Post Opening Project Evaluation
M40 Junction 15 (Longbridge) Bypass

Five Years After Opening Study

January 2017

Notice

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Executive Summary

Scheme Description

The M40 Junction 15 (Longbridge) Bypass Scheme opened on the 18th June 2010. The scheme was implemented in two stages:

- **Phase One** (opened December 2009) involved construction of a dual carriageway bypass link to the west of M40 Junction 15, connecting the existing A46 north and south of the motorway in order to allow vehicles on the A46 to continue without having to travel through Junction 15 of the M40. The northern connection is a two level free-flow link and the southern connection is a roundabout which also includes an unopposed segregated left turn from the bypass to the main roundabout junction.

- **Phase Two** (opened June 2010) involved the widening and upgrading of the M40 Junction 15 roundabout in order to relieve congestion.

Scheme Objectives

Objective (Appraisal Summary Table, 2006)	Objective Achieved?
To reduce congestion at M40 Junction 15 and improve travel times by reducing the amount of A46 traffic travelling through the junction.	✓
To improve safety for road users at the junction through the various improvements to the roundabout	✓

Key Findings

- Forecast levels of traffic growth were not as high as expected within the vicinity of M40 Junction 15 but did increase. This is a result of two key assumptions outlined within the forecasting process: firstly the forecast models were unable to account for the impacts of the economic recession; secondly the forecast level of development at the Tournament Fields/Chase Meadow development site to the north of the M40 junction was less than expected at Five Years After (FYA).

- The new A46 scheme bypass has successfully diverted traffic that does not require the M40 away from junction 15 during the post-opening period, with 26,400 vehicles using the new A46 scheme bypass on an average weekday. This has resulted in journey time savings being delivered for the vast majority of vehicles.

- Vehicles which use the scheme bypass experience the greatest time savings per vehicle, however in terms of total savings, the majority of time benefits are accrued through reduced congestion at M40 Junction 15.

- Forecast collision savings for the scheme opening year were higher than expected. They were based on savings over a wider study area and did not account for the background reduction in the number of personal injury collisions on the network.

- Analysis of collision data revealed an annual collision saving of 0.9 collisions per annum across the key links analysis area. However, the reduction in the annual average collision rates are not statistically significant and therefore cannot be directly attributed to the scheme measures.

- Monetary benefits are lower than the expected forecast of £268.9 million but are still high with outturn present value benefits of £126.6 million to the economy.

- The impact of the scheme on various environmental issues is better than forecast, however, there was some negative feedback from the consultation process.

Summary of Scheme Impacts

Traffic

- The new A46 scheme bypass has successfully diverted traffic that does not require the M40 away from junction 15 during the post-opening period, with approximately 26,400 vehicles using the new link on an average weekday and 23,200 on an average day.

- Turning counts demonstrate that over a 12-hour weekday period, total inbound flow at M40 Junction 15 has decreased by around 7% from approximately 62,900 vehicles to 58,300 vehicles. This change is attributed to the large increase in vehicles joining the M40 westbound carriageway via the new A46 scheme bypass.

- The observed traffic levels were lower than expected due to the economic downturn during the recession, however there was still an increase in traffic flows. The forecast flows along the existing A46 post opening exceeding observed flows by 22% and forecast flows along the new A46 scheme bypass exceeding observed post-opening flows by 31%.

- Vehicles which use the new scheme bypass experience the greatest journey time savings per vehicle, with most experiencing savings during all times of the day.

- For A46 through traffic, the greatest savings are experienced during the morning peak (0800 to 0900) with an average saving of 2 minutes and 45 seconds for vehicles travelling southbound and 2 minutes 50 seconds for vehicles travelling northbound. There were also considerable time savings for vehicles accessing the M40 westbound carriageway via the A46 scheme bypass, with an average saving of 3 minutes and 15 seconds per vehicle during the PM peak (1700-1800).

- Considerable improvements to journey reliability have also been demonstrated for A46 through movements, with all time periods demonstrating a reduction in the inter-quartile range for journey times in both directions.

- Savings at M40 Junction 15 as a result of reduced congestion are largely confined to a 12-hour period (0700 to 1900) with the greatest savings occurring during peak hours. In particular, all movements from the northern arm of the A429 (the only priority junction at the roundabout) experience average savings during the PM peak of over 2 minutes due to the reduction in conflicting traffic making it easier for traffic to join the circulatory carriageway.

Safety

- Analysis of collision data has revealed an annual collision saving of 0.9 collisions per annum across the scheme key links analysis area (when compared to the scheme counterfactual in order to account for the background reduction in collisions). No fatal or serious collisions have taken place on either the M40 Junction 15 roundabout or the southern connection roundabout during the post-opening period.

- The observed reduction in the average annual number of collisions is not statistically significant. Therefore, the observed reduction in the number of collisions cannot be not directly attributed to the scheme measures.

- However, there has been a reduction the number of incidents involving vehicles making a ‘poor turn or manoeuvre’ has decreased by an average of 1.0 collisions per annum which suggesting that the junction has reduced certain types of collisions.

- The implementation of an underpass at the southern connection roundabout near Sherbourne is likely to improve security for a small number of pedestrian users by reducing the conflict between vehicles and pedestrians.

Environment

- Traffic levels are significantly lower than predicted at FYA, on which basis it is likely that noise levels were better (lower) than expected. Only the east-bound M40 off-slip is likely to be worse than expected, although there are no sensitive receptors nearby.

- Traffic levels are significantly lower than predicted at FYA, on which basis it is likely that air quality was better than expected.

- The AST predicted an increase in CO_2 levels with the development of the scheme. However, at FYA, a decrease in CO_2 levels has been calculated with benefits from reduced congestion at M40 Junction outweighing the increases in CO_2 resulting from traffic travelling at high speeds along the bypass.

- The scheme was built as designed, including mitigation, and planting was generally established although has been somewhat patchy.

- Given the landscape planting has been implemented as planned and is generally establishing sufficiently, and the recent publication of archaeological findings, the impact on heritage is deemed to be as predicted, slight adverse.

- The scheme and mitigation has been implemented as expected, including wetland habitat, mammal ledges and mitigation planting. Consultation revealed concerns from the county ecologist regarding lapwing, and Sherbourne Parish Council regarding birds and bats. The conclusion was that the scheme remains “slight adverse” overall for biodiversity as expected.

Accessibility

- The implementation of a new underpass leading under the Sherbourne roundabout has had a beneficial impact for a small number of non-motorised users (NMUs). Furthermore, improvements made to the bus stop on the A46 near Sherbourne improves access to local services.

Integration

- The scheme generally aligns with national, regional and local policies, delivering improvements to transport efficiency as well as improving safety conditions and improving access for a small number of pedestrians and cyclists.

Summary of Scheme Economic Performance

All in 2002 prices, discounted to 2002		Forecast Central Growth	Outturn
Present Value Costs (PVC)	Investment Cost	£57.0m	£60.1m
Present Value Benefits (PVB)	Journey time benefits	£232.2m	£127.54m
	Vehicle operating costs[1]	£5.0m	£5.0m
	Safety benefits[2]	£37.6m	-
	Construction maintenance and delay[3]	-£5.9m	-£5.9m
	PVB subtotal	**£268.9m**	**£126.6m**
	Indirect tax	£4.0m	£0.24m
Benefit Cost Ratio (with indirect tax in PVC)		**4.8**	**2.1**
Benefit Cost Ratio (with indirect tax in PVB)[4]		**5.1**	**2.1**

- Journey time benefits are lower than forecast. This is primarily due to traffic growth being lower than forecast due to the economic downturn. However, the scheme has still generated a significant journey time benefit.
- Safety benefits are not included in the BCR calculation because the benefits are not statistically significant and therefore cannot be directly attributed to the scheme measures.
- The cost of the scheme is 5% higher than forecast.
- The scheme represents good value for money despite the outturn BCR being lower than forecast (due to the lower benefits). The longer term benefits may be higher as post-recession traffic flows return to trend, hence the BCR of 2.1 is considered conservative.
- The scheme has not had any immediate discernible impact in terms of stimulating economic activity. However, improved infrastructure is likely to facilitate increased activity in the future.

[1] VOC assumed as forecast.
[2] Note that the outturn safety benefits are not included in the BCR calculation because the observed benefits are not statistically significant and therefore the benefit cannot be directly attributed to the scheme measures.
[3] Construction maintenance and delay assumed as forecast.
[4] 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, therefore two BCRs are presented here.

1. Introduction

Background

1.1. This report presents a Five Years after (FYA) opening evaluation of the M40 Junction 15 (Longbridge) Bypass, which opened to traffic in June 2010. The evaluation has been prepared as part of Highways England's Post Opening Project Evaluation (POPE) programme. The purpose of this report is to build upon the findings of the One Year After (OYA) report published in August 2012.

Scheme Context and Location

1.2. The M40 Junction 15 is located approximately 3.2km (approximately 1.9 miles) south of Warwick, Junction 15 is a grade separated junction where the M40 and the A46 intersect. The M40 is a strategic link within Highways England's core network, connecting the M42 (south-east of Birmingham) with the M25 (which encircles Greater London) to the south. Junction 15 is also of regional significance, particularly serving journey to work movements along several key routes including the A429, which offers a direct route from the centre of Warwick to the South West of England.

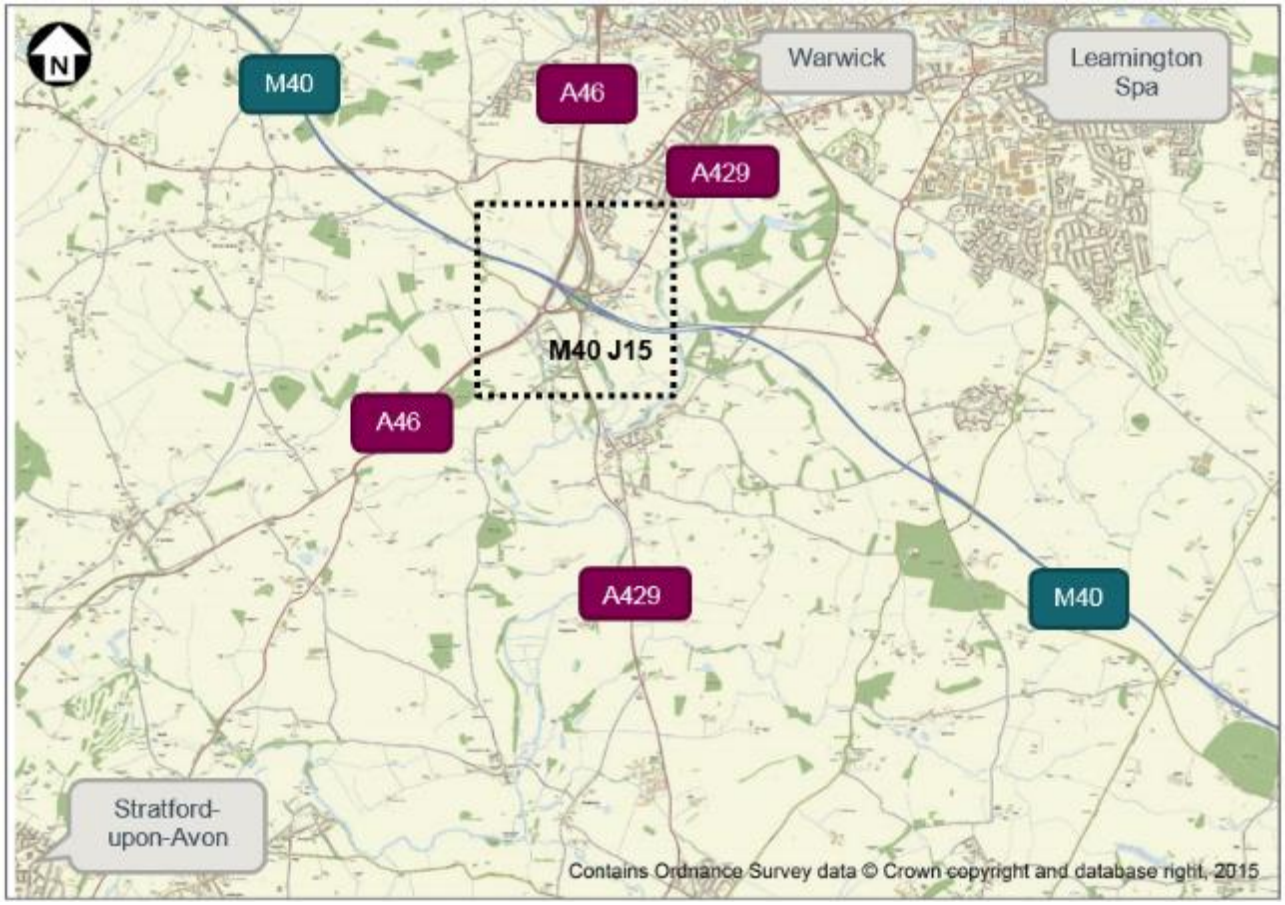
1.3. A key underlying trend in the transport context of the West Midlands region has been the reduced ability of the transport network to accommodate the demands placed upon it, resulting in an increased level of congestion on strategic transport corridors. Widespread congestion has a major impact on both business and the economy. Further problems include the increased risk of accidents and the diversion of traffic to local roads, resulting in a deterioration of conditions over a wider area.

1.4. Prior to scheme implementation, traffic along the A46 (the main trunk road linking Stratford-upon-Avon, Warwick and Coventry) experienced congestion and delays at Junction 15, which was considered unable to cope with the high volume of traffic passing through.

1.5. Traffic flows at M40 Junction 15 exceeded over 70,000 vehicles per day prior to scheme implementation, causing significant delays on the junction approaches especially during peak hour periods. Queues on the M40 exit slips extended back to the mainline carriageway and were considered dangerous given the increased potential for high-speed accidents. Congestion at the junction was also believed to result in considerable driver stress. Anticipated increases in future traffic levels were expected to exacerbate these problems, consequently, policy T12 of the West Midlands Spatial Strategy identified the scheme as a priority for investment.

1.6. The geographical location of the scheme in relation to the region and the surrounding highway network is illustrated in Figure 1-1.

Figure 1-1 Location of M40 Junction 15 (Longbridge) Bypass Scheme



Historical Context

1.7. Traffic issues associated with the M40 Junction 15 were first identified during the West Midlands Area Multi Modal Study which arose following the publication of "A New Deal for Trunk Roads in England" by the Department of Environment, Transport and the Regions' (DETR) in1998.

