE impacts during maintenance	-£22.2m	
Safety Benefits	£0.3m	£0m
Journey Time Reliability	£71.6m	£94.3m
Noise	-£0.7m	
Carbon	-£29.9m	-£15.0m
Total Present Value Benefits (PVB)	**£1,335.5m**	**£2, 225.1m**
Investment costs (Construction)	£476.1m	£421.8m
Maintenance costs	£-15.4m	
Indirect Tax Revenue	-£229.5m	-£110.9m
Total Present Value Costs (PVC)	**£231.3m**	**£295.4m**
Benefit Cost Ratio (BCR)-Indirect Tax as Cost	**5.8**	**7.5**
Benefit Cost Ratio (BCR)-Indirect Tax as Benefit	**3.4**	**5.7**

[1] Costs to users when driving their cars on the network, mainly derived from fuel cost changes

- The outturn investment cost is 11% lower than forecast.
- The difference between outturn and forecast PVB is 67%. The reason for higher benefits in the outturn is due to greater than expected journey time and reliability benefits and a lower than expected carbon disbenefit.
- The outturn Benefit to Cost Ratio (BCR) is higher than expected owing to the outturn benefits exceeding forecasts and costs remaining relatively in line with the forecast. This is based on a 60 year appraisal period.
- The scheme is likely to facilitate wider economic benefits through increased capacity, improved journey times and reliability, although it is too early to quantify at this stage.

1. Introduction

Background

1.1 This report represents the One Year After (OYA) post opening study of the **M25 Junctions 16 to 23 Widening** scheme (hereafter known as 'the scheme') which opened in May 2012. The evaluation has been prepared as part of the Highways Agency's (HA's) Post Opening Project Evaluation (POPE) programme. POPE is undertaken one year and five years after the opening of all major schemes.

1.2 The purpose of the POPE OYA study is to evaluate whether the original objectives of the scheme have been achieved, and to provide a comparison of predicted and actual scheme impacts. The study presents an evaluation of the scheme's impact according to the five transport objectives; economy, safety, environment, accessibility and integration.

1.3 More specifically, the report sets out the following:

- A comparison of the 'before' and 'after' traffic volumes on the M25 J16-23 and other roads in the vicinity of the scheme.
- A comparison of 'before' and 'after' journey times on the M25 J16-23.
- An outline of the changes in accident rates on the M25 J16-23 following the opening of the scheme.
- A monetised comparison of the predicted and actual impacts of the scheme.
- An evaluation of the impact of the scheme upon the environment, more specifically its impact upon noise, air quality, landscape, biodiversity, heritage and water.
- An assessment of the scheme's impact on the accessibility and integration objectives.

Scheme Context

1.4 The M25 is a strategic orbital road in South East England surrounding London and plays a pivotal role in the Highways Agency'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 through traffic. The M25 is of local, regional, national and international importance, forming part of the E30 route on the European E-road network. Junctions 16 through to 23 are on the northwest section of the M25 proximate to Watford, as shown in ***Figure 1-1*** (overleaf).

1.5 As 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 In March-April 2004, the preferred routes for the widening works were announced for the M25. These schemes were informed by the London Orbital Multi Modal Study (ORBIT), published in 2002. The works were divided into five sections for construction purposes:

- Section 1 – from Junctions 16 (M40) to 23 (A1(M)).
- Section 2 – from Junctions 5 (M26) to 7 (M23).
- Section 3 – from Junctions 1b (A282) to 3 (M20).
- Section 4 – from Junctions 27 (M11) to 30 (A13).
- Section 5 – from Junctions 23 (A1(M) to 27 (M11).

1.7 In addition to the scheme evaluated here (Section 1), the widening works for Section 3 and Section 4 were completed as planned (in 2008 and 2012 respectively). In more recent years, however, proposals to widen the physical extents of motorways have been curtailed, with Managed Motorway schemes becoming the preferred option for increasing route capacity. Managed Motorway programmes allow for hard shoulder running and traffic management systems to effectively manage vehicle flow. The widening schemes for Section 2 and Section 5 were therefore suspended and have been replaced by smart motorway schemes.

Figure 1-1 – Geographical context of the M25 Junctions 16-23 Widening Scheme

1.8 The M25 crosses a number of roads and railway lines as it passes between Junctions 16 and 23 as follows:

- Junctions 16 to 17: M40, A40 and A413 carriageways and London Northwestern railway line
- Junctions 17 to 18: A412 carriageway and London Underground Metropolitan Line
- Junctions 18 to 19: A404 carriageway
- Junctions 19 to 20: no crossings
- Junctions 20 to 21: A41 (T) carriageway and Euston – Rugby TV Junction railway line
- Junctions 21 to 22: M1 and A405 (T) carriageways and Midland Mainline railway line
- Junctions 22 to 23: A1081, A1(M) and A1 carriageways

Scheme Objectives

1.9 The primary objectives of the scheme, as taken from the Non-Technical Summary of the Environmental Statement (August 2007) were:

- **Improve Reliability.**
- **Improve Safety.**
- **Reduce Congestion.**
- **To minimise adverse environmental impacts of the upgraded section.**
- **Improve Driver Information.**

Scheme Description

1.10 The scheme section runs between M25 Junction 16 at Iver Heath near Uxbridge to Junction 23 near South Mimms. Prior to scheme completion there were three lanes in each direction, with full width hard shoulders.

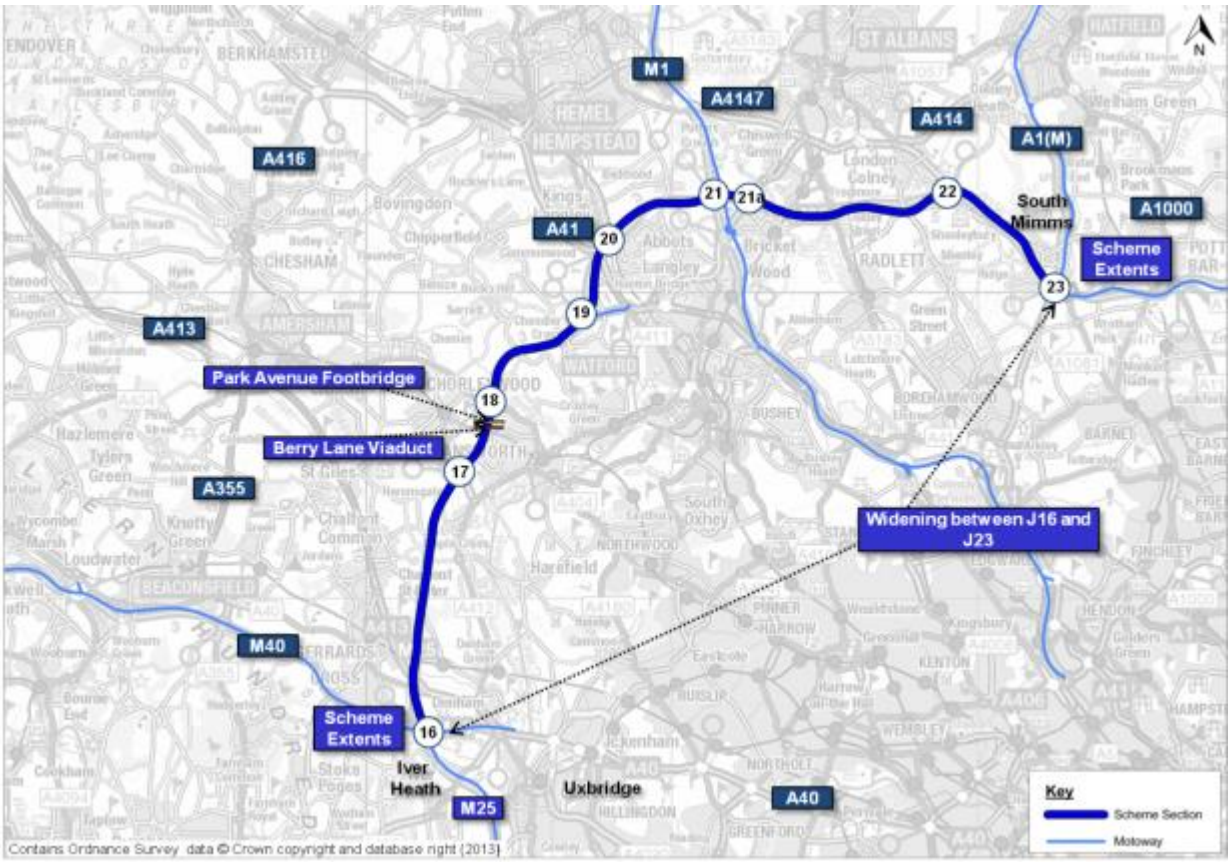
1.11 The scheme involved widening the M25 from three to four lanes in both directions along the length of the route. The scheme also comprised:

- Construction works on the Berry Lane Viaduct to allow for widening.

- The replacement of the existing Park Avenue Footbridge just south of junction 18 at Chorleywood.

1.12 Construction began in May 2009 and the scheme opened in May 2012. Key features of the scheme are shown in ***Figure 1-2*** below.

Figure 1-2 – Key Features of the M25 Junctions 16-23 Widening Scheme



History of the Scheme

1.13 A brief history of the principal events involved in the development of the scheme is provided in ***Table 1-1***.

Table 1-1 – Chronology of the M25 Junctions 16-23 Widening Scheme

Date	Event
April 2004	Preferred Route Announcement Date
September 2004	Public Consultation
March 2007	Invitation to Tender
August 2007	Draft Order/ Environmental Statement
May 2008	Secretary of State Declaration
May 2009	Date of Contract Award
May 2009	**Construction starts**
May 2012	**Scheme opens**

Local Network Supply and Demand Changes

1.14 Local road network changes in the locality of the scheme area can sometimes have an impact on traffic flows, journey times or collisions. A number of schemes are either in construction or have been completed recently on M25. Those in the vicinity of, and of most relevance to the widening between junction 16 and junction 23 are listed in ***Table 1-2*** and shown in ***Figure 1-3***. In addition to this, other schemes on the feeder roads to this scheme are also listed.

1.15 Section 1 of the M25 is amongst a number of schemes in the area, forming an overall long-term strategy to manage the existing motorway network more effectively.

Table 1-2 – Other schemes in the vicinity of the M25 Junction 16-23 Widening Scheme

Scheme Name	Current Status	Start Date	Opening Date/ Latest Forecast Opening Date
M25 J27-30 Widening (Section 4)	Completed	July 2009	May 2012
M25 J28/A12 Brook Street Improvement	Completed	May 2007	March 2008
A1(M) Hatfield Tunnel Refurbishment	Completed	June 2009	May 2011
M25 J1b-3 Widening	Completed	June 2007	July 2008
M1 J10-13 Improvements	Completed	December 2009	December 2012
M1 J6a-10 Widening	Completed	March 2006	December 2008
M25 J30 – Interim scheme	Planned	April 2013	October 2013
M25 J23-25 (Section 5a) – Smart Motorway	Completed	February 2013	April 2014
M25 J25-27 (Section 5b) – Smart Motorway	Under Construction	February 2013	End 2014
M25 J5-7- Smart Motorway	Completed	May 2013	April 2014

Changes since Scheme Appraisal

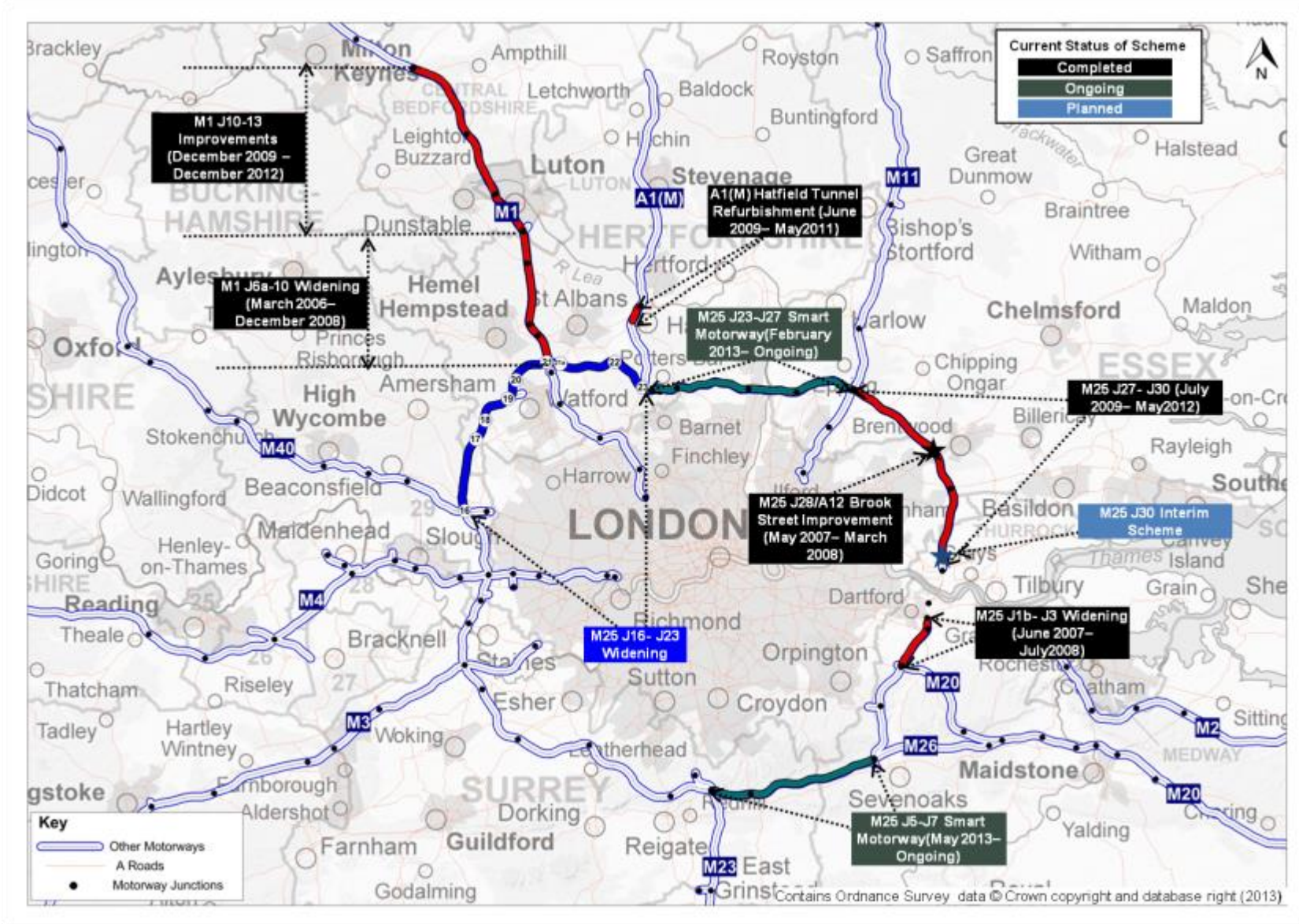
1.16 The pre-scheme appraisal (in 2007) made assumptions about which schemes would be implemented over the modelled appraisal period. The network used in the appraisal comprised the M25 and any committed schemes or schemes on the verge of approval that were likely to have an impact on the M25 sections to be widened. This excluded widening of Section 4 and Section 5 but included the proposed widening schemes for the rest of the M25.

1.17 Construction for Section 5(M25 J23-27) started in February 2013 and at the time of reporting junction 23 through to junctions 25 is complete, and the SM-ALR for J25-27 is due to open in late 2014. The impact of these works has been considered when drawing conclusions about the impact of the scheme on strategic traffic. The timeline of the Section 5 construction has been considered in the evaluation presented here in order to develop conclusions that consider the impact of Section 1 alone.

1.18 Widening from three to four lanes in both directions for Section 4 (M25 J27-30) started in July 2009 and scheme opened to traffic in May 2012. Controlled motorway at this section was operational from May 2014.

1.19 Gantries were erected along the M25 between junctions 16 and 23 as part of the scheme and the scheme cost included this element. The scheme section has the capacity to operate as a controlled motorway, but any use of the gantries was only advisory during the period covered by this evaluation. The speeds/messages are manually inputted as the system does not currently respond automatically to changes in flow. The HA project manager for the scheme confirmed that the controlled motorway element was operational from March 2014.

Figure 1-3 – Other schemes in the vicinity of the M25 Junction 16-23 Widening Scheme



Post Opening Project Evaluation (POPE)

1.20 The HA is responsible for improving the strategic highway network (motorways and trunk roads) by delivering the Major Schemes programme. At each key decision stage through the planning process, schemes are subject to a rigorous appraisal process to provide a justification for the project's continued development.

1.21 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 DfT's objectives for transport have been achieved. 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 ***Table 7-1*** on page 108.

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 vital 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 to traffic, against predictions made during the planning process. The outturn impacts of a scheme are summarised in an Evaluation Summary Table (EST) which summarises the extent to which the objectives of a scheme have been achieved. The EST for this scheme can be found in ***Table 7-2*** on page 109.

1.23 POPE of Major Schemes goes beyond monitoring progress against targets set beforehand. Instead, it provides the opportunity to study which aspects of the intervention and appraisal tools used to evaluate it are performing better or worse than expected, and how they can be made more effective. More specifically the objectives of POPE evaluation reports are as follows:

- Provide a quantitative and qualitative analysis of scheme impacts consistent with national transport appraisal guidance (WebTAG) and scheme specific objectives.
- Identification and description of discrepancies between forecast and outturn impacts.
- Explanations of reasons for differences between forecast and outturn impacts.
- Identification of key issues relating to appraisal methods that will assist the HA in ongoing improvement of appraisal approaches and tools used for major schemes.

Report Structure

1.24 The remainder of this report is structured as follows:

- ***Chapter 2*** – Traffic Impact Evaluation.
- ***Chapter 3*** – Safety.
- ***Chapter 4*** – Economy.
- ***Chapter 5*** – Environment.
- ***Chapter 6*** – Accessibility and Integration.
- ***Chapter 7*** – Appraisal Summary Table and Evaluation Summary Table.
- ***Chapter 8*** – Conclusions.

1.25 There are also a number of appendices listed below as follows:

- ***Appendix A***. – Tables and Figures in this Report
- ***Appendix B*** – Glossary
- ***Appendix C*** – M25 Journey Time Sections
- ***Appendix D***. – Information requested for Environmental section
- ***Appendix E***. – Environmental Barrier Reconciliation
- ***Appendix F*** – Photographic Record of Scheme – ES photomontage comparisons (existing views –March 2006)
- ***Appendix G*** - *Extracts from popular Archaeological publication*

2. Traffic Impact Evaluation

Introduction

2.1 This section examines traffic data from a number of sources to provide a before and one year after opening comparison of traffic flows and journey times on the M25 between junctions 16 and 23. The purpose of this evaluation is to understand whether changes in traffic flows and journey times may be attributable to the scheme.

2.2 This section comprises:

- A summary of the sources used to compile data for this evaluation.
- A description of national, regional and local background traffic trends to provide context against which observed changes in actual traffic can be considered.
- A detailed comparison of before and one year after traffic flows on key routes in the study area likely to be affected by the scheme to provide context against which observed changes in actual traffic can be considered.
- An evaluation of key differences between forecast and outturn impacts of the scheme in terms of traffic flows and journey times to identify whether traffic flow changes were as expected or otherwise. Consideration is then given for any differences to identify whether alternative approaches in scheme appraisal would have lead to a more accurate forecast.

Data Sources

2.3 This section of the report uses data from several sources to inform the “before” and “after” analysis of changes in traffic volumes and journey times on key routes that may be attributable to the scheme.

Traffic Count Data

2.4 For the purposes of this evaluation study, the main sources of count data include:

- Permanent count data obtained from the TRADs[1] database for count locations on the HA network.
- Pre-scheme 24-hr classified automatic traffic count (ATC) data conducted in March 2009, commissioned specifically for the purpose of this study.
- Post-opening 24-hr classified ATC surveys conducted in November 2013, commissioned for the purpose of this study.
- Permanent monitoring count site data provided by Hertfordshire County Council (HCC), both pre-scheme and post-opening.
- Permanent monitoring count site data provided by Buckinghamshire County Council (BCC), both pre-scheme and post-opening.

Journey Time Data

- Journey times along the M25 between junctions 16 and 23 have been extracted from the HA’s Journey Time Database (JTDB). The JTDB contains average journey times and average speeds for each junction to junction link on the Highways Agency’s core network.

[1] TRADS is the Highways Agency website containing traffic flow data from automatic traffic counts on the HA’s strategic network.

Background Changes in Traffic

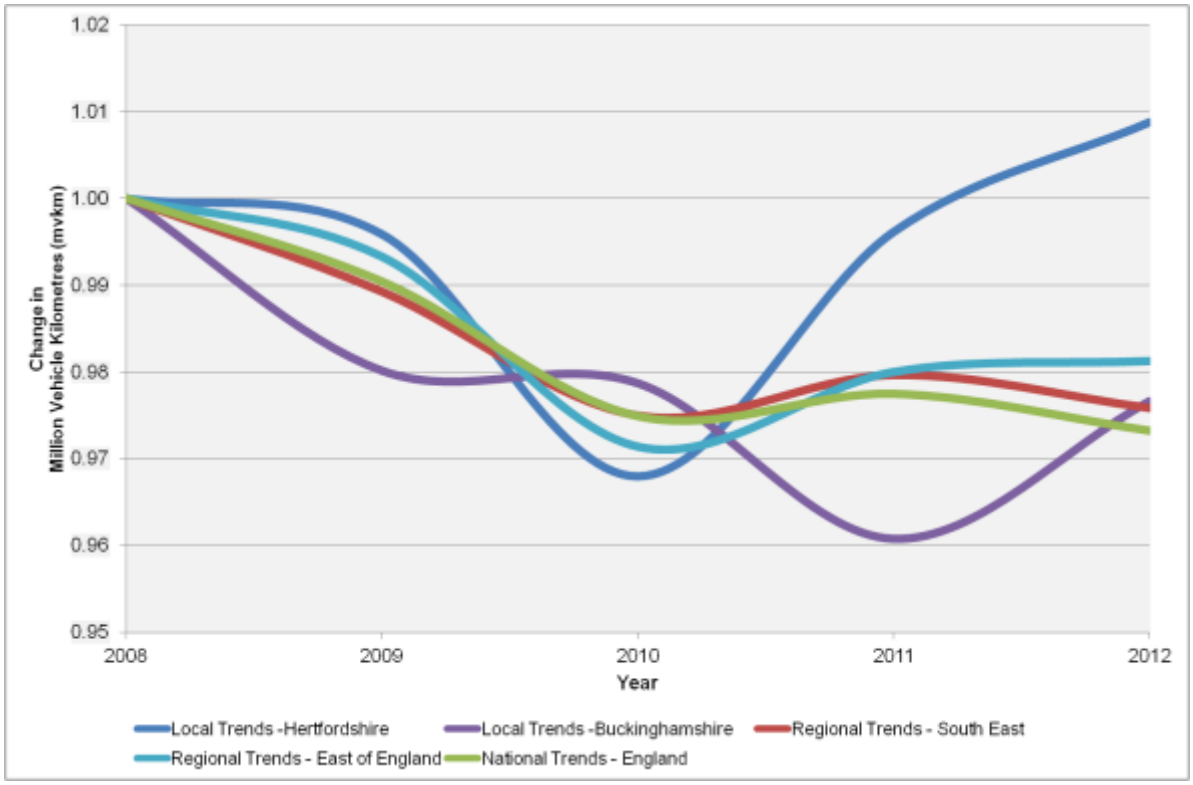
2.5 Historically in POPE scheme evaluations, the 'before' counts have often been factored to take account of background traffic growth so that they are directly comparable with the 'after' counts. This usually involves the use of National Road Traffic Forecasts (NRTF), with local adjustments made using National Transport Model (NTM) Local Growth Factors.

2.6 However, in light of the recent economic climate, which has seen widespread reductions in motor vehicle travel in the United Kingdom (UK) as a whole since 2008, it is no longer deemed appropriate to use this method of factoring 'before' counts to reflect background changes in traffic. Rather, recent POPE studies have taken a more considered approach in order to assess changes in the vicinity of the scheme, within the context of national, regional and locally observed background changes in traffic.

National, Regional and Local Trends

2.7 The Department for Transport (DfT) produces observed annual statistics for all motor vehicles by local authority[2]. Data between 2008 (before start of construction) and 2012 (the latest available) is shown in million vehicle kilometres (mvkm) for Hertfordshire, Buckinghamshire, the South East, the East of England and England in ***Figure 2-1***.

Figure 2-1 – National, Regional and Local Traffic Trends



2.8 The following points can be made from ***Figure 2-1***:

- At a national and regional level, traffic trends are broadly similar, with a slight decline in vehicle kilometres from 2008 to 2010 and then a marginal increase in 2011.
- Traffic trends in Hertfordshire have shown a different trend to those seen nationally and regionally, with the vehicle kilometres travelled falling drastically from 2009 to 2010 and then increasing by 4.2% between 2010 and 2012.
- Traffic levels in Buckinghamshire have changed by a similar level between 2008 and 2012, compared to national and regional trends, though the profile of traffic between

[2] Motor vehicle traffic (vehicle kilometres) by region in Great Britain, annual from 1993 to 2012. Table TRA8904 (Department for Transport).

these years is quite different, with traffic remaining same between 2009 and 2010 and then dropping by 2% between 2009 and 2011 and the increasing in 2012.

M25 Growth Trends

2.9 As the remainder of this section explores the changes that have occurred since the opening of the scheme, and attempts to establish to what degree the changes can be attributed to the scheme, it is therefore fitting to establish how the M25 motorway fits within this wider context of background traffic changes. A control site has been chosen on M25 between J13 and J14 (see ***Figure 2-2***). This section of the M25 lies between the A3113 Airport Way/Horton Road and the A30 Staines Bypass and has five lanes in each direction. ***Table 2-1*** shows the change in AADT by direction observed between 2008 and 2013 for this section of the M25.

Figure 2-2 – Location of Control Sites on Other Local Roads

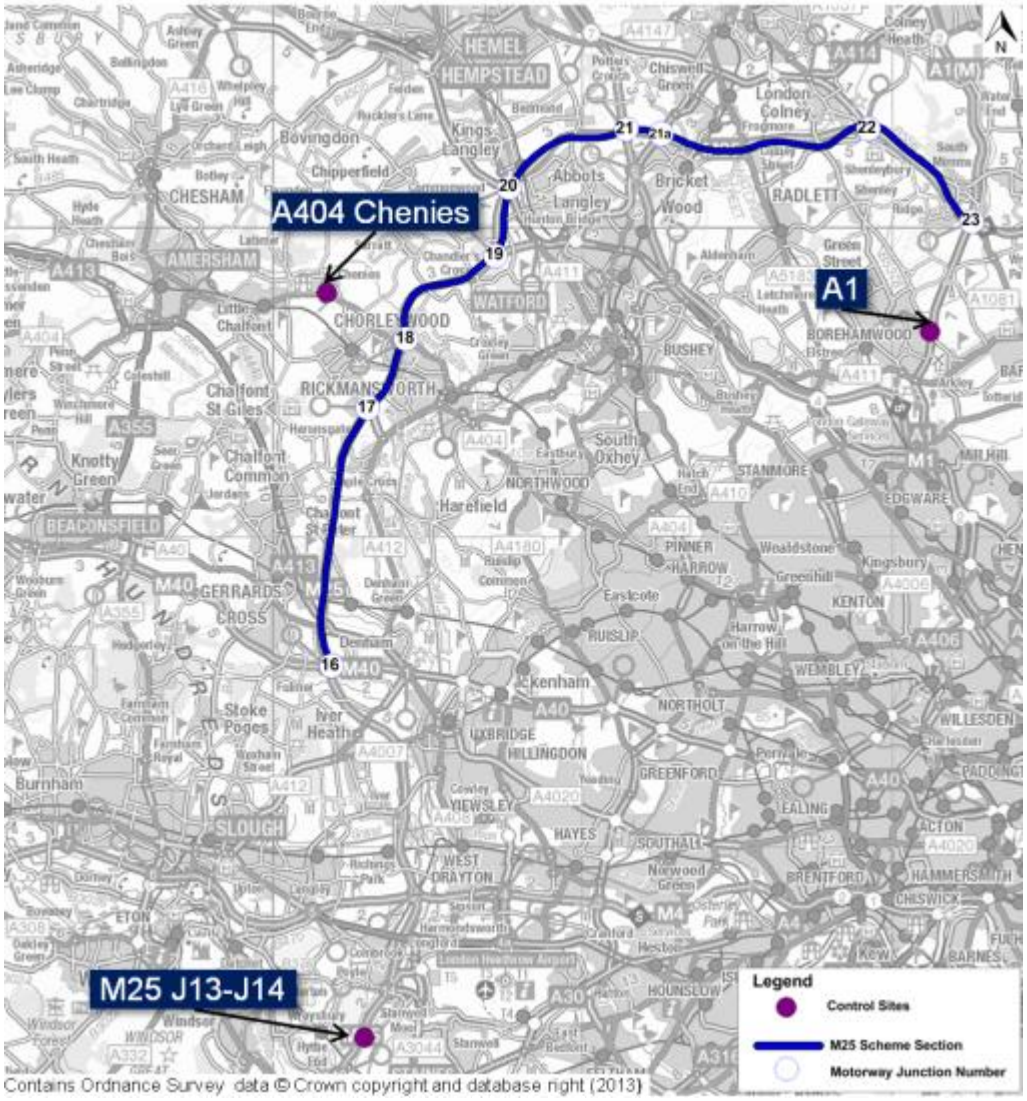


Table 2-1 – Long Term Trends in AADT on M25 J13-J14

Year	AADT		Factor of Change on 2008	
	Clockwise	Anti-Clockwise	Clockwise	Anti-Clockwise
2008	101,200	102,000	1.00	1.00
2009	100,100	101,400	0.99	0.99
2010	100,800	101,100	1.00	0.99
2011	104,200	103,500	1.03	1.01
2012	102,700	102,900	1.01	1.01
2013	103,800	103,200	1.03	1.01

2.10 It can be seen from ***Table 2-1*** that traffic levels on this section of M25 (J13-J14) have seen a slight increase since 2008. The clockwise direction carries slightly more traffic than the anti-clockwise direction and the same trend is observed in traffic growth. The slight increase in traffic on the M25 remote from the scheme suggests that any increases beyond this level on the scheme itself are a result of the widening scheme.

Long Term Traffic Trends on other local roads in the scheme vicinity

Before analysing the differences between pre-scheme and post-opening traffic flows, it is important to recognise that this only presents a 'snap-shot' of traffic conditions at particular moments in time. Therefore, it is useful to consider the historical profile of yearly traffic flows in order to provide further context with which to assess the scheme's impact. In order to do this on other local roads in the vicinity of the scheme, two control sites have been chosen to investigate the background trend in traffic – one on the western side at the beginning of the scheme section (A404) and the other at the end of the scheme section (A1). The location of the control sites within the context of M25 is shown in ***Figure 2-2***.

Table 2-2 – Long Term Trends in AADT on other local roads

Year	AADT		Factor of Change on 2008	
	A404 Chenies	A1	A404 Chenies	A1
2008	13,400	49,700	1.00	1.00
2009	13,300	48,800	0.99	0.98
2010	13,400	49,200	1.00	0.99
2011	13,300	50,600	0.99	1.02
2012	13,500	48,600	1.01	0.98
2013	13,700	48,100	1.02	0.97

2.11 It can be seen from ***Table 2-2*** that prior to scheme opening (i.e. between 2008 and 2011), traffic on roads in the immediate vicinity of the scheme were broadly consistent with regional trends (***Figure 2-1***). Though it should also be noted that there is no clear pattern of background changes to traffic prior to the scheme's opening. Changes to traffic since 2012 are discussed in greater detail below.

Conclusions on Background Growth

2.12 This section has considered a number of issues which may have influenced observed traffic flows pre-scheme and post-opening:

- National and regional trends show a reduction of approximately 2% in traffic levels between 2008 and 2011.
- Local trends (i.e. Buckinghamshire and Hertfordshire) do not show a consistent pattern in background changes to traffic across the area which is likely to be affected by the scheme. This is consistent with the long term trend seen in the local control counts.
- Traffic trends on the M25 show a slight increase in traffic (1%) between 2008 and 2011.

2.13 As there is no consistent trend in background traffic growth prior to the scheme opening, it is not appropriate to derive a factor to apply to the before traffic counts to account for background traffic changes.

Traffic Volume Analysis

2.14 The changes between pre-scheme and post-opening traffic flows on all key roads in the vicinity of the M25 scheme section are now considered in the context of the wider traffic trends, in order to assess the scheme's impact on traffic patterns.

2.15 This section of the report uses data from a variety of sources to inform the before and after analysis of changes in traffic volumes and journey times for the scheme. To complete this evaluation, data from before construction (November 2008) and after scheme opening (November 2012) is compared.

2.16 Construction for Section 5 (junctions 23 to 27, Smart Motorway), adjacent to the scheme considered here, started in February 2013 and is ongoing at the time of this evaluation. As such, the post -opening impacts for this evaluation have been taken from November 2012, a neutral month prior to the start of construction for Section 5. This has been done to ensure that the evaluation is not affected by the ongoing construction on the adjacent section.

Traffic Count Data Sources

2.17 The sources for the traffic count data were listed at the start of this section. It should also be noted that the HA's TRADS database does not contain pre-scheme traffic data for the following M25 sections along the scheme:

- M25 between junction 18 and junction 19 – anti-clockwise.
- M25 between junction 19 and junction 20 – anti-clockwise.
- M25 between junction 21 and junction 21a – clockwise and anti-clockwise.

2.18 Given the lack of data for some of the scheme sections, it should be noted that the majority of conclusions drawn in this section of the report about the scheme's impacts on traffic between junctions 16 and 23 will be based on the sections where both pre-scheme and post-opening information is available only.

2.19 The locations of the traffic count data sources used in this evaluation are shown in ***Figure 2-3*** for the scheme section, and ***Figure 2-4*** for other motorways and wider area alongside details of each traffic count site.

Section	Source	Map Reference	Site Name and Description
M25-Scheme Section	TRADS	A	M25 between J16 and J17
		B	M25 between J17 and J18
		C	M25 between J18 and J19
		D	M25 between J19 and J20
		E	M25 between J20 and J21
		F	M25 between J21 and J21A
		G	M25 between J21A and J22
		H	M25 between J22 and J23
Other Motorways in the scheme vicinity	TRADS	J	M40 J1 - J1A
		K	M25 J16-15
		M	M4, Junction 4b - 5
		N	A1(M), Junction 1 - 2
		O	A1(M), Junction 2 - 3
		P	A1(M), Junction 3 - 4
		Q	M25, Junction 24 - 25
		R	M40, J1A - J2

Figure 2-3 – Location of TRADS Count Sites

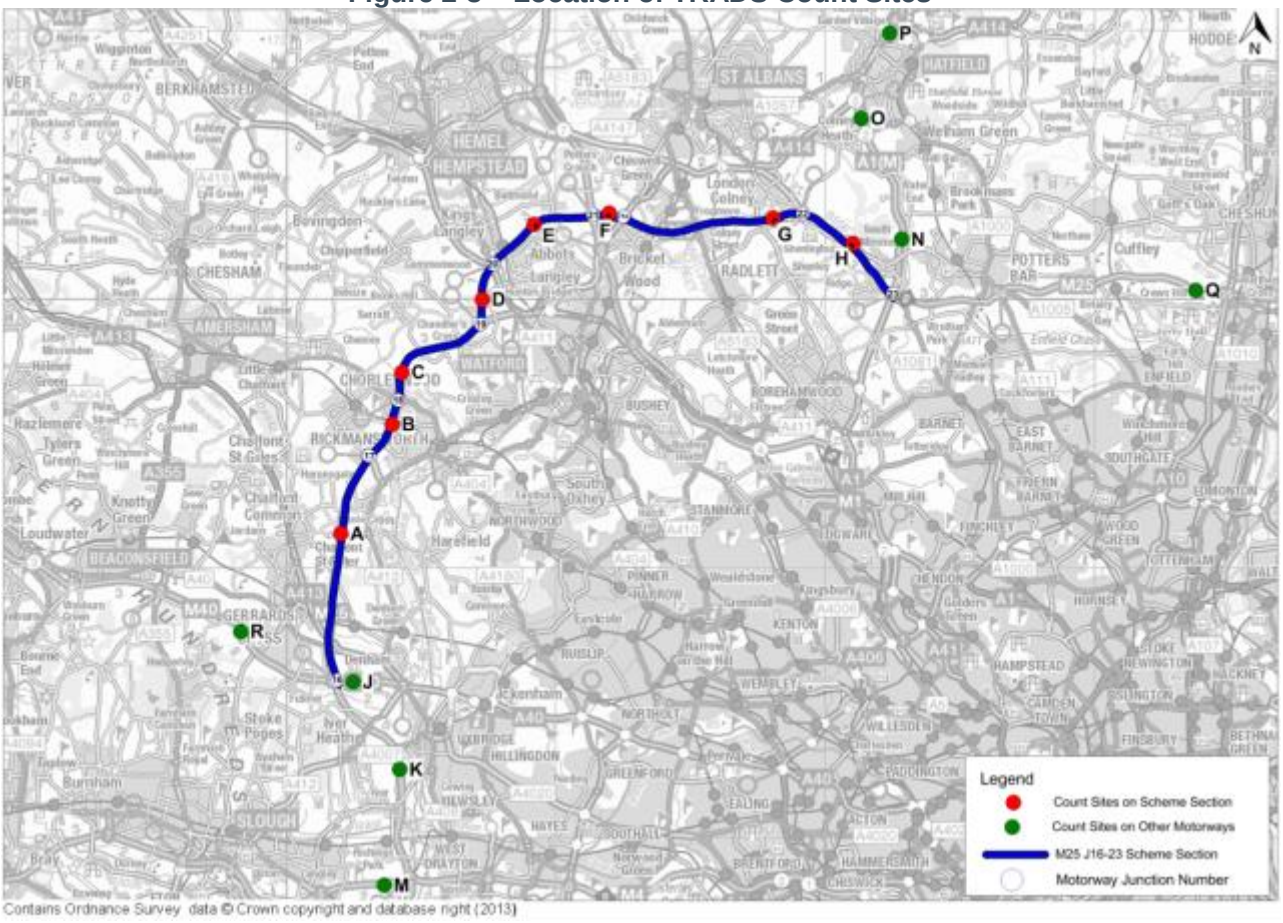


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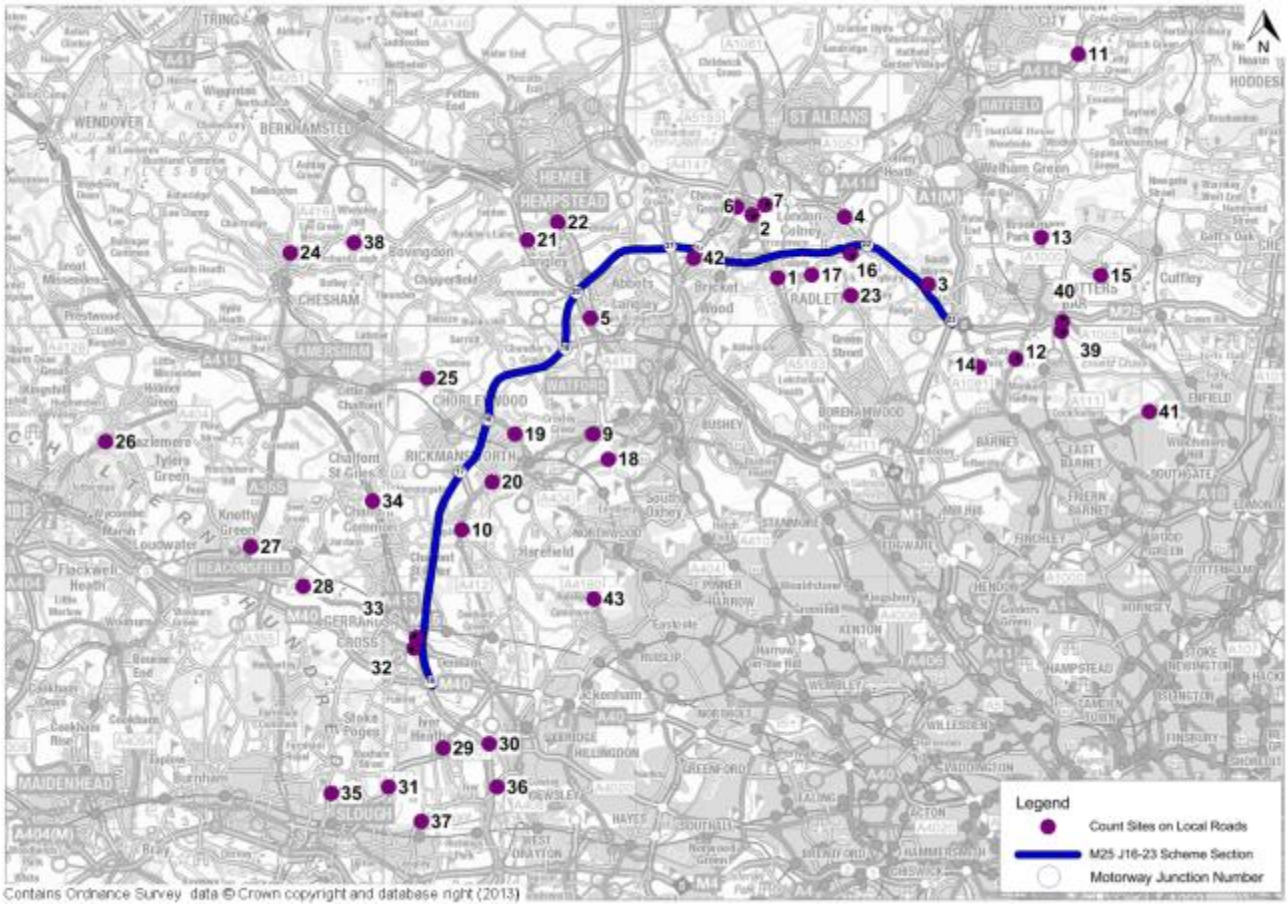
Figure 2-4 – Location of Count Sites in wider area



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	Map Ref	Site Name and Description		Map Ref	Site Name and Description
Hertfordshire County Council	1	A5183 Watling Street, Radlett	Buckinghamshire County Council	24	A416 Berkhamsted Rd Chesham
	2	A5183 Watling Street, Park Street		25	A404 Chenies
	3	B556 St Albans Road, South Mimms		26	A404 Hazlemere
	4	A1081		27	A355 Amersham Road Beaconsfield
	5	A41 Watford Road, Hunton Bridge		28	A40 Oxford Rd East of Potkiln Ln
	6	A405 North Orbital Road, Chiswell Green		29	A412 Iver Heath
	7	A414 North Orbital Road, Park Street		30	A4007 Slough Road, Iver Heath
	9	A412 Watford Rd, Croxley Green		31	A412 George Green
	10	A412 Denham Way, West Hyde		32	A40 Tatling End
	11	A414 Hatfield Road, Hatfield		33	A413 Gerrards Cross
	12	A1000 Barnet Road, Kitts End		34	A413 Chalfont St Giles
	13	A1000 Great North Road, Potters Bar		35	B416 Stoke Green Crematorium
	14	A1081 St Albans Road, Potters Bar		36	B470 Iver Lane
	15	B156 Northaw Road, Cuffley		37	B470 Shreding Green
	16	B556 Bell Lane, London Colney		38	B4505 Orchard Leigh
	17	B556 Harper Lane, London Colney	Surveys commissioned for this study	39	A111 Stagg Hill
	18	A4145 Moor Lane, Batchworth		40	A1005 The Ridgeway
	19	A404 Chorleywood Road, Rickmansworth		41	A110 Enfield Road
	20	A412 Uxbridge Road, Rickmansworth		42	A405 North Orbital Road
	21	A41 Bypass, Kings Langley		43	Ducks Hill Road
	22	A4251 Hempstead Road, Kings Langley			
	23	B5378 Black Lion Hill, Shenley			

Observed Flows

2.20 A comparison of pre-scheme and post-opening 24-hour Average Weekday Traffic (AWT) flows along the scheme section is presented in ***Figure 2-5***. The change in traffic flows across the wider area is shown in ***Figure 2-6***. The percentage change in flow at OYA compared to the before stage is indicated by colour code.

Figure 2-5 – Comparison of Pre-scheme and Post-opening AWT along the scheme section

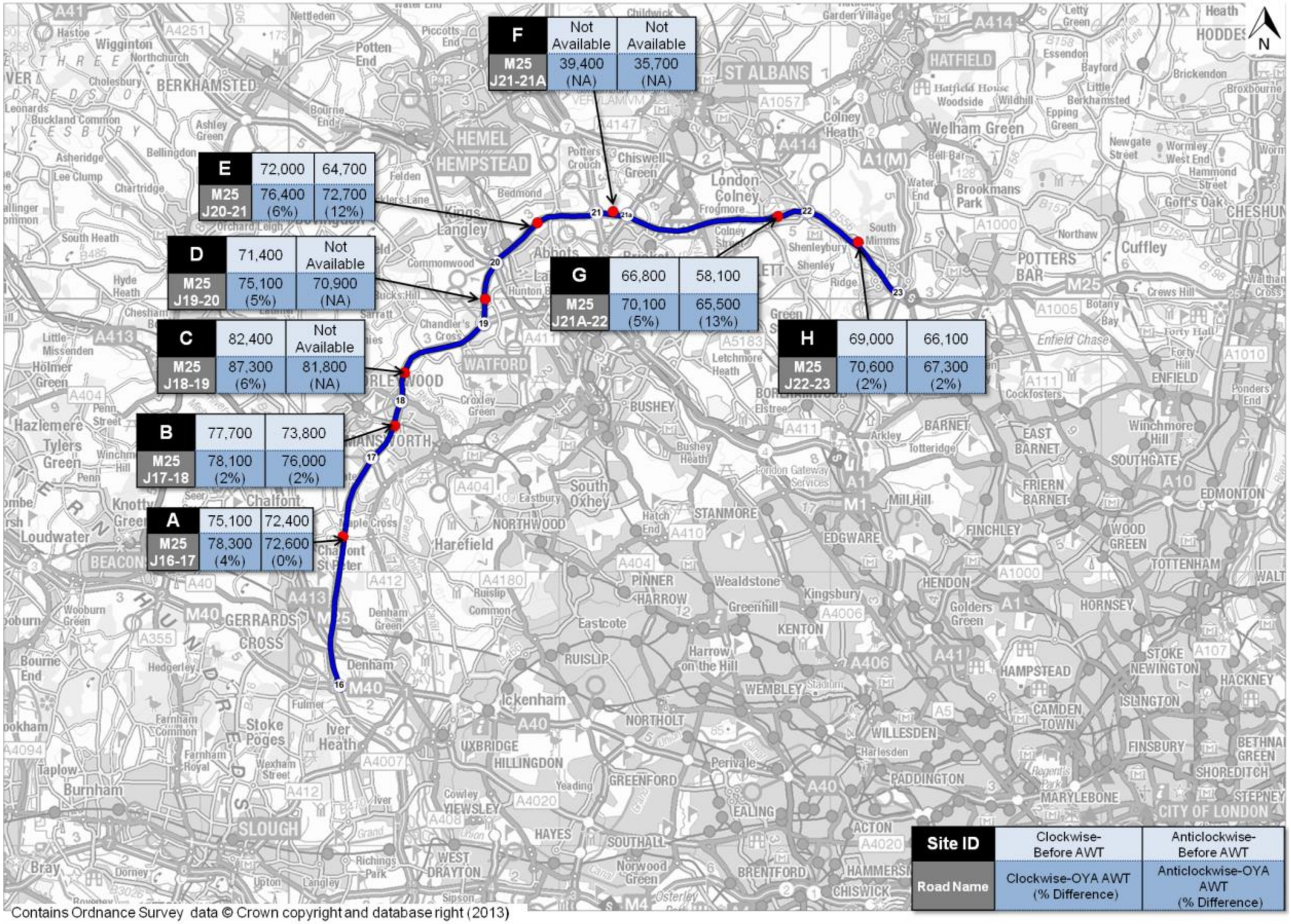

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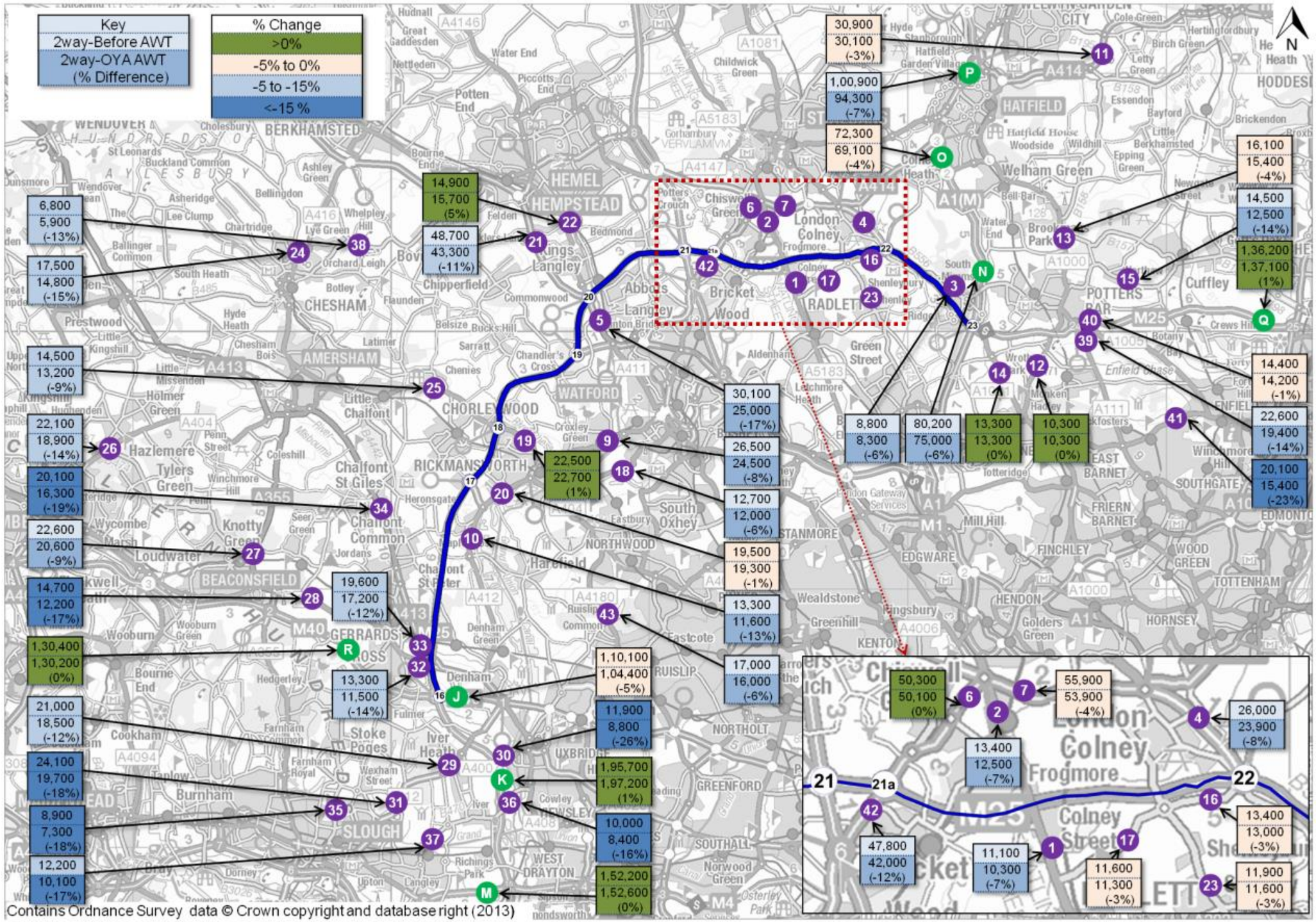
Figure 2-6 – Comparison of Pre-scheme and Post-opening 2-way AWT in the wider area



2.21 The following observations regarding changes in Average Weekday Traffic(AWT) along the scheme section, other motorways and local roads in the study area can be made from ***Figure 2-5*** and ***Figure 2-6***:

Scheme Section

- Traffic volumes on the section of the scheme where data is available in the pre-scheme and post opening period (J16 – J23) have increased at OYA.
- An increase of 4 to 6% is observed in the clockwise direction. The middle section of scheme (J20 to J22) has seen an increase of 12 to13% in the anti-clockwise direction whereas the start and end of scheme section the change in traffic is between 0% and 2%.

Other Motorways in the Study Area

- It can be seen that the traffic on eastern section on M40 close to the M25 J16 has seen a decrease of 5% and negligible increase on the western side of this section.
- Traffic on A1(M) has also reduced post scheme opening.
- To the south of the scheme section i.e. M25 J15-J16; there is a slight increase in traffic of 1%.
- To the north of the scheme section i.e. M25 J24-J25; there is a slight increase in traffic of 1%.

Other Local Roads in the Study Area

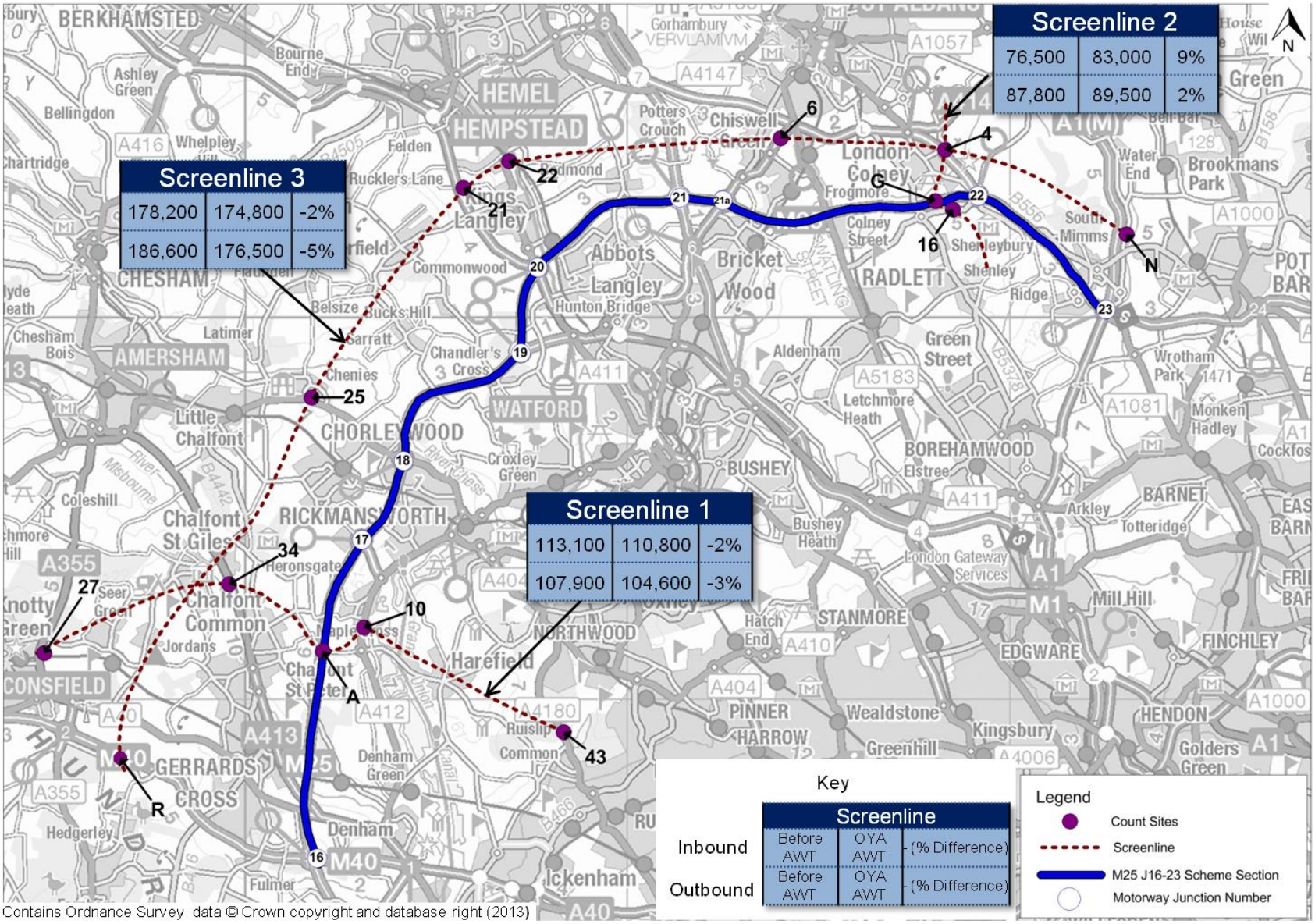
- Almost all 'A' roads where data is available within the study area have shown a reduction in traffic volumes between the before and OYA period.
- There is some evidence that the scheme may have helped to reduce traffic on local roads, since most roads on either side of the scheme section have seen a reduction in traffic.

Screenlines

2.22 In order to further investigate the overall impact on traffic in the vicinity of the scheme, a screenline analysis has been undertaken as shown in ***Figure 2-7***. Screenlines allow for a better understanding of vehicular movements across a wider corridor area.

2.23 Three screenlines have been identified for this study: one north-east of the scheme, and two running parallel to the scheme. This analysis enables a comparison of how east-west and north-south movement on the major roads have been affected by the scheme. All available count locations have been considered to represent a complete screenline and capture the changes to traffic patterns in and around the scheme location.

Figure 2-7 – Location of Screenlines



2.24 The results of the screenline analysis are presented in ***Table 2-3*** to ***Table 2-5.***

Table 2-3 – Screenline 1, Two Way AWT

Map Reference	Location	Two Way AWT		
		Before	OYA	% Diff
27	A355 Amersham Road Beaconsfield	22,600	20,600	-9%
34	A413 Chalfont St Giles	20,100	16,300	-19%
A	M25 between J16 and J17	147,500	150,900	2%
10	A412 Denham Way, West Hyde	13,300	11,600	-13%
43	Ducks Hill Road	17,000	16,000	-6%
Total Screenline 1		**220,500**	**215,400**	**-2%**

Table 2-4 – Screenline 2, Two Way AWT

Map Reference	Location	Two Way AWT		
		Before	OYA	% Diff
4	A1081	26,000	23,900	-8%
G	M25 between J21A and J22	124,900	135,600	9%
16	B556 Bell Lane, London Colney	13,400	13,000	-3%
Total Screenline 2		**164,300**	**172,500**	**5%**

Table 2-5 – Screenline 3, Two Way AWT[3]

Map Reference	Location	Two Way AWT		
		Before	OYA	% Diff
25	A404 Chenies	14,500	13,200	-9%
21	A41 Bypass, Kings Langley	48,700	43,300	-11%
22	A4251 Hempstead Road, Kings Langley	14,900	15,700	5%
6	A405 North Orbital Road, Chiswell Green	50,300	50,100	0%
N	A1(M), Junction 1 - 2	80,200	75,000	-6%
R	M40, J1A - J2	130,400	130,200	0%
4	A1081	26,000	23,900	-8%
Total Screenline 3		**364,000**	**351,400**	**-4%**

2.25 It can be seen from ***Figure 2-7*** and ***Table 2-3*** to ***Table 2-5*** that:

- Traffic accessing the M25 from north of the scheme section has decreased since the introduction of the scheme as can be seen from Screenline 3.
- There has been an increase in traffic along Screenline 2 with the major change seen on M25 scheme section between J21a and J22. Unfortunately, there is insufficient count data to extend this screenline further north or south.
- The total traffic crossing Screenline 1 has decreased, but this is made up of an increase in flow on the M25 and a decrease in flow on the local roads.

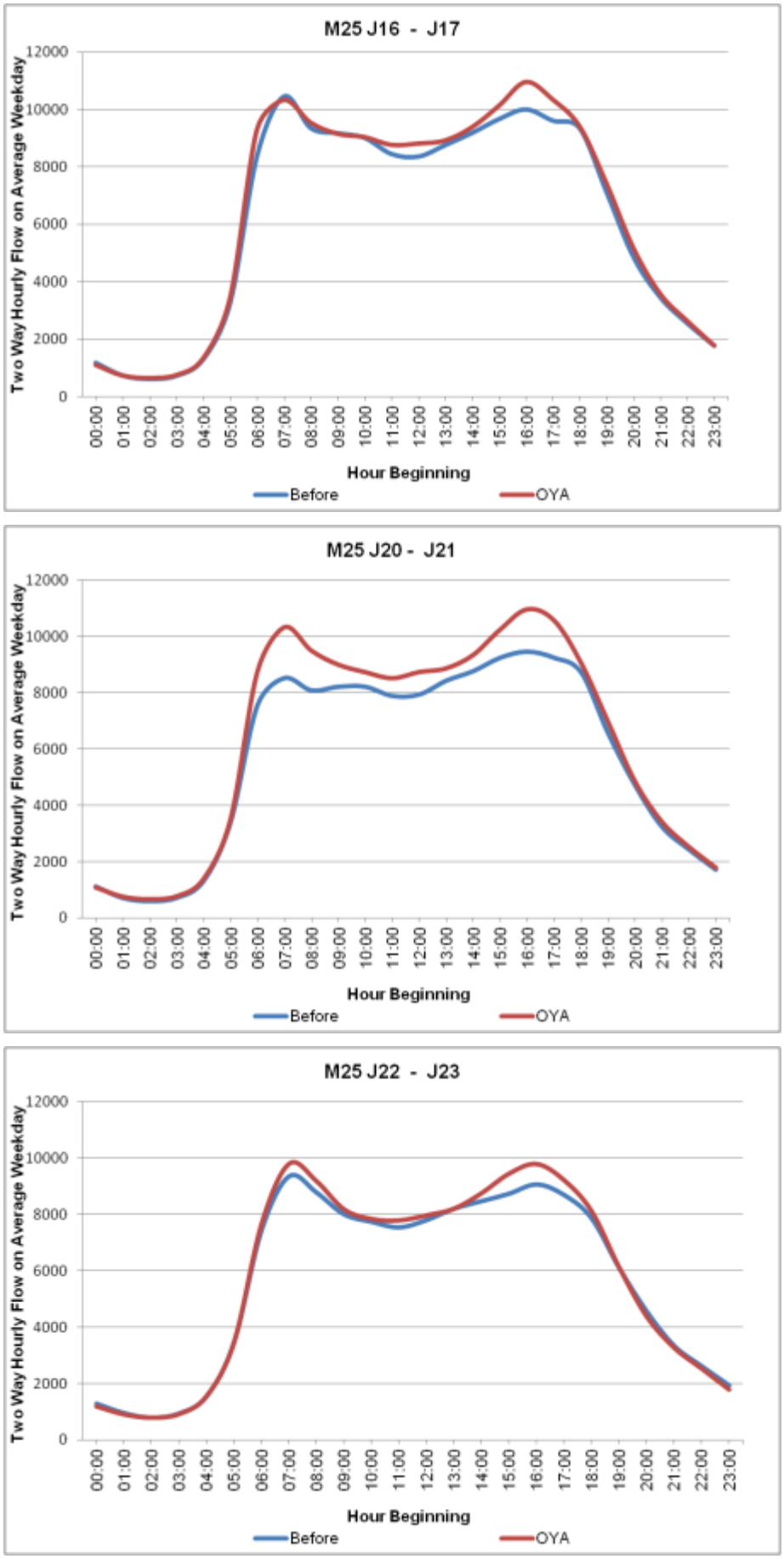
Hourly Distribution of Flows on the M25

2.26 The hourly distribution of flows across the day can be useful to determine the nature of peak flows on a particular link, and whether for instance peak spreading or contracting is occurring.

2.27 The following figures present the hourly profile of traffic throughout an average weekday, before and one year after opening for the three section of the scheme where data is available.

[3] Almost complete screenline, with the exception of traffic accessing from M1 at J21, as equivalent pre and post opening data unavailable.

Figure 2-8– Hourly Flow Profile on various sections of M25 between J16 and J23



2.28 The following conclusions can be drawn from ***Figure 2-8***:

- At OYA, each section has seen an increase in traffic in the AM and PM peaks. The most noticeable difference is between junctions 20 and 21.
- Whilst the increase in flow is evident in the AM and PM peak and, to some extent, during the Interpeak period, the flow has remained the same during the offpeak/overnight period.
- There is evidence, therefore, of pre opening congestion leading to suppression of traffic in the peaks which has come back after opening of the scheme.

Forecast vs. Outturn Traffic Flows

2.29 This section compares the observed traffic impacts of the scheme to the traffic changes forecast in the scheme appraisal. Before undertaking an evaluation of the forecast traffic impacts compared to those which have actually occurred, it is first necessary to develop an understanding of how the scheme has been appraised and the key assumptions used. This may then assist in explaining any potential differences between the traffic forecasts and the observed impacts.

Traffic Modelling Approach and Forecast Assumptions

2.30 The M25 North of Thames Assignment Model (NoTAM) was developed from the Highways Agency's NAOMI strategic traffic model v5.5 and used in the appraisal for Sections 1, 4 and 5 of the M25. SATURN (version 10.3) modelling suite has been used to develop the M25 NoTAM model.

2.31 The modelled base year was 2004 and networks and demand matrices were developed for Section 1 using the following forecast years:

- 2012 – Proposed Opening Year.
- 2015 – Intermediate Year/Proposed Opening Year for Section 5.
- 2027 – Design Year (15 years after opening).

2.32 This evaluation will focus on the 2012 forecasts to provide a direct comparison against the observed traffic flows in 2012.

2.33 Modelled time periods were as follows:

- Morning peak hour (AM) from 08:00 to 09:00.
- Inter peak hour (IP), average hour between 10:00 and 16:00.
- Evening peak hour (PM) from 17:00 to 18:00.

Network Coverage

2.34 The base network consisted of a simulation area, buffer area and a skeletal network covering a large part of Great Britain. The area covered by the SATURN simulation network included the entire area within the M25 and an area roughly bounded by Luton, Reading, Guildford, Crawley, Maidstone, Chelmsford and Stansted. Inside the simulation area, all motorways, A and B roads, as well as important unclassified roads, were included in the modelled network. Junctions were represented at several levels, with important junctions generally fully simulated.

Forecast Traffic Growth Rates

2.35 Planning forecasts were taken from TEMPRO Version 5.3 to provide traffic growth for cars. Goods vehicle growth factors were derived from NRTF (NRTF 1997). The forecast flows for appraisal purposes were forecast assuming the most likely traffic growth (central) to future years. There were no low or high traffic growth forecasts.

Forecast Networks

2.36 The Do-Minimum network comprised of the M25 (in 2004) and any committed schemes or schemes on the verge of approval that were likely to have an impact of the M25 sections to be widened. This included the proposed widening schemes for the rest of the M25 and excluding widening of Section 4 and Section 5 as discussed in Chapter 1.

2.37 The Do-Something networks comprise the Do-Minimum network plus the Section 1 widening scheme.

Forecasts vs. Observed Traffic Flows

2.38 Forecast traffic flows and speeds are provided in the 'North of Thames Assignment Model-Section 1 Forecasting Report (July 2007)'. Traffic Forecasting report provides the forecast traffic flows and speeds on the M25 mainline for section 1 in each modelled period, i.e. Morning Peak Hour, Inter Peak Hour and Evening Peak Hour. ***Table 2-6***, ***Table 2-7*** and ***Table 2-8*** presents the modelled Do-Minimum flows vs. Do-Something flows for the 2012 opening year and observed flows (pre-scheme -2008 and post-opening-2012) in the study area for each time period respectively. Observed flows are unadjusted due to the fact that background traffic growth shows inconsistent change in overall traffic volumes between 2008 and 2012. The traffic flows for section on M25 between J21 and J21a are not presented due to unavailability of data for a like for like comparison.

Table 2-6 – Forecast vs. Observed Traffic Flows-AM peak Hour, Two Way AWT

Section	Forecast				Observed			
	DM	DS	Diff	% Diff	2008	2012	Diff	% Diff
J16 - J17	11,800	13,300	1,500	13%	9,300	9,600	300	3%
J17 - J18	11,800	13,800	2,000	17%	9,800	9,900	100	1%
J18 - J19	12,800	14,900	2,100	17%	9,900	11,000	1,100	10%
J19 - J20	9,800	11,300	1,500	15%	7,700	8,900	1,200	16%
J20 - J21	10,500	12,000	1,500	14%	8,100	9,500	1,400	18%
J21 - J21a	8,500	9,900	-	-	-	-	-	-
J21a - J22	11,300	12,800	1,500	13%	8,300	9,400	1,100	14%
J22 - J23	10,700	11,800	1,100	10%	8,800	9,200	400	4%

Table 2-7 – Forecast vs. Observed Traffic Flows – Interpeak, Two Way AWT

Section	Forecast				Observed			
	DM	DS	Diff	% Diff	2008	2012	Diff	% Diff
J16 - J17	11,700	13,400	1,700	14%	8,900	9,000	100	1%
J17 - J18	11,600	13,300	1,700	15%	9,100	9,100	0	0%
J18 - J19	12,400	14,100	1,700	14%	9,400	10,000	600	6%
J19 - J20	10,600	12,000	1,400	13%	7,700	8,800	1100	14%
J20 - J21	10,700	12,200	1,500	14%	8,400	9,000	600	7%
J21 - J21a	8,700	9,900	-	-	-	-	-	-
J21a - J22	10,300	11,500	1,200	12%	7,500	8,000	500	7%
J22 - J23	10,700	11,600	900	8%	8,100	8,200	100	2%

Table 2-8 – Forecast vs. Observed Traffic Flows- PM peak Hour, Two Way AWT

Section	Forecast				Observed			
	DM	DS	Diff	% Diff	2008	2012	Diff	% Diff
J16 - J17	11,500	13,500	2,000	17%	9,600	10,200	600	7%
J17 - J18	12,000	14,400	2,400	20%	10,200	10,500	300	3%
J18 - J19	12,900	15,700	2,800	22%	10,400	12,300	1,900	18%
J19 - J20	10,400	12,600	2,200	21%	7,700	10,200	2,500	32%
J20 - J21	10,800	12,700	1,900	18%	9,200	10,500	1,300	14%
J21 - J21a	9,500	11,100	-	-	-	-	-	-
J21a - J22	11,100	12,800	1,700	16%	8,000	9,600	1,600	19%
J22 - J23	10,400	11,500	1,100	11%	8,700	9,200	500	6%

2.39 It can be seen from and ***Table 2-6***, ***Table 2-7*** and ***Table 2-8*** that:

- The average increase along the scheme section was forecast to be approximately 14% in the AM peak and 18% in the PM peak, whereas the observed increase is 9% and 14% respectively.
- The forecasts assumed a consistent growth in background traffic between the base year and opening year, whereas the observed trend shows little growth in traffic between 2008 and 2012 across the region. This suggests that the forecasts overestimated the traffic using the corridor in the opening year, as can be seen by comparing the forecast and outturn DMs.
- The forecast difference between Do-Minimum and Do-Something is consistent with the observed change in the middle of the scheme section (junctions 20-21).
- The scheme was forecast to have less of an impact at the eastern end of the scheme compared to the western end of the scheme. This trend is consistent with the observed impact in the outturn traffic data.
- The appraisal forecast that the scheme's impact would be greater in the PM peak (compared to the AM peak) and this too is consistent with the change in traffic observed in the outturn data.
- In summary, the observed traffic along the scheme is consistently lower than the forecast traffic. This difference is explained by the lower than expected background traffic growth. This is likely to be due to the economic downturn and associated reduction in traffic volumes which commenced in 2008. The general change in traffic patterns is consistent between the forecasts and observed impacts.
- The forecasts for the Do Something scenario did not consider the impact of widening between M25 J27 and J30 which opened at the same time as M25 J16-J23. The opening of Section 4 may have had some influence on the observed traffic along the scheme section. However, due to the neighbouring section of the M25 (J23 – J27) operating at three lane standard for the duration of the evaluation period, it is not considered that the Section 4 scheme would have had a significant impact on traffic flows along Section 1 at this stage.