1.8. The M40 Junction 15 Longbridge Roads Based Study was published in September 2002 in order to present potential mitigation options. Three feasible options were identified:

- **Option A3**: A new off-line route for the A46, crossing a bridge over the M40 to the west of Junction 15 with local improvements to the Junction 15 roundabout;
- **Option A6**: A new alignment for the A46, passing beneath Junction 15 with local improvements to the roundabout at Junction 15; and
- **Option B1**: That the A46 would pass straight through the existing roundabout, with a new bridge provided to carry it over the M40 and with traffic signals provided at crossings with the roundabout. In addition, an A429 eastern bypass of the junction would be provided to assist local traffic as well as a link road to enable access to Junction 14 of the M40.

1.9. Following an Option Appraisal Report, Option A3 was selected as the preferred option given that it offered the best net present value (NPV) with significant time savings and low construction risks. This view was endorsed by the West Midlands Local Government Association in addition to a Wider Reference Group including representatives from relevant sectors and organisations within the West Midlands. Subsequently, this option was admitted to the Targeted Programme of Improvements.

Scheme Description

1.10. Construction of the M40 J15 (Longbridge) Bypass Scheme commenced in March 2008, the scheme opened to traffic on the 18th June 2010. The scheme was constructed in two separate phases, the work associated with each phase is presented in Table 1-1.

Table 1-1 M40 J15 (Longbridge) Bypass Construction Process.

Phase	Opening Date	Description of Works
Phase One	December 2009	Construction of the A46 bypass to allow vehicles travelling along the A46 to circumvent Junction 15 of the M40. The bypass is a dual carriageway, 1.8 miles (2.85km) in length, which connects the existing A46, north and south of the motorway. The northern connection of the bypass and the A46 Warwick Bypass is a two level free flow link. As part of this phase, a four span bridge was constructed to take the new dual carriageway bypass over the M40. The southern connection between the bypass and the A46 Stratford Road is a roundabout, which additionally provides access to the B4463 and the M40 Junction 15. The roundabout includes an unopposed segregated left turn from the bypass heading to Junction 15. Underpasses are also included to allow the safe movement of non-motorised users (NMU's) under the A46.
Phase Two	June 2010	Phase Two comprised of widening and upgrading of the existing M40 Junction 15 roundabout in order to relieve congestion at the junction. The junction was widened to four lanes, with improvements made to the roundabout approach arms. Unopposed segregated left turns were incorporated on the M40 eastbound off-slip, and from the southern arm of the A46 connecting to the M40 westbound on-slip. Traffic lights were installed on the approach, and signing, lining, road lighting and pavements were also updated in order to improve safety and driver understanding. Environmental works including earth mounding, noise fencing, landscaping and improved drainage measures to minimise the effects of the scheme on the surrounding area.

1.11. The key scheme measures are illustrated in Figure 1-2.

Figure 1-2 M40 J15 (Longbridge) Bypass Key Scheme Measures

Scheme History

1.12. A concise history of the events involved in the development of the M40 Junction 15 scheme are outlined in Table 1-2.

Table 1-2 M40 J15 Scheme Timeline

Date	Event
July 2003	Scheme enters Targeted Programme of Improvements*
May 2005	Contract tendered
Summer 2005	Ecological surveys (Discovery of bat roost on original alignment)
November 2005	Public information exhibition of revised scheme
July 2006	Draft orders and Environmental Statement published
July 2006	Draft orders exhibition
March 2007	Public Inquiry
Spring 2007	Detailed design
March 2008	**Work commences on site**
December 2009	Phase One completion – scheme open to traffic
June 2010	**Phase Two completion – scheme completed**
August 2012	Post Opening Project Evaluation One Year After Report published

** Now known as Programme of Major Schemes*

Scheme Objectives

1.13. The objectives of the M40 Junction 15 Longbridge Bypass scheme are outlined in Table 1-3.

Table 1-3 M40 J15 (Longbridge) Scheme Objectives

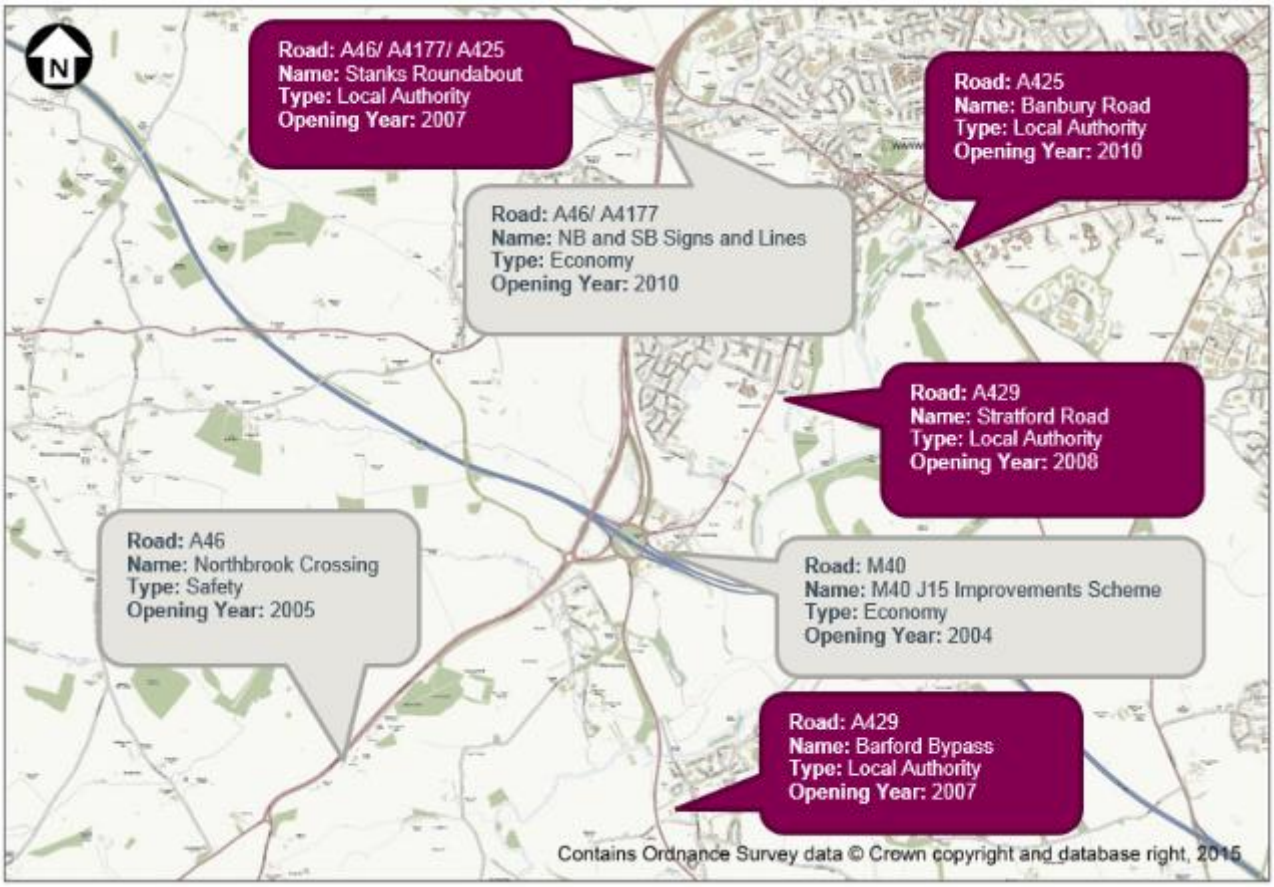
Objective (AST, 2006)	Description
Traffic/ Journey Times	To reduce congestion at M40 Junction 15 and improve travel times by reducing the amount of A46 traffic travelling through the junction.
Safety	To improve safety for road users at the junction through the various improvements to the roundabout

1.14. All potential impacts of the scheme are considered in the Appraisal Summary Table (see Table 7-1).

Local Network Supply and Demand Changes

1.15. Other Highways England and/or local authority schemes implemented in proximity of M40 J15 are included here as these may have had an impact on traffic flows in the vicinity of the scheme. Descriptions are provided for each scheme whilst the locations are displayed in Figure 1-3. In addition, changes to land use in the vicinity of the scheme are documented as these may also have had an impact on local traffic levels.

Figure 1-3 Highways England and Local Authority Network Schemes in the vicinity of M40 Junction 15 (Longbridge)



M40 J15 Improvements Scheme

1.16. Interim improvements were made to Junction 15 of the M40 in 2004 under the M40 J15 Improvements Scheme. This scheme involved three main components:

- Installation of MOVA (Microprocessor Optimised Vehicle Actuation) signal control – in order to optimise the allocation of green time for key movements in response to changing traffic flows on approach to the junction.
- Installation and renewal of junction signing and lining – to improve safety as a result of better lane discipline on the approaches and circulatory carriageway of the roundabout.
- Carriageway resurfacing and localised lane widening – to enhance the condition of the road surface and junction capacity (specifically on the circulating carriageway).

1.17. Outturn costs for the scheme totalled £3.2 million (2002 prices). Post-scheme evaluation revealed overall delay savings at the junction during peak periods leading to projected monetary benefits of £0.480m (significantly lower than expected) over a 6 year design life prior to the implementation of phase 2 of the bypass scheme. In addition, the scheme received an anticipated accident saving of 16.8 incidents over 6 years, equating to a monetary benefit of £1.25m.

1.18. It is important to note that in order to account for the impact of the junction improvements scheme, post-scheme evaluation of the accident rates for the M40 Junction 15 Bypass scheme will only use pre-scheme accident data from 30th September 2004 to 16th March 2008 (following the completion of the improvements scheme).

Other Highways England Schemes

1.19. The A46 Northbrook Crossing Scheme was implemented to the south of the M40 J15 scheme and involved the separation of the existing central reserve safety fence barrier to provide a crossing point for pedestrians. It is not expected that this scheme would have had an impact on traffic flows at M40 J15.

1.20. To the north of the scheme, the A46/A4177 northbound (NB) and southbound (SB) Signs and Lines Scheme opened during 2010 to improve journey time reliability on the A46. Main works included provision of lane drop signs and road markings, reducing the existing A46 on-slips at this junction from two lanes to one in order to reduce delays caused by vehicles merging too early with the mainline carriageway. It is not considered that this scheme has had an impact on observed traffic volumes at the M40 J15 scheme.

A429 Barford Bypass

1.21. The A429 Barford Bypass scheme was implemented by Warwickshire County Council (WCC) to divert through traffic (particularly heavy goods vehicles) away from the historic village of Barford. Works on the scheme commenced during February 2006 and completed in May 2007. The scheme involved the construction of a 2.1km single carriageway lying to the west of Barford village with 3 embankments and a 4 span steel beam and concrete deck bridge (spanning over the River Avon) being implemented along the length of this link.

1.22. A flood compensation area, 4 precast concrete box flood culverts and an additional flood culvert under the existing A429 causeway were also provided, along with a comprehensive landscaping programme.

1.23. It seems possible that this scheme may influence traffic levels on the A429 to the south of M40 J15 due to the likely improvements to journey time and route reliability.

Other Local Authority Network Schemes

1.24. There are three further local authority network schemes which were introduced in the vicinity of the scheme.

1.25. The A425 Banbury Road/ Heathcote Lane scheme and the A429 Stratford Road scheme were both referenced in the Warwickshire Local Transport Plan (LTP). Both schemes were implemented in conjunction with the M40 J15 (Longbridge) Bypass Scheme. It is possible that these schemes may have had a small influence on observed traffic counts on the A46.

1.26. Works on the A429 Stratford Road scheme were completed in 2008 and involved the widening of Stratford Road to create back to back ghost islands for right turning traffic accessing a residential development located on the western side of the road. This scheme is not expected to have any major impacts on traffic flow.

1.27. The A425 Banbury Road/Heathcote Lane scheme involved the construction of a new traffic signals control system at the junction to the south of Tollgate Cottage, with a new link road constructed across the field behind the cottage. Completed in June 2010, the scheme was expected to be of particular benefit for those seeking to access Warwick Technology Park as well as local residents.

Land Use Changes

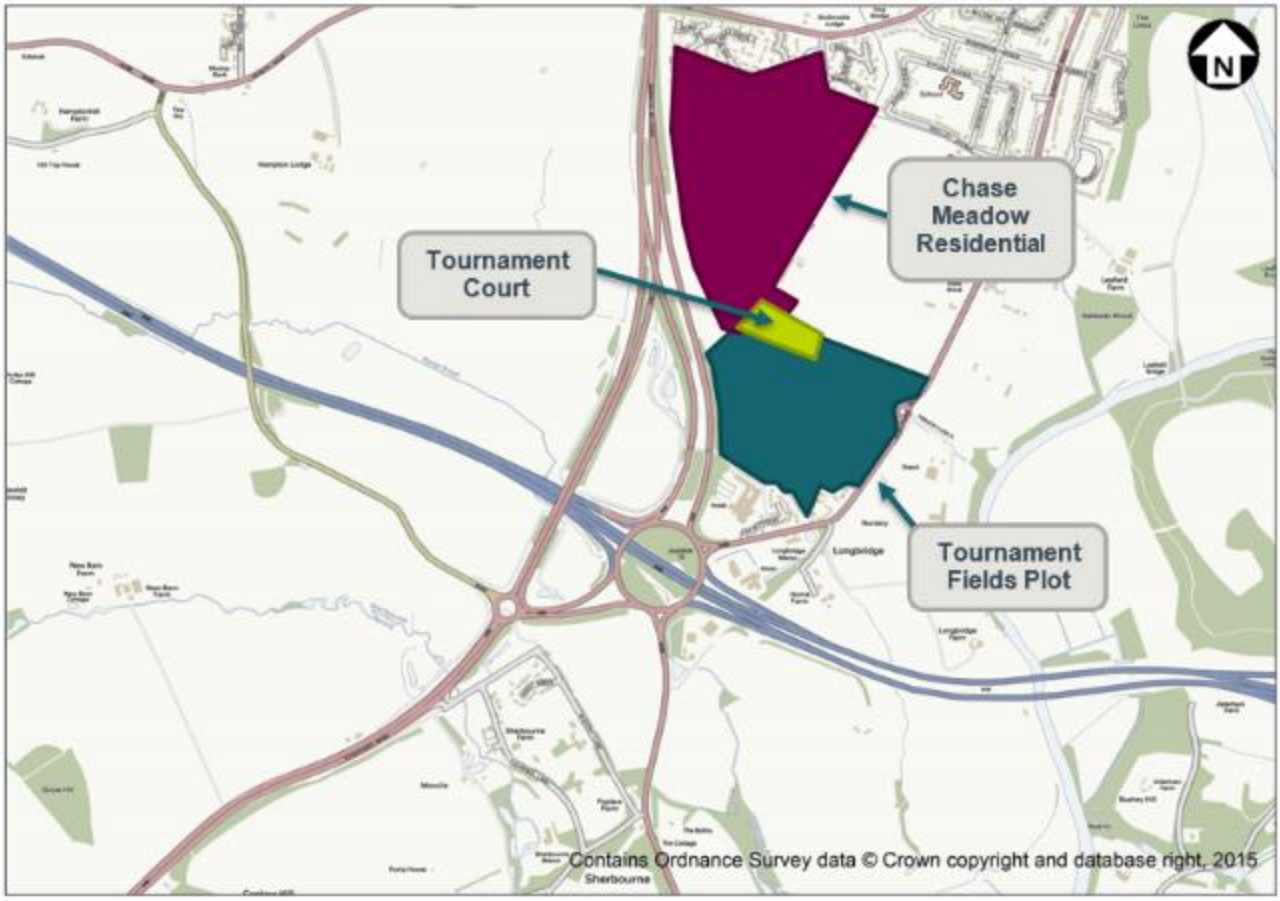
Tournament Fields and Chase Meadow

1.28. As identified within the OYA report, the most significant developments completed during the assessment period in terms of traffic flows at Junction 15 of the M40 were the Tournament Fields Business Park and the neighbouring Chase Meadow residential development. Both developments are located to the North East of M40 Junction 15, with vehicular access via the A429 (approximately 0.8km from the motorway junction). The location of the Tournament Fields Business Park and Chase Meadow Development is identified in Figure 1-4.