Journey Time Analysis

Scheme Objective: to reduce congestion

2.40 This section considers the impact on journey times following the scheme's implementation. Pre-scheme journey times along the M25 route are compared with post-opening journey times for both directions. 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.

2.41 The journey time periods assessed align with the modelled journey times in the Traffic Forecasting Report, and are as follows:

- Weekdays AM peak (07:00 to 10:00).
- Weekdays inter-peak period (10:00 to 16:00).
- Weekdays PM peak (16:00 to 19:00).

2.42 The calendar periods used in this OYA study are:

- Pre-scheme: October 2008
- Post-Opening: October 2012

Observed Journey Times

2.43 Observed journey times have been taken from the HA's Journey Time Database (JTDB). The links used in the analysis can be found in ***Appendix C***. This section will analyse the journey time results along the M25 J16-J23 scheme section. ***Table 2-9*** gives the direction wise pre-scheme and post-opening journey time along the scheme section and the observed savings in journey time.

Table 2-9 – Average Journey times and savings on the M25 J16-J23 (mm:ss)

	Time Period	Before	OYA	Savings	% Change
M25 J16-J23 CW	AM	24:47	22:01	02:46	11%
	IP	22:36	20:55	01:41	7%
	PM	31:12	24:27	06:45	22%
M25 J16-J23 AC	AM	41:38	31:36	10:02	24%
	IP	25:33	21:12	04:21	17%
	PM	29:15	22:22	06:53	24%

2.44 It can be seen from ***Table 2-9*** that:

- Average journey times for each peak period in the post-opening period are consistently lower than the pre-scheme journey times along the length of the scheme. A reduction of approximately 20% is observed along the anti-clockwise direction for all time periods whereas in the clockwise direction savings are lower outside of the PM peak period.
- Time savings are greater in the anti-clockwise direction in the peak periods as would be expected. A saving of 10 minutes is shown in the AM peak period and about 7 minutes in the PM peak.
- In the clockwise direction, however, time savings are lower. In the AM peak period, journeys have become faster by over 2 minutes and a reduction in journey time of 6 minutes 45 seconds is seen in the PM peak.
- Journey times have decreased despite an increase in traffic along the scheme. This indicates that the extra capacity created by the scheme has catered for the increased traffic. This suggests that the scheme has met its objective to reduce congestion.

Forecast vs. Observed Journey Time Savings

2.45 Forecast traffic speeds are provided in the 'North of Thames Assignment Model-Section 1 Forecasting Report (July 2007)'. This provides forecast information for the M25 mainline for the Do-Minimum and Do-Something scenario for the opening year of 2012. Section 1 speeds in the Do-Minimum (2012) were forecast to deteriorate by up to 13% compared with the 2004 base year. The proposed widening was predicted to bring about an improvement in journey times on most sections of between 3-11% in the opening year of 2012 compared with the 2004 base year. A slight reduction in average speed was predicted between Junction 21-21a resulting from the impact of weaving traffic on this short section.

2.46 The forecast journey times, alongside observed journey times are presented in Table 2-10. Observed journey times for the DM scenario are taken from October 2008, before scheme construction; for the DS scenario, observed journey times are taken from October 2012, after the scheme opened.

Table 2-10 – Forecast vs. Observed Journey Times (mm:ss)

Section	Time Period	Forecast				Observed			
		DM	DS	Diff	% Diff	2008	2012	Diff	% Diff
M25 J16-23 CW	AM	27:23	24:36	-02:46	-10%	24:47	22:01	-02:46	-11%
	IP	26:07	23:48	-02:19	-9%	22:36	20:55	-01:41	-7%
	PM	27:14	24:48	-02:26	-9%	31:12	24:27	-06:44	-22%
M25 J16-23 AC	AM	25:04	23:20	-01:44	-7%	41:38	31:36	-10:03	-24%
	IP	25:12	23:28	-01:44	-7%	25:33	21:12	-04:21	-17%
	PM	25:15	23:49	-01:25	-6%	29:15	22:22	-06:52	-24%

2.47 ***Table 2-10*** shows that:

- Observed journey time savings far exceed the forecast saving for all time periods, suggesting that the impact of the scheme has clearly been better than expected in terms of resolving problems of congestion along this section of the M25.
- Forecast savings were particularly low for the anti-clockwise direction whereas there is significant improvement in observed data along with the increased traffic at the middle of the section in this direction.
- In the interpeak period the observed savings in the clockwise direction is slightly less than that was expected and the observed savings are consistent with those forecast in the morning peak hour.
- The appraisal forecast the same impact on journey time savings in the clockwise and anti-clockwise directions whereas the outturn impact is more evident in the anti-clockwise direction.
- The success of the scheme in improving journey times must, however, consider that the forecasts assumed that traffic volumes would increase by approximately 14% to 18% during peak periods when in fact outturn flows have not increased to the same level as expected.
- These results provide sufficient evidence to conclude that the scheme has achieved its objective of reducing congestion along the scheme section.

Journey Time Reliability

Scheme Objective: to improve reliability

2.48 One of the scheme's key objectives was to improve journey time reliability along the M25 between junctions 16 and 23. Reliability is concerned with variability in journey times within the same time periods on different days. Therefore, a proxy for reliability can be determined by examining the variation of journey times using the data extracted from the JTDB, as used earlier in this report.

2.49 The metric used in the analysis is the standard deviation of mean journey times for each time period for the pre-scheme and post-opening periods. Data is presented for a twelve hour period (07:00-19:00). ***Figure 2-9*** presents the journey time reliability for the scheme section in the clockwise direction, and ***Figure 2-10*** presents journey time reliability in the anti-clockwise direction.

Figure 2-9– Journey Time Reliability on M25 between J16 and J23-Clockwise

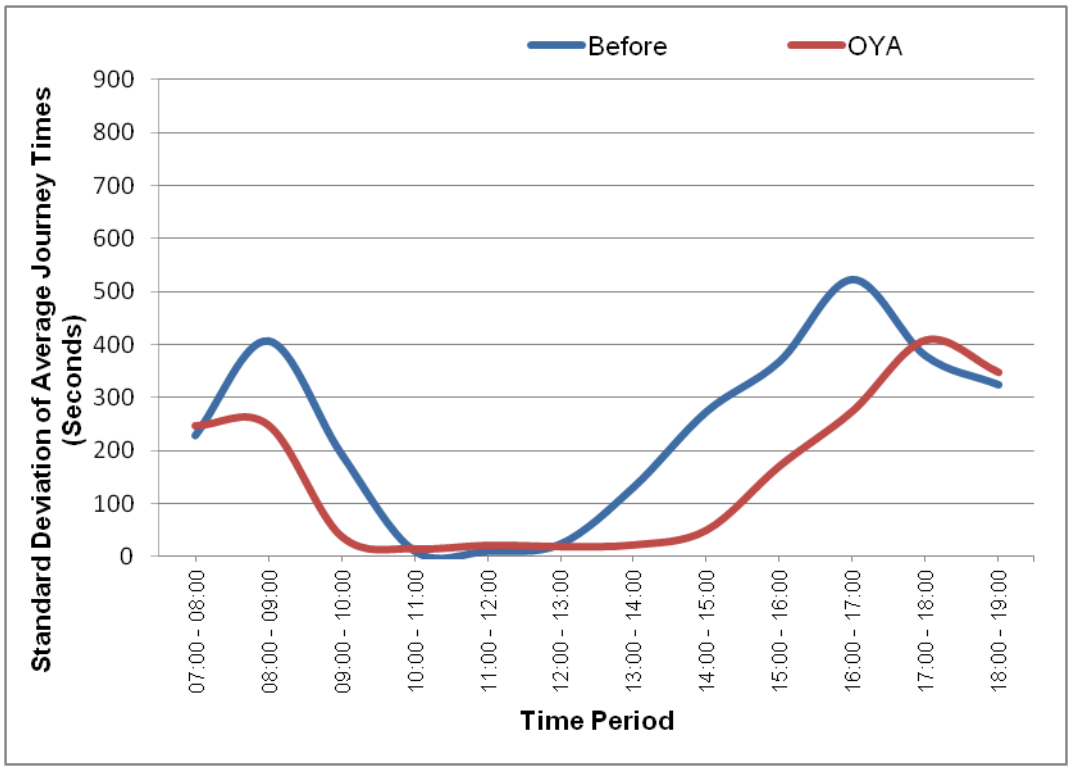
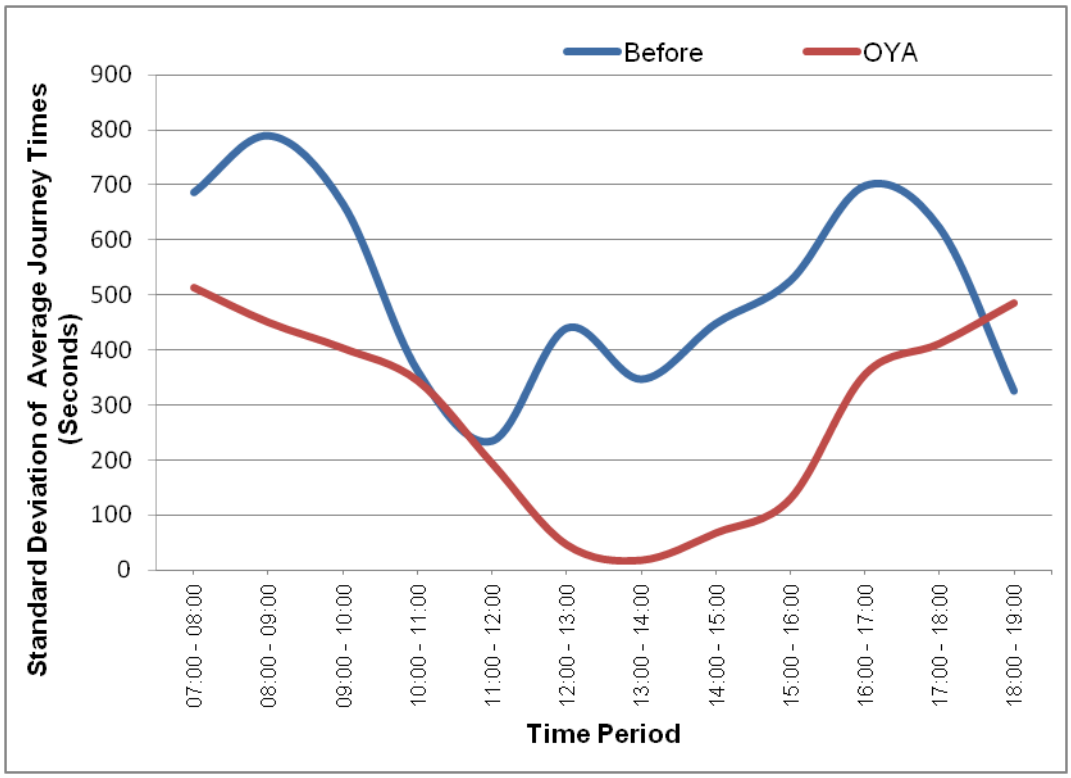


Figure 2-10– Journey Time Reliability on M25 between J16 and J23-Anti-Clockwise



2.50 It can be seen from ***Figure 2-9*** and ***Figure 2-10***, based on spread of standard deviation of average journey times, that:

- Before the scheme, there were pronounced differences in the standard deviation (i.e. the variability) in the journey times between the different peaks. This reflects the congestion and delays in the AM and PM peaks. After the scheme opening the standard

deviation of journey times is lower in the busier periods indicating that journey times have become more reliable.

- Journey times have a greater variability in the anti-clockwise direction, this is consistent with the fact that journey times tend to be greater in this direction. Following the scheme's introduction the standard deviation of journey times along the scheme has reduced particularly in the busier hours. This provides an indication that journey time reliability has improved as a result of the scheme.

2.51 The appraisal of the reliability impacts for this scheme involved the use of INCA (INcident Cost Benefit Analysis) which attributes a monetary value to the journey time reliability impacts. This is considered further in Section 4 on page 46.

2.52 As discussed in Section 1 page 9, the scheme is part of a series of schemes in the area and more specifically along the M25, forming an overall long-term strategy to manage the existing motorway network more effectively.

2.53 At the time of writing this OYA report, the construction of smart motorway along M25 between J23 and J27 (Section 5), immediately east of the scheme is ongoing and the expected opening period is the end of 2014. Smart motorways help relieve congestion by using technology to vary speed limits. They also allow the hard shoulder to be used as a running lane to create additional capacity. This indicates that the section of the motorway immediately east of the scheme section is currently highly congested and therefore likely to suppress the traffic growth towards this end of the Section 1 scheme.

2.54 Gantries were erected along the scheme section as part of the scheme and the speed limits were only advisory until March 2014 when they became enforceable. (See ***Figure 5-15)***. The speeds/ messages were manually inputted as the system was not yet up and running for flow change recognition, however this was automated in March 2014. Controlled motorway will enable proactive management of the motorway network by displaying Variable Mandatory Speed Limits above each lane of the main carriageway that takes in to account prevailing traffic conditions with the aim of ensuring smooth flow of traffic.

2.55 On completion of the smart motorway scheme at J23 to J27 and implementation of the controlled motorway on M25 from J16 to J23, i.e. along the scheme section, it is likely that the traffic would increase further in the future years and subsequent changes in journey times and average speed can be expected. Hence this OYA report only presents a snapshot of the changes at one year after scheme opening and the long term impacts of the scheme can be greater than currently observed at OYA given the nature and quantum of improvements taking place in the vicinity. It should be noted that the appraisal did not include the controlled motorway and simply modelled the motorway widening as considered in this evaluation.

Key Points – Traffic Impacts

Traffic Flow impacts

- Traffic volumes on the section of M25 improved by the scheme have increased since the scheme opened.
- Traffic volumes on minor roads in the vicinity of scheme has seen a reduction in traffic volume post scheme opening. This is indicative of the reduction in rat-running on the local network around the scheme.
- Sections of the M25 beyond the scheme extent have seen an increase in traffic, but less than the increase observed along the scheme section at OYA compared to before the scheme.
- Traffic growth on the M25 scheme section after the scheme opened is concentrated in the morning and evening peak periods with the highest increase observed between J20 and J21. The flow has remained nearly the same for overnight/Offpeak period.
- Analysis of screenlines on either side of the scheme extent shows that there is little new traffic generated by the scheme and the increase in traffic along the scheme is justified by the decrease in traffic at the local roads in the scheme vicinity.

Traffic Forecasting

- The average increase along the scheme section was forecast to be approximately 14% in the AM peak and 18% in the PM peak, whereas the observed increase is 9% and 14% respectively.
- The forecasts assumed a consistent growth in background traffic between the base year and opening year, whereas the observed trend shows little growth in traffic between 2008 and 2012 across the region. This suggests that the forecasts overestimated the traffic using the corridor in the opening year.
- The general change in traffic patterns is consistent between the forecasts and observed impacts.

Journey Times

- Average journey times for each peak period in the post-opening period are consistently lower than the pre-scheme journey times along the length of the scheme.
- Journey time savings are more predominant in the anti-clockwise direction compared to clockwise direction.
- Journey times have decreased despite an increase in traffic along the scheme. This indicates that the extra capacity created by the scheme has catered for the increased traffic and meets the scheme objective to reduce congestion.

Journey Time Forecasting

- Observed journey time savings far exceed the forecast saving for all time periods, suggesting that the impact of the scheme has clearly been better than expected in terms of resolving problems of congestion along this section of the M25.
- The appraisal forecast the same impact on journey time savings in the clockwise and anti-clockwise directions whereas the outturn impact is more evident in the anti-clockwise direction.

Journey Time Reliability

- Journey time reliability has improved as a result of the scheme.

3. Safety Evaluation

Scheme Objective: to improve safety

Introduction

3.1 This section of the report examines how successful the scheme has been in addressing the objective of improving safety. The focus of this objective is to reduce the loss of life, injuries and damage to property resulting from transport accidents and crime. This is assessed by analysing the changes in Personal Injury Collisions[4] (PICs) occurring in the five years before start of construction compared to the available post-opening data.

3.2 The Economic Assessment Report (EAR) stated that: '*The proposed scheme is expected to be accident neutral over the 60-year evaluation period'*. This section of report assesses how far the scheme has achieved this expectation, based on observed data.

3.3 In order to assess the impact of the scheme on collisions, this section of the report analyses the change in personal injury collisions (PICs) occurring in the pre construction period, and the post-opening period. Evaluation of the scheme's impact on personal security has been undertaken through the use of observations made during a site visit.

Data Sources

Forecast Data

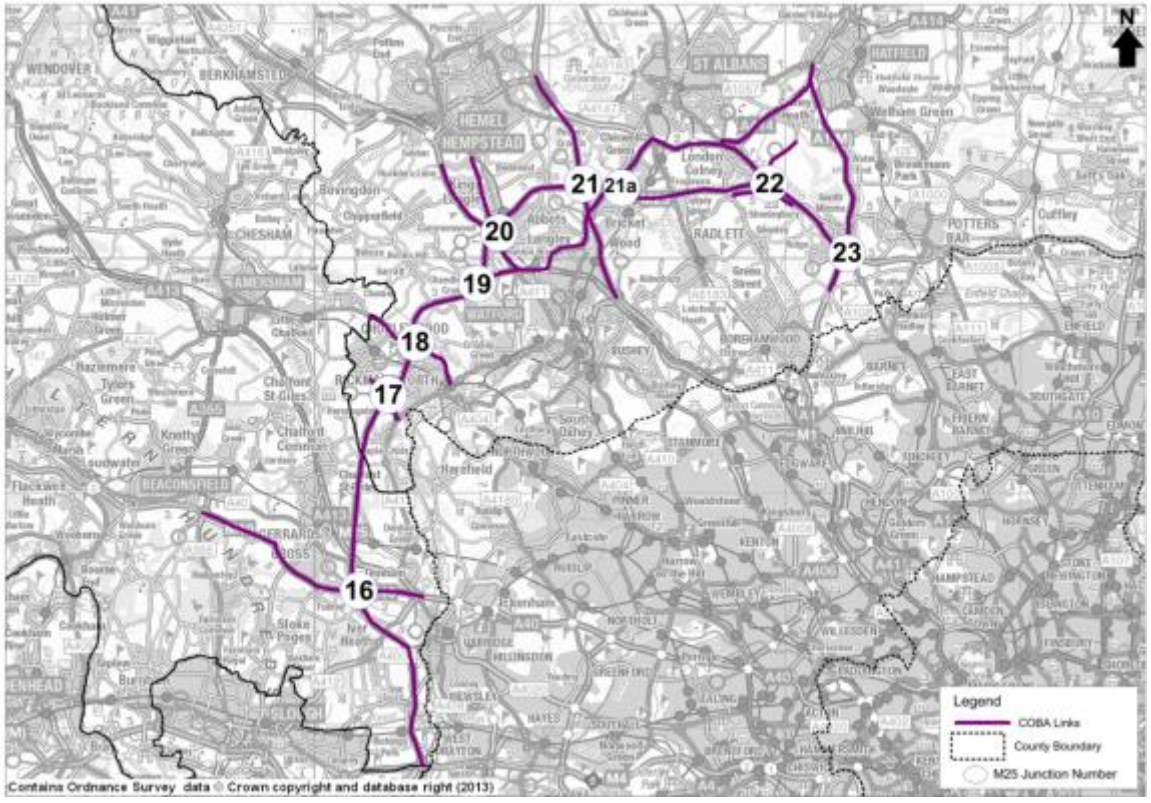
3.4 Forecasts of the impact of the scheme on safety have been obtained from the COBA (Cost Benefit Analysis) model (Version 11R7) and the Appraisal Summary Table (AST).

3.5 The forecast impact on safety is expressed in terms of numbers of personal injury collisions saved with the associated numbers of casualties and the economic benefit of the saving. This section of the evaluation concerns collision numbers; the economic impact of changes in collisions is evaluated in ***Section 4***.

3.6 The COBA network consisted of the M25 main carriageways, slips and junctions, as well as all-purpose roads along the M25 corridor. The extent of the network in the appraisal was determined after a comparison between the Do-Minimum and Do-Something 2015 forecast flows within the SATURN network. Links close to the widening scheme showing a forecast change in Annual Average Daily Traffic flow (AADT) of ±5% were included in the COBA network. This is illustrated in **Figure 3-1**.

[4] Collisions previously referred to as accidents, naming convention has been changed in line with HA's terminology.

Figure 3-1– Safety Study Area



Observed Data

3.7 Collision data for this study was obtained from the MAC, Buckinghamshire County Council and the Department for Transport (DfT).

3.8 The collision data is based on the records of PICs (Personal Injury Collisions) (i.e. collisions that involve injuries to one or more persons) recorded in the STATS19 data collected by the police when attending collisions. Collisions that do not result in injury are not included in this dataset and are thus not considered in this evaluation.

3.9 It should be noted that at this stage, not all the collision data has been validated by the Department for Transport (DfT). The requirement for up to date and site specific information necessitated the use of unvalidated data sourced from the local authority. The data is judged to be sufficiently robust for use in this study, but it may be subject to change. However, it is not anticipated that this would be significant in terms of the analysis of collision numbers presented in this report.

Forecast Approach

3.10 Two alternative methods were considered for Do-Something collision rates and accordingly the collision benefit calculations were performed with both forecast rates:

- Method One – apply the national default rate for a Dual 4-lane Motorway to the upgraded section of the M25. This test formed the basis for the main forecasts in accordance with the national guidance.
- Method Two – assume that the widened motorway retains its existing characteristics.

3.11 A summary of the forecast change in collisions (using method one described above) over the 60-year evaluation period is shown in ***Table 3-1*** .

Table 3-1 – Forecast Safety Impact (60 years)

Section of COBA Network	Scenario	Number of Collisions	Casualties		
			Fatal	Serious	Slight
M25 main carriageways	DM	16,310	239	1,423	26,340
	DS	15,564	228	1,358	25,136
	Change	746▼	11▼	65▼	1204▼
Local Roads, M25 junctions and slip roads	DM	28,301	436	2,783	44,076
	DS	29,031	447	2,849	45,244
	Change	730▲	11▲	66▲	1168▲
M25 and local roads (combined)	DM	44,611	675	4,206	70,416
	DS	44,595	675	4,207	70,380
	Change	16▼	0	1▲	36▼

3.12 The results presented in ***Table 3-1*** show that a small reduction in collisions and casualties was forecast to occur with the scheme in place. Over the 60-year appraisal period this is a reduction in collisions of approximately 5%. Using the national default collisions rates for the widened M25 main carriageway, a reduction in collisions was forecast, despite the increase in traffic flows along the scheme. However, this reduction was almost entirely offset by the increase in collisions on other links in the road network caused by changes in traffic flow as a result of reassignment from traffic accessing the widened M25.

Evaluation Approach

3.13 The evaluation is divided into two parts in line with the standard POPE methodology:

- **Key links**: M25 mainline between J16 and J23 including slip roads and junctions.
- **COBA network**: M25 mainline between J15 and J23 including slip roads and junctions and other local roads as represented in ***Figure 3-1***.

3.14 The original appraisal was based on observed data for the period January 2000 to December 2004 inclusive. This OYA report compares the five years prior to the start of construction, with the maximum of post opening data at this time (7 months) for key links. We also briefly examine the collisions during the construction period. The periods considered are as follows:

- Pre-construction (May 2004 – April 2009)
- During construction (May 2009 – May 2012)
- Post opening (June 2012 – December 2012)

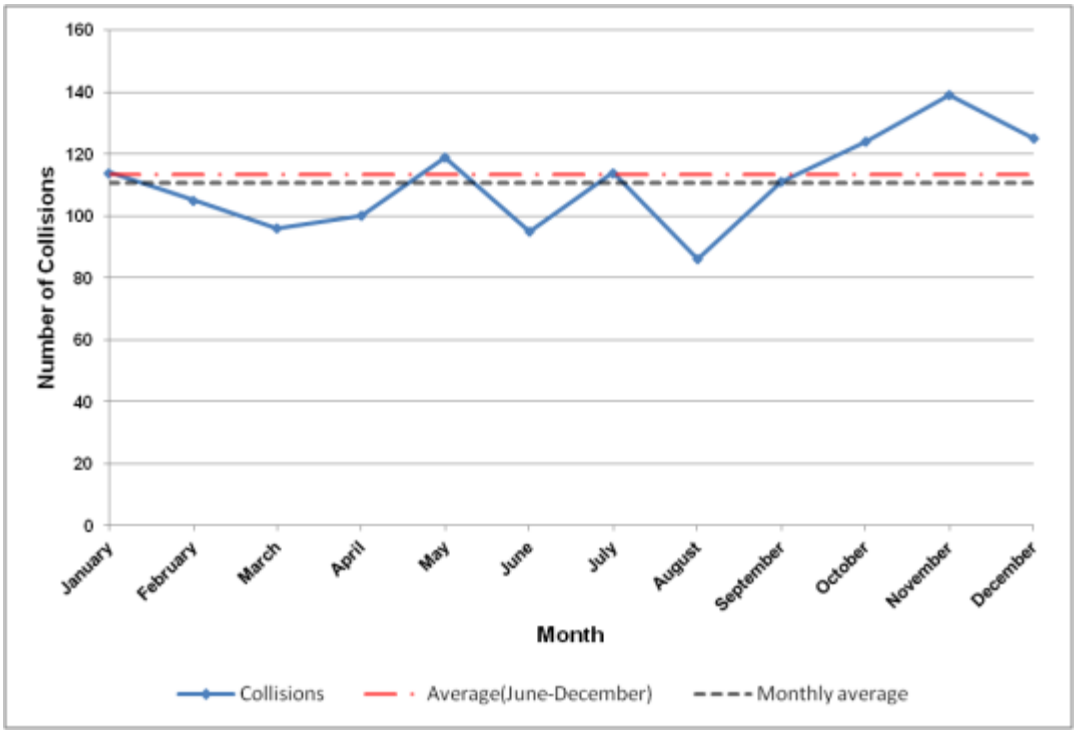
3.15 Due to unavailability of complete accident data for local roads, the main analysis is centered on the key links. For the COBA network, the evaluation will be carried out with a shorter post-opening period as follows:

- Pre-construction (January 2005 – April 2009)
- During construction (May 2009 – May 2012)
- Post opening (June 2012 – December 2012)

Seasonal Trend in Collisions

3.16 In order to assess the seasonal trend in collisions along the M25 J16 to 23 (including slip roads and junctions), the number of collisions for each year and month in the before period is presented in ***Figure 3-2***.

Figure 3-2– Seasonal Variation in Injury Collision Numbers



3.17 ***Figure 3-2*** shows that the monthly average of collisions in the before period was 111 and the June to December average was 113. Since the variation between monthly average and June to December is negligible, it is considered appropriate to assume that the collisions will follow a similar trend in the post opening. This supports the decision to present the post opening results with only seven months of data. However firm conclusions about the scheme's impact on safety cannot be made with this relatively small sample size in the post opening, and all results presented are only an indication of the trends at OYA. The seven months of post opening data is converted to an annual average for comparison against the before data.

Collision Numbers

3.18 This section analyses the observed changes in PICs following the implementation of the scheme. One of the stated objectives of this scheme was to improve safety. 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. We first consider the impact on the scheme key links, and then further detail is provided regarding the impacts on the whole modelled (COBA) area.

Background Changes in Collision Reduction

3.19 It is widely recognised that, for 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 during 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. We need to consider this background trend when considering 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.

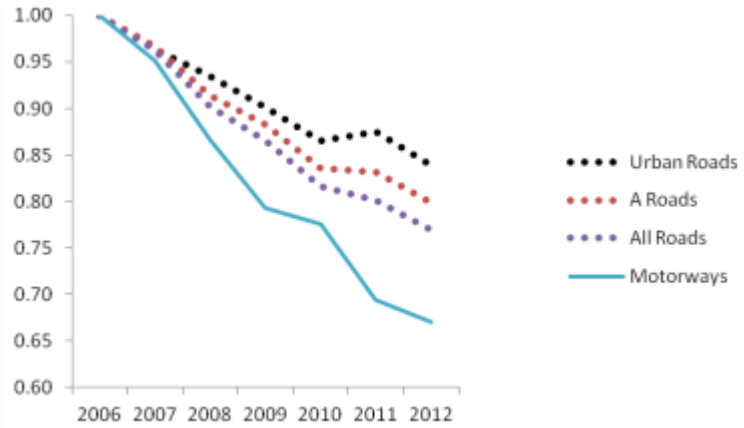
3.20 When we compare the number of collisions in this area in the years before and after the scheme was built, and associate the net change primarily with the scheme, we need to take this background reduction into account. The best way to do this is to assume that, if the scheme had not been built, the number of collisions on the roads in the study area here would

have dropped at the same rate as they did nationally during the same time period[5]. This gives us what is known as a counterfactual scenario. We can now compare this data for the counterfactual 'without scheme' scenario on a like-for-like basis with the observed post opening data which is the 'with scheme' scenario.

3.21 The difference between the numbers of collisions in these two scenarios can then be attributed to the scheme rather than the wider national trends. This result will inform the calculation of monetised safety benefits achieved by the scheme as discussed in the economy chapter of this report.

3.22 The comparison or the counterfactual scenario compares the national collision data in the One Year After period (2012) and for a representative year in the pre-construction period (taken as the middle year, 2006). The change in the number of collisions over this period for motorways is calculated from the national collision data.[6] ***Figure 3-3*** illustrates the change in collision numbers by road type between 2006 and 2012.

Figure 3-3– Trends in Injury Collision Numbers



3.23 The reduction in national collision numbers presented above is used in the development of the counterfactual scenario for the post-constructions accident data.

Collision Numbers – Scheme Key Links

3.24 The key links for this scheme comprise the M25 between junctions 16 to 23, including the junctions and slip roads. An evaluation of the before and after collision numbers by year for the key links is shown in ***Table 3-2*** and ***Figure 3-4***. This enables a direct comparison with forecast collision savings derived from COBA for the same key links. The severity of a collision is defined by the most serious injury incurred.

3.25 The table also includes the counterfactual without scheme which is comparable to the after data. It should be noted that where periods of less than one year are displayed, the number of collisions for the period has been extrapolated to provide an equivalent number of collisions per year; the number of collisions added as a result of the extrapolation is shown as a dotted bar.

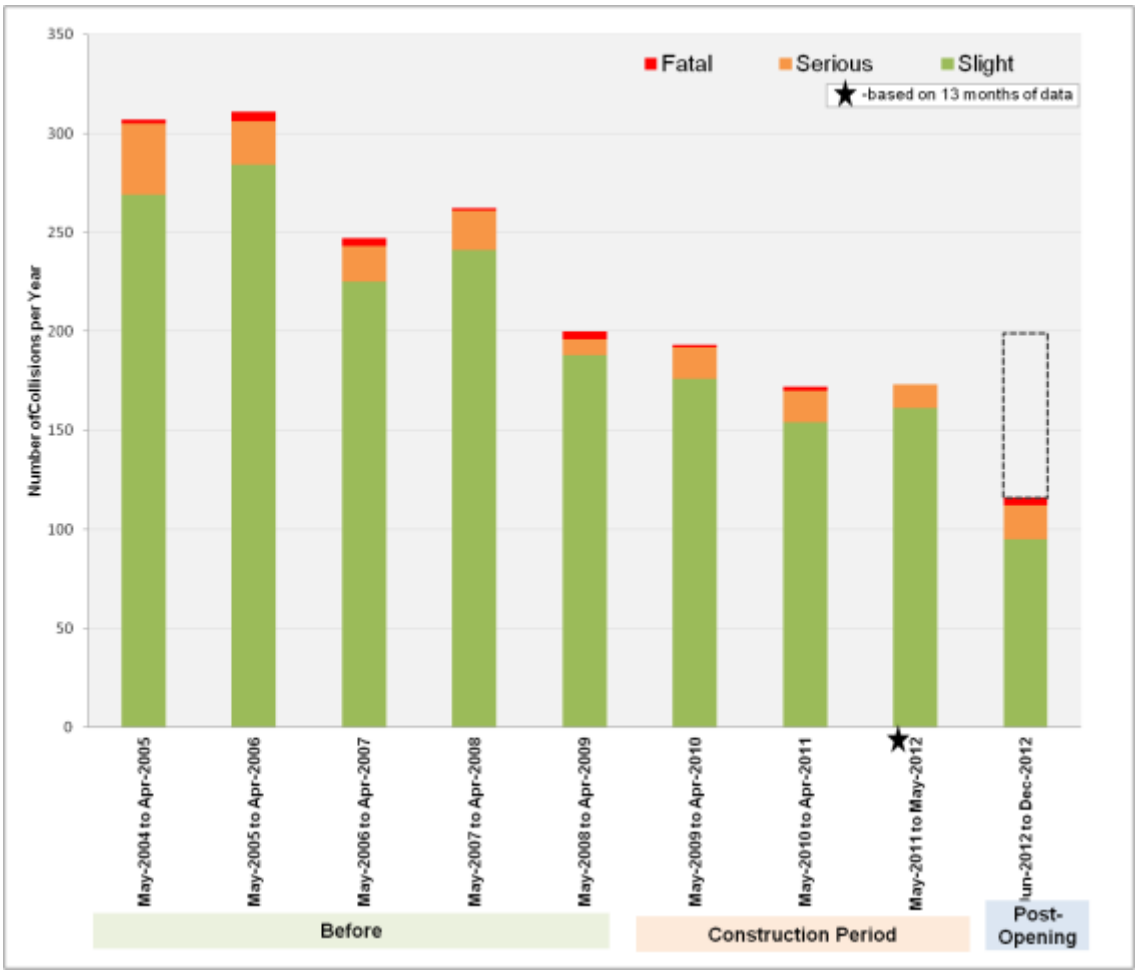
[5] National trend data is sourced from DfT table RAS10002

[6] Data sourced from DfT table RAS10002 which includes reported accidents and accident rates by road class and severity, Great Britain.

Table 3-2 – Number of Collisions by Severity on the Key Links

Period	Time Period		Collision Severity			Total	Annual Average
	From	To	Fatal	Serious	Slight		
Observed Pre Scheme	May-2004	Apr-2005	2	36	269	307	**265.5**
	May-2005	Apr-2006	5	22	284	311	
	May-2006	Apr-2007	4	18	225	247	
	May-2007	Apr-2008	1	20	241	262	
	May-2008	Apr-2009	4	8	188	200	
Without scheme Counterfactual (adjusted for background reduction)[7]							178
Observed Construction	May-2009	Apr-2010	1	16	176	193	**174.5**
	May-2010	Apr-2011	2	16	154	172	
	May-2011	May-2012	0	12	161	173	
Obs Post Opening	Jun-2012	Dec-2012	4	17	95	116	**198.9**

Figure 3-4 – Number of Collisions on Year by Year Basis for Key Links



3.26 The post opening data in ***Figure 3-4*** has been presented to allow identification of the seven months of observed data and the extrapolation to an annual average.

3.27 It can be seen from ***Figure 3-4*** and ***Table 3-2*** that:

- The average number of collisions have reduced post opening along M25 scheme section.

[7] Background factor in collision numbers for Motorways 2006-2012 was 0.67

- The observed annual collision rate in the post opening is slightly higher than the 'without scheme' counterfactual collision rate (accounting for the background reduction in collisions over time).
- The number of slight collisions has reduced significantly post opening, but fatal and serious collisions have increased marginally. It should again be noted that this is based on seven months of data so can only be taken as an indication of the scheme's impact at this stage.
- The decrease in collisions in the after scenario (compared to the unfactored before data) is despite the increase in traffic along the scheme section compared to before scenario.

Collisions - COBA Area

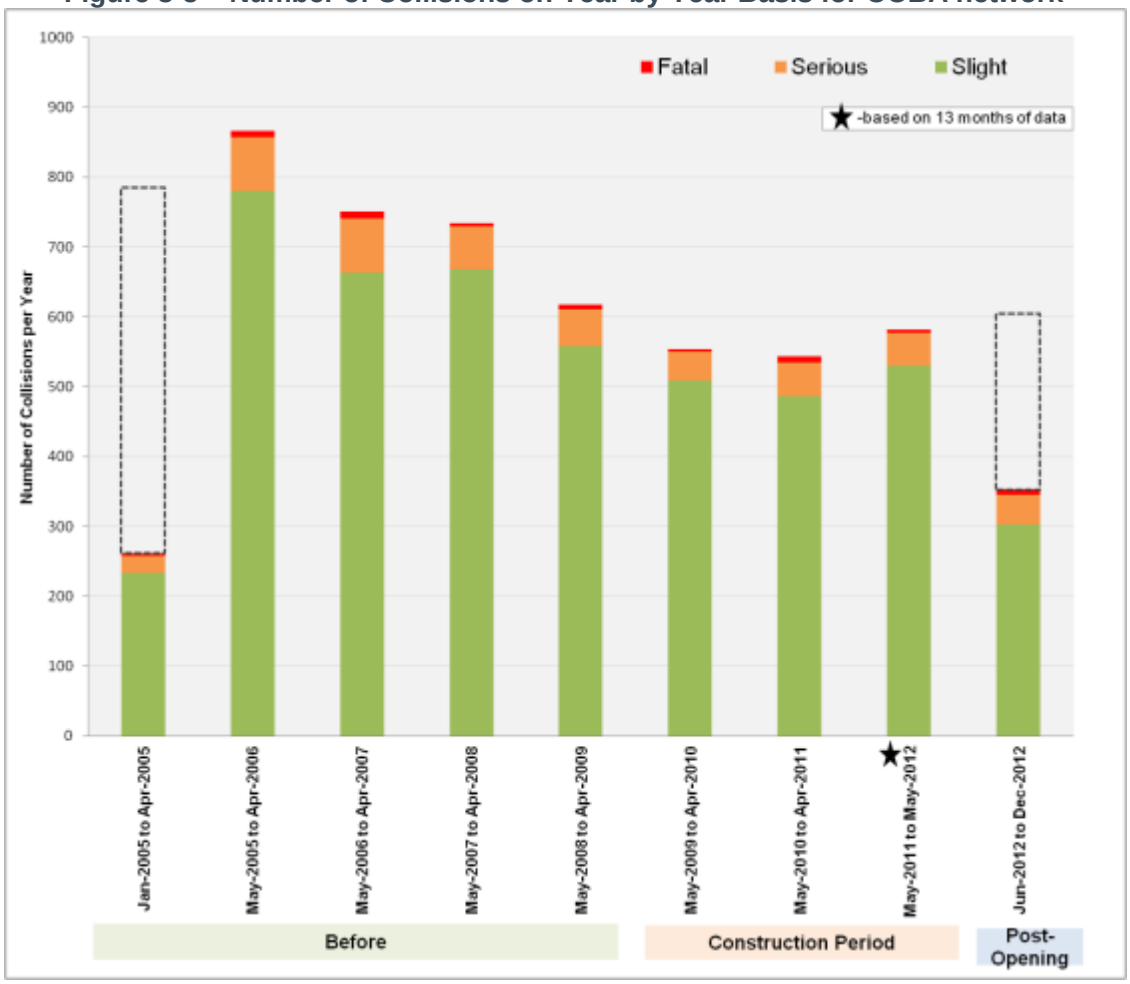
3.28 The COBA network includes the mainline M25 between J15 and 23 including slip roads and junctions and local roads in the scheme vicinity as considered for the COBA appraisal. The extent of the COBA network considered is shown in ***Figure 3-1***. An evaluation of the before and after collision numbers by year for the COBA area is shown in ***Table 3-3 and Figure 3-5***.

Table 3-3 – Number of Collisions by Severity in the COBA Area

Period	Time Period		Collision Severity			Total	Annual Average
	From	To	Fatal	Serious	Slight		
Pre Scheme	Jan-2005	Apr-2005	4	24	234	262	**746.3**
	May-2005	Apr-2006	9	78	780	867	
	May-2006	Apr-2007	10	77	664	751	
	May-2007	Apr-2008	4	62	668	734	
	May-2008	Apr-2009	7	53	558	618	
Pre scheme Counterfactual (adjusted for background reduction)[8]							574.3
Construction	May-2009	Apr-2010	3	42	509	554	**544.9**
	May-2010	Apr-2011	9	48	487	544	
	May-2011	May-2012	4	48	530	582	
Post Opening	Jun-2012	Dec-2012	7	43	303	353	**605.1**

[8] Background factor in collision numbers for All roads 2006-2012 was 0.77

Figure 3-5 – Number of Collisions on Year by Year Basis for COBA network



3.29 The 2005 before and post opening data in ***Figure 3-5*** have been presented to allow identification of the observed data and the extrapolation to an annual average.

3.30 It can be seen from ***Table 3-3*** and ***Figure 3-5*** that:

- The average number of collisions have decreased post opening across the wider COBA network without applying the background reduction.
- The observed annual collision rate in the post opening is slightly higher than the 'without scheme' counterfactual collision rate (accounting for the background reduction in collisions over time).
- The number of slight collisions has reduced significantly post opening, but fatal and serious collisions have increased marginally. However this is based on a small sample size and hence cannot be directly linked to the scheme impact at this OYA stage.
- The decrease in collisions in the after scenario (compared to the unfactored pre-scheme data) is despite the increase in traffic along the scheme section and decrease in traffic on the local road network compared to before scenario.

Collision Severity Index – Key Links

3.31 The collision severity index is the ratio of the number of collisions classed as serious or fatal compared to the total number of collisions. The average collision severity index for the key links is shown in ***Table 3-4***.

Table 3-4 – Average Collision Severity Index on Key Links

Period	Time Period		Key Links	
	From	To	Collision Severity Index	Annual Average
Pre Scheme	May-2004	Apr-2005	0.12	**0.09**
	May-2005	Apr-2006	0.09	
	May-2006	Apr-2007	0.09	
	May-2007	Apr-2008	0.08	
	May-2008	Apr-2009	0.06	
Construction	May-2009	Apr-2010	0.09	**0.09**
	May-2010	Apr-2011	0.10	
	May-2011	May-2012	0.07	
Post Opening	Jun-2012	Dec-2012	0.18	**0.18**

3.32 It can be seen from ***Table 3-4*** that the collision severity index has increased marginally in the post opening data. This can be attributed to the fact that the total number of slight collisions has reduced drastically compared to the number of fatal and serious collisions. Another contributing factor may be the increase in traffic speeds along the scheme as seen in Section 2 of this evaluation. Given the limited quantity of post-opening accident data, it is too early to draw conclusions on accident severity and a clearer picture will be available at the Five Year After (FYA) POPE stage when a larger sample size will be available to identify the impact of the scheme on accidents.

Fatalities & Weighted Injuries

3.33 The collision rate discussed previously and shown in ***Table 3-2*** does not take into account the severity of collisions. To analyse this we now present the Fatalities and Weighted Injuries metric which is a combined measure of casualties based on the numbers of fatal, serious and slight casualties. The FWI for the five years before and the available after period are shown in ***Table 3-5***. To take into account the change in traffic on the M25 and for comparison with other schemes, we also present the FWI rate per billion vehicle kilometres (bvkm). It should be noted that these figures do not account for changes in the background reduction in casualties.

Table 3-5 – FWI on the Key Links

Period	FWI/collision	FWI/year	FWI/bvkm
Before	0.037	9.79	5.7
After	0.066	13.06	6.9

3.34 ***Table 3-5*** shows that the FWI/bvkm has increased post opening. However this is based on a small sample size at OYA. A clearer picture will be available at the FYA study when before and after trends will be compared with respect to a full 5 years of data.

Forecast vs. Outturn Collision Numbers

3.35 This section compares the number of observed collisions, as discussed earlier, with the forecast accidents for the scheme opening year. The forecasts have been obtained from the COBA model for this scheme and cover the scheme key links (including junctions and slip roads). For the outturn collisions the observed annual average before and after the scheme opening are used for the same area.

Table 3-6 – Comparison of Forecast and Outturn Collisions for the scheme Key Links

Average Annual Collisions		Central Growth
Forecast Opening Year	Do Minimum (without scheme)	328.5
	Do Something (with scheme)	325.9
	Saving	2.6
	% Change	**1%**
Observed Annual Average	Observed before opening	265.5
	Without scheme (counterfactual)	178.0
	Observed after opening	198.9
	Change*	-20.9
	% Change*	**-12%**

* Comparison of before and after completed using counterfactual scenario for before.

3.36 It can be seen from ***Table 3-6*** that the scheme appraisal forecast a marginal decrease of 1% in collisions in the opening year. However, there has been an observed average increase in collisions of 20.9 per year, representing an increase of 12%, when comparing the post-opening data to the counterfactual example which adjusts the pre-scheme data for background collision trends.

3.37 Without the counterfactual adjustment we see that there has been a decrease in collisions along the scheme, but we cannot attribute this saving solely to the scheme without adjusting for background collision trends.

3.38 A comparison of the forecast and observed collisions levels in all scenarios shows that a higher number of collisions were expected in the forecasts. This difference could be because traffic was forecast to grow significantly between the base year of 2004 and the scheme opening year. As there has been less growth in background traffic, traffic did not increase to the same scale as was forecast resulting in fewer accidents.

Collision Rates – Key Links

3.39 The number of collisions along a length of road used together with the AADT for the same section can be used to calculate collision rate, known as PIC/mvkm. This allows comparisons to be made which take into account traffic growth. The analysis presented here is performed for the Key Links.

3.40 ***Table 3-7*** shows the forecast collision rate calculated for the key links compared to that observed pre and post opening.

Table 3-7 – Forecast vs. Observed Collision Rates (PIC/mvkm) for the Key Links

Forecast (opening year)	Do-Minimum (without scheme)	0.134
	Do-Something (with scheme)	0.119
	Forecast Saving	**0.016 (12%)**
Observed (Pre-scheme vs. Post-opening collision rates)	Observed before opening	0.154
	Without scheme (counterfactual)[9]	0.102
	Observed after opening	0.104
	Observed Saving*	**0.002 (-2%)**

*Observed saving is calculated using counterfactual before scenario.

3.41 ***Table 3-7*** shows that the appraisal forecast a decrease in collision rate as a result of the scheme. However post opening, there has been a marginal increase of 2% in the collision rate after accounting for the background trend in collisions.

3.42 The increase in collision rates along the scheme (for the key links) is based on a small sample size at this OYA stage. It should be noted that this does not consider the collision rates for the wider study area.

[9] Counterfactual is the observed rate in the before period multiplied by the national reduction in collisions rate per mvkm during the comparable period. The reduction factor in the collision rate for motorways was 0.66.

Statistical Significance of Outturn Collision Impacts

3.43 In order to determine whether the changes in collision rates observed before and after the scheme opened are statistically significant, Chi-Square tests have been undertaken. This test uses the before (counterfactual) and after numbers of collisions and traffic flows to establish whether the changes are significant or likely to have occurred by chance.

3.44 The result found that, when adjusted for the background reduction in collisions over the same time period, the reduction is not significant within the scheme key links.

3.45 The results are based on five years of data before scheme opening and only seven months of data post opening. Hence a clearer picture will be available at the five year after stage for this scheme when a larger sample will be available for post opening comparison.

Security

3.46 The aim of this sub-objective is to consider both the changes in security and the likely number of users affected by the changes. For highway schemes, security includes the perception of risk from damage to or theft from vehicles, personal injury or theft of property from individuals or from vehicles. Security issues may arise from the following:

- On the road itself (e.g. being attacked whilst broken down).
- In service areas/car parks/lay-bys (e.g. vehicle damage while parked at a service station, attached whilst walking to a parked car).
- At junctions (e.g. smash and grab incidents while queuing at traffic lights.

3.47 The primary indicators for roads include surveillance, landscaping, lighting and visibility, emergency call facilities and pedestrian and cycling facilities.

Forecast

3.48 The AST states that the impact of the scheme on security is neutral. The AST stated that “Boundary fencing and provision of emergency roadside telephones would be unaffected by the Scheme. Formal surveillance by full CCTV coverage would be same as existing. There would be no change to informal surveillance. Lighting proposals would improve security along existing unlit areas.”

Evaluation

3.49 This outturn evaluation supports the AST assessment of neutral as the scheme did not affect the provision of security facilities. The outturn traffic flows are lower than forecast, had changes been made to the security provision the number of users affected would have been a consideration.

Key Points - Safety

Collisions

- The annual average number of collisions on the scheme key links, i.e. M25 J16-23, has seen an increase in at the OYA stage when accounting for the background trend in collision reduction. However this is based on seven months of post opening data and a clearer picture will be available at FYA.
- Without accounting for the background trend in collision reduction we see a reduction in the number of collisions along the key links.
- Analysis of collision data for the wider COBA area shows a similar trend to the key links and there is a marginal increase in the number of collisions at OYA. This increase should be considered against the increased traffic along the scheme section and reduced traffic on the local road network in the vicinity of the scheme, which were part of COBA appraisal.
- There is a large reduction in the number of slight collisions since the scheme opening compared to the before scenario.
- Collision rates along the scheme key links have reduced slightly post opening suggesting that the scheme has had a beneficial impact for safety along the key links. It should be noted that this does not reflect changes in the wider study area.

Forecast vs. Outturn Collision Savings

- A reduction in collisions of 1% was forecast for the opening year, but observed data shows that collisions have increased by 12% compared to pre scheme (after accounting for the background trend in collision reduction).
- Calculated collision rates using forecast accident levels and traffic flows showed that the appraisal expected a decrease in collision rates of 12%. The seven months of available post-opening data shows that there has been a slight increase in collision rates of 2% along the key links after accounting for the background trend in collisions.

Security

- The scheme's impact on security was as forecast in the scheme appraisal, which is a neutral impact due to no change in the provision of security measures along the length of the scheme.

4. Economy

Introduction

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

To support sustainable economic activity and get good value for money

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

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

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

- Transport Economic Efficiency (TEE) benefits (savings related to travel times, vehicle operating costs and user charges).
- Accident costs (savings related to numbers and severity level of accidents).
- 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 assessment presented in this section is based upon:

- M25 DBFO – Section 1 Widening – Economic Appraisal Report (August 2007).
- Outturn costs obtained from the Highways Agency Regional Finance Manager.
- The forecast scheme costs have been taken from the pre-construction ministerial approved budget (MP Director's Instruction 06/07, Annex 1, Version 1.2 final-a, issued May 2007).

Forecast Benefits

4.6 A summary of the predicted scheme impacts from the Economic Assessment Report is shown in ***Table 4-1***. This shows that over the 60 year appraisal period the scheme was predicted to generate in excess of £1335 million benefits with the vast majority arising from reduced journey times. ***Table 4-1*** also provides a summary of the benefits which will be considered in this post opening evaluation, and those which have been excluded (i.e. assumed same as forecast).

4.7 A green tick in Table 4.1 indicates that this element of the benefits will be considered as part of this evaluation. A red cross indicates that the forecast impact from the appraisal will be used in place of a full evaluation at this stage.

Table 4-1 – Economic Impact of Scheme

Benefit Stream	Predicted Benefits		Evaluation	
	£m	%	Evaluate?	Reasons
Journey Times	1415.7	106%	✓	Represents a considerable proportion of the overall scheme benefits Relatively straightforward to measure outturn impacts in opening year.
Vehicle Operating Costs	-115.2	-9%	✓	Calculation based on the ratio of fuel consumption forecast and observed
TEE impacts during construction	15.9	1%	✗	Not within the remit of POPE Small proportion of the overall scheme impacts.
TEE impacts during maintenance	-22.2	-2%	✗	Small proportion of the overall scheme impacts.
Safety	0.3	0%	✗	Safety impact was found to be insignificant so is not included at this stage.
Journey time reliability	71.6	5%	✓	Journey time reliability benefits were calculated using INCA in the appraisal. For the OYA evaluation the INCA has been rerun with the observed flows to calculate the opening year impacts
Noise	-0.7	0%	✗	Small proportion of the overall scheme impacts.
Carbon	-29.9	-2%	✓	See Section 5, Greenhouse Gases for full detail of the evaluation.
Total	**1335.5**	**100%**		

Journey Time Benefits

Forecast Journey Time Benefits

4.8 Journey time benefits for this scheme were forecast using the Department for Transport's (DfT) TUBA (Transport Users Benefit Analysis) (version 1.7a) program. The forecast journey time benefits over the whole 60-year appraisal period have been taken from the Economic Appraisal Report. These are shown in ***Table 4-2***.

Table 4-2 – Summary of TEE forecast impacts

Consumers & Business users combined	£m 2002 prices and values
Journey Time	1,415.7

4.9 Journey time benefits expected as a result of the scheme were 106% of the PVB. This was expected as a result of the reduced journey time on the dual four lane carriageway and congestion relief provided by the scheme.

Evaluation of Journey Time Benefits

4.10 TUBA modelling for the appraisal was based on the benefits across a wide area, but for this evaluation the benefits along the scheme section have only been considered. It is not possible to use TUBA outputs to create a comparable forecast based on the impacts of scheme section

only as TUBA is matrix based and its output does not give any breakdown of the impacts on a link-wise basis.

4.11 The POPE methodology for evaluating the economic value of benefits arriving from vehicle hour savings is based upon comparing the observed vehicle hour savings, combined with the assumption that the observed vehicle hour saving at the OYA stage can be taken as indicative of that over the whole 60 year appraisal period. Based on this assumption, comparing the forecast vehicle hour saving with the observed vehicle hour saving enables the calculation of the 60 year monetised benefit.

4.12 The same calculation has been completed using the forecast and observed flows and journey times for M25 J16 to J23.

4.13 Savings were considered for the weekday peak periods and interpeak. In order to establish the proportion of vehicle hours saved compared to that forecast, it was necessary to calculate the observed vehicle hours saved per annum based on the OYA journey times and traffic flows. This was done using a 'saving per vehicle' approach for existing traffic. Additional traffic in the corridor, which is the traffic attracted by the improved M25 scheme, was attributed with half the benefits using the economic principle of rule-of-half in line with WebTAG guidance.

4.14 The opening year savings forecast and observed are shown in ***Table 4-3.***

Table 4-3 – Opening Year Vehicle Hour Savings (hours)

Scheme Section	Forecast	Observed	% difference
M25 between J16 and J23	1,269,390	1,983,014	56%

4.15 From ***Table 4-3*** it can be seen that the observed vehicle hour savings on the scheme section links are more than the forecast savings. From ***Table 2-10*** it can be seen that the observed pre-opening journey times are higher than the forecast Do Minimum journey times and the observed post-opening journey times are lower than the forecast Do Something journey times. This has resulted in higher observed journey time savings than were forecast.

4.16 The 56% difference between forecast and outturn savings is applied to the forecast journey time benefits in line with the POPE methodology. ***Table 4-4*** compares the forecast with the outturn assessment.

Table 4-4 – Monetised Journey Time Benefits

Present Value Benefits (£m 2002 prices, discounted)	Forecast	Observed
Journey Time Benefits	1,415.7	2,208.5

4.17 The re-forecast journey time benefits are higher than forecast as there has been a greater vehicle hour saving than was expected. It should also be noted that the scheme forms part of an overall strategy along the M25. When all the schemes are complete it is likely that there will be additional benefits that cannot be attributed to any one scheme.

4.18 As discussed in section ***2.36*** page ***26***, the scheme appraisal did not take into account the impacts of widening on M25 between J27 and J30 and the smart motorway between J23 and J27. Controlled motorway was operational along the scheme from March 2014 and M25 J27-30 in May 2014. These changes mean that the potential benefits from the scheme in the long term could be higher than what was forecast at the appraisal.

Vehicle Operating Costs

Forecast Benefits

4.19 As with journey time benefits for this scheme, the change in vehicle operating costs were forecast using the Department for Transport's (DfT) TUBA (Transport Users Benefit Analysis) (version 1.7a) program. The forecast vehicle operating costs over the whole 60-year appraisal

period have been taken from the Economic Appraisal Report. The forecast was a disbenefit which reduced the PVB by 9%.

Evaluation of Vehicle Operating Costs

4.20 For most highway schemes including this one, the VOC and indirect tax impacts are both very closely linked to changes in fuel consumption (e.g. changes in speeds) which has similar magnitude of impacts, but from opposite sides of the benefits balance. That is, if there is increased fuel consumption, VOC will increase due to users paying more for fuel (i.e. a disbenefit) and thus more indirect tax will be collected by the Treasury which is considered to be a benefit according to current guidance. For this evaluation, the ratio used for the reforecast indirect tax calculation (section 4.49) has been applied to the monetary value for VOC.

4.21 The forecast and the outturn vehicle operating cost comparison is shown in ***Table 4-5***.

Table 4-5 – Monetised Vehicle Operating Costs

Present Value Benefits (£m 2002 prices, discounted)	Forecast	Observed
Vehicle Operating Costs	-115.2	-55.7

4.22 This evaluation shows that the outturn disbenefit is lower than forecast due to lower than expected increase in traffic and less change in speeds.

Collision Benefits

Forecast Benefits

4.23 For the purpose of assessing the economic impacts of road schemes changes in safety are monetised, as measured by changes in accident numbers and severity. Forecast benefits were appraised in line with the COBA Manual (DMRB Volume 13, Section 1) and produce by the computer program, COBA (version 11R7).

4.24 The safety impact of the scheme was appraised over the COBA area shown in ***Figure 3-1*** which included the M25 scheme section and local roads in the scheme vicinity.

4.25 The EAR predicted a very slight (almost negligible) accident benefit over the 60 year evaluation period. The benefits predicted over the 60 year appraisal period were 2% of the total benefits.

4.26 The forecast was based on a central growth scenario and was £0.32m over 60 years for the M25 and local roads combined.

Evaluation of Collision Benefits

4.27 The analysis performed at this OYA stage showed that there is no statistical evidence that the scheme has had an impact on safety within the study area. As such the monetised safety impact is reforecast to be £0m. It should be noted that this analysis is based on a limited sample size and will be revisited at the FYA study for this scheme when a more robust sample size will be available.

4.28 The key points for the outturn safety outturn benefits are:

- Outturn safety benefits are reforecast to be £0m.
- As the saving is lower than predicted at this stage due to the greater than expected background reduction in collision, the long term monetary benefits are expected to be lower than predicted.

Journey Time Reliability

Forecast Benefits

4.29 The scheme appraisal estimated the reliability benefits for the scheme. The monetised reliability benefit was included in the Analysis of Monetised Costs and Benefits table (AMCB).

The reliability sub-objective includes the impact of the scheme on incidents and day-to-day journey time variability.

4.30 The appraisal used INCA (INcident Cost Benefit Assessment) version 3.0 for estimating the benefits of reduced delay and travel time variability (TTV) caused by unforeseen incidents that reduce capacity, such as accidents, breakdowns, debris on the carriageway and major disruptions such as fire, load shedding or spillage.

4.31 The benefits presented in this section are in 2002 prices, discounted to 2002 in line with the methodology set out in the Present Value of Benefits section below.

Table 4-6 – Monetised Journey Time Reliability Benefits Forecast

Journey Time Reliability Benefits	£m 2002 prices and values
Journey Time Savings During Incidents	-25.3
Travel Time Variability Benefits	96.9
Total	**71.6**

4.32 The results presented in ***Table 4-6*** shows that benefits were predicted from reductions in journey time variability and during incidents a negative journey time saving during incidents was predicted. The latter is likely to be a result of the increase in forecast traffic flows along the scheme.

Evaluation

4.33 ***Section*** 2 of this report considered the change in the standard deviation of journey times resulting from the scheme and the scheme has improved journey time reliability during the day.

4.34 A full re-run of INCA would require data and analysis that is beyond the scope of the OYA evaluation. In line with the traditional POPE methodology, the opening year benefits have been re-calculated and then translated into a 60 year re-forecast. The opening year benefits were calculated by updating the appraisal INCA files with the observed changes in traffic data. INCA includes default values for incident rates, average lanes blocked, maximum diversion proportion, etc and these default values were assumed to be unchanged as part of this OYA evaluation. The outturn monetised journey time reliability benefits are presented in ***Table 4-7***.

Table 4-7 – Monetised Journey Time Reliability Benefits Outturn

Journey Time Reliability Benefits	£m 2002 prices and values
Journey Time Savings During Incidents	-4.8
Travel Time Variability Benefits	99.1
Total	**94.3**

Present Value Benefits (PVB)

4.35 A cost benefit analysis of a major scheme requires all the benefits 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 (or at a set consistent date) 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.

4.36 Following current Treasury Green Book guidance, calculation of the present value entails the conversion to market prices, then discounting by year. This using a rate of 3.5% for the first 30 years and 3% thereafter.

4.37 A comparison of all forecast and outturn benefits is presented in ***Table 4-8***.

Table 4-8 – Summary of Forecast and Observed Present Value Benefits

Present Value Benefits (£m 2002 prices, discounted)	**Forecast**	**Outturn**
Journey Times	1,415.7	2,208.5
Vehicle Operating Costs	-115.2	-55.7
TEE impacts during construction	15.9	
TEE impacts during maintenance	-22.2	
Safety	0.32	0.0
Journey time reliability	71.6	94.3
Noise	-0.7	
Carbon*	-29.9	-15.0
PVB	**1,335.5**	**2,225.1**

*See Section 5, Greenhouse Gases

4.38 The outturn benefits are higher than forecast benefits largely due to the higher than expected journey time savings.

Scheme Costs

Introduction

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

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

- Investment costs : before and during construction;
- Indirect Tax Revenues: during the 60 years after opening.

4.41 Investment costs are considered in terms of a common price base of 2002 for comparison with forecast. For comparison with the benefits, overall costs are expressed in terms of present value, termed Present Value Cost (PVC).

Investment Costs

4.42 The investment cost is the cost to the HA of constructing the scheme and purchasing any land. The forecast scheme cost has been obtained from the latest Ministerial Approved Budget. This provides the undiscounted M25 Section 1 Widening costs (including forecast spend, scheme risks, optimum bias and land provisions) in 2006 costs for second quarter. This has been converted to 2002 prices for comparison with outturn costs using a 2006Q2 RPI of 197.6 and 2002 RPI of 176.2. Historic costs are excluded from the calculation of forecast investment cost. Outturn scheme costs have been supplied by the HA Regional Finance Manager. The scheme costs included the cost of gantries erected as part of the scheme which are now displaying mandatory speed limits.

4.43 A comparison between the forecast and outturn investment cost is presented in ***Table 4-9***.

Table 4-9 – Summary of Investment Costs

Forecast Cost (May 2007)		Outturn Cost (as of December 2013)		% Difference
Ministerialy approved budget (May 2007), 2006 Q2 prices	£578.3m	As spent costs in 2004-2014 years and prices	£594.5m	-
Costs in £m 2002 prices, undiscounted	£515.8m	Costs in £m 2002 prices, undiscounted	£460.0m	-11%

4.44 It can be seen from ***Table 4-9*** that the outturn cost is lower than forecast cost by 11%.

Maintenance Costs

4.45 The total maintenance cost over 60 years was estimated to be -£15.4 m in 2002 prices and values. This represents a reduction in forecast maintenance costs. This cost saving occurs primarily because of the renewal to the motorway during widening reducing the need for future maintenance. The user impact during maintenance has already been included in the PVB.

Table 4-10 – Forecast Maintenance Costs

£m 2002 prices and values	
Maintenance	-15.4

4.46 For this evaluation, these costs are still almost entirely in the future and no evaluation has been done of maintenance costs to date. It will therefore be assumed that the outturn maintenance costs are the same as forecast. It can be noted that the maintenance cost is only a small proportion (6%) of the total construction cost.

Indirect Tax Revenues

4.47 Indirect tax revenue is the expected change in indirect tax revenue to the Government due to changes in the transport sector as a result of the scheme over the appraisal period. For the highway scheme in this study, the tax impact is derived primarily from the change in fuel consumption over the 60 year period resulting in changes to the revenue from tax on fuel. A scheme may result in changed fuel consumption due to the following reasons:

- Changes in speeds resulting in greater or lesser fuel efficiency for the same trips.
- Changes in distance travelled.
- Increased road use through induced traffic or the reduction of trip suppression.

4.48 Forecast changes to indirect tax revenues were taken from the TUBA model and the value represents the change over the whole study area. The scheme was expected to increase tax revenue over the 60 year appraisal period in comparison with the Do Minimum (i.e. no scheme) scenario.

4.49 To assess the outturn impact the change in fuel use along the scheme section has been calculated from observed changes to traffic flows and speeds. A corresponding calculation was performed using the forecast changes to traffic flows and speeds for the same section. The difference between the forecast and observed changes in fuel use is the applied the monetised impact on indirect tax revenues to determine an outturn impact.

Table 4-11 – Indirect Tax Revenues as a cost

£m 2002 prices and values	Forecast	Outturn
Change to Indirect Tax Revenues	-229.5	-110.9

4.50 This evaluation shows that the outturn assessment of indirect tax revenue as a costs is lower than forecast. This is due to the fact that the forecasts assumed higher background traffic growth and hence higher changes to indirect tax, whereas in the outturn the background traffic

growth is negligible compared to pre-scheme. This assessment is based on the scheme section where both pre-scheme and post opening traffic counts are available.

Present Value Costs (PVC)

4.51 A 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 (or at a set consistent date) 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.

4.52 Following current Treasury Green Book guidance, calculation of the present value entails the conversion to market prices, then discounting by year. This using a rate of 3.5% for the first 30 years and 3% thereafter.

4.53 The total Present Value of Cost (PVC) is made up of the following costs converted to present value:

- Investment costs – construction.
- Investment costs – maintenance.
- Changes to indirect tax revenues.

4.54 The final TUBA model (2007) and the AST both present the PVC as £256m. This is the 2002 costs, expressed in market prices discounted at the annual rate of 3.5%. The outturn costs are presented likewise*Table* 4-12 shows the total of the present value costs.

Table 4-12 – Summary of Forecast and Observed Present Value Costs

Present Value Costs (£m, 2002 prices and values)	Forecast	Outturn
Investment costs (Construction)	476.1	421.8
Maintenance costs	-15.4	
Indirect Tax Revenue	-229.5	-110.9
Total	**231.3**	**295.4**

4.55 It can be seen from ***Table 4-12*** that the outturn scheme present value costs are 28% higher than forecast costs. These values for the costs are used in the calculation of the Benefit Cost Ratio in ***Table 4-13***.

Benefit to Cost Ratio (BCR)

4.56 The Benefit Cost Ratio (BCR) is used as an indicator of the overall value for money of the scheme. It is the comparison of the benefits (PVB) and costs (PVC) expressed in terms of present value. For the purpose of evaluating the BCR the forecast and outturn costs have been discounted to 2002 using the standard discount rate of 3.5% and converted to market prices.

4.57 Schemes with a BCR greater than one have greater benefits than costs; hence they have a positive Net Present Value (NPV). The higher the BCR, the greater the benefits relative to the costs.

4.58 At the time of scheme appraisal, Treasury guidance was to include indirect tax as a cost. However, the most recent guidance on indirect tax impacts is to include these as a benefit, rather than a reduction in cost. This means that when a scheme leads to increase fuel consumption and hence increase tax revenue, the PVB is increased rather than the PVC being decreased. ***Table 4-13*** below presents the BCR for both scenarios.

Table 4-13 – Predicted vs. Reforecast BCR

All costs in £m 2002 prices and values	Indirect Tax impact as Cost		Indirect Tax impact as Benefit	
	Forecast	Outturn	Forecast	Outturn
PVB	1335.5	2225.1	1565.0	2336.1
PVC	231.3	295.4	460.7	406.4
NPV	1104.2	1929.7	1104.2	1929.7
BCR	**5.8**	**7.5**	**3.4**	**5.7**

4.59 ***Table 4-13*** shows that the outturn BCR is higher than forecast largely due to the journey time benefits being higher than forecast.

4.60 It should be noted that the BCR ignores non-monetised impacts. In the Transport Business Case, the impacts on wider objectives must be assessed but are not monetised. The evaluation of the environmental, accessibility and integration objectives is covered in the following sections.

Wider Economic Impacts

Forecast

4.61 The AST (***Table 7-1***) for this scheme stated that '*The scheme does not affect any Regeneration Areas'*. The forecast impact of the scheme was '*Neutral*'.

4.62 The EAR for this scheme states that '*there was no need for an EIR (Economic Impact Report) as it does not pass through a regeneration area and thus the results were not monetised*'.

Evaluation

4.63 A large proportion of the wider benefits come from the agglomeration and imperfect condition components (whereby changes to the transport system allow improved access to higher productivity areas for employment). These components are largely driven by the travel time and accessibility benefits of the scheme. Previous sections have shown that the scheme has led to increased capacity, improved journey times and reliability. Whilst this is likely to facilitate the wider economic benefits, as the appraisal has stated, there is no regeneration area in the vicinity of the scheme.

4.64 In the absence of a full evaluation into the possible wider impacts of the M25 junction 16 to 23 scheme, this evaluation is in agreement with the appraisal's assessment of 'neutral'.

Key Points - Economy

Present Value Benefits (PVB)

- The scheme has provided greater journey time benefits than expected, despite carrying less traffic than expected. This is because of the higher than expected savings in journey time along the scheme section.
- Safety benefits expected as a result of the scheme were only a small part of the overall benefits; over the 60 year appraisal period they were forecast to be £0.3m. The analysis performed at this OYA stage showed that there is no statistical evidence that the scheme has had an impact on safety within the study area. As such, the monetised safety impact is reforecast to be £0m.
- The disbenefit from carbon emission is less than forecast owing to the outturn traffic flows being lower than forecast.
- The outturn PVB is 67% higher compared to forecast. This is as a result of the journey time benefits and improvements to journey time reliability being higher than forecast, the disbenefit from carbon emissions and vehicle operating costs being lower than forecast and higher reliability benefits.

Scheme Costs

- The outturn investment costs were 11% lower than forecast.
- The outturn impact on indirect tax is lower than forecast due to lower traffic growth than was expected during appraisal.
- The outturn PVC of £295.4m is higher than the forecast PVC of £231.3m. This is due to the indirect tax revenues (a negative cost) being lower than forecast.