1.29. The Tournament Fields site encompasses an area of approximately 216,000 square metres (sqm). The first phase of the project involved the construction of 21,300sqm of office space known as the Tournament Court development. This site was fully occupied at OYA (as confirmed during a site visit undertaken in 2011), with occupiers moving in to the site from March 2007 onwards. An additional 3,850sqm two-storey headquarters office was constructed for Geberit (a Swiss sanitary ware company). A site visit undertaken in September 2015 confirmed that two further Grade A office developments have been constructed since the OYA report was published. These include a 1,900sqm three storey business centre facility completed by Pure Offices, and a 1,400sqm office and R&D workshop facility for Eagle Burgman (Supplier of Industrial Sealing Technology). The Tournament Fields site still has over 113,000sqm of land remaining for further development.

1.30. The Chase Meadow housing development was originally expected to consist of a total of 1,100 dwellings once completed, however data provided by WCC at OYA indicated that only approximately 800 dwellings had been completed by 2011. A site visit undertaken in September 2015 confirmed that no additional residential development has been constructed at Chase Meadow since OYA and that the development is now complete.

Figure 1-4 Location of Tournament Fields and Chase Meadow Developments



Summary of the M40 Junction 15 (Longbridge) Bypass One Year After (OYA) Opening Study

1.31. The purpose of the FYA study is to verify and study in more detail the emerging trends and conclusions presented in the OYA study report. The main conclusions made in the M40 Junction 15 (Longbridge) OYA study report were as follows:

- The Forecast levels of traffic growth were over-estimated by more than 40% along the scheme bypass and at M40 Junction 15. This is owing to two key assumptions: firstly the forecast models were unable to account for the impacts of the economic recession; secondly the forecast level of development at the Tournament Fields/Chase Meadow site to the north of M40 Junction was considerably over-estimated compared to the level of development that actually occurred.

- The scheme bypass successfully diverted 16% of traffic away from M40 Junction 15 during the opening year period, with 23,600 vehicles using the new link on an average weekday. This resulted in journey time savings for the vast majority of vehicles.

- Vehicles which used the scheme bypass experienced the greatest time savings per vehicle, however in terms of total savings, the majority of time benefits were accrued through reduced congestion at M40 Junction 15. This observation may change should traffic levels increase to those forecast.

- Forecast accident savings for the scheme opening year were considered overly optimistic as they were based on savings over a wider study area. The POPE evaluation provided a conservative assessment, only considering the scheme impact on the accident rate within the immediate scheme area, however this still demonstrated an accident saving of 7 accidents per annum in the first year of opening.

- Monetary benefits were significantly lower than expected, with the outturn present value benefits only reaching £145.3 million compared to a forecast value of £263.9 million. This is primarily owing to the over-estimated levels of traffic growth.

- Lower than forecast traffic flows suggested that the scheme impact on various environmental issues was not as severe as forecast, but this view was not discussed with parish councils.

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

Post Opening Project Evaluation

Highways England Appraisal Process

1.33. Highways England is responsible for improving the strategic highway network (motorways and trunk roads) through the Major Schemes programme. At each key decision stage through the planning process, schemes are subject to a rigorous appraisal process to provide a justification for the project's continued development. 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 five objectives have been achieved[5]. The AST for this scheme is presented in Table 7-1.

Post Opening Project Evaluation

1.34. POPE studies are undertaken at two stages after all Major Schemes have opened: one year after scheme opening and five years after scheme opening. The purpose of POPE studies is to document outturn impacts and evaluate the strengths and weaknesses of the techniques used for appraising schemes, so that informed improvements can be made to the appraisal process in the future. This is achieved by comparing information collected before and after the opening of the scheme against predictions made during the planning process. The outturn impacts of a scheme are summarised in an Evaluation Summary Table (EST) which summarises the extent to which the objectives of a scheme have been achieved. The EST for this scheme is presented in Table 7-2.

Report Structure

1.35. Following this introduction, the remainder of this report is structured as follows:

- **Chapter 2 – Traffic Impact Analysis**
- **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**

[5] In recent years these have changed, but the evaluation of this scheme in this study will use those defined at the time of its appraisal, namely Environment, Safety, Economy, Accessibility and Integration.

2. Traffic Impact Analysis

Introduction

2.1. This section analyses both pre-scheme and post-scheme traffic data in order to compare the traffic growth on key links around the scheme with the forecast levels of growth. This section also considers the changes in journey times on key links surrounding the M40 J15 (Longbridge) scheme.

2.2. This chapter comprises:

- An evaluation of national, regional and local trends in background traffic;
- A summary of the sources used to compile data for this evaluation;
- A detailed comparison of pre scheme, OYA and FYA traffic flows in addition to the changes in journey times on the key routes in the study area likely to be affected by the scheme; and
- An evaluation of the key differences between forecast and outturn impacts of the scheme with regards to traffic flows and journey times.

Background Changes in Traffic

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

2.4. However, in light of the recent economic climate which has coincided with a widespread reduction in motor vehicle travel in the United Kingdom as a whole since 2008, it is no longer deemed appropriate to use this method of factoring to reflect background changes in traffic. Rather, recent POPE studies have taken a more considered approach in order to assess the background traffic changes in the vicinity of the scheme, within the context of national, regional and local observed background changes in traffic.

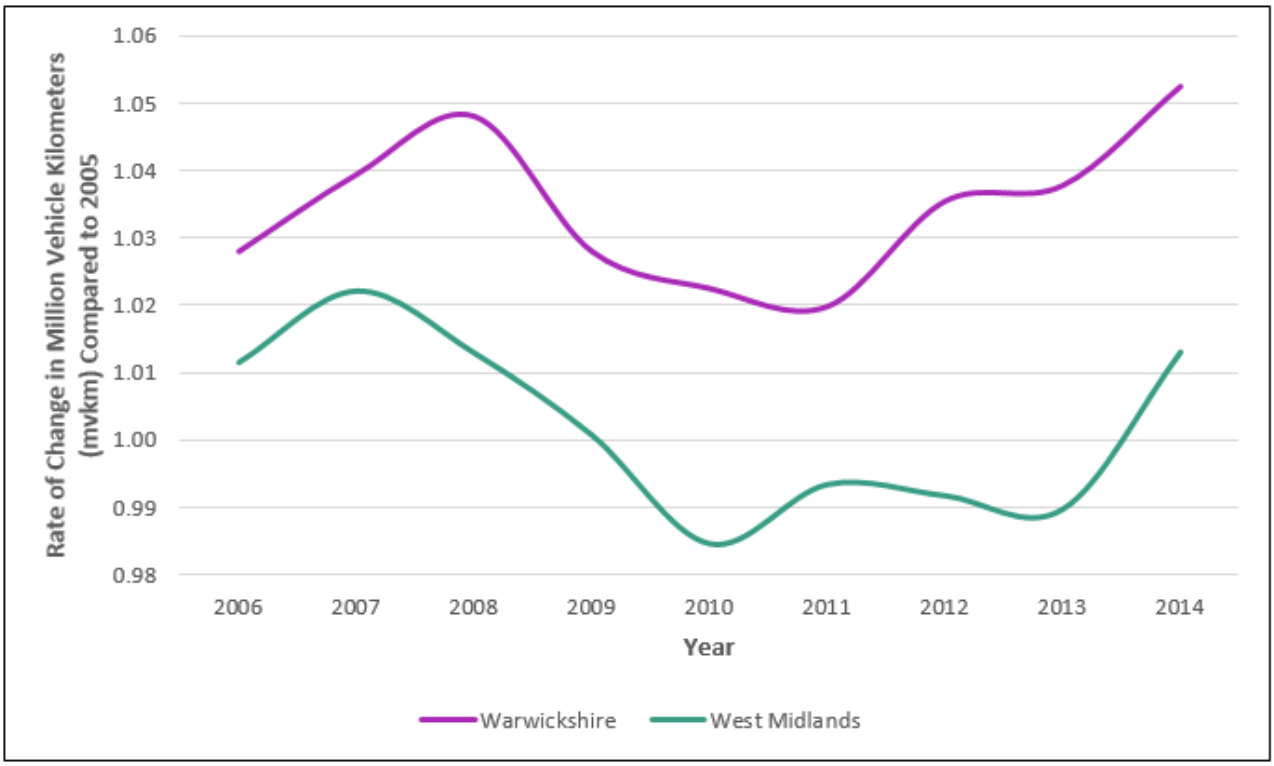
Local, Regional and National Trends

2.5. The Department for Transport (DfT) produces observed annual statistics for all motor vehicles by local authority and road type[6]. Figure 2-1 presents the rate of change in Million Vehicle Kilometre Miles (MVKM) travelled compared to 2005 (pre-scheme) up to 2014 (the latest data available) across Warwickshire and the West Midlands.

2.6. Figure 2-2 presents nationally observed trends in the rate of change compared to 2005 in MVKM for 'Rural A Roads', 'All A Roads' and 'Motorways'.

[6] *Motor vehicle traffic (vehicle kilometres) by region in Great Britain, annual from 1993 to 2014. Table TRA8904 (Department for Transport; accessed December 2015).*

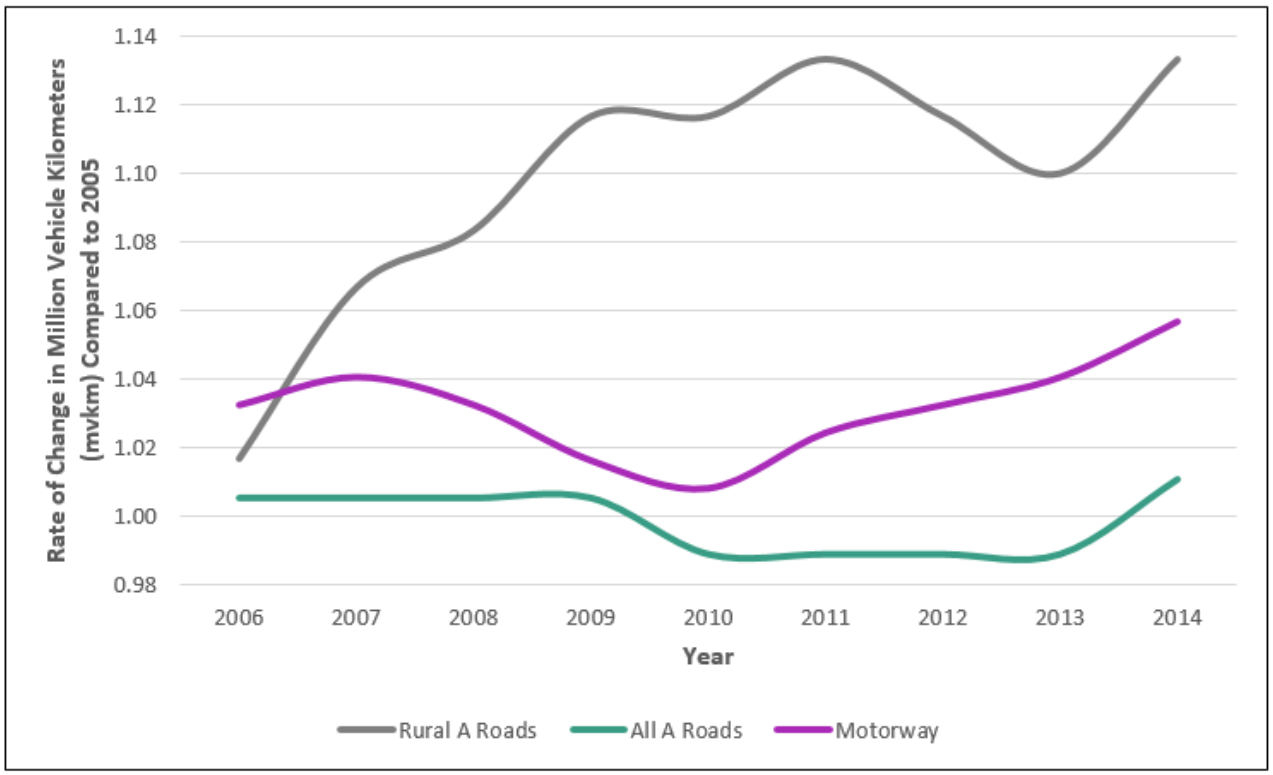
Figure 2-1 Regional and Local Observed Vehicle Kilometre Rate of Change Compared to 2005



2.7. The regional and local trends outlined in Figure 2-1 demonstrate that the change in mvkm travelled within Warwickshire is reflective of the regional changes in mvkm travelled within the West Midlands. The data demonstrates that in relation to 2005, the total number of mvkm travelled within Warwickshire increased between 2006 and 2008 before falling between 2008 and 2011. The decline in mvkm travelled between 2008 and 2011 coincides with the economic recession. However, during the period between the OYA (2012) report and the FYA assessment (2016), there is a gradual increase in mvkm travelled across Warwickshire and the West-Midlands year on year.

2.8. Overall, it is evident that there has been a slight increase between 2005 and 2014 with traffic levels only just recovering to pre-2008 levels in 2014.

Figure 2-2 Nationally Observed Vehicle Kilometre Rate of Change Compared to 2005



2.9. The following observations can be made from Figure 2-2:

- The national trends outlined in Figure 2-2 demonstrate that the rate of change in mvkm travelled on 'Rural A roads' increased by over 10% from 2005 to 2014.
- The number of vehicle kilometres travelled on 'All A Roads' has remained relatively constant between 2005 and 2014, with traffic flows in 2014 similar to those in 2005.
- National trends demonstrate that traffic levels on motorways are 6% higher in 2014 compared to 2005, having experienced a reduction between 2008 and 2010 perhaps as a result of the economic recession.

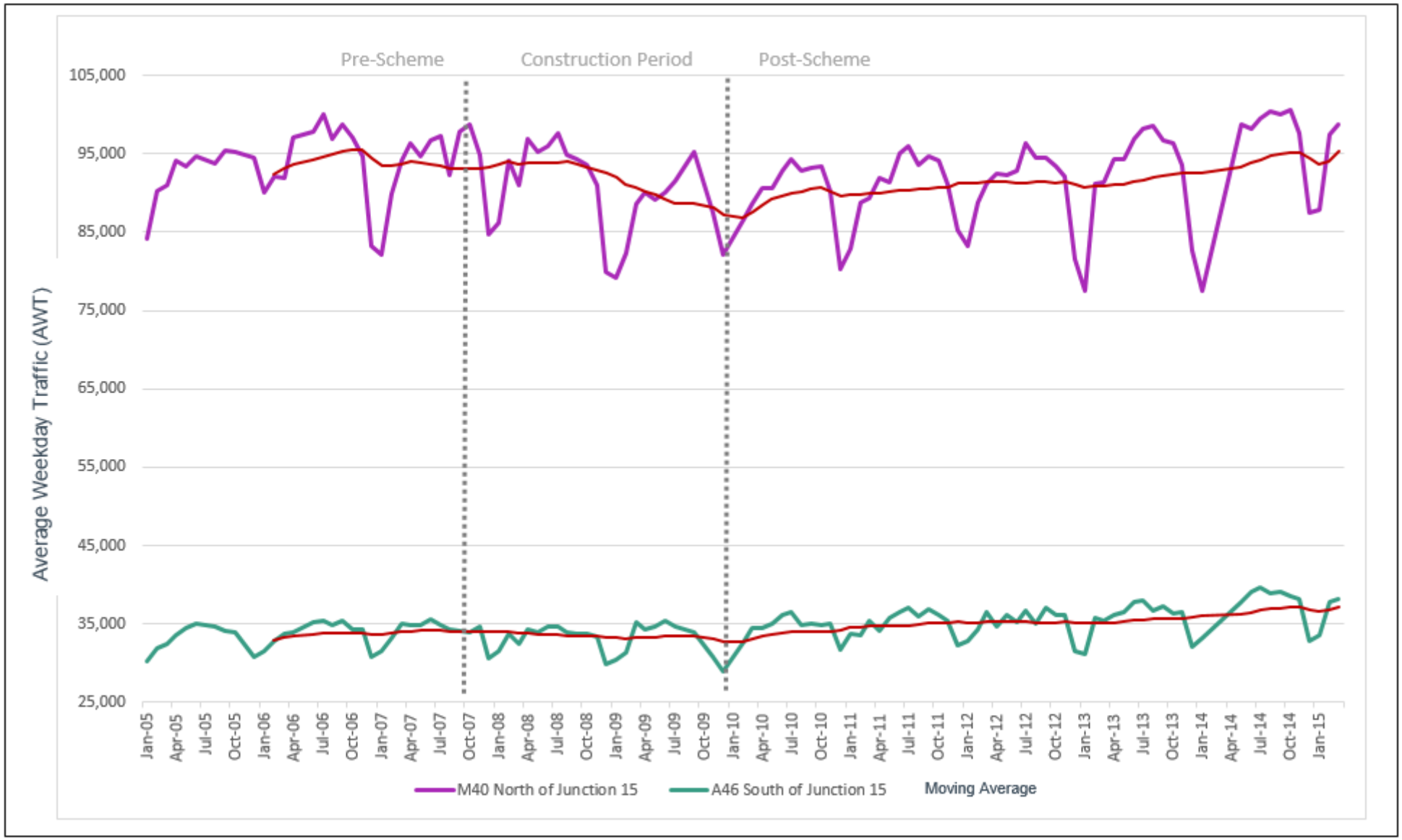
Long Term Traffic Trends

2.10. In order to comprehend the historical fluctuations within annual traffic flows, the two-way Average Weekday Traffic (AWT) flows at M40 J15 and the A46 Warwick Bypass are outlined in Figure 2-3. The trends have been presented for the Pre-Scheme, Construction and Post-Scheme periods.

2.11. The following observations can be made from Figure 2-3:

- Overall, the two-way AWT flows along the M40 carriageway north of J15 have remained fairly consistent between 2005 and 2015.
- Traffic flows along the A46 have increased gradually between 2005 and 2015, with an increase of approximately 4% in two-way AWT flows.
- Since the M40 J15 scheme opened in June 2010, the A46 Warwick Bypass has experienced an increase in traffic volumes of approximately 1,980 vehicles a day (5%).
- This section of the M40 has experienced an overall increase in traffic volumes since the M40 J15 scheme opened in June 2010. This is reflective of the nationally observed trends in mvkm travelled on Motorways, with traffic volumes decreasing between 2009 and 2010, before starting to increase steadily between 2011 and 2014.
- Both the A46 and the M40 experience strong seasonality in traffic volumes. The lowest traffic volumes are observed between December and January, whilst traffic volumes peak between July and August. This trend is observed in both the pre-scheme and post-scheme periods.

Figure 2-3 Historic Profile of Average Weekday Traffic along the M40 J15 and the A46 Warwick Bypass



Summary on Background Changes in Traffic

2.12. It is important to consider the trends in national, regional and local traffic volumes in order to determine the impact of the scheme measures on the local network. Based on the information presented within this section, it has been considered that no annual growth factors should be applied to the data presented within this report because AWT flows along the A46 (south of Junction 15) and the M40 carriageway (north of Junction 15) have remained fairly consistent between 2005 and 2015. However, it is also important to note that any increase in vehicle flows of up to 5% could potentially be attributed to the background growth in mvkm travelled across Warwickshire rather than the scheme measures.

2.13. Considering that the pre-scheme count data was collected in July 2005 and post-scheme surveys were commissioned in October 2015, it has been necessary to account for seasonality.

Traffic Volume Analysis

Data Sources

2.14. This section uses a variety of data sources to inform the before and after analysis of changes in traffic volumes and journey times for the M40 J15 scheme. In order to complete this evaluation, data has been compared from the pre-scheme (2005), post-scheme OYA (August 2012) and post-scheme FYA (October/ December 2015) periods. Both the pre-scheme and post-scheme data has been collected on neutral days to avoid the impact of holiday/seasonal traffic along the M40 as identified in Figure 2-3.

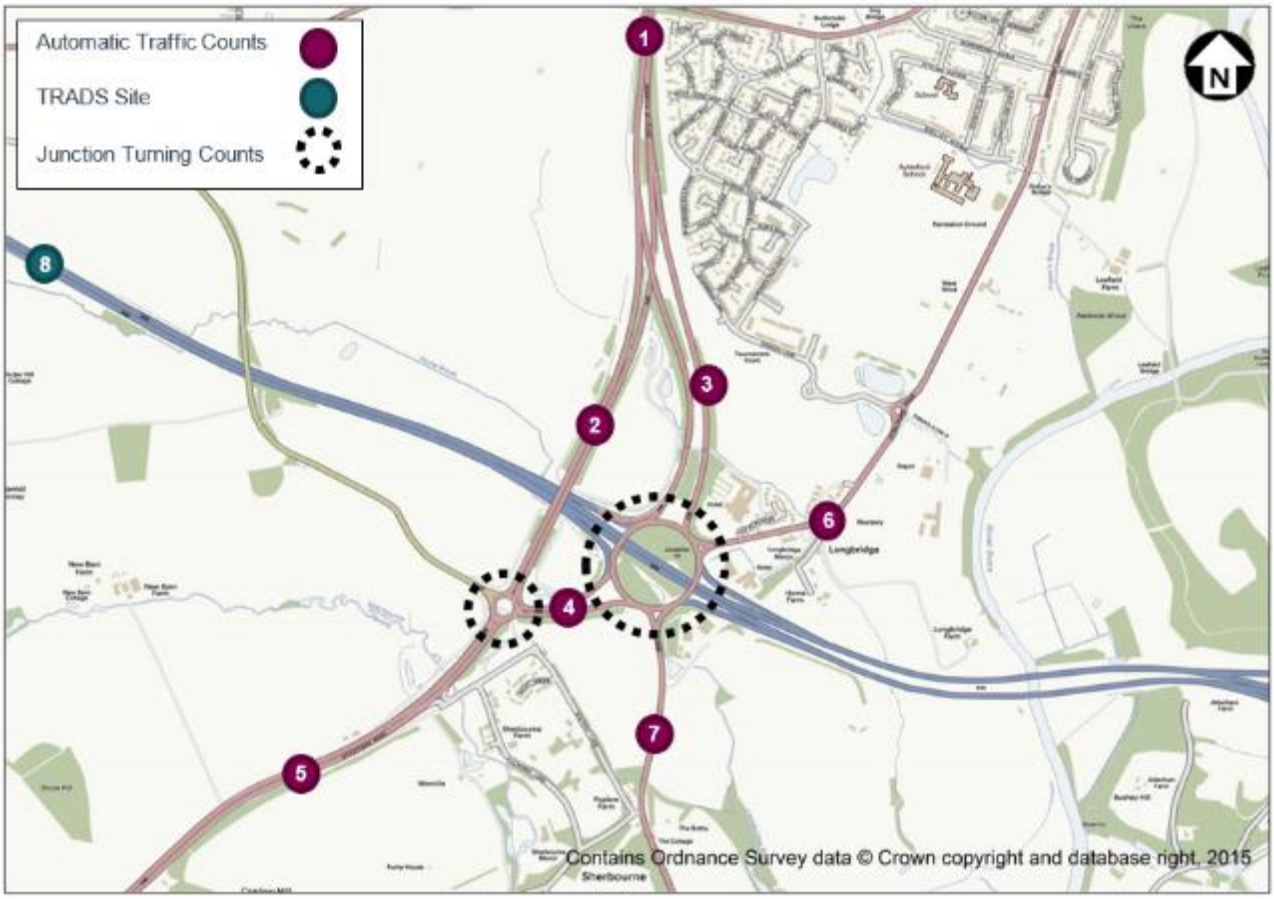
Traffic Count Data Sources

2.15. For the purpose of this evaluation study, the following sources of traffic data have been used:

- Permanent traffic count data obtained from the TRADS database for count locations on Highways England's network at Pre-scheme, OYA and FYA.
- Temporary Automatic Traffic Count (ATCs) sites were commissioned in seven locations at Pre-scheme, OYA and in October 2015 (FYA).
- Temporary Junction Turning Count (JTCs) data sites were commissioned in two locations at Pre-scheme, OYA and in October 2015 (FYA).

2.16. The locations of the traffic count data sites used in this evaluation are summarised in Figure 2-4.

Figure 2-4 Traffic Count Locations



Observed Flows

2.17. Observed two-way Average Annual Weekday Traffic (AAWT) flows and Average Annual Daily Traffic flows for the M40 J15 scheme area are displayed in Figure 2-5.

- On the A46 to the north of Junction 15 (site 1), two-way AWT flows have increased by approximately 13% (7,100 vehicles) between the pre-scheme and FYA periods. This is 10% higher than the difference between the pre-scheme period and the OYA observed AWT flows. Additional traffic flows along the A46 could be a result of induced traffic capitalising on the scheme benefits outlined at OYA.