Benefit Cost Ratio (BCR)

- Taking the indirect tax impact as part of the costs the scheme achieves an outturn BCR of 7.5 compared against a forecast value of 5.8. When the tax impact is treated as part of the benefits, the scheme achieves a BCR of 5.7 compared against a forecast value of 3.4. The outturn BCR is higher than forecast due to a higher than forecast PVB and a marginal difference between forecast and outturn PVC.

Wider Economic Impacts

- The scheme is likely to facilitate wider economic benefits through increased capacity, improved journey times and reliability. However, in the absence of a full evaluation into the possible wider impacts of the M25 junction 16 to 23 scheme, this evaluation is in agreement with the appraisal's assessment of 'neutral'.

5. Environment

Introduction

5.1 This section documents the evaluation of the impacts of the scheme on the environmental sub-objectives.

5.2 The ES notes that the objectives for the scheme were:

- *to deliver the trunk road improvements accepted by the Secretary of State following the recommendations of the ORBIT MMS[10].*
- *to improve journey time reliability and safety on the M25.*
- *to ensure no worsening of the Appraisal Summary Table (AST) sub-criteria assessment results and improve on them where possible.*

Data Collection

5.3 The following documents have been used in the environmental evaluation part of this study:

- Appraisal Summary Table (AST), August 2007.
- Environmental Statement (ES) Volumes 1, 2 and 3 August 2007.
- As Built Appraisal Summary Table and Report (May 2012).
- As Built drawings including landscape design proposals, ecology mitigation and environmental masterplans (including environmental barriers, ponds and PROWs).
- Works Information.
- Alternative Design Proposal reports.
- Various as built acoustic reports including Specification Appendices 25/4 – Environmental Barriers.
- Air Quality Technical Report and Summary of Design Changes Impacts 2009.
- Specification appendices series 3000 Landscape & Ecology.
- Section 1 Landscape & Ecology Establishment Monitoring Annual Summary 2012.
- Gantry Amendments – Landscape and Visual Reviews.
- Water Quality and Hydrology reports.
- Draft Popular report (archaeology).

5.4 A full list of the background information requested and received to help with the compilation of this report is included in ***Appendix D***.

Alternative Design Proposals and Design Development Changes

5.5 During design development, alternative design proposals were assessed for approval. These alternative design proposals utilised private land outside the highway boundary. The purchase of the land was subject to General Permitted Development Orders.

5.6 Purpose of land purchases included:

- Reduction in sheetpile retaining structures[11] – purchase of 5 to 10 metre strips of land adjacent to the original highway boundary to allow re-grading of slopes as opposed to installation of sheetpile walls the benefit of which included a whole life cost benefit by reducing maintenance of structures on the highway network. The short term impact to

[10] London Orbital Multi-Modal Study - The aim of ORBIT MMS was to develop a long-term multi-modal strategy for the sustainable management of the M25 orbital motorway and more generally for the transport corridor around London.

[11] Sheet pile walls are retaining structures made out of steel, which are driven into the ground

the scheme would be the removal of areas of existing roadside planting which served to soften the engineered slopes of the motorway cuttings and embankments which provided a degree of visual screening to the limited number of receptors within view of the scheme. It was expected that these impacts would be reduced in time as reinstatement tree planting matured and the re-graded slope become reintegrated into the wider landscape.

- Installation of additional ponds which reduced the capacity required on drainage networks, reduced storage capacity requirements within ponds and reduced the pumping head of the rising main and therefore a reduction in the requirement for the pump station and rising main size. It was expected that there would be a greater effect on the environment if the pond alternatives were not considered due to the requirement for significant online storage and alternate retaining solutions.

5.7 Ponds subject to change included:

- Pond 3 – reshaping of pond to fit within HA land.
- Pond 22 – reshaping of pond to suit embankment re-grade.
- Pond 23 – pond location changed within the original parcel of highway land in order to utilise an existing access track.
- Pond 27 – Access track moved. The bell mouth junction for the original access track would have been on the A1081, a local authority road, which would have resulted in the need for an application to be submitted to the local authority under section 278[12] of the Highways Act. By moving the bell mouth junction to the slip road, the interface with the local authority road was avoided. Pond 27B - pond footprint reduced by use of gabion wall in order to retain vegetation acting as a visual screen.
- Pond 28 – reshaping of pond including use of gabion walls to ensure excavation works were outside 15m exclusion zone of gas main. Also gabion wall added to allow for access track.

5.8 Other alternative design proposal assessments included for the provision of 4 bunds (Chorleywood, Junction 20, Bricket Wood and South Mimms).

Additional Design Development Changes

5.9 New access tracks provided from the junction 17 anticlockwise offslip to a drainage storage tank, and from Shenley Lane to a Hertfordshire pollution control unit near junction 22.

5.10 On the junction 18 anticlockwise offslip the temporary platform used for driving in the sheet piles was retained as the permanent solution. Consequently the slope is steeper than would otherwise have been the case. The ES showed the area as grassland to be retained. Due to this change Species Rich Grassland has been sown and is establishing well.

5.11 Matting on steep chalk slopes near junctions 17 and 18 was installed to cater for solution features and slope face protection (see ***Figure 5-1*** below).

[12] Section 278 of the Highways Act - Agreements as to execution of works.

Figure 5-1– Matting on steep chalk slopes near junctions 17 and 18

5.12 Sheetpile walls were not painted as originally proposed primarily due to cost and programme savings during construction and reducing future maintenance. Safety was also put forward as a justification.

5.13 A 2.4m close boarded fence was provided on the anti-clockwise carriageway on the approach to Micklefield Green Bridge for 80m in order to screen the motorway from horses on the adjacent bridleway.

5.14 As a result of these alternative design proposals and design development changes, an update to the Scheme Appraisal Summary Report was required.

Updated Environment AST report

5.15 An updated AST report was undertaken during the Construction stage to confirm that no worsening to the AST score had resulted from changes undertaken.

5.16 Changes from the ES proposed scheme included:

- Re-landscaping of slopes, including loss of vegetation shown to be retained.
- Inclusion of additional bunds.
- Addition of noise barriers to reduce noise insulation requirements.
- Relocation of proposed ponds and additional ponds.

5.17 Conclusions reached in this AST have been included within each Environment topic.

Site Inspections

5.18 A site visit was undertaken in June 2013. OYA photographs for inclusion in this report were taken at this time.

5.19 Photomontages are available in the ES and have been used for comparison in this report. View comparison photos were taken in March 2014 to mirror the Winter conditions taken in the ES

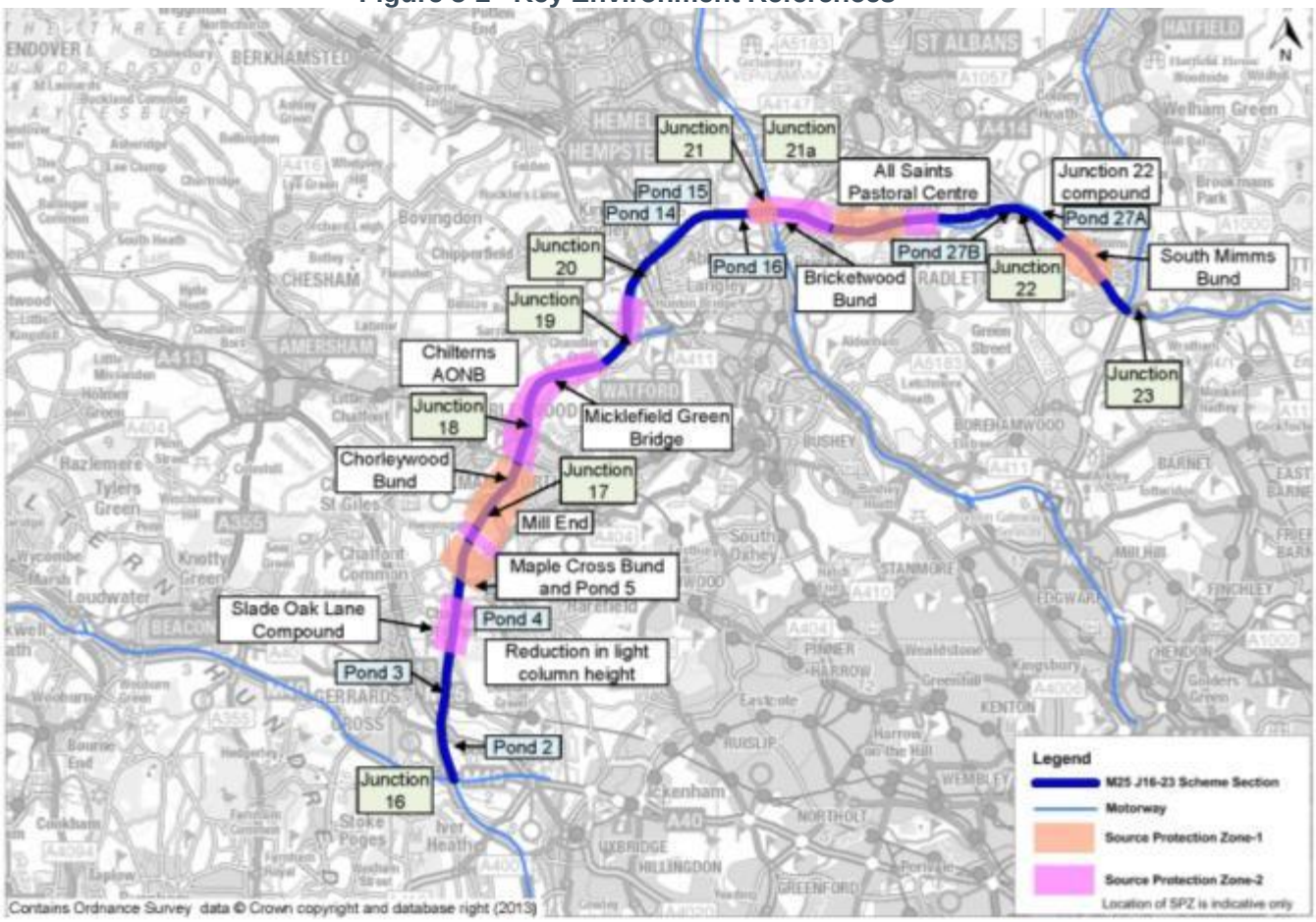
Consultations

5.20 ***Table 5-1*** lists the organisations contacted regarding their views on the impacts they perceive the road scheme has had on the environment, and whether they feel that the mitigation measures implemented have been effective.

Table 5-1 – Summary of Environmental Consultation Responses

Organisation	Field of Interest	Comments
Environment Agency	Water	Comprehensive positive response received. This response has been recorded in the Water Quality and Drainage section
Natural England	Biodiversity and Landscape	Responses received, included in biodiversity and Journey Ambience sections
English Heritage	Archaeology	No response to consultation request received
Buckinghamshire County Council	General	Commented that PROWs were not affected by the scheme, no comment on air quality and noise due to original contacts having left BCC. Landscape character assessment review, possibly available at a cost.
South Bucks District Council	General	No response to consultation request received
Chiltern District Council	General	No response to consultation request received
Dacorum Borough Council	General	No response to consultation request received
Hertsmere Borough Council	General	Responses received from the HBC included in noise, air quality and drainage sections
Hertfordshire County Council	General	No response to consultation request received
Three Rivers District Council	General	No response to consultation request received
The City and District of St Albans Council	General	No response to consultation request received
Groundwork Hertfordshire	General	No response to consultation request received
Countryside Agency	General	No response to consultation request received
Chilterns AONB	General	Response received. Comments included in noise, air quality and Landscape
Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT)	General	No response to consultation request received
Hertfordshire and Middlesex Wildlife Trust	General	No response to consultation request received
Gerrards Cross Parish Council	General	No response to consultation request received
Denham Parish Council	General	No response to consultation request received
Chalfont St Peter Parish Council	General	Commented that due to the distance of the council from the M25 residents have seen little change to the village but the effect on the M25 has been beneficial.
Chorleywood Parish Council	General	No response to consultation request received
Sarratt Parish Council	General	No response to consultation request received
Abbotts Langley Parish Council	General	Commented that they agreed the traffic flow at junction19 was improved but not solved; junction 20 required lane markings on the roundabout and traffic lights to be repainted; questioned why metal piling had been painted in some areas of the motorway but not these sections and that they felt that noise levels had increased at Bedmond.
Kings Langley Parish Council	General	No response to consultation request received
St Stephen Parish Council	General	No response to consultation request received
Ridge Parish Council	General	No response to consultation request received
Shenley Parish Council	General	No response to consultation request received
Northaw and Cuffley Parish Council	General	No response to consultation request received

Figure 5-2– Key Environment References



Animal Mortality

5.21 The DBFO[13] Contractor has been consulted with regard to animal mortality figures. Figures received have been included in the Biodiversity section.

Environmental Awards

5.22 This scheme has won a number of environmental awards, as listed below:

- CEEQUAL[14] excellent awards:
  - Winner of a CEEQUAL Outstanding Achievement Award 2013 for Project Management.
  - Winner of a CEEQUAL Outstanding Achievement Award 2013 for Land Use.
  - Highly Commended CEEQUAL Outstanding Achievement Award 2013 for Material Use.
- Green Apple Award – Bronze
- Considerate Constructor Award (Bronze 2009, 2010; Silver 2011; Gold 2012)
- HA Supplier Recognition Award – Delivering Sustainable Value and Solutions, November 2011 Highly Commended
- CIR15 Risk Management Award – Major Capital Project, November 2012

[13] Design, Build, Finance and Operate - A Design, Build, Finance and Operate (DBFO) contract period runs for 30 years and focuses on the provision of an operating service rather than an asset. The private sector assumes responsibility for the operation and maintenance of a length of existing road (where appropriate) and for building specified improvement schemes for the life of the contract.

[14] Civil Engineering Environmental Quality Assessment and Award Scheme.

[15] Continuity, Insurance and Risk.

- Brownfield Briefing Award – Best Reuse of Materials, October 2011
- ICE16 East of England – Sustainability, Exceptional Merit and Technical Excellence and Innovation, Merit, June 2013.

Traffic Forecasts and Evaluation

5.23 Three of the environmental sub-objectives (noise, local air quality and greenhouse gases) are directly related to traffic flows. No new environmental surveys are undertaken for POPE and an assumption is made that if the observed level of traffic is in line with forecasts, then it is likely that local noise and air quality are as expected.

5.24 The traffic forecasts used in the noise and local air quality appraisals from the ES were for the predicted year 2012. The comparison is summarised in ***Table 5-2*** with traffic flows rounded to the nearest 100.

5.25 Traffic speeds were included in the ES and have been included in *Table* 5-3.

5.26 Percentage of HDV's were not included in the ES, therefore have not been reported on in this section.

Table 5-2 – With the Scheme (2012) Traffic Flows (AADT): Observed vs. Forecast

Location / Link	Traffic Flows (2-way) – Do-Something			
	Predicted Opening year (2012)	Observed (OYA 2012)	Difference	% Difference
Junction 16 -17	173,900	144,400	-29,500	-17%
Junction 17 -18	179,700	146,800	-32,900	-18%
Junction 18 -19	194,400	160,600	-33,800	-17%
Junction 19 -20	155,900	139,000	-16,900	-11%
Junction 20 -21	160,800	141,700	-19,100	-12%
Junction 21-21a	131,400	-	-	-
Junction 21a -22	157,200	127,100	-30,100	-19%
Junction 22 - 23	157,200	130,300	-26,900	-18%

Table 5-3 – With the Scheme (2012) Traffic Speeds: Observed vs. Forecast

Location / Link	Average Speed (Kph)-Do Something								
	Forecast-AM	Observed-AM	Difference	Forecast-IP	Observed-IP	Difference	Forecast-PM	Observed-PM	Difference
Junction 16 -17	89	74	-15	89	101	12	88	90	2
Junction 17 -18	86	79	-5	88	103	15	84	97	16
Junction 18 -19	83	86	3	86	102	16	81	98	17
Junction 19 -20	95	88	-7	93	104	13	91	101	10
Junction 20 -21	92	92	0	93	103	10	91	100	9
Junction 21a -22	91	100	9	95	105	10	91	101	10
Junction 22 - 23	94	90	-1	95	103	8	95	81	-14

AM = Morning peak; IP = Inter peak; PM = Evening peak

[16] Institute of Civil Engineers.

5.27 The observed traffic information is not provided for the section J21-21a since no data is available for a like for like comparison. This section is very short and it is not clear from ES forecasts which section traffic data is reported for this link.

5.28 Predicted opening year traffic is high compared to the observed traffic on all sections. This is due to the traffic forecasting model assuming a higher level of background growth in traffic than has been observed in the outturn data. From regional traffic trends there is little change in 2012 compared to 2008 (i.e. the pre-scheme scenario).

Noise

Forecast

AST

5.29 The 2007 AST stated that properties exposed to >66 dB in 2012 would reduce from 253 to 202 with the Scheme. Mitigation of noise impacts from increased traffic flows would include a central reserve concrete wall and new Environmental Barriers. A slight increase in noise levels would occur by 2027 with the Scheme and four properties (including 2 Listed Buildings) would qualify for noise insulation. With regard to sensitive receptors Langlebury School would benefit from a slight reduction in noise, for Allington Nursing Home and Sunrise Old People's Home there would be no change in noise level and a Pastoral Centre would experience a slight increase in noise level <3 dB.

Updated AST

5.30 The appraisal was based on an assessment including design development that occurred since the Environmental Statement design, including updated surfacing information and the addition of landscape bunds and further noise barriers. The appraisal results are similar to or better than those reported previously, with noise mitigation limiting increase in noise. [17]Twelve houses and four properties within a caravan park were shown to be eligible for discretionary noise insulation.

Environmental Statement

5.31 The ES stated that the design aim of the Scheme was to provide a benefit by way of a reduction in noise and where this was not practicable the aim was to limit any increase in noise, wherever possible, to 1 dB LA10 18hr[18].

5.32 The ES confirmed that in terms of noise mitigation measures, the Scheme would include low noise surfacing on both carriageways and a concrete barrier at the central reservation. In addition, new Environmental Barriers had been proposed, where necessary; to further reduce the noise effects.

5.33 Noise calculations showed that there were four properties that would qualify for a discretionary offer of noise insulation under Regulation 3 Noise Insulation Regulations 1975 (as amended 1988).

5.34 Noise calculations also showed that there was expected to be reductions in noise of up to 6 dB in the Opening Year at some properties. This reduction was considered to be a moderate

[17] The increase in properties qualifying for discretionary noise insulation was due to resurfacing works between 2007 and 2009 changing the baseline.

[18] LA_{10} 18hr refers to the noise level just exceeded for 10% of the measurement period (18 hours). LA10 is extensively used for rating traffic noise. For example, LA10(18-hour) is considered good practice when reporting Road Traffic Noise measurements.

decrease, and the majority of residential properties within 300 metres of the Scheme would benefit from a reduction in noise levels as a result of the Scheme. It was also expected that there would be a general reduction in the number of people bothered by noise.

5.35 The ES concluded that when considering the overall impacts of the Scheme on the wider area, the assessment indicated that there would be more dwellings with increases in noise and noise nuisance with the Scheme than without it, but there would also be an increase in the number of dwellings with a decrease in noise and noise nuisance with the Scheme than without it.

Consultation

5.36 Chilterns AONB confirmed that mitigation measures have been installed as expected (including noise barriers).

5.37 Hertsmere Borough Council (HBC) confirmed the following:

- The mitigation measures described in Table 3.6 and Figure 3.2 of the Environmental Statement have been implemented as expected. Additionally, it appears that an extra environmental barrier that was not specified in the Environmental Statement has been erected opposite Salisbury Hall Lodge adjacent to the anti-clockwise carriageway[19].

5.38 Abbotts Langley Parish Council noted that they felt that noise levels had increased at Bedmond.

Evaluation

5.39 Further to the consultation response received from Abbotts Langley Parish Council, it is noted that the Scheme is mostly in cutting (including the use of sheetpiles) in this area. It is further noted that an area of the M25, west of Bedmond Road, is at grade with the surrounding landscape. This has resulted in the motorway moving slightly closer to some properties in Bedmond. The impact of this move together with the lower than expected traffic flows in this section of the scheme is not considered significant enough to influence an increase in noise.

5.40 To assess whether traffic flows have impacted on the overall AST scoring undertaken as part of the ES, traffic flows need to be 20% lower than forecast. ***Table 5-2*** shows that observed traffic flows are lower than expected when compared with those predicted in the ES for the Do Something scenario but not sufficient to allow a 'better than expected' local noise impact assessment.

5.41 Traffic speeds need to vary by 10kph when compared with what was originally forecast in a particular year. As is noted in ***Table 5-3*** speed differences exceed 10kph in most areas during the interpeak and evening peak time periods. This suggests a 'worse than expected' result for traffic speeds.

5.42 Low noise surfacing (LNS) has been used for the widened lane and other repairs required as a part of the Scheme. LNS has a Road Tyre Noise Level 3 which is equivalent to a Road Surface Influence (RSI) of -3.5dB(A).

19 Chainage 33050-33250 noted in Environmental Barrier Reconciliation table in ***Appendix E***.

Audit of Environmental Barrier locations against the ES

Existing barriers

5.43 As part of the construction phase, sensitivity tests on existing environmental noise barriers proposed to be retained as part of the M25 widening was undertaken. This testing demonstrated that actual barrier locations and heights were different to those reported in the ES, and therefore different to what was previously modelled during detailed design.

Figure 5-3– Retained Environmental Barrier near Junction 18 (clockwise)

5.44 With the updated environmental barrier information adopted in the noise model, calculations showed that there were minor changes in predicted absolute noise levels, at receptors in proximity to these barriers. These changes affected the do minimum and do something scenarios similarly, and therefore the changes in the overall predicted noise impact of the scheme. These changes remained negligible (less than 1dB) noise impact

Additional barriers

5.45 For this Scheme, the ES indicated that four properties were likely to require noise insulation under the Noise Insulation Regulations.

5.46 Additional calculation points were added to all facades of potentially eligible buildings between junction 21a and 23 during detailed design to provide greater resolution representative of the individual facades of individual properties. Following this updated assessment the Noise Insulation Regulations requirements for discretionary noise insulation, were predicted to be fulfilled at approximately 49 additional residential locations not identified in the ES.

5.47 Following this assessment, the noise model was reviewed in detail against a range of mitigation options which were tested to reduce the number of properties which would be eligible for noise insulation. Mitigation in the form of environmental barriers, to reduce the scheme impacts, was shown to be practical to install and cost effective at selected properties.

5.48 The results of this audit can be found in ***Appendix E***. This table shows both ES barriers, changes made to lengths and height of barriers and additional barriers as required under the Noise Insulation Regulations between junction 21a and 23.

5.49 As a result of this audit, a total of thirteen properties qualified for noise insulation under the Noise Insulation Regulations 1975 (as amended in 1988).

Figure 5-4– New Environmental Barrier located on the approach to Junction 18 off slip (anticlockwise)

As built Appraisal Summary Report Noise evaluation

5.50 In the As built Appraisal Summary Report (ASR) it is stated that the assessment results are similar to or better than those reported in the scheme AST, although twelve houses and four properties within a caravan park are shown to be eligible for discretionary noise insulation or grants.

5.51 There have been a range of changes to the scheme since the publication of the ES,

- Existing surfacing changes as per data update from 2009.
- Addition of landscaping earth bunds at Chorleywood, Brickett Wood, J20 and South Mimms.
- Removal of some previously proposed noise barriers.
- Addition of further noise barriers to minimise impacts.
- Various changes to barrier heights and positions from that in the ES design.
- Some re-grading to embankments and cutting slopes in some areas.

5.52 The ASR notes that the noise mitigation and landscape bunds included in the scheme limit increases in noise from the scheme.

5.53 This As built ASR is based on a study area considering 4749 properties, whereas the previous ES appraisal was based on a limited study area considering 1460 properties (the limited study area refers to the size of the sample and not the physical area). If the appraisal was restricted to the previous limited study area, the results would show approximately no more people annoyed, demonstrating an appraisal score improvement on a like-for-like basis.

5.54 Further to the table of environmental barriers in ***Appendix E***, environmental barriers are as reflected in the As built information. The barriers are a mix of new and retained barriers which have resulted from the audit of barriers discussed in the above section. It is noted that the life expectancy of noise mitigation to be gained from retained barriers is less than new barriers due to their age. The retained barriers may require replacing ahead of newly installed barriers to maintain their noise reducing qualities. As the maintenance of this scheme is the subject of a DBFO contract, future maintenance of environmental barriers will be the responsibility of this contract within its 30 year life.

Overall Noise Evaluation

5.55 Although lower than expected traffic flows are recorded, they are not sufficient to affect the assessment of ‘as expected’. Due to inter peak and evening peak traffic speeds exceeding the 10kph threshold it is considered that noise based only on traffic speed could be ‘worse than

expected' at these times. Traffic flow and speed data provided in Table 5-2 and Table 5-3 has been converted to noise data. In addition to this, an HGV figure, based on the ES for predicted and DfT data for observed has been included. Roadside noise levels are based on flow, speed and %HGV for each case. Purely on the basis of changes in traffic, the noise on the motorway is lower than predicted although not sufficient to affect an '**as expected**' assessment for noise.

Origin of Assessment	Summary of Effects on Noise	Assessment
AST	Properties exposed to >66dB in 2012 reduce from 253 to 202 with the Scheme. Mitigation of noise impacts from increased traffic flows would include a central reserve concrete wall and new Environmental Barriers. Slight increase in noise levels would occur by 2027 with the Scheme. 4 properties (including 2 listed buildings) would qualify for noise insulation. Langlebury School sensitive receptor would benefit from a slight reduction in noise, Allington Nursing Home and Sunrise Old People's Home with no change and a Pastoral Centre with a slight increase in noise level <3 dB.	Change in population annoyed: +27 PVB(residential) -£705,410
As built AST	The appraisal is based on an assessment including design development that has occurred since the Environmental Statement design, including updated surfacing information and the addition of landscape bunds and further noise barriers. The appraisal results are similar to or better than those reported previously, with noise mitigation limiting increase in noise. Twelve houses and four properties within a caravan park are now shown to be eligible for discretionary noise insulation.	Change in population annoyed: 33 PVB(residential) -£1,029k
EST	Lower than expected traffic flows are not significant enough to affect an 'as expected' assessment. Although higher than expected speeds during the inter and evening peak times has been observed they are not sufficient to influence an 'as expected' assessment.	As expected

Local Air Quality

Forecast

5.56 The 2007 AST stated that there were 7 AQMAs[20] along the scheme, declared by 4 of the local districts. It stated that no new AQMAs would be created.

Updated AST

5.57 The updated AST assessment concurred with the 2007 AST and remained unchanged.

Environmental Statement

5.58 The ES stated that in the baseline year, fifty one NO_2 (nitrogen dioxide)annual average Air Quality Standard (AQS) objective/ EU Limit Value exceedances had been predicted, together with forty PM_{10} 24 hour mean EU Limit Value exceedances and one annual average PM_{10}[21] EU Limit Value exceedances.

5.59 No exceedances of the EU Limit Values were predicted in any of the opening year (2012) scenarios with respect to any of the pollutants modelled, except for Receptor 54 with respect to annual average NO_2 in the Do-Minimum scenario. The opening year was predicted to be the worst-case air quality year of the two forecast years assessed (2012 and 2015). An

[20] Air Quality Management Area

[21] Particulate Matter up to 10 micrometers in size

assessment of traffic re-routing during construction did not predict any exceedances of the EU Limit Values, except for at two locations (Glen View, Chandlers Cross).

5.60 The regional assessment of the opening year predicted that there would be an overall increase in all emissions with the Scheme alone and cumulatively with additional widening Schemes.

5.61 The ES stated that a background reduction of NO×[22] and PM_{10} emissions was expected due to an improvement in vehicle technology, but that there would be an overall increase in NO× and PM_{10} emissions with the scheme. This was as a result of an overall increase in traffic flow with the scheme.

Consultation

5.62 Chilterns AONB confirmed that mitigation measures have been installed as expected.

5.63 Hertsmere Borough Council (HBC) confirmed the following:

- HBC monitors NO_2 by diffusion tubes; there are three monitoring sites close to the M25 between J22-23. Two of these sites have seen a slight decrease in annual mean NO_2 levels between 2012 and 2013, however, until longer term trends are established this improvement cannot be attributed to the scheme.
- HBC has a motorway related AQMA at Blanche Lane, South Mimms, close to Junction 23. There is one diffusion tube monitoring site within this AQMA, data collected shows that there has been a decrease in the annual mean NO_2 levels measured at this site, however, until longer term trends are established this improvement cannot be attributed to the scheme.

Evaluation

5.64 The ES found that in the 2012 Do Something Scenario none of the relevant receptors were predicted to exceed the EU limit value for Nitrogen Dioxide (the only pollutant to show any exceedance in the base or Do Minimum).

5.65 During the construction phase, further screening calculations were undertaken at Glen View, Chandlers Cross. This was to determine whether a design change moving the carriageway closer to the property would cause any deterioration in the predicted air quality. This receptor is within an AQMA. Calculations showed no exceedance of the EU limit value for Nitrogen Dioxide, and that the change in concentration arising from the design change was negligible.

5.66 For all other locations, design changes reported would be insignificant in the context of air quality responsiveness and available assessment techniques.

5.67 The traffic data shows that the observed flows are lower than forecast along all sections of the motorway, which should indicate that pollutant concentrations are lower than those estimated in the ES. However, in recent years, there has been no change to the AQMAs in the surrounding area, indicating that air quality has remained the same in recent years, with continued breaches of the NO_2 annual average EU Limit Value at sites near the M25.

5.68 It is recommended that monitoring data at sites near the M25 is further examined in the FYA report.

[22] Generic term for mono-nitrogen oxides NO and NO_2 (nitric oxide and nitrogen dioxide)

Origin of Assessment	Summary of Effects on Air Quality	Assessment
AST	7 AQMAs along the Scheme, declared by 4 of the 7 local districts. No new AQMAs have been created. No predicted exceedances of NO_2 or PM_{10} EU Limit Values in Do-Something opening year (2012) but 1 NO_2 exceedence in Do-Minimum (DM). Overall a net improvement in air quality is predicted in the generalised assessment for NO_2, but deterioration for PM_{10}, although the percentage changes are small (e.g. 0.007% from DM 2012 for NO_2).	PM_{10} + 5.64 NO_2 - 21.33
As built AST	Unchanged	
EST	The traffic data shows that the observed flows are lower than forecast along all sections of the motorway, which should indicate that pollutant concentrations are lower than those estimated in the ES. However, in recent years, there has been no change to the AQMAs in the surrounding area, indicating that air quality has remained the same, with continued breaches of the NO_2 annual average EU Limit Value at sites near the M25.	As expected

Greenhouse Gases

5.69 The assessment of the impacts of transport schemes on emissions of greenhouse gases is one of the environment sub-objectives. WebTAG notes that carbon dioxide (CO_2) is considered the most important greenhouse gas which is therefore used as the key indicator for the purposes of assessing the impacts of transport options on climate change. Changes in CO_2 levels are expressed in terms of equivalent tonnes of carbon released as a result of the scheme.

Forecast

5.70 The AST stated that 'The scheme is forecast to slightly increase carbon emissions over the 60 year appraisal period, compared to the Do-Minimum scenario'. The increase was forecast to be less than 0.175% across the study area. Net Carbon emissions over the 60 year appraisal period were estimated to be 869,560 tonnes and in the opening year this was forecast to be 18,576 tonnes. It is not clear how the AST calculations were carried out.

5.71 The methodology used in the ES for changes in carbon emissions was from the Transport User Benefit Appraisal (TUBA) software. Emissions were calculated for the Do-Minimum and Do-Something scenarios for the Opening year (2012) and Design year (2027) compared to base year (2004). The net carbon emissions in the opening year and over 60 year appraisal period were consistent with AST.

5.72 For this study it is not possible to analyse carbon emissions for such a large geographical area. Rather, an analysis of emissions from vehicles using the M25 scheme section has been undertaken. In order to undertake this analysis, current Design Manual for Roads and Bridges (DMRB) guidance has been used to re-forecast carbon emissions for the DM and DS scenarios using data contained in the Traffic Forecasting Report. Observed carbon emissions were calculated using the same methodology for the before and after scenarios, using flow and speed data collected for this study. As the same geographic area has been modelled for the forecast and observed scenarios, a clear comparison can be made between the data outputs. Reforecast and outturn carbon emissions are provided in ***Table 5-4***.

Table 5-4 – Reforecast and Outturn Carbon Emissions (Carbon tonnes/year)

	Reforecast	Observed
Do Minimum/Counterfactual(based on before)	154,933	120,448
Do-Something/Post opening	182,240	134,148
Net Difference	**27,307(18%)**	**13,700(11%)**

5.73 It can be seen from ***Table 5-4*** that the outturn carbon emissions along the scheme section are lower than the forecast emissions. The difference between forecast and outturn net emissions as a result of the scheme is 13,607.

5.74 The observed proportionate increase in emission as a result of the scheme is 11% whereas the forecast value is 18%. This difference is primarily due to the fact that the forecasts assumed higher traffic growth along the scheme section, whereas in the observed the traffic growth is less than the forecast. The background growth observed in the vicinity of the scheme is marginal compared to base year.

5.75 From Section 2 it can also be noted that the increase in speed along the length of the scheme is greater than forecast. Whilst an increase in speeds would generally increase the change in emissions, in the case any such increase has been offset by the negligible change in traffic levels.

Table 5-5 – Summary of Greenhouse Gases Evaluation

Sub-Objective	AST Score	OYA Evaluation
Greenhouse Gases	Carbon Emissions change (tonnes) 60 year = 869,560, Opening yr = 18,576 Net Present Value of Emissions (60 yrs) = - £29.9m	Better than expected

Landscape

Forecast

AST

5.76 The 2007 landscape AST stated that continuous lighting (previously intermittent), gantries and signage would bring the greatest change in landscape character and increased perception of urbanisation in the countryside, including in Chilterns Area of Outstanding Natural Beauty. Due to land constraints, effects would be hard to mitigate with a slight reduction in overall screening expected. The impact overall was assessed as **Moderate Adverse**.

Updated AST

5.77 The As built AST stated that the continuous lighting as shown in the illustrative design had not changed during the design. Lighting, gantries and signage remain as the greatest change in landscape character and increased perception of urbanisation in the countryside, including in the Chilterns Area of Outstanding Natural Beauty. Land purchase areas had increased the area of soft estate and as such, increased the planting included in the Scheme. The impact overall remained as **Moderate Adverse**.

Environmental Statement

Landscape Effects

5.78 The ES stated that the landscape impacts would generally result from the loss of vegetation within the Scheme Boundary, introduction of new elements such as gantries and lighting columns and new lighting in the currently unlit sections.

Figure 5-5– Calcareous grassland is establishing by naturalisation on new cut slopes – no direct seeding was undertaken

5.79 The Scheme would result in **moderate adverse** landscape effects in year 15 in three main areas: the landscape character areas between Junctions 16 and 17, the Chilterns Area of Outstanding Natural Beauty, Chorleywood settlement and the landscape character areas between Junctions 21a and 22.

Visual Effects

5.80 The ES stated that the Scheme crossed undulating ground in a wide sweeping curve across several shallow river valleys which opened up panoramic views from and to the Scheme where it followed higher ground or cut through ridgelines. The existing motorway was currently a visible element in many views, particularly where it crossed rivers or dry valleys or was on high embankments or viaducts.

5.81 The key visual effects on receptors resulting from the Scheme would be from the loss of existing vegetation and the introduction of signage, gantries and lighting.

5.82 Broadly, the Scheme would result in a **moderate** to **slight adverse** effect at year 1 reducing to **slight adverse** with the maturing of the planting proposals on surrounding visual amenity receptors. During the summer the impacts would be broadly reduced due to the screening provided by the surrounding woodland, trees, shrubs and hedgerows in leaf. However, this would largely not reduce the significance of effects.

Night-time Effects

5.83 The ES stated that the key night-time effects resulting from the Scheme would be from the loss of existing vegetation and the introduction of signage, gantries and lighting. This would include lighting in currently un-lit areas and the movement of lighting columns from central reserve lighting to verge lighting.

5.84 Broadly, the Scheme would result in effects on the surrounding landscape relevant designations, the landscape character areas and visual amenity receptors. Effects would range from **slight adverse** to **moderate adverse** at year 1, reducing generally to **slight adverse** with the maturing of the Scheme planting by year 15.

Overall Effects

5.85 The overall effects of the Scheme was determined through balancing the year 15 effects on landscape character (including designations) and visual amenity receptors, during the day and night time.

5.86 The effects of the Scheme, including continuous lighting, gantries and signage as well as the increase in road surface and the subsequent removal of vegetation within the Scheme boundary would continue to affect the landscape character and visual amenity at year 15.

5.87 The greatest effects to landscape character would be the increase in built elements and the subsequent increased perception of urbanisation in the largely rural landscape surrounding the Scheme. The Scheme would also affect the recognised high quality landscape of the Chilterns Area of Outstanding Natural Beauty.

5.88 Day-time effects on visual amenity receptors would be from increased views of lighting columns, gantries and signage. Night-time effects would be intrusion from continuously lit areas along the Scheme.

5.89 Overall, the balance of these effects of the Scheme would be **moderate adverse**.

Consultation

5.90 The Chiltern AONB responded that the impact of the scheme on the character and quality of the local landscape is as expected. They confirmed that the mitigation measures installed as part of the scheme to reduce the visual impacts and allow the scheme to be integrated into the surrounding landscape are as expected.

5.91 Hertsmere Borough Council (HBC) responded as follows:

- The new Environmental Bund at South Mimms was implemented in accordance with the proposed plans submitted to HBC. We were kept well informed of the works as they were undertaken and were allowed access at all times to the site to inspect. We consider the Bund has had a positive impact on the South Mimms area and has been integrated well into the surrounding environment.

Evaluation

5.92 Comparison views with selected ES photomontages and FYA photographs are shown in Appendix F

5.93 As expected in the ES the impact of the scheme on landscape is as a result of the increased width of carriageway resulting in permanent removal of vegetation from within the Scheme boundary. Overall there is a local reduction in the quantity of trees/woodland, grassland and dense scrub within the highway estate as a result of the Scheme. Planting was undertaken within the three construction phases and as such varying growth achievements were noted during the site visit.

5.94 The introduction of the new scheme lighting, gantries and signage into sections of the M25 where none existed has resulted in the greatest change to landscape character, tranquillity, and pattern within the Scheme. These man-made vertical elements result in the M25 being viewed as a continuous element within the landscape where before it was intermittent. The increased visibility resulting from the Scheme lighting increases the perception of urbanisation

within the countryside and reduces the tranquillity of the existing landscape setting. Introduction of verge lighting through the Chilterns Area of Outstanding Natural Beauty has an adverse effect upon the landscape character within this designated area.

5.95 Further intrusion into the landscape is seen in ***Figure 5-6*** below where a combination of noise barrier, sheetpile retaining wall and loss of existing vegetation has resulted in a negative visual impact on Mill End near junction 17. This retaining feature is constructed as proposed in the ES, although an increase in vegetation removal compared with that proposed in the ES has resulted in views to the motorway being more open than expected. Vegetation clearance was in anticipation of the inclusion of a bund which was discontinued due to resident objections. Large specimen trees were planted in place of the removed vegetation at the request of the residents. These specimen trees, together with both existing and planted woodland should achieve the screening objectives required by the design year.

Figure 5-6– Sheetpile retaining wall and noise barrier near junction 17

5.96 The loss of road side vegetation and the limited opportunities to reinstate this planting has resulted in an overall greater visibility of vehicle movement and road infrastructure reinforcing the perception of the urbanisation of the countryside. The introduction of lighting, gantries and associated signage cannot be completely mitigated within the Scheme.

5.97 Land purchase areas outside the original scheme boundary required additional clearing of vegetation in some instances and opportunities to plant in new areas in others. Additional clearance areas within land purchase areas has allowed for soft landscaping within the highway boundary, replacing retaining features which would have been a permanent artificial feature in the landscape (see ***Figure 5-7*** below). The introduction of new ponds to the Scheme gives rise to increased opportunities for planting.

Figure 5-7– Land purchase slope visible on the right-hand side (anticlockwise near junction 18) – re-grading replaces sheetpile feature

5.98 Whilst land purchase areas have allowed for a softening of the effects of the Scheme at the cost of existing scrub and woodland, other areas where retaining features have been retained demonstrate the positive effect that retention of existing vegetation has on the local environment.

Figure 5-8– Use of sheetpile retaining structures has allowed for the retention of mature vegetation within the Scheme boundary

5.99 It is understood that some planting plot soil preparation issues were noted during construction and that remedial ground preparation work was undertaken to select planting plots to alleviate concerns identified in soil analysis reports regarding compaction and insufficient depths of topsoil. Auguring of plant pits and the addition of compost and soil ameliorant were applied to the identified planting plots to ensure plant growth would reach growth targets in the Design Year. It is recommended that difference in establishment between different techniques and growth targets are reviewed at FYA.

Planting assessment and establishment (excerpts from the Section 1 Landscape & Ecology Establishment Monitoring Annual Summary 2012)

Grassland Seeding Plots

5.100 A 2012 annual summary stated that there was continued progress in establishment and no incidents occurred that had significantly damaged any plots. The number of species derived from the species-rich grassland (SRG) seed mix per m² was said to have generally increased in the sampled plots or remained the same throughout. Cover and number of species had generally increased throughout the sampled plots.

Figure 5-9– Example of growth of Species Rich Grassland plot

5.101 Natural colonisation of plants from the seeds already within the soil used within plots is more prevalent than establishment of sown seed. It is noted that topsoil stripped during construction has been used on site. This topsoil would have contained a seed source from which germination could be anticipated. The naturally colonising plants are not considered to be significantly affecting the establishment of the sown seed to date. Topsoil depths were reduced in areas where SRG was sown, although it appears some areas were not subject to this reduction.

Figure 5-10– Slope demonstrating seeding success as well as occupation by the seed source contained within the topsoil

5.102 There is a steady increase in the numbers of injurious weed species (ragwort, dock and thistles) recorded, but there was no observed spread of these species to neighbouring land. Goat's-rue, although not listed as invasive or injurious in this case is a species that has become abundant on highway verges in the South East, and is regenerating in some plots. Of the species listed as invasive in the contract, bramble and gorse, are also present in some species-rich grassland plots.

Tree and Hedge Planting Plots

5.103 The 2012 annual summary considered that the success rate of plant establishment was good within the plots. Plant failures were occasional and estimated to be typically less than 2% of the plot if at all. No sign of disease or concentrated areas of plant failures were observed.

5.104 The majority of the plants inspected were alive at the time of the annual monitoring report site visit; therefore, the percentage of successful establishment was considered to be high. However, given the establishment criteria being limited to percentage cover of the plot, the plant cover percentages recorded are still low in the woodland plots due to the young age of stock.

5.105 The wet summer had promoted flushes of weed growth including injurious weeds such as creeping thistle and spear thistle in a number of the planted plots.

Figure 5-11– Planting plot – between junction 16 and 17

5.106 Due to their close planting distances hedgerows are achieving relatively high percentages of cover, with some of the hedgerows also reaching up to 2 m in height. Hedgerow establishment varied through the scheme due to planting undertaken within the three construction phases.

Figure 5-12– Hedgerow planting along the clockwise onslip at junction 17 (taken from footpath 19)

5.107 Planting within pond areas is establishing well with positive signs of growth of marginal and species rich grassland as well as trees and shrubs.

Figure 5-13– Pond 27a – Clockwise within junction 22

Assessment of Landscape Bunds

5.108 Landscape bunds were included at Chorleywood, Brickett Wood, adjacent to the onslip at junction 20 and near South Mimms. These bunds served to assist in the balancing of construction material generated within the scheme and provide additional screening of the motorway from surrounding receptors.

Figure 5-14– Chorleywood bund near junction 17 – planting on bund will ensure increased screening of the motorway, in addition to that achieved by the bund earthworks

5.109 The landscape bunds were reviewed during the OYA site visit. Species rich grassland is establishing and woodland planting progress on the bunds is progressing satisfactorily and should reach screening targets by the Design Year. The final shaping of the bunds has been undertaken in sympathy with the surrounding local landscape which will assist in its final integration within the landscape.

Landscape and Visual Impact of Gantries

5.110 The gantry proposals in the ES were reviewed in detail during the detailed design phase of the contract and changes which would result in improvements in driver information, buildability, value for money and ease of maintenance were proposed.

5.111 As a result of this review, the numbers of gantry and MS3 structures were reduced, although the scheme incorporates a greater number of gantries that span across both carriageways. These revised proposals were reviewed further during the detailed design phase by a Landscape Architect to establish whether there would be any significant changes to the environmental impact of the gantry proposals as set out in the ES. Adjustments were made to the position of gantries where adverse effects were identified and intervisibility and spacing requirements permitted.

Figure 5-15– Superspan gantry on the anti-clockwise carriageway approaching Junction 22

5.112 Overall, the changes undertaken are considered to be worse than expected in comparison with the ES. However, given that the majority of the gantries have been positioned, in so far as spacing and intervisibility standards allow, with consideration to the wider environmental impact, the gantries are considered as necessary component features of the immediate road corridor.

Visual Effect of the Scheme

5.113 The limits of the Visual Envelope shown in the ES identified the areas from which the Scheme would be visible.The main factors that have caused a permanent intrusion upon existing views and impact upon visual amenity include:

- new and/or altered road infrastructure including gantries, lighting, crash barriers, environmental barriers, retaining walls, signage and maintenance parking bays.
- landscape changes impacting the composition of the view including removed vegetation, replacement planting and earthworks.
- increased vehicular movement.

Figure 5-16– New gantries, environmental barriers, signs and lighting add to the increased visual intrusion of the scheme

5.114 The key day and night visual effects on receptors resulting from the Scheme are from the loss of existing vegetation and the introduction of signage, gantries and lighting.

Lighting Change and its effect on the Scheme

5.115 The ES shows the lighting proposals between junction 16 and 17 to be 15m high columns at 45-50m spacing, set 3-4m into the grass verge along both carriageways.

5.116 The amended lighting solution has provided 8m high columns at 25m spacing for approximately 360 metres between Denham and Hornhill Lanes (approximate). The columns were reduced in height to ensure there was no conflict with overhead power lines which run across the carriageway (approximate position marked on ***Figure 5-2***– key environment references). This is a reduction in height of 7m compared to overall column heights of 15m as assessed in the Environmental Statement. To achieve the same levels of illumination the reduction in column spacing results in approximately twice as many columns.

Figure 5-17– Reduced height light columns and overhead cables near Hornhill Lane (image from Google Maps)

Figure 5-18– Reduced height light columns and overhead cables near Shenley Lane (image from Google Maps)

5.117 This increase in columns numbers does not significantly alter the quality and character of the local landscape as the natural topography and dense woodland cover adjacent to the site in most areas serves to preserve the rural character of the area. There are areas around Shenley Lane where woodland is absent which has resulted in a slight increased exposure. The overall impact on the wider landscape is therefore considered to be negligible.

5.118 There are five visual receptors within the vicinity of the amended lighting configuration:

- Owls Hoot Cottage is situated approximately 200m to south west of the site.
- Mopes Farm buildings are approximately 360m from the road in a westerly direction and are screened by existing woodland.
- Cottages adjacent to Mopes Farm (listed buildings).
- Slade Oak Lane which runs under the M25.
- South Bucks Way which passes under the M25 and runs adjacent to the clockwise carriageway for approximately 250m.

5.119 Daytime impacts on these receptors identified in the ES range from minor to intermediate adverse in years 1 and 15, with the introduction of the lighting columns to this section of road being a contributory factor in these assessments. By night, the increase in column numbers and the type of luminaires used in the amended design results in a very slight overall increase in the amount of light spillage compared with the ES. Given the relatively long distances from the motorway to the visual receptors, the overall impact is considered to be unchanged.

Landscape overall evaluation

5.120 Overall, it is considered at OYA that impacts are mostly as expected. Design development during the construction phase has resulted in both negative and positive effects within the Scheme as discussed. Woodland planting plots should be reassessed due to compaction issues noted on site.

Origin of Assessment	Summary of Effects on Landscape and Visual Evaluation	Assessment
AST	Continuous lighting (previously intermittent), gantries and signage bring the greatest change in landscape character and increased perception of urbanisation in the countryside, including in Chilterns Area of Outstanding Natural Beauty. Due to land constraints, effects are hard to mitigate with a slight reduction in overall screening. Daytime effects for visual receptors would be more intrusion from lighting columns, gantries and signage. Night-time effects for visual receptors would be intrusion from continuous lit areas along the M25.	Moderate adverse
As built AST	The continuous lighting as shown in the illustrative design has not changed during the As built design. Lighting, gantries and signage remain as the greatest change in landscape character and increased perception of urbanisation in the countryside, including in the Chilterns Area of Outstanding Natural Beauty. Due to land constraints, effects are hard to mitigate with a slight reduction in overall screening. Daytime effects for visual receptors would be more intrusion from lighting columns, gantries and signage. Night-time effects for visual receptors would be intrusion from continuous lit areas along the M25. Land purchase areas have increased the area of soft estate and as such, increased the planting included in the Scheme.	Moderate adverse
EST	Alternative Design Proposals have brought about a change to vegetation to be retained through the introduction of re-graded embankments. Despite this immediate loss of vegetation, the permanent visual effect of vegetated slopes rather than the use of hard retaining features is considered to be positive. Due to the increased ground preparation measures that were required due to soil compaction issues on site, which may impact on achievement of growth targets it is recommended that plant establishment is reconsidered at FYA. This is especially relevant for planting plots that have a screening requirement. Grassland plots and hedges are establishing within acceptable limits, although natural colonisation from existing seed banks have added to the grassland mix found on site.	Moderate Adverse As expected

Townscape

5.121 A separate assessment of townscape was not undertaken and townscape elements, such as urban or suburban character and features, were incorporated into the ES landscape assessment. No further assessment of the Townscape sub-objective has therefore been undertaken in this report.

Origin of Assessment	Summary of Effects on Townscape	Assessment
AST	No townscape features would be affected as the areas within the visual envelope are part of the landscape as a whole	Neutral
As built AST	Unchanged	
EST	No further assessment has been undertaken	Neutral As expected

Biodiversity

Forecast

AST

5.122 The 2007 AST stated that reinstatement would lessen the impacts of habitat losses and improve connectivity. Habitat availability would be increased for wetlands/species rich hedgerows and/or the quality improved for calcareous grasslands. In all other situations habitat availability would be decreased and the net result would be a 15% reduction in habitat overall including those of local value and regional value (ancient woodlands). **Large beneficial** effects would result for otter and water vole through improved habitat. Bats, birds and aquatic species would experience permanent **slight adverse** effects from increased lighting resulting in reduced habitat quality, most prominent in areas currently unlit. Overall the scheme would have a **Slight Adverse** effect on Biodiversity

Updated AST

5.123 The As built AST stated that there would be **slight beneficial** impacts from the reinstatement of species-rich grasslands, the creation of new wetland and species-rich hedgerow habitat, and strategic planting to improve habitat connectivity. It stated further that there would be a **large beneficial** impact on otters through the provision of new artificial holts. However, following reinstatement, there would be an overall 11.7% net loss of habitats of local or regional value (reduced from 15% net loss in the ES), and bats, birds and aquatic species would experience permanent **slight adverse** impacts from increased lighting resulting in reduced habitat quality, most prominent in areas currently unlit. The conclusion was that the overall assessment score would remain at **Slight Adverse**.

Environmental Statement

5.124 The ES stated that the existing motorway impacted upon surrounding habitats and species through disturbances such as noise, vibration, air quality, water quality and animal mortality due to traffic. The Scheme was designed to minimise and mitigate these effects through the use of low noise surfacing, Environmental Barriers, and improved drainage design. Disturbance through noise and air pollution would persist, although the change in effect from pre-construction levels was expected to be negligible.

5.125 The ES predicted an overall loss of habitat due to the widening of 15%. This would be mitigated for by creation of species-rich grassland on reinstated verges, new areas of tree and shrub planting, enhancement of existing habitats, and improved habitat connectivity through the planting of hedgerows.

5.126 Impacts on habitats (including designated sites) outside the Scheme were mostly limited to loss of buffer habitat and increased light spill. However, further impacts were predicted where the widening was planned to reach outside the current highway boundary, with some loss of ancient woodland (including that within County Wildlife Sites), at Junction 16, Berry Lane viaduct near Rickmansworth, and Long Wood north of Abbots Langley. Reinstatement and where possible improved connectivity and habitat structure would reduce these impacts during operation of the Scheme. Overall the residual effects of the Scheme on habitats and designated sites were considered to be **slight adverse**.

5.127 The ES predicted moderate adverse operational effects on breeding birds due to loss of habitat, and slight adverse operational effects on terrestrial and aquatic invertebrates, fish, reptiles, wintering birds, water voles, bats, badger and deer. There would be residual impacts on species from loss of habitats, increased risk of mortality from motorway traffic, and increased lighting. Reinstatement and enhancement of habitats and an increase in

connectivity would provide mitigation for many species. In addition, species-specific measures such as hibernacula for reptiles, bird and bat boxes were included in the mitigation. The ES also proposed the creation of new ponds for water voles to mitigate for impacts on the species within Junction 16. The ES predicted a large beneficial effect for otters due to the introduction of two new artificial otter holts on the River Colne and Ver. The residual effect of the Scheme upon species was considered to be **slight adverse**.

5.128 The ES predicted a neutral residual effect on notable plants (ie. bluebell at Junction 16) and great crested newt (despite this species being present in ponds close to the motorway and possibly using terrestrial habitat on the verge) following mitigation employed before and during construction.

Changes to the Assessment of Impacts following the ES

5.129 Despite the reduced impact on designated sites and species, the overall loss of habitat (including ancient woodland) and the residual effects of increased lighting remain with the updated design and the overall effect was also assessed as slight adverse.

Consultation

5.130 Overall, Natural England considers the impacts and mitigation to have been, broadly, as expected. Natural England is not able to provide any more detailed comments.

Evaluation

Designated Sites

5.131 Designated sites were largely protected by the updated Scheme design. Loss of woodland at Long Wood CWS[23] was not required, although a small area at Berry Lane Viaduct (Horns Wood CWS) was lost.

Habitats

5.132 Loss of ancient woodland and translocation of ancient woodland material was not undertaken at Junction 16, due to the decision not to upgrade the attenuation ponds at this location. However, ancient woodland was lost due to widening at Denham Marsh Wood (between Junction 16 and 17) and Horns Wood (at Berry Lane viaduct). The woodland at these locations was not considered of sufficient quality to be viable for translocation, and management of retained established woodland was planned as an alternative. The ES proposed management to remove conifers and rhododendron from Denham Marsh Wood as compensation for loss of ancient woodland. At the time of this evaluation, it is not clear if this management has been undertaken.

5.133 Overall loss of habitat to the widening was reduced to 11.7% under the construction design (compared to 15% in the ES). However, there has been some loss of habitat (arable land or species-poor pasture) outside the highways boundary for new attenuation ponds and environmental bund sites. Mitigation for these impacts includes new habitat creation of woodland or species-rich grassland. New habitats are considered to be of higher quality than those lost, and to provide improved habitat connectivity.

5.134 Species-rich grassland (calcareous and neutral grassland mixes) were sown throughout the scheme and seed establishment has been variable. In some locations where topsoil was reinstated seed establishment has been affected by vigorous regeneration of weed species. This has not been such a problem where seeding was carried out on sub-soil. Species-rich

[23] County Wildlife Site

wildflower seed is establishing throughout with oxeye daisy, red fescue, bird's-foot-trefoil, wild carrot, common knapweed and kidney vetch the most successful to date. Other species are more scattered and some seed species have not yet been recorded in monitoring surveys. Grassland management is evident in most plots, and annual mowing has been carried out with clippings removed from site.

5.135 A greater number of new attenuation ponds were included in the updated design with predicted benefits for aquatic invertebrates.

Great Crested Newt

5.136 Approximately 150 great crested newts were translocated prior to construction. Receptor sites were located within the verge outside the works area. Logpiles have been provided as refuges and hibernacula within these receptor sites as enhancements, and the habitat will be retained as rough grassland with developing scrub. Therefore no residual effects on this species are expected.

Reptiles

5.137 Reptiles were also translocated from one location close to Smug Oak Lane where 100+ slow worms were rescued from both sides of the motorway. The ES did not predict specific locations for reptiles, but indicated that much of the habitat was suitable. Elsewhere only a few grass snakes were encountered. Reptile receptor sites were combined with those of great crested newts. Due to the restricted distribution of reptiles within the Scheme and the abundance of reinstated grassland habitat, it is expected that the residual effects on reptiles will be negligible.

Breeding Birds

5.138 Despite the loss of scrub and trees during construction it is expected that new potential nesting sites for breeding birds will arise within developing scrub and woodland plots. However, this potential will not fully develop for several years. As mitigation for the interim loss of nesting opportunities, 200 bird boxes have been provided in retained woodland. The residual effects on breeding birds are as expected in the ES which stated that "Providing mitigation for key areas is undertaken, the impact of the Scheme on breeding birds should be limited to the impact of noise in key areas above that which is currently experienced. This is not regarded as a significant impact upon the breeding bird community."

Figure 5-19– Bird box located in retained woodland adjacent to the highway boundary at Long Wood

Bats

5.139 A verification survey on a known bat roost at the railway viaduct over the motorway east of Gerrards Cross was undertaken prior to construction but no bats were recorded and no roost found. Therefore mitigation works, other than precautionary working methods were not employed at this location.

5.140 Two pipestrelle roosts were indentified in oak trees that were to be removed for construction of an attenuation pond close to Smug Oak Lane. This new pond was added to the design after the ES and therefore was not assessed at that time. The trees were felled under a European protected Species licence. As compensation for the loss of roosting opportunities, 5 new wood-concrete bat boxes were installed in nearby trees on land adjacent to the Scheme as part of the licence conditions.

5.141 As general mitigation for loss of habitat to the widening, 20 wooden bat boxes were provided in retained woodland. Overall, residual effects on bats are as expected in the ES.

Figure 5-20– Bat boxes provided as part of bat licence close to Smug Oak Lane

Water Vole

5.142 Verification surveys found that water voles were absent from the watercourses within the Scheme area, including Junction 16 where they had been recorded during surveys for the ES. The most likely cause of this was considered to be mink predation. Therefore there were no impacts on this species, and no mitigation (including new ponds) was employed. However, the Alder Bourne river corridor habitat was improved for water voles should they return, through selective removal of trees on the river bank within Junction 16. Due to this enhancement works, the residual effects on water voles are expected to be large beneficial should the species return to the area, which differs from the slight adverse effect predicted in the ES.

Badger

5.143 A number of active and inactive badger setts were closed to prevent injury to badgers during the works. Although certain setts with predicted impacts (from the ES) were left undisturbed due to changes in the design, new setts were discovered which required closure. The existing badger tunnel close to Junction 20 was refurbished and extended at both ends due to the widening works. Monitoring to date has not recorded any use of this tunnel by badgers

following the works completion, perhaps due to a lack of cover between the tunnel entrance on the clockwise side of the M25 and nearby woodland. Connective habitat on the verge was removed for the works, and a replacement hedgerow at the top of the cutting has not yet grown to provide sufficient cover for badgers. Overall, residual effects on badgers are as expected in the ES.

Otter

5.144 Two new otter holts were constructed, one on the banks of each of the River Colne and River Ver. These holts were constructed of blocks and plastic piping, and the locations are not obvious at the time of this evaluation due to dense regrowth of nettles and bramble at the sites. It is not known if they have been used by any animals, although there are no known recent records of otters from these locations. The expected residual effects on otters remains large beneficial as in the ES.

Figure 5-21– Location of buried otter holt on the bank of the River Colne – entrances lead to the river and to the terrestrial habitat

Animal Mortality Figures

5.145 The DBFO Contractor has been consulted with regard to animal mortality due to motorway traffic between Junctions 16 and 23, and provided the records shown in ***Table 5-6*** below. There is an early indication of a reduction in total mortality numbers in 2013 compared to previous years. This may be due to the effect of the completed widened motorway, which may deter animals from attempting to cross due the additional width.

5.146 The figures demonstrate high deer mortality, particularly in 2012, clustered between marker board 102/8-103/4 (junction 16), 117/0-117/9 (junction 19) and 130/0-134/9 (Junction 21-23). It is noted that deer proof fencing was not installed as a part of the scheme.

Table 5-6 – Animal Mortality Figure provided by the DBFO Contractor

Location	Species	2010	2011	2012	2013
J16-17	Deer	2	2		
	Fox	1	3	1	1
	Badger		1		
J17 slip	Deer			1	
J18	Fox			1	
J18-19	Fox			2	
J19	Deer	1		1	
	Badger		1		
J19-20	Badger				1
J20 slip	Deer	1		1	
	Badger	1			
	Fox		1		
J20-21	Deer				1
J21A	Deer			1	
J22 slip	Deer	1			
J22-23	Barn Owl				1
	Deer	1		1	
J23	Deer			1	
Totals		8	8	10	4

Origin of Assessment	Summary of Effects on Biodiversity	Assessment
AST	Reinstatement would lessen impacts of habitat losses and improve connectivity. Habitat availability would be increased for wetlands/species rich hedgerow and/or quality is improved (calcareous grasslands). In all other situations habitat availability is decreased and the net result is a 15% reduction in habitat overall including those of local value and regional value (ancient woodlands). Large beneficial effects result for otter and water vole through improved habitat. Bats, birds and aquatic species would experience permanent slight adverse effects from increased lighting resulting in reduced habitat quality which is most prominent in areas currently unlit	Slight Adverse
As built AST	The Scheme will result in slight beneficial impacts from the reinstatement of species-rich grasslands, the creation of new wetland and species-rich hedgerow habitat, and strategic planting to improve habitat connectivity. There will be a large beneficial impact on otters through the provision of new artificial holts. However, following reinstatement, there will be an overall 11.7% net loss of habitats of local or regional value (reduced from 15% net loss in the ES), and bats, birds and aquatic species would experience permanent slight adverse impacts from increased lighting resulting in reduced habitat quality which is most prominent in areas currently unlit. The conclusion is that the overall assessment score remains at Slight Adverse.	Slight Adverse
EST	Habitat reinstatement is establishing as expected, although management of seeding and planting plots is not applied equally throughout. Species enhancements (hibernacula, bird and bat boxes, and otter holts) have been provided as expected although the success of these enhancements, as well as the refurbished badger tunnel at Junction 20, cannot be determined at OYA stage and therefore should be reconsidered in the FYA assessment. Residual effects on great crested newts, birds, bats, badgers and otters are as expected in the ES, but the residual effects on reptiles and water voles are less than expected, and habitat enhancements will have a residual benefit for water voles. Management works proposed in the ES as compensation for impacts on ancient woodland do not appear to have commenced and should be reconsidered in the FYA assessment.	Slight Adverse As expected

Cultural Heritage and Archaeology

Forecast

AST

5.147 The 2007 AST predicted that there would be potential impacts upon possible, previously unrecorded, remains. Existing motorway construction would have extensively damaged remains within the Secretary of State land, although there may be localised survival, while outside the boundary, survival was likely to be good. The impact overall was assessed as **Neutral**.

Updated AST

5.148 The As built AST stated there was no survival of archaeological remains within the highway boundary, and so within the highway boundary there was no impact on archaeological remains. In sites outside the highway boundary, there has been some impact on

archaeological remains at twelve sites. These were mitigated through a programme of archaeological excavation and recording. The impact overall remained as **Neutral**.

Environmental Statement

5.149 The ES stated that, assuming implementation of the recommended mitigation strategy (preservation by record); the majority of adverse cultural heritage effects would become neutral. For example, the adverse effect of the permanent removal of an archaeological feature would be offset by the positive effect of increased knowledge. The ES expected that this might contribute to the development of strategies that would assist future research, conservation and management of the historic landscape and heritage resources within it.

5.150 In addition, there were several locations where archaeological remains could theoretically be present beneath existing embankments, although the probability might be low (due to disturbance in the original motorway construction). Where piled retaining walls are inserted through embankments, it would not be feasible to mitigate any impacts locally (along the wall line) and here the residual effect would remain uncertain.

5.151 The Scheme would have a **slight adverse** effect upon the setting of one Grade II* Listed Building and 36 Grade II Listed Buildings, and **moderate adverse** effects upon the setting of two Grade II Listed Buildings. There would be a **moderate** to **slight adverse** effect on the Chilterns AONB as a designated historic landscape.

5.152 There was an uncertain effect on Misbourne / Chalfont Viaduct (S194) as the exact nature of the proposed works would not be defined until the detailed design stage undertaken by the DBFO Contractor. However the scale of the works were considered unlikely to cause more than a **slight adverse** effect.

Consultation

5.153 No response has been received from English Heritage at the time of writing.

Evaluation

5.154 The popular archaeology publication was provided for the OYA assessment. The final results of the archaeological work on the M25 will be published in Hertfordshire Archaeology and History, and Records of Buckinghamshire. It is understood that the draft academic report is currently subject to review and should be available for consideration in the FYA report. The finds and archives have yet to be deposited and will be subject to the finalisation of the Academic report and this aspect of archiving should be confirmed at FYA.

5.155 The scheme has not adversely impacted the fabric of any historic buildings. Sensitive design in the construction of cuttings, embankments and bunds, and in the placement of vegetation screening and noise screening, has resulted in a **neutral** residual impact on the setting of historic buildings.

5.156 Creation of new gantries as shown in ***Figure 5-22*** and ***Figure 5-23*** below has resulted in a **slight adverse** impact (with respect to cultural heritage) to the context of the Chalfont Viaduct.

5.157 Relevant extracts from the popular archaeological report produced for this scheme are presented in ***Appendix G***.

Figure 5-22– M25 Chalfont Viaduct – Clockwise (image from Google Maps)

Figure 5-23– M25 Chalfont Viaduct – Anti-clockwise (image from Google Maps)

Origin of Assessment	Summary of Effects on Cultural Heritage and Archaeology	Assessment
AST	Potential impacts upon possible, previously unrecorded, remains. Existing motorway construction would have extensively damaged remains within the Secretary of State land, although there may be localised survival, while outside the boundary, survival is likely to be good.	Neutral
As built AST	There is no survival of archaeological remains within the highway boundary, so within the highway boundary there is no impact on archaeological remains. In sites outside the highway boundary, there has been some impact on archaeological remains at twelve sites. These have been mitigated through a programme of archaeological excavation and recording.	Neutral
EST	Neutral effect on the settings of listed buildings due to the sensitive design in the construction of cuttings, embankments and bunds, and in the placement of vegetation screening and noise screening. This has resulted in a neutral residual impact on the setting of historic buildings. Creation of new gantries has resulted in a slight adverse impact to the context of the Chalfont Viaduct. Archaeological finds and information discovered during site investigations has had the positive effect of increased knowledge as predicted in the ES. The finds and archives have yet to be deposited and will be subject to the finalisation of the Academic report and this aspect of archiving should be confirmed at FYA	Neutral As expected

Water Quality and Drainage

Forecast

AST

5.158 The 2007 AST stated that there would be increased runoff volume but no increase in peak flow rates due to the scheme and there would be no further encroachment onto floodplains. The Scheme would also improve overall water quality through increased mitigation. Five watercourses would be made better but four watercourses would receive increased pollution loading after mitigation but would not exceed EQS[24]. One watercourse would maintain its existing exceedance of an EQS. Pollution risk from accidental spillage would be reduced by containment provision. Soakaways would be located further away from public water supply abstraction points Overall the scheme would have a **Slight Beneficial** effect on Water Quality and Drainage.

Updated AST

5.159 The As built AST stated that there would an increased runoff volume but no increase in peak flow rates. There would be no further encroachment onto floodplains. The Scheme would improve overall water quality through increased mitigation and removal of some discharges to SPZ1[25]. Six watercourses would be improved, Two watercourses would receive increased pollution loading and a further two watercourses would show improvement for one indicator and deterioration for a different indicator. Three watercourses would maintain their existing potential to exceed an EQS but with a reduced level of exceedance. Pollution risk from accidental spillage would be reduced by containment provision. Soakaways would be located further away from public water supply abstraction points. The impact overall remained as **Slight Beneficial**.

Environment Statement

5.160 The ES stated that the existing motorway generated both flood runoff and contamination which were discharged to surface waters via outfalls and to groundwater via soakaways. Little or no treatment was provided in the existing motorway, and there was little provision for the containment of accidental spillage.

5.161 As a result of the scheme, the ES stated that drainage would take runoff from the motorway and would incorporate treatment, containment and attenuation through the use of a number of drainage features such as filter drains, swales, bio-retention systems and ponds. These features would counteract the adverse impacts to be expected from the increase in motorway area and has been designed to prevent a deterioration compared to the current situation, and where possible provide an improvement.

General Surface Water Quality Effects

5.162 The ES stated that there was a mixture of general water quality effects over the whole Scheme and at half of the receiving watercourses an improvement would result. Most of these changes would be relatively minor and only one of the receiving watercourses would exceed the EQS levels in either dissolved copper or zinc.

[24] EQS – Environment Quality Standard

[25] Source Protection Zone 1 – Inner protection zone: Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.

5.163 In the River Colne (at London Colney) the DMRB methodology predicted that dissolved copper concentration exceeded the EQS without the Scheme and would continue to do so with the Scheme.

5.164 A new discharge was proposed to the Catharine Bourne to replace an existing soakaway system. This was not predicted to cause a significant water quality impact.

5.165 The Scheme would not have an impact on flood risk in receiving watercourses.

5.166 The ES stated that overall; the Scheme was expected to have a **neutral** effect on routine surface water runoff.

Accidental Spillage – Surface Water

5.167 The ES stated that the risk of accidental spillage reaching receiving watercourses was expected to be acceptable (i.e. less than 1%) without mitigation.

5.168 The Scheme would incorporate spillage containment throughout and was therefore fully compliant with guidance. As there was little provision for spillage containment in the existing motorway the Scheme would have a **slight beneficial** effect on accidental runoff.

Flooding Effects

5.169 The ES stated that the widening of the carriageway would be achieved without encroaching further onto floodplains so there would be no effect on floodplain storage. The overall impact of the Scheme on floodplain conveyance[26] was considered to be **neutral**.

5.170 The drainage design allowed for a 1 in 100 year flood event attenuation, plus 20% for increases in rainfall intensity as a result of climate change projections. The design was noted to provide a benefit over the existing drainage system, which did not accommodate any climate change increase. Storage would be provided through a combination of ponds, oversized ditches and storage pipes, to ensure that discharges to the existing outfalls would be limited to the existing discharge rates, with a reduction where possible.

Groundwater Effects

5.171 The ES stated that the significance of the potential effect of routine runoff of the Scheme on groundwater was **neutral** compared to the existing conditions. The exception to this was between Junctions 18 to 19 and Junctions 19 to 20, where the Scheme would produce a **moderate** to **large beneficial** effect, on the anti-clockwise and clockwise carriageways respectively, compared to existing conditions. In other words, the Scheme would have no additional impact on the quality of road runoff discharging to ground, compared to the existing (baseline) conditions. The risk assessment demonstrated that the Scheme would have a **neutral** effect on groundwater.