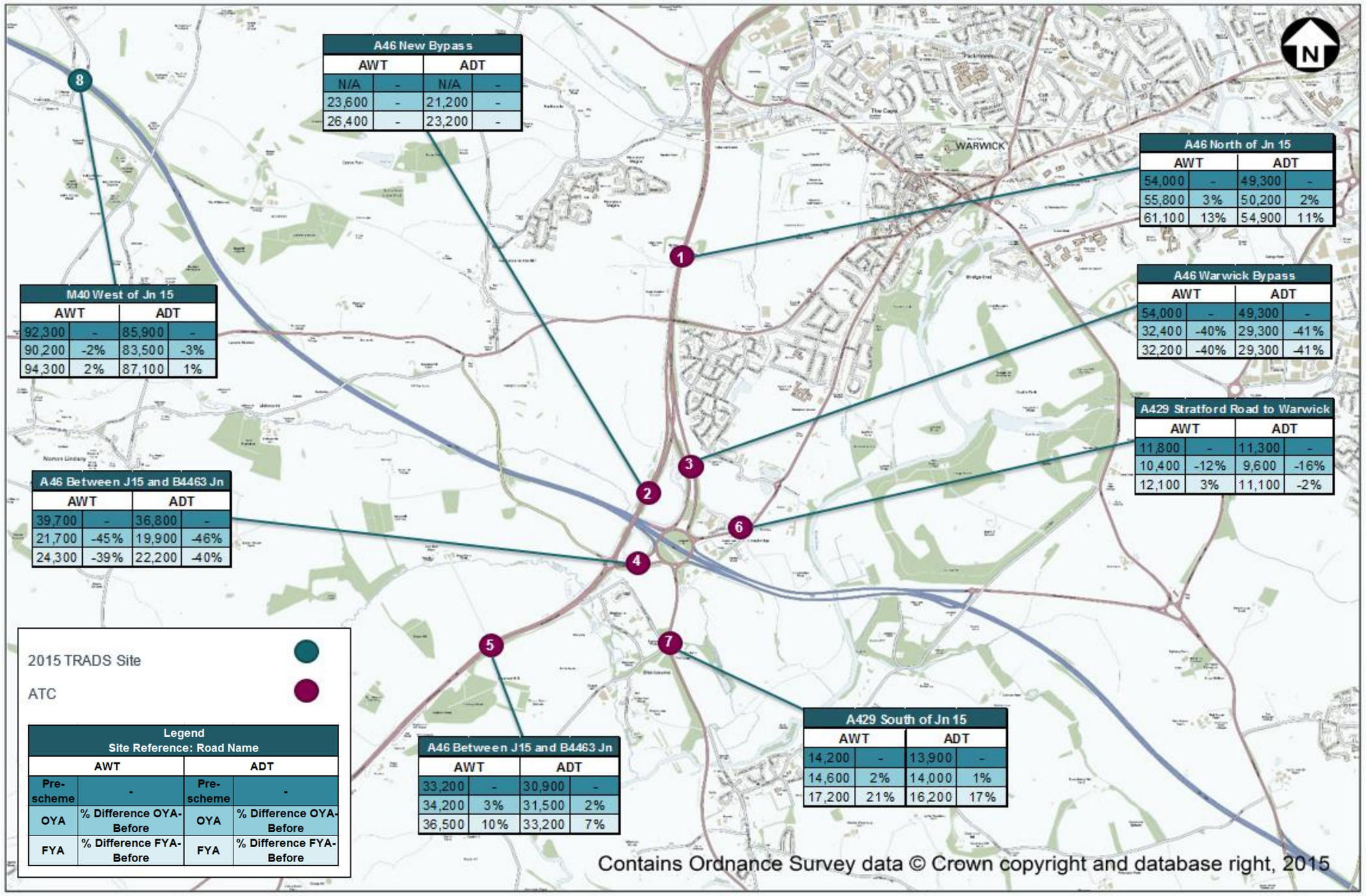
- The two-way AWT flows along the A46 Warwick Bypass (site 3) have reduced by approximately 21,800 (-40%) between the pre-scheme and FYA periods. In comparison, the two-way AWT flows along the A46 new bypass (Site 2) have increased by 2,800 vehicles to 26,400 between OYA and FYA (an increase of 12%). The increase in traffic flows along the new A46 Warwick bypass (site 2) is likely to be caused by a combination of induced traffic capitalising on the journey time benefits demonstrated at OYA encouraging drivers to use the quicker less-congested route, and/or a change in driver behaviour with more vehicles now familiarised with the new layout and operation of the junction five years after the scheme opened. However, once again it is important to consider that up to 5% of the growth along the new A46 bypass could potentially be attributed to the background growth in mvkm travelled across Warwickshire rather than the scheme measures.

- Between OYA and FYA, the two-way AWT flows on the A46 link road between M40 J15 and the southern connector roundabout (site 4) increased by 2,600 vehicles. When considering this increase in conjunction with the increased traffic flows along the new A46 Warwick bypass (Site 2) it suggests that an increased number of vehicles are utilising the unopposed left-turn link at the southern connector roundabout to access the M40 westbound carriageway.

- The OYA report suggested that the M40 J15 scheme had diverted a proportion of the existing traffic away from the A429 to the north of Junction 15, with a 12% reduction seen in average weekday traffic (approximately 1,400 vehicles) between the pre-scheme period and the OYA period (Site 6). The OYA report indicated that vehicles using the A46 to the south of Junction 15 were potentially using the new A46 bypass and entering/leaving Warwick town centre via the A46/A4177 junction to the north of Junction 15 rather than via the A429. However, the two-way AWT flows along the A429 (site 6) increased by approximately 1,700 vehicles between the OYA and FYA assessment periods with traffic volumes now above pre-scheme levels on this link. A proportion of the additional traffic using the A429 at FYA could be attributed to the additional 3,300sqm of Grade A office development constructed at the Tournament Fields site (as identified in Section 1).

- The two-way AWT flows along the A46 Stratford Road, south of the southern connector roundabout (site 5), have increased by 10% (approximately 3,300 vehicles) between the pre-scheme and FYA assessment periods. Additionally, the two-way AWT flows along the A429, south of M40 J15 (site 7), have increased by approximately 3,000 (21%) vehicles between the pre-scheme and FYA assessment periods. Further analysis identified that a significant proportion of the additional traffic along the A429 and the A46 was generated within the AM and PM peak hours, indicating that the additional demand is generated by commuter trips.

Figure 2-5 Observed Two-way AWT and ADT Flows in Vicinity of M40 J15 Scheme[7] [8]



[7] All flows are rounded to the nearest 100.
[8] Adjusted for Seasonality

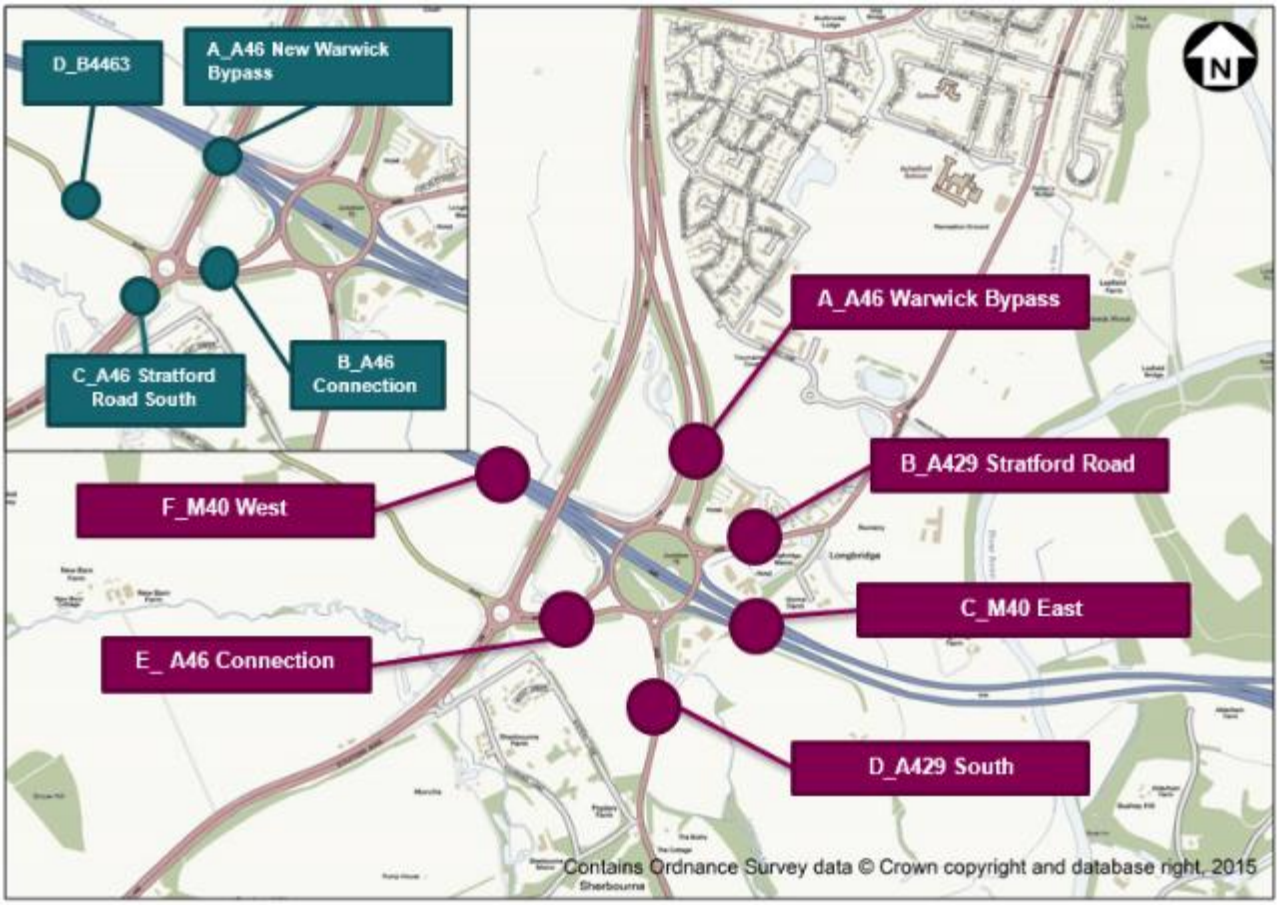
Classified Turning Count

2.18. In order to further comprehend the changes in vehicle flows outlined above, and to demonstrate the impact of the M40 J15 bypass scheme on vehicle flows it is important to analyse changes in specific turning movements at Junction 15 in addition to turning movements at the new southern bypass connection. The turning movements outlined in this section of the report are presented as 12-hour flows only.

2.19. It is important to note that the classified turning counts presented within this section of the report represent traffic flows on a neutral weekday for both the pre-scheme and post-scheme periods. This is sufficient to determine the primary movements at both the M40 J15 junction and the new bypass connection.

2.20. The turning movements outlined within this chapter refer to the naming conventions defined in Figure 2-6.

Figure 2-6 Classified Turning Count Junction Naming Convention



Classified Turning Count at M40 Junction 15

2.21. A comparison of 12-hour classified turning movements at M40 Junction 15 is presented in Table 2-1 for both the pre-scheme and post-scheme (FYA) assessment periods.

Table 2-1 Comparison of 12-Hour Classified Turning Movements at M40 J15[9] [10]

From	To	Pre-scheme (2005)	Post-scheme FYA (2015)	% Change (2005-2015)
A_A46 Warwick Bypass	B_A429 Stratford Road	700	1,400	86%
A_A46 Warwick Bypass	C_M40 East	7,600	7,300	-7%
A_A46 Warwick Bypass	D_A429 South	1,800	3,100	67%
A_A46 Warwick Bypass	E_A46 Connection	7,000	200	-97%
A_A46 Warwick Bypass	F_M40 West	2,100	100	-95%
B_A429 Stratford Road	C_M40 East	1,000	1,000	-10%
B_A429 Stratford Road	D_A429 South	1,300	600	-54%
B_A429 Stratford Road	E_A46 Connection	1,400	1,600	14%
B_A429 Stratford Road	F_M40 West	600	1,000	50%
B_A429 Stratford Road	A_A46 Warwick Bypass	200	700	250%
C_M40 East	D_A429 South	300	500	67%
C_M40 East	E_A46 Connection	4,400	5,700	27%
C_M40 East	A_A46 Warwick Bypass	7,700	8,100	1%
C_M40 East	B_A429 Stratford Road	100	200	100%
D_A429 South	E_A46 Connection	300	600	67%
D_A429 South	F_M40 West	2,000	2,400	15%
D_A429 South	A_A46 Warwick Bypass	2,100	3,700	71%
D_A429 South	B_A429 Stratford Road	500	500	0%
D_A429 South	C_M40 East	300	200	-33%
E_A46 Connection	F_M40 West	1,500	5,300	247%
E_A46 Connection	A_A46 Warwick Bypass	7,700	10	-100%
E_A46 Connection	B_A429 Stratford Road	2,800	1,900	-32%
E_A46 Connection	C_M40 East	2,600	4,800	77%
E_A46 Connection	D_A429 South	100	200	100%
F_M40 West	A_A46 Warwick Bypass	3,100	4,100	29%
F_M40 West	B_A429 Stratford Road	500	1,700	220%
F_M40 West	D_A429 South	1,600	2,400	50%
F_M40 West	E_A46 Connection	1,600	800	-50%

2.22. The following observations can be made from Table 2-1:

- There has been an 11% (approximately 5,700 vehicles) increase in the number of vehicles using the M40 J15 roundabout over a 12-Hour period when comparing the FYA assessment period to the OYA period. It is important to consider that a proportion of this increase could be attributed to the background growth in mvkm travelled across Warwickshire rather than the scheme measures. In order to determine the impact of the additional vehicle flows on the journey time benefits, journey time analysis will be presented later on within this report in order to determine the impact of the additional traffic flows on journey time benefits and journey time reliability in vicinity of the scheme.

[9] Adjusted for Seasonality
[10] All flows are rounded to the nearest 100.

- The number of vehicles accessing the M40 West via the A46 Warwick Bypass has decreased by 95% between the pre-scheme and FYA assessment periods (approximately 2,000 vehicles). This is in accordance with the trends acknowledged within the analysis of the AWT flows, which identified an increase in the volume of traffic along the new A46 bypass. The number of vehicles making the turning movement from the new A46 connection to the M40 West has increased by approximately 3,800 vehicles (247%), indicating that a significant proportion of vehicles are now accessing the M40 carriageway via the new A46 Warwick bypass.

- This change in vehicle behaviour was clarified during an inception meeting with Highways England in September 2015, when the project sponsor confirmed that there has been a change in driver behaviour within the vicinity of the scheme within the five year post-opening period. Initially a significant proportion of the existing traffic was diverted away from the existing A46 onto the new A46 Bypass, however there was still a proportion of the existing traffic negotiating Junction 15 (this was identified during the OYA assessment). The project sponsor suggested that this was a combination of both driver behaviour and a time lag between the implementation of the M40 J15 scheme and the update of personal Satellite Navigation Systems, resulting in vehicles being routed down the existing A46.

Classified Turning Count at A46 Bypass Roundabout

2.23. A comparison of 12-hour classified turning movements at the A46 Bypass Roundabout are presented in Table 2-2 for both the OYA and FYA assessment periods. There has been no pre-scheme comparison.