5.172 Relocation of existing soakaways that were within Inner SPZs (Source Protection Zones), or are in locations close to the groundwater table, to sites that were less sensitive would provide further benefits to groundwater.

5.173 The spillage assessments demonstrated that the return period for the proposed conditions (and existing conditions) would be acceptable for every drainage length that had a discharge to groundwater.

[26] Floodplain Conveyance - areas that are likely to have overland flow as part of the floodplain.

5.174 The inclusion of accidental spillage containment throughout the Scheme was considered an improvement on the existing drainage system and represented a significant reduction in an important risk factor for groundwater discharges.

Overall Assessment

5.175 The ES concluded that overall, combining the surface and groundwater effects and taking into account the improved treatment and containment provided for soakaway discharges, and the removal of major discharges from SPZs, it was considered that the Scheme would have a **slight beneficial** effect on the water environment.

Consultation

5.176 The Environment Agency responded as follows:

- *Through the development of the scheme design and subsequent design changes, particularly in respect of drainage, we were satisfied that the development would not have an adverse impact on local watercourses, floodplains or the groundwater/aquifer. This was achieved through balancing new and existing flows from the carriageway, inclusion of pollution control (including increased control for more sensitive outfalls), and using piling techniques that minimised risks to groundwater. In sensitive groundwater areas / where the works posed higher groundwater risks we agreed a monitoring programme with the contractor to check for impacts on the local groundwater quality.*
- *Some of the greatest environmental risks occur during the construction phase and we found the contractor's environment team to be very competent and maintained strong environmental controls to minimise environmental risks from the works. The close working relationship between the contractor and EA was important to ensuring the environmental risks were minimised.*
- *We were satisfied that the agreed designs would adequately mitigate adverse impacts on the water environment. In some cases, such as the pollution control measures, the measures are an improvement on the previous controls. Since construction was completed there has been an incident on the carriageway that resulted in a large spill of an organic liquid fertiliser. All of this liquid was contained within the balancing ponds which protected the local watercourse.*
- *Some of the sensitive outfalls (to soakaway) now benefit from online, real time monitoring for hydrocarbons and automatic shut off facilities. It is obviously very important that these are properly maintained if the expected level of protection is to be provided. Similarly we would recommend regular training for control room staff in the remote activation of the shutoff valves to protect the soakaways and underlying aquifer (e.g. in the incidence of spillage of a (non-hydrocarbon) pollutant on the carriageway).*

5.177 The Hertsmere Borough Council (HBC) responded as follows:

- *The only drainage related problem that has come to light so far regarding post M25 works is internal flooding of a property on St Albans Rd, Potters Bar opposite the site of the new Environmental bund.*
- *From the bund there is an Ordinary Watercourse, flowing from the direction of the M25 towards St. Albans Road, it then enters a pipe and continues flowing under St. Albans Road and along the backs of properties in Black Horse Lane and outfalls to the Catharine Bourne Main River. This set up has worked ok until the recent M25 works when we started getting reports of internal flooding from the complainant. Investigations show that while the internal flooding is most likely from water flowing off the highway the highway itself is flooding due to surcharge of this pipe / watercourse. Further investigation of the watercourse upstream of the complainant's property revealed multiple new land drains discharging into the watercourse. This land was used during*

the M25 works as some sort of storage or compound area and the land drains presumably installed as part of the land remediation measures. While the installation of the land drains would not have necessarily increased the total volume of water entering the watercourse it has drastically shortened the time it takes the water to enter the watercourse, hence the piped in section downstream now can't cope. If this was a new development we would ask for our standard drainage condition CG01 to be applied this would limit the discharge and require water to be stored so as not to overload the existing system. There may also be a breach of HBC Land Drainage Byelaws which require prior approval for new connections to watercourses. I understand that the property in question insurance company have been in contact with the Highway Agency / Skanska but apparently they were not very helpful. We have also reported it to Herts County Council as the Lead Local Flood Authority who will carry out an investigation.

Evaluation

5.178 Further to the consultation received from the HBC, it is noted that work undertaken on this watercourse was limited to the accommodation of the watercourse through a culvert under the South Mimms bund. This design was submitted to the EA (Thames Division) on behalf of the landowner (Hertfordshire County Council – County Farms) for consent under the Land Drainage Act 1991. This consent was provided by the EA. As part of the bund works (permitted development), the Contractor liaised with the EA in respect of works on the watercourse downstream of the new culvert.

5.179 The DBFO have confirmed that they have liaised with an affected landowner. It would appear that the sizes between existing and installed culverts do not match up which may be the cause of localised flooding. It is expected that Hertfordshire County Council as the landowner of the bund area may investigate this further.

5.180 This culvert and watercourse is only for land drainage and does not take any discharge from the M25 – this section of the M25 partially discharges to Catharine Bourne via balancing ponds and soakaways.

5.181 It should be noted that the properties on Blackhorse Lane may have suffered flooding prior to the M25 works.

Evaluation Based on the As built Water Quality and Hydrology Reports

5.182 The Scheme mitigates the pre-scheme drainage via chalk aquifers and surface water courses through the net movement of 23 soakaways away from direct run-off to public water abstractions (in SPZ 1 and 2[27]) and inclusion of automated penstock controlled spillage containment (for SPZ1), on-line treatment, bypass petrol interceptors, hydrodynamic separators, ponds and infiltration basins.

5.183 Overall the scheme effects include:

- Benefit of improved water quality to 6 watercourses.
- Overall worsening of discharge to 2 of the existing surface waters (although within EQS) due to an increase in pollution loading (and despite mitigation).
- 3 watercourses exceeding EQS (although with improved water quality due to mitigation as part of the scheme).
- General improvement to routine discharge to groundwater.
- No further encroachment onto any floodplains, and flood risk remains unchanged.
- Increased volume of runoff but no increase in peak flow rates.

[27] SPZ2 – Outer Protection Zone: Defined by a 400 day travel time from a point below the water table. This zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction.

5.184 The benefits provided by the accidental spillage containment, by relocating soakaways and the treatment of highway runoff balanced against insignificant effects for the majority of other water attributes suggests that, overall, there is a **slight beneficial** effect for water quality through movement and removal of some soakaways and increased mitigation as a result of the Scheme.

Figure 5-24– Pond 15 between junction 20 and 21

5.185 The widening undertaken for the Scheme is within the existing footprint of embankments and therefore has had no impact on the floodplain storage or restriction of floodplain conveyance routes.

5.186 Discharge rates to watercourses from direct outfalls to watercourses and discharge rates to existing ponds meet the existing pre-widened 1 in 5 year design. Where required, in addition to ponds or where no ponds existed, online storage tanks have been used to ensure that sufficient storage is provided for the 1 in 100yr event plus 20% climate change.

5.187 Changes in the Design when compared to the pre-scheme situation include:

- Treatment in the form of filter drains, wet ponds, bypass separators, hydrodynamic separators and penstock valves.
- An overall decrease in the length of filter drains.
- The benefit of new ponds before discharge to soakaway.
- The benefit of the net removal soakaways from SPZ1 and SPZ2.
- Automated penstock valves for all discharges to SPZ1 or SPZ2.

5.188 There may be a few areas where the Scheme results in slightly poorer water quality than the previous situation (notably to three surface waters) there are other areas where there is a benefit shown by the Scheme; notably, removal of soakaways, improvements in routine run-off provision and significant improvements in the spillage containment arrangements which reduce the risk of pollution from spillage. There is no impact to the floodplains, either from encroachment (through making use of HA land available) or through greater peak discharges (as they have been attenuated to the required flow volumes).

Figure 5-25– Pond 27a at Junction 22

5.189 Ponds assessed during the FYA site visit confirm that maintenance is being undertaken. Ponds appeared to be operating within their required parameters.

Summary for Water Evaluation

5.190 Mitigation measures have been implemented with reference to the ES and in consultation with the Environment Agency (EA). New ponds before discharge to soakaways and a net removal of soakaways have been included as part of the detailed design, with agreement from the EA which results in an improvement on the pre-scheme situation. No information has been provided to POPE that would indicate that it is performing other than as intended. Whilst a flooding issue has been raised by the Hertsmere Borough Council, and some decrease in water quality is noted, based on the information available at OYA, it is considered that the scheme's overall impact has been **slight beneficial**, and **as expected**.

Origin of Assessment	Summary of Effects on Water	Assessment
AST	Increased runoff volume but no increase in peak flow rates. No further encroachment onto floodplain. The Scheme would improve overall water quality through increased mitigation. 5 watercourses would be made better but 4 watercourses would receive increased pollution loading after mitigation but would not exceed EQS. 1 watercourse would maintain its existing exceedance of an EQS. Pollution risk from accidental spillage would be reduced by containment provision. Soakaways would be located further away from public water supply abstraction points.	Slight Beneficial
As built AST	Increased runoff volume but no increase in peak flow rates. No further encroachment onto floodplain. The Scheme would improve overall water quality through increased mitigation and removal of some discharges to SPZ1. 6 watercourses would be improved, 2 watercourses would receive increased pollution loading and a further 2 watercourse would show improvement for one indicator and deterioration for a different indicator. 3 watercourses would maintain their existing potential to exceed an EQS but with a reduced level of exceedance. Pollution risk from accidental spillage would be reduced by containment provision. Soakaways would be located further away from public water supply abstraction points.	Slight Beneficial
EST	Mitigation measures have been implemented with reference to the ES and in consultation with the Environment Agency (EA). New ponds before discharge to soakaways and a net removal of soakaways have been included as part of the detailed design, with agreement from the EA which results in an improvement on the pre-scheme situation. No information has been provided to POPE that would indicate that it is performing other than as intended. Whilst a flooding issue has been raised by the Hertsmere Borough Council, and some decrease in water quality is noted, based on the information available at OYA, it is considered that the scheme's overall impact has been as expected.	Slight Beneficial As expected

Physical Fitness

Forecast

AST

5.191 The 2007 AST stated that it was expected that there would be negligible impacts on journey times for cyclists and pedestrians as there would be no change to routes crossing over/under the M25, and health benefits would be largely unchanged.

Updated AST

5.192 The updated AST assessment concurred with the 2007 AST and remained unchanged.

Environmental Statement

5.193 The ES stated that only 2 crossing points would be directly affected during the construction phase of the Scheme (Berry Lane Viaduct - temporary closure of the footpath (C15) under the viaduct; and Park Lane footbridge (C16) affected during demolition works and construction of new bridge).

Figure 5-26– Park Lane footbridge near junction 18 – new structure replaced original bridge

5.194 The Scheme would not have a permanent direct impact on any routes used by pedestrians and others. There would be some adverse impacts on ease of crossing resulting from changes in traffic flows, but overall, the Scheme would have a **neutral** impact on travel patterns and journey times.

5.195 The changes in traffic flows on some routes used by pedestrians and others, or roads adjacent to routes used by pedestrians and others as discussed above, would have a **minor adverse** impact on amenity experienced by NMUs[28], but these impacts were expected to be localised. Loss of vegetation would have an adverse impact on the amenity experienced by pedestrians and others in the immediate vicinity of the Scheme.

5.196 As there were numerous communities in the vicinity of the Scheme, a large number of people would have the potential to be affected. The impact on pedestrians and others would not be significant enough to deter any journeys, and therefore there would be **no overall change** in community severance following implementation of the Scheme.

[28] Non-Motorised Users

Consultation

5.197 Buckinghamshire County Council responded that PROWs were not affected within their area by the Scheme.

Evaluation

5.198 NMU surveys have not been undertaken within the construction and operation phases of the Scheme. During the site visit, footpaths near London Colney (near junction 22), Chorleywood (near junction 17) and Park Avenue (near junction 18) were assessed. The timing of the site visit to the footpaths was between 11am and 2pm – no use of footpaths was noted during this time, although the footpaths themselves indicated regular use and upkeep.

5.199 Through the introduction of alternative design proposals, footpaths near ponds 4, 23 and 28 and Chorleywood, Bricket Wood and South Mimms Bunds were affected by the scheme and required some realignment.

5.200 It is also understood that the proximity of the motorway to a bridleway at the Micklefield Green Bridge has resulted in the inclusion of an additional wooden closed boarded screening fence. This fence was not proposed in the ES, but was installed as a result of a safety issue identified during the Stage 2 Road Safety Audit.

Figure 5-27– Footpath 66 on the clockwise side at Junction 17 – footpath relocation around Chorleywood bund

Figure 5-28– Watling Chase Timberland Trail – existing footpath over the M25 near Junction 22

5.201 Whilst the realignment of footpaths due to Chorley Wood, Bricket Wood and South Mimms bunds and near ponds 4, 23 and 28 is permanent, the impact is considered slight and has little impact on users. The removal of vegetation as a part of the Scheme has had some effect on

pedestrians and others which is as expected. It is concluded that the overall scheme impact on Physical Fitness, is **as expected**.

Origin of Assessment	Summary of Effects on Physical Fitness	Assessment
AST	Negligible impacts on journey times for cyclists & pedestrians as no change to routes crossing over/under M25, so largely unchanged health benefits.	-
As built AST	Unchanged	-
EST	Whilst the realignment of footpaths due to Chorley Wood, Bricket Wood and South Mimms bunds and near ponds 4, 23 and 28 is permanent, the impact is considered slight and has little impact on users. The removal of vegetation as a part of the Scheme has had some effect on pedestrians and others which is as expected. It is concluded that the overall scheme impact on Physical Fitness, is as expected.	As expected

Journey Ambience

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

Forecast

AST

5.203 The 2007 AST stated that there would be an overall beneficial effect as a result of the Scheme. Changes in vegetation would slightly alter views from the road but would have a neutral effect. Drivers would experience future elevated stress levels, but they would improve in Do-Something scenario compared to Do-Minimum scenario. The Scheme would have no provision for additional traveller facilities. The ***Table 5-7*** demonstrates the effects on Traveller Care, Views and Stress (extract from 2007 Appraisal Summary Report).

Table 5-7 – Table extract from AST and Worksheets Report – Unit 3.3.13: Journey Ambience

Factor	Sub-factor	Better	Neutral	Worse
Traveller Care	Cleanliness		✓	
	Facilities		✓	
	Information	✓		
	Environment		✓	
Travellers' Views	-		✓	
Traveller Stress	Frustration	✓		
	Fear of potential accidents			✓
	Route uncertainty	✓		

Updated AST

5.204 The updated AST assessment concurred with the 2007 AST and remained unchanged.

Environmental Statement

5.205 The ES discussed the overall effect of traveller views, care and driver stress

Traveller Views

5.206 The ES expected that views from the road would not significantly change as the profile of the Scheme would be accommodated within Secretary of State owned land and so the profile of the Scheme would mirror that of the existing carriageway. The proportion of vegetation that would be removed would increase the extent of the view from the road at one location (near junction 19 - reduction in screening vegetation would open views towards Juniper Hill). The extent of the view from the road would diminish at six other locations, with the extension of Environmental Barriers (Chalfont Viaduct) and as vegetation matured (Chorley Bottom, Frogmore, Earls Farm, Mansion House Farm and Woodcock Hill). However, the locations where the view from the road would change, was said to represent a small proportion of the overall view from the road, representing very slight changes. As a result, the impact of the Scheme upon travellers' views is considered **neutral.**

Driver Stress

5.207 The ES stated that the Scheme would improve driver stress levels compared to the Do Minimum in 2027. In addition the Scheme would incorporate modern design specifications, low noise surfacing, improved signage, improved alignment of Junction 18 slip road and street lighting which would help alleviate fear of accidents, uncertainty of route and improve ride comfort. However, the Scheme would involve reduced lane widths at 26 locations where Secretary of State owned land was constrained or the carriageway passed an existing structure. The lanes would not be less safe than standard lane widths and the change of lane width was designed to be very gradual so it would not be noticeable by drivers. The overall effect of the Scheme on drivers' stress was therefore considered to be **beneficial**.

Travellers' Care

5.208 The Scheme would have no influence on the provision and quality of driver facilities along the motorway in the future and would have a neutral effect on traveller care in terms of driver facilities.

5.209 The overall assessment score for the Scheme's effect on vehicle travellers was **beneficial**.

Consultation

5.210 Natural England commented that due to the scheme it would be expected that the resultant reduction in congestion will presumably have reduced the tendency of frustrated drivers to attempt to 'rat-run' on nearby local roads.

Evaluation

5.211 ***Table 5-8*** summarises the evaluation of Traveller Views and Driver Stress. Traveller Care has benefitted from increased information through the use of variable message signs, no facilities within the Scheme extents were expected to be provided. Overall the scheme impact is considered to be **beneficial** as expected.

5.212 Traveller Views are generally considered to be in line with expectation although the inclusion of additional environmental barriers between junctions 21a and 23 and landscape bunds at Chorleywood, Junction 20, Bricket Wood and South Mimms has restricted long distant views in the immediate location of these structures and will have had little to no effect on the overall assessment of traveller views. Some short term views have been opened up by additional vegetation removal, until new replacement planting establishes.

5.213 In the One Year After scheme evaluation, analysis has shown that congestion has reduced along the scheme and journey times have improved despite an increase in traffic along the M25 for the length of the scheme (see Section 2.44)

5.214 However, the appraisal did not highlight any particular roads/sections that were used as alternate routes (or 'rat-runs') to the Scheme. Therefore this aspect has not been investigated at OYA.

Table 5-8 – Summary of Journey Ambience Evaluation

Traveller Factor	Score	OYA evaluation
Care	Beneficial / Neutral	The increase in variable messaging within the scheme has a positive effect for traveller care. No facilities were required to be provided for motorists as a part of the Scheme.
Views	Neutral	Generally views from the road are considered to be as expected in the ES. There are some locations where changes since the ES have affected views e.g. in areas where bunds have been included within the Scheme design. In other locations increased vegetation removal in preparation for accommodating re-graded slopes in place of sheetpiles has resulted in a more open immediate landscape within the road corridor which has opened up views . These views will become more limited as planting matures and by the design year will be similar to those predicted in the ES The extent of the views from the road has also diminished from those originally proposed in the ES due to the increase in the use of environmental barriers to attenuate noise
Driver Stress	Beneficial	The Scheme improves driver stress levels compared to the Do Minimum in 2027. In addition the Scheme incorporates modern design specifications, improved signage, improved alignment of Junction 18 slip road and street lighting which helps to alleviate fear of accidents, uncertainty of route and improve ride comfort. However, the Scheme includes reduced lanes widths at 26 locations where Secretary of State owned land is constrained or the carriageway passes an existing structure. The lanes are not less safe than standard lane widths and the change of lane width has been designed to be very gradual so it is not noticeable by drivers. Reduced congestion and improved journey times contribute to a decrease in driver stress as predicted in the ES.
Summary Score	**Beneficial**	

Origin of Assessment	Summary of Effects on Journey Ambience	Assessment
AST	Changes in vegetation would slightly alter views from the road but would have a neutral effect. Drivers would experience future elevated stress levels, but they would improve in Do-Something compared to Do-Minimum. The Scheme would have no provision for additional traveller facilities.	Beneficial
As built AST	Unchanged	
EST	Increased vegetation removal has altered views at opening year, although it is expected that replacement planting will reduce this impact to neutral by the design year. Decreased driver stress levels due to reduced congestion and improved journey times despite increased traffic levels has resulted in an improvement overall to Journey Ambience as predicted.	Beneficial As expected

Key Points – Environment

Noise

- Lower than expected traffic flows are not significant enough to affect an 'as expected' assessment. Higher than expected speeds during the inter peak and evening peak times has resulted in a 'worse than expected' evaluation.

Local Air Quality

- The traffic data shows that the observed flows are lower than forecast along all sections of the motorway, which should indicate that pollutant concentrations are lower than those estimated in the ES. However, in recent years, there has been no change to the AQMAs in the surrounding area, indicating that air quality has remained the same in recent years, with continued breaches of the NO^2 annual average EU Limit Value at sites near the M25.

Greenhouse Gases

- The observed proportionate increase in emission as a result of the scheme is 11% whereas the re-forecast value is 18% over the scheme extent. This difference is primarily due to the fact that the forecasts assumed higher traffic growth along the scheme section, whereas in the observed the traffic growth is less than the forecast.
- Therefore it can be concluded that whilst the scheme has led to an increase in carbon emissions from vehicles travelling on the M25 scheme section, this net increase is not as high as expected.

Landscape and Townscape

- Alternative Design Proposals have brought about a change to vegetation to be retained through the introduction of re-graded embankments. Despite this immediate loss of vegetation, the permanent visual effect of vegetated slopes rather than the use of hard retaining features is considered positive.
- Due to the increased ground preparation measures that were required due to soil compaction issues on site, compaction issues identified may impact on achievement of growth targets. This is especially relevant for planting plots that have a screening requirement and planting establishment should be reviewed at FYA.
- Grassland plots and hedges are establishing within acceptable limits, although natural colonisation from existing seed banks have added to the grassland mix found on site.

Biodiversity

- Habitat reinstatement is establishing as expected, although management of seeding and planting plots is not applied equally throughout.
- Species enhancements (hibernacula, bird and bat boxes, and otter holts) have been provided as expected although the success of these enhancements, as well as the refurbished badger tunnel at Junction 20, cannot be determined at OYA stage and therefore should be reconsidered in the FYA assessment.
- Residual effects on great crested newts, birds, bats, badgers and otters are as expected in the ES, but the residual effects on reptiles and water voles are less than expected, and habitat enhancements will have a residual benefit for water voles.

Cultural Heritage

- Archaeological remains were found in areas affected by the Scheme, beyond the boundaries of the original Scheme. A number of discoveries were made which add significantly to the known archaeology of the area.
- Sensitive design in the construction of cuttings, embankments and bunds, and in the placement of vegetation screening and noise screening, has resulted in a neutral residual impact on the setting of historic buildings.
- Creation of new gantries has resulted in a slight adverse impact as predicted, to the context of the Chalfont Viaduct.

Water

- Drainage systems have been installed as expected and appear to be working as required.
- Although there may be a few areas where the Scheme results in slightly poorer water quality than the previous situation (notably to three surface waters) there are other areas where there is a benefit shown by the Scheme; notably, removal of soakaways, improvements in routine run-off provision and significant improvements in the spillage containment arrangements which reduce the risk of pollution from spillage. There is no impact to the floodplains, either from encroachment (through making use of HA land available) or through greater peak discharges (as they will be attenuated to the required flow volumes).
- Some of the sensitive outfalls to soakaway now benefit from online, real time monitoring for hydrocarbons and automatic shut off facilities.

Physical Fitness

- Whilst the realignment of footpaths due to ponds 23 and 27 and Chorley Wood, Bricket Wood and South Mimms bunds is permanent, the impact is considered slight and changes have had little impact on users.
- The removal of vegetation as a part of the Scheme has had some affect on pedestrians and others which is as expected.

Journey Ambience

- The view from the road is generally as expected although views have changed in areas where bunds have been included within the Scheme design.
- Increased vegetation removal in preparation of accommodating regraded slopes in place of sheetpiles has resulted in a more open immediate landscape within the road corridor.
- The extent of the view from the road has diminished from that originally proposed in the ES due to the increase in the use of environmental barriers to attenuate noise.

6. Accessibility and Integration

6.1 This chapter evaluates the impact of the scheme in terms of the accessibility and integration objectives; comparing qualitative forecast assessments from the scheme AST (as shown in ***Table 7-1***) with post-opening findings and analysis of policy objectives.

Accessibility

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

- Option values.
- Access to the transport system.
- Severance

Option Values

6.3 Option values, as defined in WebTAG, relate to the availability of different transport modes within the study area, even if they are not used. For example, a car user may value a bus service along their route even if they never use it because they have the option of another mode should their car become unavailable.

Forecast

6.4 For the objective regarding option values, the AST states that *'the scheme would not result in any new option values'*. As such the AST forecast a score of *'neutral'* for this objective.

Evaluation

6.5 It is considered that the AST forecast is valid and that no further evaluation would reveal any changes to option values connected to the scheme.

Access to the Transport System

6.6 WebTAG states that access to the transport system is strongly influenced by the two key variables introduced at the start of this section, i.e. access to a private car and proximity to a public transport service.

Forecast

6.7 The scheme appraisal stated that *'Access to the transport system would not be affected by the scheme'* and forecast a score of *'neutral'* for this objective.

Evaluation

6.8 The outturn evaluation for this objective is the same as forecast i.e. neutral.

Severance

6.9 Community severance refers to the degree to which movement and activities within the community are affected by the presence of a major road or other transport link, and particularly the degree of separation of residents from the facilities and services they use within their community.

Forecast

6.10 The scheme appraisal stated that *'Impact on traffic flows, journey patterns and amenity would not be large enough to deter Non-Motorised User journeys, including vulnerable users'*. The forecast impact for this sub objective was *'neutral'*.

Evaluation

6.11 The AST forecast of 'neutral' is considered valid. Traffic on local roads within the vicinity of the scheme has been shown to have reduced slightly as a result of the scheme. This reduction is not considered great enough to affect the severance in any communities along these routes.

Integration

6.12 The integration objective consists of two main elements:

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

Transport Interchange

6.13 The transport interchange objective relates to the extent to which the scheme contributes towards the Government objective of improving transport interchange for passengers and freight.

Forecast

6.14 The AST states that *'The Scheme would not result in any change to transport interchange'*.

Evaluation

6.15 With regard to highway schemes, this sub-objective will only be applicable in certain cases where an interchange between different modes forms part of the scheme, such as a park and ride facility; therefore the scheme has no impact on this sub-objective.

Land Use Policy

6.16 This section looks at the scheme in relation to national, regional and local level land use and development policies.

Forecast

6.17 The scheme forecast an AST rating of beneficial with regards to the integration with local, regional and national policy.

Evaluation

6.18 An evaluation of the impact of the scheme in relation to local, regional and national policy is contained in Table 6-1.

Table 6-1 – Scheme Alignment with National, Regional and Local Policy

	Policy/Document	Relevant Policy Objective/Reference	Relevant Scheme Impacts	Alignment
Regional Policy	**Core Strategy for Chiltern District** **(Adopted November 2011)**	The Core Strategy for Chiltern District identifies the following main challenges relevant to the scheme: • Supporting the economy, business and people in the economic recession; • Reducing impact on the environment in terms of emissions of carbon dioxide and consumption of natural resources; and • Managing road congestion and maintaining the transport network. Policy CS25: dealing with the impact of new development on the transport network states that Development proposals shall be consistent with, and contribute to, the implementation of the agreed transport strategies and priorities set out in the Buckinghamshire Local Transport Plan 3 (2011-16). Policy CS22: Chilterns Area of Outstanding Natural Beauty(AONB) mentions that: • All proposals must conserve and enhance the special landscape character, heritage, distinctiveness of the Chilterns AONB; • All proposals must protect the setting of the AONB and safeguard views into and out of the area; and • Schemes which facilitate the environmental, economic and social well being of the AONB and its communities will generally be supported.	• The scheme has improved journey time reliability and journey times. • The scheme has delivered congestion relief by increased road capacity to cater for growth in traffic. • The scheme has delivered major journey time benefits, improving the efficiency of the motorway network, with potential for wider economic benefits • The scheme has resulted in lower than expected growth in carbon emissions.	✓
	South Bucks Local Development Framework: Core Strategy Development Plan Document **(Adopted February 2011)**	The strategic spatial issues faced by South Bucks are identified as: • To reduce traffic problems, including congestion (for example, at Beaconsfield) and the impact of HGV movements (for example at Iver Village and Richings Park); and • To improve accessibility to facilities and services, particularly for those in rural areas. Strategic objectives set out are: • Encourage more sustainable forms of transport and increase travel choice to help reduce traffic congestion and facilitate healthier, lower carbon lifestyles; • Address traffic congestion (including on the A355 / A40 to the east of Beaconsfield) and mitigate the amenity impacts of HGV movements (particularly in and around Iver Village and Richings Park); • Focus new development in accessible locations, reducing the need to travel and increasing opportunities for walking, cycling and public transport use; and • The core policies through which these objectives are to achieved are – CP6-Local Infrastructure Needs, CP7-Accessibility and Transport, CP14- Wilton Park Opportunity Site and CP16-South of Iver Opportunity Area.	• The scheme has addressed traffic congestion issues along the scheme section. • Post scheme opening, traffic levels on local roads are lower than pre-scheme levels coupled with the increased traffic along the scheme section, suggesting that the scheme has diverted traffic from these roads to the scheme section.	✓
	Dacorum Borough Local Plan(1991-2011, Adopted April 2004)	Policy 49-Transport planning strategy outlines the following principles: • Motor traffic volumes and impacts should be reduced, especially in peak periods and in congested urban areas. Through traffic will be restricted to the Primary Road Network; and • Other transport measures which minimise adverse environmental impact and improve facilities for passenger transport, walking and cycling and promote the integration of different transport modes will be encouraged.	• The scheme has led to increased traffic in the peak periods along the scheme section and reduced traffic on other local routes. • The scheme has led to improvement in journey times along with higher traffic thus helping in reducing congestion.	✓
	Buckinghamshire Local Transport Plan 3 **(2011-2026)**	The Buckinghamshire Local Transport Plan sets out how the Council will address transport related challenges and issues across the County. The key transport objectives set out in Buckinghamshire Local Transport Plan 3 are: • To maintain or improve the reliability of journey times on key routes; • To improve connectivity and access between key centres; • To deliver transport improvements to support and facilitate regeneration and sustainable housing and employment growth; and • To ensure local transport networks are resilient and adaptable to shocks and impacts.	• There is significant improvement in journey time along the scheme section. • Journey time reliability has improved post scheme opening. • The scheme helped to improve the motorway network, thus improving connectivity and access since M25 is a strategic network. • The scheme is likely to support the economic growth of the South East England through improved connectivity with the rest of the UK.	✓
	Hertfordshire Local Transport Plan **(2011-2031)**	The overall aim of the Local Transport Plan is summarised in Hertfordshire's transport vision statement: "To provide a safe, efficient and resilient transport system that serves the needs of business and residents across Hertfordshire and minimises its impact on the environment." Key challenges identified in the Local Transport Plan relevant to the scheme are: • To keep the county moving through efficient management of the road network to improve journey time, reliability and resilience and manage congestion to minimise its impact on the economy; • To support economic growth and new housing development through delivery of transport improvements and where necessary enhancement of the network capacity; • To improve accessibility for all and particularly for non car users and the disadvantaged; • To maintain and enhance the natural, built and historic environment managing the streetscape and improving integration and connections of streets and neighbourhoods and minimising the adverse impacts of transport on the natural environment, heritage and landscape; • To reduce the impact of transport noise especially in those areas where monitoring shows there to be specific problems for residents; • To improve road safety in the county reducing the risk of death and injury due to collisions; and • To reduce greenhouse gas emissions from transport in the county to meet government targets through the reduction in consumption of fossil fuels. The widening of M25 J16-23 is mentioned as part of the implementation plan.	• The scheme has provided increased capacity to cater for growth in traffic and potential economic benefits. • The scheme has not increased carbon emissions to the extent as forecast. • The scheme has catered to congestion relief and improved journey time and reliability. • The scheme has not led to a significant increase in accidents at OYA, but a clearer picture about the scheme's impact on safety will be available at FYA. • The scheme's impact on noise levels is worse than expected. • The scheme's impact on landscape and townscape were as expected.	**Partial** **(safety too early to conclude at OYA and noise is worse than expected)**

	Policy/Document	Relevant Policy Objective/Reference	Relevant Scheme Impacts	Alignment
National Policy	**The Future of Transport: a Network for 2030**	The Strategy builds on the progress that had already been made since the implementation of the 10 year plan for transport. This plan extended out to 2014-2015 but strategy also looks even further ahead, at the challenges we face over next 20-30 years. The Strategy is build around three themes: • Sustained investment; • Improvements in transport management; and • Planning ahead. The main goal is to provide a road network that provides a more reliable and free-flowing system for motorists, other road users and businesses, where travellers can make informed choices about how and when they travel, and so minimise the adverse impact of road traffic on the environment and other people.	• The scheme is part of a series of improvement measures along the M25, and as such provides an improved road network to cater for the increased traffic along the corridor. • The improved scheme section has resulted in less traffic in alternate routes with the possibility of further developments at these alternate routes.	✓
	Action for Roads - A network for the 21st century (July 2013)	• Support the UK economy and drive growth into the future through provision of a well-connected road infrastructure with sufficient capacity; • Push for greater safety, and avoid letting the improvements of recent years breed complacency; and • Ensure transport plays its part in meeting carbon budgets and other environmental targets.	• By improving the strategic road network in the area, the scheme enhances the integrated transport network at both a local and regional level, supporting economic growth objectives. • Observed growth in carbon emissions is lower than forecast as a result of the scheme.	✓

Key Points – Accessibility and Integration

Accessibility

- It is considered that the AST rating of neutral for the Option Values, Severance and Access to the Transport System sub-objectives is appropriate given the outturn impact of the scheme.

Integration

- The scheme has not had an impact on the provision of public transport interchange, as expected.
- The scheme integrates well with the objectives set out in regional policies and contributes to improving the reliability of the transport system in region. The scheme's impact on Land Use and Other Government Policies is therefore considered to be beneficial.

7. Appraisal Summary Table & Evaluation Summary Table

Appraisal Summary Table

7.1 The AST is a brief summary of the main economic, safety, environmental and social impacts of a highway scheme. Table 7-1 presents the AST for the M25 J16-23 widening scheme.

7.2 The AST presents a brief description of the scheme, a statement detailing the problems that the scheme planned to address, and makes an assessment of the scheme's predicted qualitative and quantitative impacts against the following core NATA objectives:

- **Environment** – an estimate of the impact of the scheme on factors such as noise, local air quality, landscape, biodiversity, and water;
- **Safety** – measured reduction in the number and severity of accidents and qualitative assessment of impacts on security;
- **Economy** – Estimated impact of the scheme upon journey times, vehicle operating costs, scheme costs, journey time reliability and wider economic impact;
- **Accessibility** – A review of scheme impact upon access to the public transport network, community severance, and non-motorised user impact; and
- **Integration** – A description of how a scheme is integrated with wider local planning, regional and national policy objectives.

Evaluation Summary Table

7.3 The EST was devised for the POPE process to record a summary of the outturn impacts against the DfT's transport objectives, compared to the predictions in the AST.

7.4 Drawing on the results presented in this report, ***Table*** 7-2 presents the EST for the scheme. An assessment of each of the objectives at the OYA stage is given. Where possible, the format of the EST mirrors the appearance and process of the AST to enable direct comparison of the two.