Table 2-2 Comparison of 12-Hour Classified Turning Movements at A46 Bypass Roundabout[11] [12]

From	To	Post-scheme OYA (2011)	Post-scheme FYA (2015)	% Change (2011-2015)
A_A46 New Warwick Bypass	B_A46 Connection	3,200	3,800	19%
A_A46 New Warwick Bypass	C_A46 Stratford Road South	7,500	8,200	9%
A_A46 New Warwick Bypass	D_B4463	800	700	-13%
B_A46 Connection	A_A46 New Warwick Bypass	300	0	-100%
B_A46 Connection	C_A46 Stratford Road South	7,300	7,500	3%
B_A46 Connection	D_B4463	600	1,000	67%
C_A46 Stratford Road South	A_A46 New Warwick Bypass	7,300	7,800	7%
C_A46 Stratford Road South	B_A46 Connection	7,000	7,000	0%
C_A46 Stratford Road South	D_B4463	200	300	50%
D_B4463	A_A46 New Warwick Bypass	600	900	50%
D_B4463	B_A46 Connection	500	1,000	100%
D_B4463	C_A46 Stratford Road South	400	400	0%

2.24. The following observations can be made from Table 2-2:

- There has been an 8% (approximately 2,900 vehicles) increase in the number of vehicles using the A46 bypass roundabout over a 12-Hour period when comparing the FYA assessment period to the OYA assessment period.

[11] All flows are rounded to the nearest 100.
[12] Adjusted for Seasonality

- As discussed, the two-way AWT flows along the A46 connection road between M40 J15 and the southern connector roundabout increased by 3,400 vehicles between OYA and FYA. Additionally, approximately 3,800 vehicles made the movement from the new A46 scheme bypass to the A46 connection road within the 12-hour assessment period. This indicates that an increased number of vehicles are utilising the unopposed left-turn link at the southern connector roundabout to access the M40 westbound carriageway.

- As identified at OYA, a proportion of the existing traffic accessing the A46 Southbound via the A46 Northbound was now travelling along the new A46 scheme bypass. This trend has continued at FYA with the number of vehicles making the movement from the A46 North to the A46 South via the new bypass increasing by 9% (approximately 700 vehicles) and the number of vehicles making the movement from the A46 South to the A46 North increasing by 7% (approximately 500 vehicles). The OYA report indicated that induced traffic was using the new A46 bypass in order to capitalise on the faster, less congested route. The journey time analysis presented later on within this report will determine the impact of the additional traffic flows at FYA on journey time benefits along the new A46 bypass.

Forecast and Observed Traffic Impacts

2.25. The justification for the M40 Junction 15 Longbridge Bypass scheme was based on an appraisal of impacts carried out before construction. POPE methodology compares modelled forecast flows with observed traffic volumes to ascertain the accuracy of the predictions.

Traffic Forecasting

2.26. The traffic forecasts for the scheme were produced in the Traffic Forecasting Report (TFR) (May 2006).

2.27. The appraisal used a base year of 2003 to predict traffic flows in an assumed opening year of 2008, an intermediate year of 2016 and a Design year of 2023 for two traffic growth scenarios, ‘Do Something’ and ‘Do Minimum’. This was achieved through the use of SATURN modelling software.

Study Area

2.28. The highway network encompassed within the model extends from the M42 J4 in the north west; the M40 J12 and B4455 to the east; Warwick and Leamington centres to the north; and Stratford to the south.

2.29. The central study area (circulating the M40 Junction 15 scheme) was modelled in greater detail using SATURN ‘simulation’ coding which enables a more accurate assessment of traffic issues and the effects of junction operation. This simulation area included junctions considered particularly sensitive to congestion and the potential impacts of the bypass. The remainder of the network was modelled as a ‘buffer’ network (considered suitable for the modelling of wider traffic movements), with traffic assigned according to link characteristics exclusive of junction operability.

Highway Network Assumptions

2.30. The 'Do Minimum' (DM) network includes the following network alterations:

- Implementation of the M40 Junction 15 Improvements Scheme – increasing M40 on slips from 1 to 2 lanes, widening sections of the circulatory carriageway and re-optimising signals timings.
- Incorporating the A429 Barford Bypass;
- Implementation of a new four-arm roundabout, providing access to the Tournament Fields/South West Warwick Development on the A429 north of M40 J15; and
- Upgrading the A425 Banbury Road/Heathcote Lane junction, the junction was signalised with a new gyratory system with limits on some movements introduced.

2.31. The 'Do Something' (DS) scenario contains all of the changes mentioned above and in addition includes the implementation of the M40 J15 bypass scheme.

Variable Demand Modelling

2.32. Department for Transport (DfT) guidance on methods to assess a scheme's propensity for induced/suppressed traffic advises that simple elastic assignment should no longer be used for the purpose of forecasting and economic assessment as this approach cannot comprehensively represent changes in trip length, transfer between modes, or transfer between time periods that would be expected in future years.

2.33. The M40 Junction 15 improvement scheme is considered to have implications for induced/suppressed traffic following an assessment of simple elastic assignment modelling results, DIADEM has therefore been used to assess the VDM effects of the proposed scheme.

Forecast vs. Observed Traffic Flows

2.34. Predicted inbound traffic flows on all approaches to M40 Junction 15 were provided in the TFR (produced by Hyder Consulting). The forecast figures are presented in Average Daily Traffic (ADT) flows based on modelled 'demand' flows; representing the estimated future level of demand on the highway network. Generally, demand flows are considered when assessing network performance, particularly when deriving forecast flows to be used for highway design and economic assessment.

2.35. Table 2-3 compares 2015 forecast flows for the Do-Something forecast scenario against 2015 post-opening observed flows. Forecast flows have been calculated using straight-line interpolation between the assumed 2008 opening year and 2023 design year in order to facilitate a like-for-like comparison.

Table 2-3 M40 J15 Forecast DS Flows vs Observed Flows (ADT)[13]

Link	Forecast DS (2015)	Observed Post-scheme (2015)	Difference	% Diff
A46 Warwick Bypass	37,600	29,300	-8,300	-22%
A429 Stratford Road	27,500	11,100	-16,400	-60%
M40 EB on-slip*	22,000	15,100	-6,900	-31%
M40 WB off-slip*	15,800	16,600	800	5%
A429 South	23,500	16,200	-7,300	-31%
A46 Connection Road	33,200	22,200	-11,000	-33%
M40 WB on-slip*	10,000	10,100	100	1%
M40 EB off-slip*	6,900	10,300	3,400	49%
A46 New Scheme Bypass	33,600	23,200	-10,400	-31%

**Based on off-slip 12-hr AWT turning counts – factored for ADT based on DfT factors*

2.36. A comparison of post-opening observed flows with the 'Do-Something' forecast flows demonstrates that:

- Observed 2015 post-scheme ADT flows are lower than the forecast 'Do-something' flows on the majority of the key scheme links, except for the M40 WB and EB off-slips and the M40 WB on-slip. This indicates that the predicted traffic growth in the immediate vicinity of the scheme has been over-estimated.

- Forecast 'Do-something' flows along the A46 links are considerably higher than the observed 2015 post scheme ADT flows. The A46 north of J15 has experienced a reduction in traffic as a result of the A46 bypass scheme as identified at OYA, however the model forecast ADT flows of approximately 37,600 along the A46, which is approximately 22% (8,300 vehicles) higher than the observed 2015 flows. ADT flows along the A46 connection road are approximately 33% (11,000 vehicles) lower than the forecast traffic flows, whilst ADT flows along the new A46 bypass are approximately 31% lower than forecast.

- Observed 2015 ADT flows on the EB off-slip are approximately 3,400 (49%) vehicles higher than the forecast 'Do-something' flows, whilst the observed 2015 ADT flows on the WB off-slip are also higher than forecast, with the observed ADT flows approximately 5% higher than forecast.

Reasons for Differences

2.37. It is evident from Table 2-3 that the forecasting process over-estimated traffic flows in the vicinity of the scheme for the year 2015; the reasons for which can largely be attributed to the forecasting assumptions made in the SATURN model as outlined below.

2.38. Table 2-3 also indicates that the forecasting process has underestimated the level of traffic flow on both the M40 Eastbound and Westbound off-slips. This may be a result of unequal traffic distribution in vicinity of the scheme.

[13] All figures are rounded to the nearest 100.
Observed post-scheme flows are adjusted for seasonality

TEMPRO Version 4.3

2.39. A key factor in determining predicted levels of growth in the forecasting process was the use of TEMPRO version 4.3, which was the latest version available at the time of scheme appraisal in 2006. TEMPRO datasets are derived from various future estimates of economic factors which influence levels of car ownership and use such as levels of employment, fuel prices and household income.

2.40. Given that the version 4.3 dataset was released prior to the economic downturn in 2008, it was not possible for this dataset to account for the impacts of the recession which are not included until TEMPRO version 6.2 released in April 2011 (after the impacts of the downturn have taken place). The result is that all projected forecast flows for the 2011 post-opening year are considerably higher than those observed.

Tournament Fields and Chase Meadow Development

2.41. The differences between the forecast 2015 ADT traffic flows and the 2015 observed ADT flows on the A429 North can be explained by the predicted impact of the Tournament Fields (and Chase Meadow) development. The M40 J15 forecasting report states that predicted increases in traffic on this link "can largely be attributed to the extensive Tournament Fields development". Naturally, some of the predicted traffic growth seen on other approach arms will also be caused by an increase in the number of vehicles heading towards the Tournament Fields site via the A429 North.

2.42. The trip generation for the Tournament Fields/Chase Meadow developments was based on the construction of 1,100 dwellings and 66,000sqm of office space by the anticipated 2008 opening year. However, as identified within the scheme background chapter, only 21,300sqm of office space and approximately 800 dwellings were constructed by 2011. A site visit undertaken in September 2015 confirmed that two further Grade A office developments have been constructed since the OYA report was published. These include a 1,900sqm three storey business centre facility completed by Pure Offices, and a 1,400sqm office and R&D workshop facility for Eagle Burgman (Supplier of Industrial Sealing Technology). However, the Tournament Fields site still has over 113,000sqm of land remaining for further development.

2.43. Consequently, the anticipated level of development expected has been considerably over-estimated, although there is potential scope for both Tournament Fields and Chase Meadow to undergo further development and reach the levels of traffic forecast.

Journey Time Analysis

Introduction

2.44. The journey time objective taken from the AST for the M40 Junction 15 (Longbridge) Bypass scheme is outlined In Table 2-4.

Table 2-4 Scheme Objective

Objective (AST, 2006)
To reduce congestion at M40 Junction 15 and improve travel times by reducing the amount of A46 traffic travelling through the junction.

2.45. Journey time analysis has been undertaken in order to further comprehend the impact of the M40 J15 scheme on journey times along the A46 scheme section. The OYA report confirmed that vehicles using the new A46 bypass experienced considerable journey time benefits by avoiding delays at M40 J15. However, as identified with in this report, traffic flows in the vicinity of J15 have increased between the OYA and the FYA assessment periods, therefore it is important to determine if the scheme's journey time objective is still being achieved at FYA. This assessment is comprised of:

- Analysis of observed pre-scheme, OYA and FYA journey times for through traffic in both northbound and southbound directions along the A46. This compares post-opening journey times along the new A46 bypass vs. pre-scheme journey times where traffic travelled through M40 Junction 15.

- Analysis of journey times for trips heading southbound along the A46 and joining the M40 westbound, comparing post-opening journey times where vehicles have used the unopposed free flow link along the A46 bypass vs. pre-scheme journey times where traffic travelled through M40 Junction 15 and navigated the circulatory; and

- Comparison of changes in journey times for all turning movements at M40 Junction 15.

2.46. Once the observed changes have been analysed, the forecast and outturn changes have been compared to identify whether or not the journey time benefits have been maintained and were as predicted.

Data Sources (Satellite Navigation Journey Time Data)

2.47. Motorists who use satellite navigation devices have the option to voluntarily allow anonymous data about their journeys to be collected and shared to provide a range of services, including the analysis of historic journey times along specific routes. This data type has been used in order to assess potential time savings for all motorists affected directly by the scheme.

2.48. A summary of the Satellite Navigation Journey Time data analysed within this FYA report is provided in Table 2-5.

Table 2-5 A Summary of the Satellite Navigation Journey Time Data Analysed

Route Name	Route Description
Route 1	From the A46 north of the M40 Junction 15 to the A46 south of the scheme via M40 Junction 15.
Route 2	From the A46 south of M40 Junction 15 to the A46 north of the scheme via M40 Junction 15.
Route 3	From the A429 north of the scheme to the A429 south of the scheme
Route 4	From the A429 south of the scheme to the A429 north of the scheme.
Route 5	Along the M40 eastbound, via the circulatory carriageway at Junction 15.
Route 6	Along the M40 westbound via the circulatory carriageway at Junction 15.
Route 7	From the A46 north of M40 Junction 15 to the A46 south of Junction 15 via the scheme bypass and southern connection roundabout.
Route 8	From the A46 south of M40 Junction 15 to the A46 north of Junction 15 via the southern connection roundabout and scheme bypass.