Table 7-1 – Appraisal Summary Table (AST) (dated 01/08/07)

OBJ	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
Environment	**Noise**	Properties exposed to >66 dB in 2012 reduce from 253 to 202 with the Scheme. Mitigation of noise impacts from increased traffic flows would include a central reserved concrete wall and new Environmental Barriers. Slight increase in noise levels would occur by 2027 with the Scheme. 4 properties (including 2 Listed Buildings) would qualify for noise insulation. Langlebury School sensitive receptor would benefit from a slight reduction in noise, Allington Nursing Home and Sunrise Old People's Home with no change in noise level and a Pastoral Centre with a slight increase in noise level <3 dB.	Change in Population Annoyed (Yr 15) = +27, Estimated Population Annoyed Do-Minimum 665, Estimated Population Annoyed Do-Something 692	PVB (Residential) = -£705,410
	Local Air Quality	7 AQMAs along the Scheme, declared by 4 of the 7 local districts. No new AQMAs would be created. No predicted exceedances of NO_2 or PM_{10} EU Limit Values in Do-Something opening year (2012) but 1 NO2 exceedence in Do-Minimum (DM). Overall a net improvement in air quality is predicted in the generalised assessment for NO_2, but a deterioration for PM_{10}, although the percentage changes are small (e.g. 0.007% from DM 2012 for NO_2).	PM_{10}: Properties Improve 976; No Change 0; Made Worse 559. NO_2: Properties Improve 1129; No Change 0; Made Worse 406	PM10 +5.64, NO2 – 21.33
	Greenhouse Gases	The scheme is forecast to slightly increase carbon emissions over the 60 year appraisal period, compared to the Do-Minimum scenario. The increase is less than 0.175%.	Change in total Carbon Emissions (tonnes): over 60 years = 869,560; in opening year = 18,576	NPV = - £29.9m
	Landscape	Continuous lighting (previously intermittent), gantries and signage bring the greatest change in landscape character and increased perception of urbanisation in the countryside, including in the Chilterns Area of Outstanding Natural Beauty. Due to land constraints, effects are hard to mitigate with a slight reduction in overall screening. Daytime effects for visual receptors would be more intrusion from lighting columns, gantries and signage. Night-time effects for visual receptors would be intrusion from continuous lit areas along the M25.	-	Moderate Adverse
	Townscape	No townscape features would be affected as the Scheme as urban areas within the visual envelope are part of the landscape as a whole.	-	Neutral
	Heritage of Historic Resources	Potential impacts upon possible, previously unrecorded, remains. Existing motorway construction would have extensively damaged remains within the Secretary of State land, although there may be localised survival, while the boundary survival is likely to be good.	-	Neutral
	Biodiversity	Reinstatement would lesson impacts of habitat losses and improve connectivity. Habitat availability would be increased for wetlands/ species-rich hedgerow and/or the quality is improved (calcareous grasslands). In all other situations habitat availability is decreased and the net result is a 15% reduction in habitat overall including those of local value and regional value (ancient woodlands). Large beneficial effects result for otter and water vole through improved habitat. Bats, birds and aquatic species would experience permanent slight adverse effects from increased lighting resulting in reduced habitat quality which is most prominent in areas currently unlit.	-	Slight Adverse
	Water Environment	Increased runoff volume but no increase in peak flow rates. No further encroachment onto floodplain. The Scheme would improve overall water quality through increased mitigation. 5 watercourses would be better but 4 watercourses would receive increased pollution loading after mitigation but would not exceed EQS. 1 watercourse would maintain its existing exceedance of an EQS. Pollution risk from accidental spillage would be reduced by containment provision. Soakaways would be located further away from public water supply abstraction points.	-	Slight Beneficial
	Physical Fitness	Negligible impacts on journey times for cyclists and pedestrians as no change to routes crossing over/under M25, so largely unchanged health benefits.	-	
	Journey Ambience	Changes in vegetation would slightly alter views from the road but would have a neutral effect. Drivers would experience future elevated stress levels, but they would improve in Do-Something compared to Do-Minimum. The Scheme would have no provision for additional traveller facilities.	-	Beneficial
Safety	**Accidents**	Slight reduction in accidents and casualties (A&C) on M25 in Do-Something (DS). Slight increase in A&C on non-M25 links in the road network from increased traffic flow on these links and M25 in DS. Overall slight reduction in A&C, but over the 60 year appraisal period, so is considered negligible.	Accidents – 16, Deaths 0, Serious Inj. 1, Slight inj, -36	PVB £320,000
	Security	Boundary fencing and provision of emergency roadside telephones would be unaffected by the Scheme. Formal surveillance by full CCTV coverage would be same as existing. There would be no change to informal surveillance. Lighting proposals would improve security along existing unlit areas.	-	Neutral
Economy	**Public Accounts / TEE**	Assuming only Section 1 of the M25 programme is built, the Variable Trip (Reference Case) shows that the consumer and business benefits of the Scheme would be more than five times the costs of constructing the Scheme. Including accident and carbon benefits, the reference case Benefit Cost Ratio (BCR) for the Scheme is 5.22.	Central Govt PVC	PVC £256m PVB £933.3m PVB £360.9m
	Reliability	Incident-related reliability impacts were quantified using INCA. Benefits have been estimated around £72 million.		PVB £72m
	Wider Economic Impacts	The Scheme does not affect any Regeneration Areas.	-	Neutral
Accessibility	**Option Values**	The Scheme would not result in any new option values.	-	Neutral
	Severance	Impact on traffic flows, journey patterns and amenity would not be large enough to deter Non-Motorised User journeys, including vulnerable users.	-	Neutral
	Access to the Transport System	Access to the Transport System would not be affected by the Scheme.	-	Neutral
Integration	**Transport Interchange**	The Scheme would not result in any change to transport interchange.	-	Neutral
	Land Use Policy	National Level: Helped DfT, HA & (former) ODPM policies (Integrated Transport White Paper, Transport White Paper and PPG13). Does not support another national transport policy/ PPG13 objective of reducing travel by private car. Regional Level: Helped policies include TR8A (Bucks Structure Plan (SP)), Policies 26 & 33 (Herts SP), Objectives A & B (Bucks LTP2 Theme 1) & Section 3.8 (Herts LTP2). Local Level: Helped policies include TR5 (S. Bucks Local Plan (LP)), Policy 53 (Dacorum LP) & Policy 28 (St Albans LP Review). Does not support anti-M25 widening Policy T6 (Three Rivers LP).	-	Beneficial
	Other Government Policies	The Scheme supports policies related to benefits to the economy, on the need for a safe and efficient trunk road network, and improved employment. Policies not supported emphasise the need to protect a range of environmental issues, including energy, climate change, heritage and biodiversity.	-	Neutral

Table 7-2 – Evaluation Summary Table (EST)

OBJ	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
Environment	**Noise**	The increase in traffic flow observed is lower than that predicted in the Environmental Statement, however there is an observed increase in traffic speeds during the inter peak and evening peak times. Speeds in the morning peak vary with slower speeds seen along some sections. Roadside noise levels are based on flow, speed and %HGV for each case. Purely on the basis of changes in traffic, the noise on the motorway is lower than predicted although not sufficient to affect an 'as expected' assessment for noise.	Traffic Flow - As expected Inter peak and PM peak traffic volumes - Worse than expected	As expected
	Local Air Quality	The traffic data shows that the observed flows are lower than forecast along all sections of the motorway, which should indicate that pollutant concentrations are lower than those estimated in the ES. However, in recent years, there has been no change to the AQMAs in the surrounding area, indicating that air quality has remained the same in recent years, with continued breaches of the NO^2 annual average EU Limit Value at sites near the M25.	-	As expected
	Greenhouse Gases	Along the scheme section, there is an increase in carbon emissions post opening compared to pre-scheme scenario. But the increase in emissions observed is lower than what was forecast to occur.	-	Better than expected
	Landscape	Alternative Design Proposals have brought about a change to vegetation to be retained through the introduction of re-graded embankments. Despite this immediate loss of vegetation, the permanent visual effect of vegetated slopes rather than the use of hard retaining features is considered to be positive. Due to the increased ground preparation measures that were required due to soil compaction issues on site, which may impact on achievement of growth targets it is recommended that plant establishment is reconsidered at FYA. This is especially relevant for planting plots that have a screening requirement. Grassland plots and hedges are establishing within acceptable limits, although natural colonisation from existing seed banks have added to the grassland mix found on site.	-	As expected (Moderate Adverse)
	Townscape	No further assessment has been undertaken	-	As expected (Neutral)
	Heritage of Historic Resources	Neutral effect on the settings of listed buildings due to the sensitive design in the construction of cuttings, embankments and bunds, and in the placement of vegetation screening and noise screening. This has resulted in a neutral residual impact on the setting of historic buildings. Creation of new gantries has resulted in a slight adverse impact to the context of the Chalfont Viaduct. Archaeological finds and information discovered during site investigations has had the positive effect of increased knowledge as predicted in the ES. The finds and archives have yet to be deposited and will be subject to the finalisation of the Academic report and this aspect of archiving should be confirmed at FYA	-	As expected (Neutral)
	Biodiversity	Habitat reinstatement is establishing as expected, although management of seeding and planting plots is not applied equally throughout. Species enhancements (hibernacula, bird and bat boxes, and otter holts) have been provided as expected although the success of these enhancements, as well as the refurbished badger tunnel at Junction 20, cannot be determined at OYA stage and therefore should be reconsidered in the FYA assessment. Residual effects on great crested newts, birds, bats, badgers and otters are as expected in the ES, but the residual effects on reptiles and water voles are less than expected, and habitat enhancements will have a residual benefit for water voles. Management works proposed in the ES as compensation for impacts on ancient woodland do not appear to have commenced and should be reconsidered in the FYA assessment.	-	As expected (Slight Adverse)
	Water Environment	Mitigation measures have been implemented with reference to the ES and in consultation with the Environment Agency (EA). New ponds before discharge to soakaways and a net removal of soakaways have been included as part of the detailed design, with agreement from the EA which results in an improvement on the pre-scheme situation. No information has been provided to POPE that would indicate that it is performing other than as intended. Whilst a flooding issue has been raised by the Hertsmere Borough Council, and some decrease in water quality is noted, based on the information available at OYA, it is considered that the scheme's overall impact has been as expected.	-	As expected (Slight Beneficial)
	Physical Fitness	Whilst the realignment of footpaths due to Chorley Wood, Bricket Wood and South Mimms bunds and near ponds 4, 23 and 28 is permanent, the impact is considered slight and has little impact on users. The removal of vegetation as a part of the Scheme has had some effect on pedestrians and others which is as expected. It is concluded that the overall scheme impact on Physical Fitness, is as expected.	-	As expected
	Journey Ambience	Increased vegetation removal has altered views at opening year, although it is expected that replacement planting will reduce this impact to neutral by the design year. Decreased driver stress levels due to reduced congestion and improved journey times despite increased traffic levels has resulted in an improvement overall to Journey Ambience as predicted.	-	As expected (Beneficial)
Safety	**Accidents**	At the OYA stage there is no statistical evidence that the scheme has had an impact on safety within the study area. As such the monetised safety impact is reforecast to be £0m. This should be revisited at FYA.	-	Too early to conclude
	Security	The scheme did not affect the provision of security facilities.	-	As expected (Neutral)
Economy	**Public Accounts**	Outturn construction costs were lower than forecast, and changes to indirect tax were also lower than forecast.	Reforecast PVC based on OYA study: -£295.4m, BCR :7.3	Better than expected
	TEE	The scheme achieves better than forecast journey time savings which has resulted in the TEE benefits exceeding that forecast.	Outturn Journey time benefits : £2208.5m	Better than expected
	Reliability	Journey time reliability has improved as a result of the scheme	Outturn reliability benefits : £94.3m	Better than expected
	Wider Economic Impacts	The scheme is likely to facilitate the wider economic benefits, as the appraisal has stated, there is no regeneration area in the vicinity of the scheme.	No quantitative assessment of the impact on wider economic benefits has been made.	As expected (Neutral)
Accessibility	**Option Values**	No impact on option values	-	As expected (Neutral)
	Severance	The scheme has not affected the provision of infrastructure.	-	As expected (Neutral)
	Access to the Transport System	No direct change in public transport provision as a result of the scheme.	-	As expected (Neutral)
Integration	**Transport Interchange**	The scheme has not had an impact on the provision of transport interchange facilities.	-	As expected (Neutral)
	Land Use Policy & Other Gov't Policies	The scheme aligns with national, regional and local policies in improving journey times and increasing the regions connectivity and removing large volumes of traffic away from local communities and it is too early to conclude about the scheme's impact on safety and noise.	-	As expected

8. Conclusions

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

Scheme Specific Objectives

8.2 ***Table 8-1*** presents an evaluation of the scheme's objectives using the evidence presented in this study.

Table 8-1 – Success against Scheme Objectives

Objective	Has the scheme objective been achieved?	
Improve Reliability	Journey time reliability has improved along the scheme section in both directions. This is evident from the hourly variation in journey times being less variable in the peak hours and the higher incident related benefits from INCA than forecast.	✓
Improve Safety	Collision rates along the M25 have increased slightly post opening after accounting for the background trend in collisions. When the background reduction is not accounted for, a reduction in the number of collisions is seen. These changes are shown to not be statistically significant, and therefore cannot be directly linked to the scheme at this stage.	Too early to conclude at this stage.
Reduce Congestion	The scheme has provided improved journey times and journey time reliability and delivered congestion relief along the scheme section.	✓
To minimise adverse environmental impacts of the upgraded section	Loss of small areas of ancient woodland within the scheme has been balanced through improved habitat creation both within the pre-scheme boundary and in additional land purchase areas. There has been a positive effect on noise and visual impacts through increased mitigation in the form of environmental barriers and bunds. Creation of new gantries either side of the listed Chalfont Viaduct has resulted in a slight adverse impact (with respect to cultural heritage)	Too early to conclude at this stage
Improve Driver Information	Speed limits displayed in the gantries erected as part of the scheme are only advisory at present. Controlled motorway along the scheme section is operational from March 2014.	Too early to conclude at this stage.

8.3 ***Table 8-1*** shows that with the data available at this one year after stage, the scheme is achieving its objectives of improving reliability and reducing congestion.

8.4 The following conclusions can be made from the analysis presented in this evaluation:

- Average weekday traffic has increased along the scheme section post-opening with reduced flows observed on alternative routes in the vicinity of the scheme.
- The scheme appraisal overestimated traffic volumes using the corridor in the opening year. This is largely due to the forecast growth being higher than has been realised as a result of the economic recession.
- Average journey times have reduced post scheme opening along with improved journey time reliability and reduced congestion. Observed journey time savings in the opening year are higher than forecast, this is in part due to traffic volumes being lower than forecast.

- It is too early to conclude about the scheme's impact on safety at this One Year After (OYA) stage.
- Economic benefits are higher than expected, with the Benefit to Cost Ratio (BCR) from this OYA evaluation being 5.7 compared to a forecast BCR of 3.4. This is primarily due to higher than expected journey time savings, this being the major contributor to scheme benefits.
- The long term scheme impacts are likely to be affected by the completion of the ongoing schemes in the vicinity and the controlled motorway along the scheme section.
- Design development changes including reduction in length of retaining features and the inclusion of additional ponds and landscape bunds has resulted in an improvement of habitat and planting in some areas whilst having a slight negative impact in others. On balance, the design changes are seen as positive.

Appendices

Appendix A. Tables and Figures in this Report

Tables

Figures

Appendix B. Glossary

Terms	Definition
AADT	**Annual Average Daily Traffic**. Average of 24 hour flows, seven days a week, for all days within a year.
Accessibility	Accessibility can be defined as 'ease of reaching'. The accessibility objective is concerned with increasing the ability with which people in different locations, and with differing availability of transport, can reach different types of facility.
ADT	**Average Daily Traffic**. Average daily flows across a given period.
AONB	**Area of Outstanding Natural Beauty**
AST	**Appraisal Summary Table**. This records the impacts of the scheme according to the Government's five key objects for transport, as defined in DfT guidance contained on its Transport Analysis Guidance web pages, WebTAG.
ATC	**Automatic Traffic Count**
AAWT	**Annual Average Weekday Traffic**. As AADT but for five days (Monday to Friday) only.
AWT	**Average Weekday Traffic**. As ADT but for five days (Monday to Friday) only.
BCR	**Benefit Cost Ratio**. This is the ratio of benefits to costs when both are expressed in terms of present value i.e. PVB divided by PVC.
Bvkm	**Billion Vehicle Kilometres**
COBA	**Cost Benefit Analysis**. A computer program which compares the costs of providing road schemes with the benefits derived by road users (in terms of time, vehicle operating costs and accidents), and expresses the results in terms of a monetary valuation. The COBA model uses the fixed trip matrix unless it is being used in Accident-only mode.
CWS	**County Wildlife Site.** Non-statutory areas of local importance for nature conservation that complement nationally and internationally designated geological and wildlife sites.
DfT	**Department for Transport**
Discount Rate	The percentage rate applied to cash flows to enable comparisons to be made between payments made at different times. The rate quantifies the extent to which a sum of money is worth more to the Government today than the same amount in a year's time.
Discounting	Discounting is a technique used to compare costs and benefits that occur in different time periods and is the process of adjusting future cash flows to their present values to reflect the time value of money, e.g. £1 worth of benefits now is worth more than £1 in the future. A standard base year needs to be used which is 2002 for the appraisal used in this report.
DM	**Do Minimum**. In scheme modelling, this is the scenario which comprises the existing road network plus improvement schemes that have already been committed.
DMRB	**Design Manual for Roads and Bridges**
DS	**Do Something**. In scheme modelling, this is the scenario detailing the planned scheme plus improvement schemes that have already been committed.
EA	**Environment Agency**
EAR	**Economic Assessment Report**
ES	**Environmental Statement**
EIR	**Economic Impact Report**
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.
EQS	**Environmental Quality Standard.** An Environmental Quality Standard is a value, generally defined by regulation, which specifies the maximum permissible concentration of a potentially hazardous chemical in an environmental sample, generally of air or water.

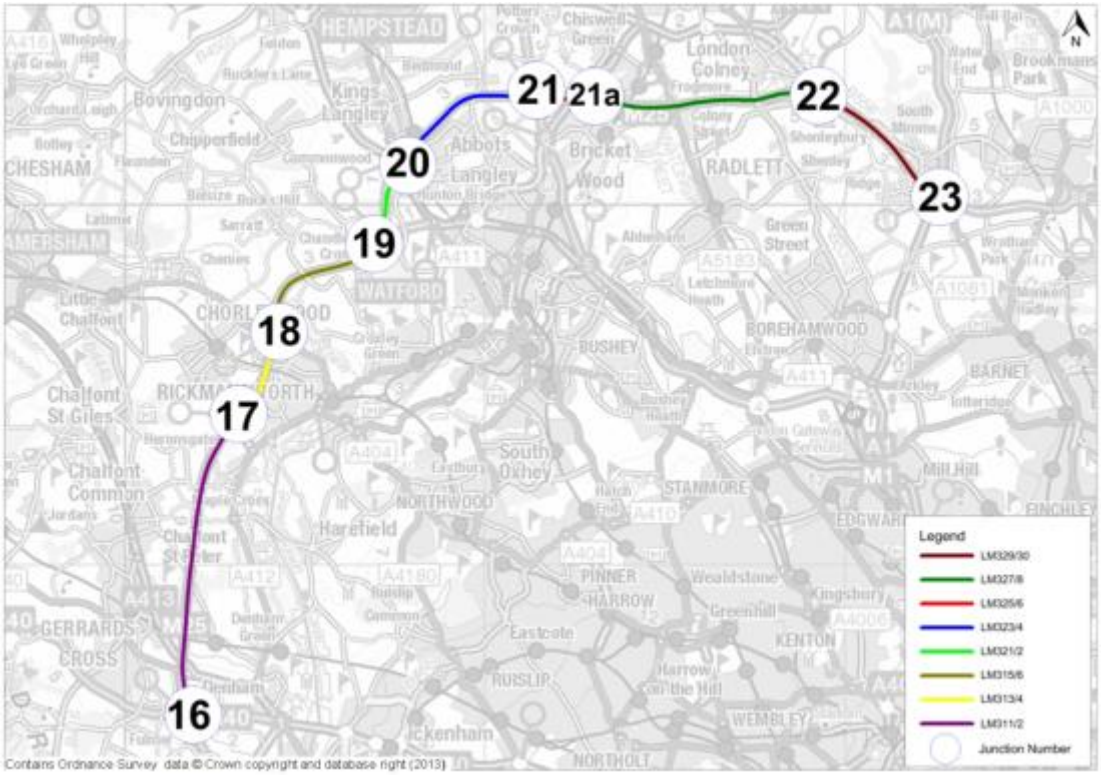
Terms	Definition
FYA	**Five Year After**
HA	**Highways Agency**. An Executive Agency of the DfT, responsible for operating, maintaining and improving the strategic road network in England.
HGV	**Heavy Goods Vehicle**
INCA	**INcident Cost Benefit Analysis.** A spreadsheet based program which calculates the benefits of reduced delay and travel time variability.
KSI	**Killed or Seriously Injured**. KSI is the proportion of casualties who are killed or seriously injured and is used as a measure of accident severity.
LNS	**Low Noise Surfacing**
MAC	**Managing Area Contractor** Organisation normally contracted in 5-year terms for undertaking the management of the road network within a HA area.
MVKM	**Million Vehicle Kilometres**
NoTAM	**North of Thames Assignment Model.** Assignment model for Sections 1, 4 and 5 of the M25 Rapid Widening Scheme.
NAOMI	Pseudonym for the Highways Agency's strategic road traffic assignment model for the South East of England.
NMU	**Non-Motorised User**. A generic term covering pedestrians, cyclists and equestrians.
NRTF	**National Road Traffic Forecasts**. This document defines the latest forecasts produced by the Department of the Environment, Transport and the Regions of the growth in the volume of motor traffic. At the time this scheme was appraised, the most recent one was NRTF97, i.e. dating from 1997.
ONS	**Office for National Statistics**
OYA	**One Year After**
PIC	**Personal Injury Collision**
POPE	**Post Opening Project Evaluation**. The before and after monitoring of all major highway schemes in England.
Present Value	**Present Value**. The value today of an amount of money in the future. In cost benefit analysis, values in differing years are converted to a standard base year by the process of discounting giving a present value.
PVB	**Present Value Benefits**. Value of a stream of benefits accruing over the appraisal period of a scheme expressed in the value of a present value.
PVC	**Present Value Costs**. As for PVB but for a stream of costs associated with a project
RSA	**Road Safety Audit**
RSI	**Road Surface Index**
SAM	**Scheduled Ancient Monument**
SSSI	**Site of Special Scientific Interest**
STATS19	A database of injury accident statistics recorded by police officers attending accidents.
TEE	**Transport Economic Efficiency**
TEMPRO	**Trip End Model Program**. This program provides access to the DfT's national Trip End Model projections of growth in travel demand, and the underlying car ownership and planning data projections.
TRADS	**Traffic Flow Data System**. Database holding information on traffic flows at sites on the strategic network.
UK	**United Kingdom**
webTAG	DfT's website for guidance on the conduct of transport studies at http://www.webtag.org.uk/

Appendix C. M25 Journey Time Sections

Table C.1 – M25 Journey Time Sections

Link ID	Link Description	Link Length (km)
LM311/2	M25 J16 to M25 J17	8.85
LM313/4	M25 J17 to M25 J18	2.34
LM315/6	M25 J18 to M25 J19	4.12
LM321/2	M25 J19 to M25 J20	2.85
LM323/4	M25 J20 to M25 J21	4.71
LM325/6	M25 J21 to M25 J21A	1.02
LM327/8	M25 J21A to M25 J22	6.8
LM329/30	M25 J22 to M25 J23	5.26

Journey Time Sections on M25 between J16 and J23



Appendix D. Information requested for Environmental section

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

Requested Information	Response
Environmental Statement	M25 junction 16-23 Environmental Statement and technical summary - August 2007
AST	Appraisal Summary Report – August 2007
Any amendments/ updates/addendums etc to the ES or any further studies or reports relevant to environmental issues. Have there been any significant changes to the scheme since the ES.	Various Alternative Design Proposal reports for landtake, ponds and bunds. As built Appraisal Summary Report and Appraisal Summary Table (June 2012)
'As Built' drawings for landscape, ecological mitigation measures, drainage, fencing, earthworks etc. Preferably electronically or on CD.	As built drawings for ecology, landscape, and Environmental Masterplans which include the above, environmental barriers, PROW's, ponds
Copies of the Landscape/Ecology Management Plan or Handover Environmental Management Plans	Draft HEMP received
Contact names for consultation	Obtained from Environmental Statement
Archaeology - were there any finds etc. Have any Archaeological reports been written either popular or academic and if so are these available?	Popular report received – Archaeological Discoveries on the M25.
Have any properties been eligible for noise insulation?	Yes, information noted in report
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?	Yes, Landscape & Ecology Establishment Monitoring: 2012 Annual Summary of Inspections
Animal Mortality Data	Supplied by DBFO
Any publicity material	None requested
Pre scheme Non Motorised User (NMU) Audit or Vulnerable User Survey	Not supplied
Copy of NMU post opening survey	None undertaken
Employers Requirements Works Information - Environment sections	Received
Health and Safety File – Environment sections	Received
Construction Environment Management Plan (CEMP)	Received
The Road Surface Influence (RSI) value of any low noise surface installed	Supplied
Has the scheme received any environmental awards	Yes, noted in report

Appendix E. Environmental Barrier Reconciliation

Environmental Barrier Reconciliation: Existing, ES, As built

Carriageway direction	Start chainage	Finish chainage	Approximate length	Minimum height	Location	Existing	ES	As built
AC	3000	3325	325	2	Top of cutting	✓	✓	✓
C	3250	3500	250	2	Top of cutting	✗	✓	✓
C	3880	4220	340	2	Top of Embankment	✓	✓	✓
C	5300	5395	95	2.5	At motorway level	✗	✓	✓
C	5395	5675	280	2	Higher than motorway	✓	✓	✗
C	5395	5675	280	2.5	Higher than motorway	✗	✓	✓
AC	5150	6170	1020	2	Top of Embankment	✓	✓	✓
AC	8200	8900	700	2.5	Top of cutting	✗	✓	✓
AC	11030	11430	370	2	At motorway level	✗	✗	✓
AC	11430	11970	540	2	Top of cutting	✓	✓	✗
AC	11430	12050	620	3	Top of cutting	✗	✓	✓
C	11100	11370	270	3	At motorway level	✗	✗	✓
C	12230	13000	770	2	Level with road up to cutting	✓	✓	✓
AC	12150	12975	825	2.5	Level with road up to cutting	✓	✓	✓
AC	13185	13850	665	2	Level with road up to cutting	✓	✓	✓
C	13025	13145	120	1	Top of cutting	✗	✗	✓
C	13145	13170	25	1.5	Top of cutting	✗	✗	✓
C	13120	13170	50	1	Top of cutting	✗	✓	✗
C	13170	13850	825	2-4m	Level with road up to cutting	✓	✓	✓
C	16840	17070	230	2	On cutting	✓	✓	✗
C	16849	16972	123	1.75	On cutting	✗	✗	✓

AC	16770	17055	285	2.5	At motorway level	✓	✓	✗
AC	16768	17054	296	3	At motorway level	✗	✗	✓
C	20240	20725	485	2	At motorway level	✓	✓	✗
C	20203	20683	480	1.5	At motorway level	✗	✗	✓
AC	20175	20875	700	2-3	At motorway level	✓	✓	✗
AC	20184	20721	537	2-3	At motorway level	✗	✗	✓
C	22490	22680	190	3.2	On cutting	✗	✗	✓
AC	25750	26400	650	3	At motorway level	✗	✓	✗
AC	25950	26400	450	3	At motorway level	✗	✗	✓
AC	27900	28400	500	2	At motorway level	✓	✓	✗
AC	27920	28420	500	2	At motorway level	✗	✗	✓
C	27900	28470	570	2	At motorway level then top of cut to bridge	✓	✓	✗
C	27910	28470	570	1.9-3	At motorway level then top of cut to bridge	✗	✗	✓
AC	30470	30895	425	1.5	On cutting	✗	✗	✓
AC	31600	31780	180	1.5	On cutting	✗	✗	✓
AC	31930	32200	270	2	At motorway level	✓	✓	✓
AC	33050	33250	200	2	At motorway level	✗	✗	✓
C	35435	35670	235	2	At motorway level	✗	✗	✓
AC	36150	36240	90	1.5	On cutting	✗	✗	✓
AC	36650	36750	100	2	Up on retaining wall	✓	✓	✗
AC	36650	36725	75	2	Top of retained cut	✗	✗	✓
C	36600	36640	40	2	Up on retaining wall	✓	✓	✓

Appendix F. Photographic Record of Scheme – ES photomontage comparisons (existing views –March 2006)

Figure F.1 – Location 1 – View North from Footpath F21 Representative of Residential Receptors on Long Lane

Pre-scheme and Year 1 predicted view from the Environmental Statement

One year after scheme opening – photograph taken in March 2014

It is noted that the sheetpile retaining wall discussed in 5.103 is more prominent that predicted in the ES.

Figure F.2 – Location 2 – View southwest from Footpath F28 (north of M25 in Chilterns AONB)

Pre-scheme and Year 1 predicted view from the Environmental Statement

One year after scheme opening – photograph taken in March 2014

Photograph demonstrates the loss of vegetation on the anticlockwise slope due to land purchase. Species rich grassland has been planted in its place due to the steepened slope, with a hedgerow providing future screening along the fenceline. A superspan gantry is a dominant feature in this view.

Figure F.3 – Location 3 View West from F28 (south of M25) in Chilterns AONB

Pre-scheme and Year 1 predicted view from the Environmental Statement

One year after scheme opening – photograph taken in March 2014

The effect of the removal of the trees along the top of the cutting as discussed in Location 2 is visible. It is expected that the hedgerow planted along the fenceline will mitigate immediate views of the road which are currently exposed.

Figure F.4 – Location 4 – View north from residential receptors at Bricket Wood

Pre-scheme and Year 1 predicted view from the Environmental Statement

One year after scheme opening – photograph taken in March 2014

The relocation of the gantry is noted in this view. Little or no impact is expected due to this design change.

Figure F.5 – Location 5 – View south from All Saints Pastoral Centre

Pre-scheme and Year 1 predicted view from the Environmental Statement

One year after scheme opening – photograph taken in March 2014

No changed noted in this view

Figure F.6 – Location 6 – View north from Salisbury Hall

Pre-scheme and Year 1 predicted view from the Environmental Statement

One year after scheme opening – photograph taken in March 2014

The gantry visible in the one year after view is not shown on the ES predicted one year view. It is noted that the gantry location is proposed in the ES (within 15 metres of the new location). It does not have a greater impact on the landscape than the proposed ES location.

Figure F.7 – Location 7 – View west from Frowkey Crescent, South Mimms

Pre-scheme and Year 1 predicted view from the Environmental Statement

One year after scheme opening – photograph taken in March 2014

The one year after photograph demonstrates screening effects of the South Mimms bund. Whilst the bund does not completely screen South Mimms from the motorway in some areas, it is noted that there is a substantial local benefit to residents in the area.

Appendix G. Extracts from popular Archaeological publication

'Archaeological Discoveries on the M25 junction 16-23 – Oxford Archaeology'

(referenced areas may be found on the key location map in Figure 5-2)

No large concentrations of struck flint were found, but scatters of flint flakes and tools indicate the presence of Mesolithic hunter gatherers and of the succeeding first Neolithic farmers. Struck flints from Pond 3 were probably made by someone from a larger hunter-gatherer camp found previously a few hundred metres to the south, where animals were butchered.

Clearance of woodland gradually increased towards the end of the Neolithic period (2900-2500) and in the early Bronze Age (2500-1600 BC). A group of tree-throw holes from Pond 14 contained struck flints and charcoal dating to these periods, and these are probably evidence of this activity.

Early Bronze Age pits at Pond 2 and Bricket Wood Bund contained parts of two Beaker pots. This is the decorated red-fired pottery used by the first metal-users, and the red colour of much of the pottery may have been intended to mimic the reddish-bronze of copper. The pit at Pond 2 is particularly important, as it is radiocarbon-dated to between 2490 and 2290 BC, which is the very earliest part of the metal age. It is therefore possible that the two fragmentary vessels are also amongst the earliest Beaker pots found in Britain. The pit from Bricket Wood Bund has not been radiocarbon-dated.

Groups of pits at Slade Oak Lane and at Bricket Wood Bund suggest domestic activity of the Middle Bronze Age (1600-1200 BC). One pit at Slade Oak Lane contained the smashed remains of a very large storage vessel, and another contained abundant charred barley grains, one of which was radiocarbon-dated to 1420- 1270 BC. Such vessels and caches indicate larger communities and a more settled way of life.

A large hollow lay next to another pit; similar hollows elsewhere were used for cereal processing. Waterholes are first dug at this time, and there were two probable examples at Bricket Wood Bund. Pollen from one of these shows that the environment was grazed grassland, with some stands of trees and shrubs, especially hazel and lime.

No post-built houses were found, but short gullies forming 3 sides of a rectangle may indicate a building. A group of ten pits containing large quantities of charcoal and then burnt stones at Pond 4 may indicate that charcoal-burning was carried out at this site. Four of the pits had the remains of an upright burnt stake in the centre, suggesting that these were not just casual bonfires, and may indicate careful stacking of timber. There were no finds from any of them, suggesting that this was not a settlement site, but the similarity of all of the pits suggests some specific activity.

Middle Iron Age at Slade Oak Lane

Stripping revealed parts of several enclosures here. The largest, an oval of which only the south-east half lay within the excavation had a substantial ditch and an entrance on the north-east side.

A number of irregular large hollows were found, which may have been quarry pits for extra spoil to heighten the bank. When topped by a palisade, it would have looked quite impressive. At the entrance, two massive postholes and a row of smaller, but still very substantial, postholes behind, suggest a monumental gateway. It has been interpreted that these postholes belonged to a gatehouse with a platform or guardhouse above the gate. Massive pairs of posts are however also known at the entrances of sites without effective defences, so the posts could also have been for show.

Only a few of the pits were investigated, as it was decided to preserve this site in situ. Charred cereals from two of the pits provided radiocarbon dates, and these showed that the site was occupied between 200 and 50 BC. The pottery consists of handmade, round-bodied bowls characteristic of this period.

The irregular quarry pits around the edge of the interior were later used for various outdoor activities; one contained slag from a hearth bottom, indicating that iron ore was worked on the site.

Technological change in Roman Britain

At Bricket Wood Bund two pottery kilns were found within an area of trackways and large fields. There was no natural stream course within the excavation area, so the potters had dug waterholes, one of which had preserved the wooden revetment used to prevent the gravel sides from collapsing. The site sits on gravel, so they presumably dug clay from the `till' a couple of hundred metres to the east.

The better-preserved kiln had an ovoid firing chamber, lined with clay, with a stoke hole at the northern end. Patching, repair and remodelling show that the kiln was in use for some time. Within the firing chamber were a number of rectangular supports, some with enlarged circular ends. One of these was still upright. Kilns of this type were only in use for a short time around the beginning of the Roman period.

The pots include a wide variety of types: jars for storage, beakers for drink, dishes for food and flagons for serving wine. The clay is tempered with grog (fired clay), and most vessels are fired pink with a grey/ black core.

The Bricket Wood kilns are close to the late Iron Age oppidum (prototown) at Verlamion, which became the Roman city of Verulamium (now St Albans) served by Watling Street, the new Roman road. The kilns at Bricket Wood were probably built to supply the growing population of the town.

Medieval rural settlements

At Slade Oak Lane stripping uncovered three sides of a medieval rectangular enclosure, the fourth having been destroyed without record during the original construction of the M25.

There were traces of two buildings inside. Neither of the buildings had a clear plan, but there were scattered postholes in both, and one had a patchy sand and gravel floor into which a pot had been sunk upright.

Outside the enclosure to the north a large area of quarrying was found, perhaps for building materials. Just outside the north-west corner of the enclosure a large undated subcircular feature was probably a pond or waterhole for the settlement.

The pottery indicates that it was occupied from the 12th to the 14th centuries. Amongst the pottery was the rim and spout of a jug or pitcher decorated with a design of flowers, used to serve ale or water. These highly decorated jugs were made in the mid-13th century, from about AD1225-1275. This was an example of the best-quality pottery available at the time, and suggests that the inhabitants of this farm were relatively well-to-do.