2.49. Each route will be considered in turn in the following sections. Journey times were surveyed during the following time periods:

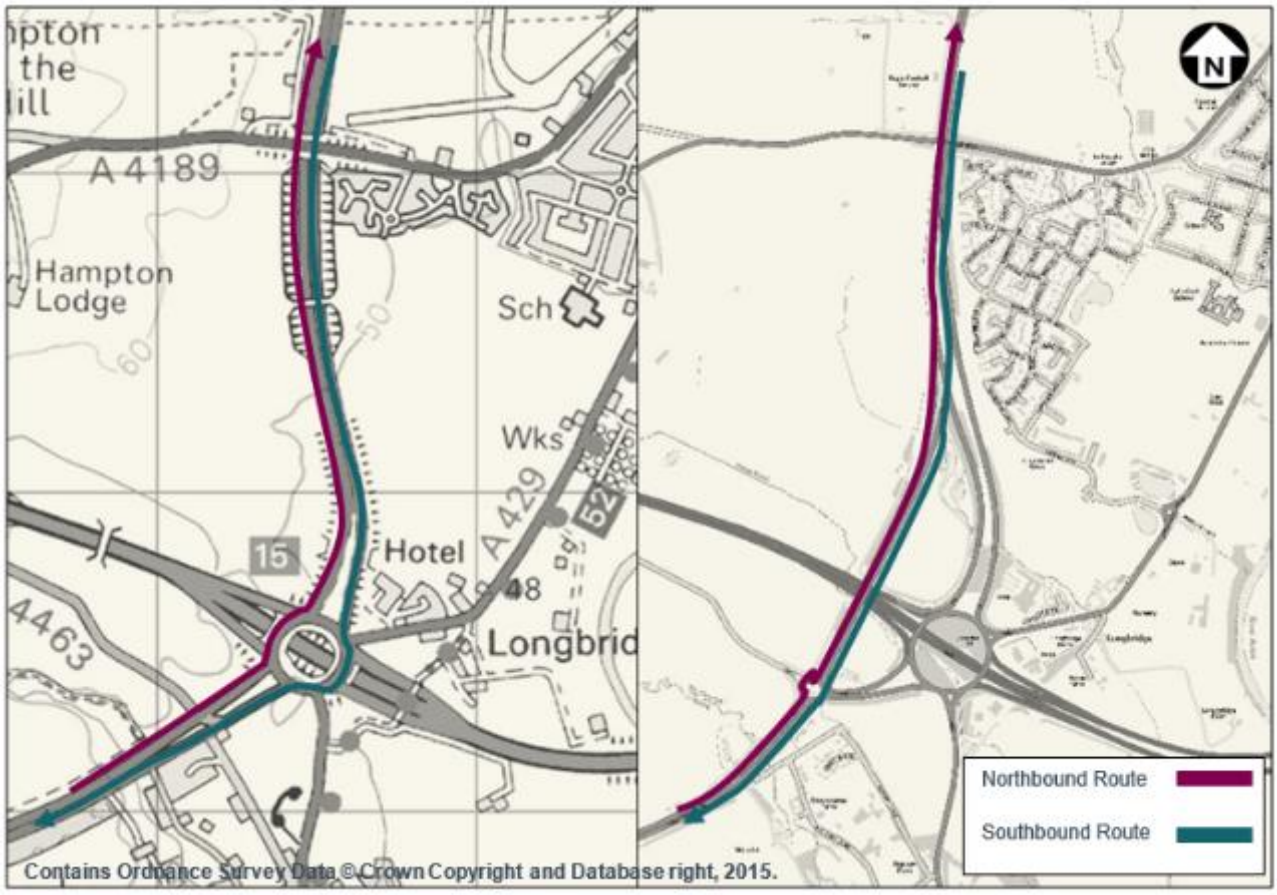
- **AM Shoulder** (0700-0800)
- **AM Peak** (0800-0900)
- **Inter-Peak** (0900-1700)
- **PM Peak** (1700-1800)
- **PM Shoulder** (1800-1900)
- **Off-Peak** (2200-0500)
- **Weekend** (0700-1900)

A46 Through Traffic

Journey Time Savings

2.50. As identified at OYA, vehicles which used the new A46 scheme bypass experienced the greatest reduction in journey times per vehicle. Therefore, in order to determine the impact of the scheme measures at FYA, journey times were surveyed along the A46 five years after the scheme opened (June 2014 – June 2015) using satellite navigation data. The FYA dataset was then compared to the OYA journey time dataset (data already available from OYA assessment) in order to determine if the journey time benefits identified during the OYA assessment period were still being achieved at FYA (see Figure 2-8 and Figure 2-9).

Figure 2-7 Journey Time Analysis Links for A46 Through Traffic



2.51. Table 2-6 presents the pre-scheme construction and FYA journey time savings along the A46 bypass scheme section.

Table 2-6 Observed Journey Times Before and After Scheme Opening for A46 Traffic

Time Period	Southbound Journey Times (mm:ss)			Northbound Journey Times (mm:ss)		
	Pre-Scheme	Post-opening	Saving	Pre-Scheme	Post-opening	Saving
AM Shoulder (0700-0800)	03:56	02:46	-01:10	03:28	02:27	-01:01
AM Peak (0800-0900)	06:10	03:25	-02:45	05:26	02:36	-02:50
Inter-Peak (0900-1700)	03:38	02:32	-01:06	03:10	02:30	-00:40
PM Peak (1700-1800)	05:42	02:43	-02:59	03:44	02:48	-00:56
PM Shoulder (1800-1900)	04:07	02:30	-01:37	03:09	02:29	-00:40
Off-Peak (2200-0500)	03:03	02:27	-00:36	02:42	02:29	-00:13
Weekend (0700-1900)	03:04	02:24	-00:40	02:42	02:22	-00:20

Note: A journey time saving is displayed as a negative value

2.52. The key points from Table 2-6 are as follows:

- Post-opening journey times are lower than the pre-scheme construction period in both northbound and southbound directions as a result of the scheme measures.
- The greatest journey time benefits are experienced during the AM peak hour between 0800-0900, with an average saving of 2 minutes 45 seconds in the southbound direction and 2 minutes 50 seconds in the northbound direction.
- Considerable time savings are also experienced during the PM peak hour between 1700-1800, with an average saving of 2 minutes 59 seconds in the southbound direction and 56 seconds in the northbound direction.
- It is important to note that the pre-scheme average journey times are longer in the southbound direction as vehicles have to navigate 3 sets of traffic signals on the circulatory carriageway compared to 2 sets of traffic signals in the northbound direction. However, the post-opening journey times on the A46 scheme bypass are relatively comparable along the unopposed free-flow route in either direction. Consequently, the journey time savings are greater in the southbound direction.

Journey Time Reliability

2.53. The scheme objectives outlined within the AST (2006) were to reduce congestion at M40 J15 and reduce travel times. The AST didn't consider journey time reliability, however, further analysis (see Figure 2-8 and Figure 2-9) of the journey time benefits along the A46 demonstrates that:

- As identified in Table 2-5, the scheme measures have delivered journey time savings for vehicles traveling in both a northbound and southbound direction along the A46. Figure 2-8 and Figure 2-9 provide a comparison between the Pre-scheme, OYA and FYA journey time reliability. The Figures demonstrate that the scheme measures had a significant impact on the journey time reliability associated with vehicle movements along the A46 at OYA. This is demonstrated by the reduction in the inter-quartile range for journey times in both directions.

- The reliability data for the scheme demonstrates that the scheme has had an overall beneficial impact to reliability. Each of the 5th, 25th, 75th and 95th percentile journey times have improved. The big changes are to the inter-quartile range and the 95th percentile. An improved inter-quartile range indicates that the core percentage of journeys through the scheme are more predictable as they fit into a tighter range of journey times. This means that motorists can plan their journeys with more confidence. The improved 95th percentile indicates that during the most extreme circumstances (high traffic volumes, collisions or other incidents) the junction is performing better than before, and so it is more resilient.

- In the northbound direction, the greatest improvement to Journey time reliability at FYA is during the AM peak hour. The inter-quartile range for the AM pre-scheme peak is 290 seconds compared to 31 seconds at FYA. In the southbound direction, the greatest improvement to journey time reliability at FYA is during the PM peak hour. The inter-quartile range for the PM pre-scheme peak is 258 seconds compared to 32 seconds at FYA. Overall the impacts are very positive and demonstrate improved reliability.

Figure 2-8 A46 Northbound Journey Time Analysis

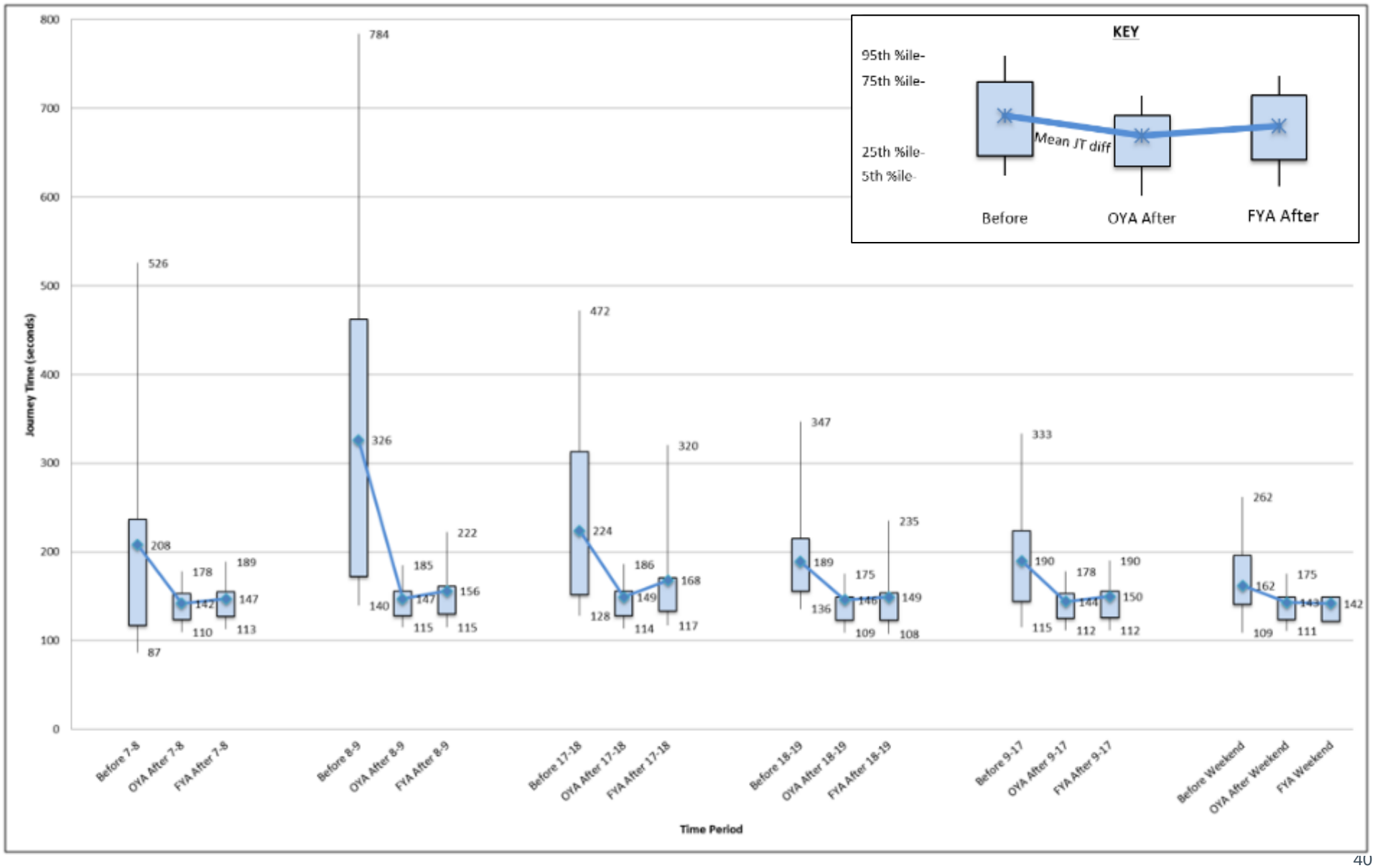
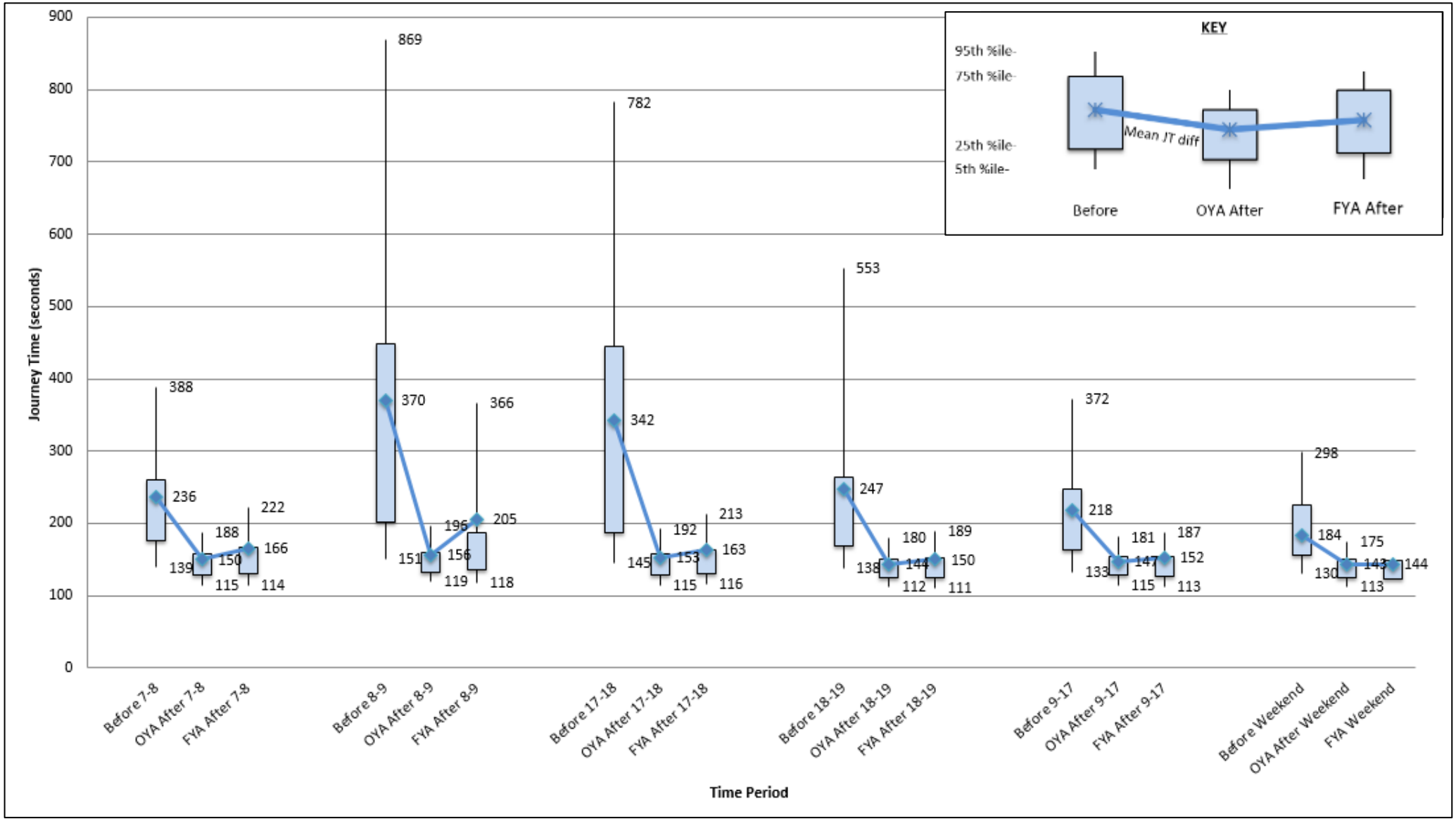


Figure 2-9 A46 Southbound Journey Time Analysis



Planning Time Index

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

2.55. Table 2-7 below shows the PTI for the before and after periods for both the Northbound and Southbound journeys along the A46 Warwick Bypass based on the sat-nav journey time data, this is weighted by flows in the individual time periods.

Table 2-7 Flow-Weighted PTI

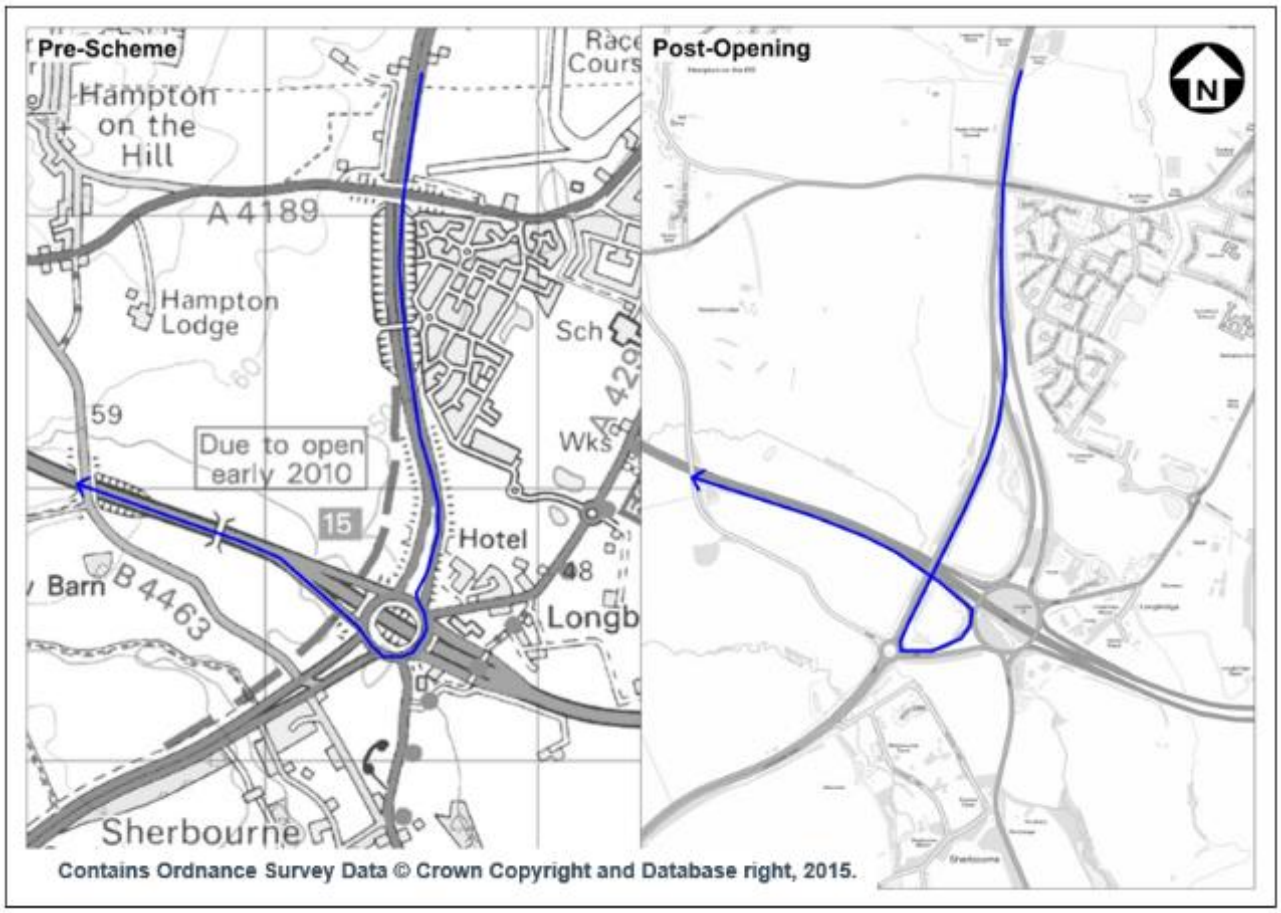
	Before	After
Northbound Journeys A46 Warwick Bypass	**2.80**	**1.66**
Southbound Journeys A46 Warwick Bypass	**3.14**	**1.67**

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

A46 Southbound to M40 Westbound Traffic

2.57. In addition to vehicles making the through movement on the A46, vehicles using the A46 bypass to access the M40 westbound carriageway are also likely to experience significant journey time benefits. Vehicles accessing the M40 westbound carriageway during the pre-scheme assessment period had to approach M40 J15 via the A46 north and circulate the junction before accessing the M40 carriageway via the westbound on-slip. However, vehicles accessing the M40 westbound carriageway during the post-opening period can travel along the A46 new scheme bypass and use the unopposed dedicated left turn lane at the southern connector roundabout to access the M40 westbound on-slip. Figure 2-1 demonstrates both the pre-scheme and post-scheme routes for comparison.

Figure 2-1 Route Comparison for A46 SB to M40 WB Traffic



2.58. Pre-scheme data is calculated using a combination of satellite navigation queries 1 and 6 (see Table 2-5) which form the pre-scheme route via Junction 15. Post-opening data is based on a combination of query 7 heading southbound along the A46 bypass and moving observer data along the unopposed dedicated left turns heading from the southern connection roundabout to the M40 westbound on-slip.

2.59. Table 2-8 presents the pre-scheme construction and FYA journey time savings for vehicles accessing the M40 westbound carriageway via the A46 SB.

Table 2-8 Comparison of A46 SB to M40 WB Journey Times

Time Period	Pre-scheme	Post-opening	Saving
AM Shoulder (0700-0800)	03:44	01:54	-01:50
AM Peak (0800-0900)	05:38	02:32	-03:06
Inter-peak (0900-1700)	03:33	01:40	-01:53
Off-Peak (2200-0500)	02:50	01:53	-00:57
PM Peak (1700-1800)	05:07	01:52	-03:15
PM Shoulder (1800-1900)	03:46	01:39	-02:07
Weekend (0700-1900)	03:00	01:34	-01:26

Note: A journey time saving is displayed as a negative value

2.60. The key points from Table 2-8 are as follows:

- All time periods demonstrate a reduction in average journey times from the A46 southbound to M40 westbound carriageway as a result of the new unopposed free-flow link. Journey time savings increase during the peak hours where traffic flows are higher. This is because vehicles during the pre-scheme assessment period had to queue on the approach arms to J15, whereas post-scheme vehicles can access the M40 carriageway via the free-flow link;

- The greatest time savings are accrued during the PM peak hour between 1700 to 1800 with an average time saving of 3 minutes and 15 seconds, representing a 64% reduction;

- Large time savings are also experienced during the AM peak hour between 0800 to 0900 with an average time saving of 3 minutes and 6 seconds, representing a 55% reduction; and

- Post-opening journey times are more consistent with a 58 second difference across all time periods compared to a 158 second difference across the pre-scheme time periods; indicating that there is less congestion along the new route.

2.61. It is important to consider that a proportion of the traffic travelling from the A46 north of Junction 15 to the M40 westbound carriageway will not have been diverted along the new A46 scheme bypass. The impact on journey times for those vehicles continuing to use the pre-scheme route is considered in the M40 Junction 15 movement's sub-section.

M40 Junction 15 Movements

2.62. Having analysed the primary journey time benefits for motorists using the new A46 scheme bypass, it is also important to consider the impact on vehicles using M40 J15.

2.63. Pre-scheme and post-opening satellite navigation queries were disaggregated to provide average journey times for individual links on approach to and exit from M40 Junction 15 as well as around the circulatory carriageway itself. This facilitated the calculation of individual time savings for all movements at the junction.

2.64. Table 2-9 outlines the average journey time savings for all possible movements around M40 Junction 15.

Table 2-9 Average Journey Time Savings for Turning Movements at M40 J15

From	To	Time Saving (mm:ss) *					
		0700-0800	0800-0900	0900-1700	1700-1800	1800-1900	Weekend
A_A46 Warwick Bypass	B_A429 Stratford Road	-00:10	-02:13	-00:12	-01:50	-00:41	00:06
A_A46 Warwick Bypass	C_M40 East	-00:11	-02:19	-00:14	-01:56	-00:42	00:06
A_A46 Warwick Bypass	D_A429 South	-00:26	-02:40	-00:19	-02:17	-00:51	00:03
A_A46 Warwick Bypass	E_A46 Connection	-00:28	-02:43	-00:20	-02:19	-00:53	00:02
A_A46 Warwick Bypass	F_M40 West	-00:51	-03:02	-00:25	-02:33	-01:03	-00:06
B_A429 Stratford Road	C_M40 East	-00:18	-00:50	00:03	-02:37	-00:18	00:03
B_A429 Stratford Road	D_A429 South	-00:29	-01:05	00:00	-02:53	-00:24	00:01
B_A429 Stratford Road	E_A46 Connection	-00:30	-01:07	00:01	-02:53	-00:24	00:03
B_A429 Stratford Road	F_M40 West	-00:48	-01:22	00:00	-03:04	-00:31	-00:02
B_A429 Stratford Road	A_A46 Warwick Bypass	-01:04	-01:42	-00:13	-03:22	-00:45	-00:14
C_M40 East	D_A429 South	-00:35	-01:17	-00:22	-01:07	-00:27	-00:03
C_M40 East	E_A46 Connection	-00:37	-01:21	-00:24	-01:09	-00:28	-00:04
C_M40 East	A_A46 Warwick Bypass	-01:09	-01:57	-00:44	-01:32	-00:48	-00:20
C_M40 East	B_A429 Stratford Road	-01:30	-02:15	-00:57	-01:47	-01:00	-00:30
D_A429 South	E_A46 Connection	-00:56	-02:04	-00:04	-00:30	-00:08	00:02
D_A429 South	F_M40 West	-01:25	-02:29	-00:17	-00:51	-00:24	-00:12
D_A429 South	A_A46 Warwick Bypass	-01:28	-02:33	-00:14	-00:51	-00:24	-00:10
D_A429 South	B_A429 Stratford Road	-01:47	-02:46	-00:15	-01:09	-00:33	-00:15
D_A429 South	C_M40 East	-01:54	-03:00	-00:18	-01:25	-00:40	-00:16
E_A46 Connection	F_M40 West	-00:47	-01:45	00:18	00:09	00:19	00:30
E_A46 Connection	A_A46 Warwick Bypass	-00:51	-01:49	00:22	00:09	00:19	00:33
E_A46 Connection	B_A429 Stratford Road	-01:15	-02:07	00:16	-00:14	00:07	00:24
E_A46 Connection	C_M40 East	-01:14	-02:14	00:17	-00:21	00:07	00:28
E_A46 Connection	D_A429 South	-01:15	-02:16	00:27	-00:24	00:13	00:37
F_M40 West	A_A46 Warwick Bypass	-00:40	-01:57	-00:21	-00:13	-00:17	-00:06
F_M40 West	B_A429 Stratford Road	-00:52	-02:03	-00:14	-00:24	-00:19	-00:03
F_M40 West	D_A429 South	-00:12	-01:32	00:33	-00:04	00:17	00:43
F_M40 West	E_A46 Connection	-00:19	-01:42	00:27	-00:12	00:11	00:38

**Note: A journey time saving is displayed as a negative value*

2.65. Table 2-9 demonstrates that:

- The greatest time savings are being accrued during the AM (0800-0900) and PM (1700-1800) peak periods. There are minimal savings observed during the inter peak and weekend time periods;

- The majority of the benefits are derived from reduced delay on the approach arms to M40 J15. During the AM peak period (0800-0900), there is an average saving of over one minute on every approach arm. The journey time savings on the approach arms during the PM peak (1700-1800) are generally lower with the exception of the approach from the A429 Stratford Road;

- All movements from the A429 north during the PM peak have savings of over 2 minutes 30 seconds. This is the only junction at the roundabout which is not signal controlled, suggesting that reduced levels of conflicting traffic make it much easier for motorists on this approach to join the circulatory carriageway during peak periods; and

- Average journey times for motorists approaching J15 from the A46 southern connection roundabout show slight increases in several time periods. This is likely due to the change in the road layout which requires vehicles to navigate the new southern connection roundabout, resulting in an increase in journey times. However, significant journey time benefits are still accrued during the AM peak and AM shoulder peak as congestion is reduced at J15.

Forecast vs. Outturn Journey Times

2.66. The model forecasting report includes a comparison between modelled journey times for the 2003 Base network and the 2008 Do-Minimum and Do-Something scenarios for the assumed 2008 opening year. However, the report only contains the overall route journey times, therefore only the two routes (southbound and northbound) along the A46 are suitable for comparison with satellite navigation data.

2.67. The forecast journey time routes in the model forecasting report are longer than the corresponding satellite navigation queries. Consequently total forecast journey times are not directly comparable with the observed data and are therefore affected by additional factors including the influence of congestion at other junctions located away from the scheme. However, the change in journey times between the forecast Do-Minimum and Do-Something scenarios are still primarily influenced by the impact of the M40 J15 scheme as there has not been any other major highway improvements along this route. This allows for a comparison to be made between forecast differences and observed savings as shown in Table 2-10.

2.68. Whilst the forecast opening year in the forecasting report is different to the outturn opening year, Figure 2-3 demonstrates that there was minimal fluctuation in the ADT along the A46 between 2005 and 2010. Therefore, it is reasonable to assume that there has been no major impact on journey times along the route as a result of traffic growth.

Table 2-10 Forecast vs. Outturn Journey Time Savings along the A46

Time Period	Direction	2008 Forecast Journey Times (mm:ss)			Sat Nav Observed Journey Times (mm:ss)		
		DM	DS	Saving	Pre-Scheme (2008)	Post-opening (FYA)	Saving
AM Peak (0800-0900)	SB	08:51	07:39	-01:12	06:10	03:25	-02:45
	NB	10:44	09:31	-01:13	05:26	02:36	-02:50
Inter-peak (0900-1700)	SB	08:20	07:09	-01:11	03:38	02:32	-01.06
	NB	07:48	07:10	-00:38	03:10	02:30	-00:40
PM Peak (1700-1800)	SB	11:13	11:14	00:01	05:42	02:43	-02:59
	NB	09:06	07:48	-01:18	03:44	02:48	-00:56

Note: A journey time saving is displayed as a negative value

2.69. The key observations from Table 2-10 are:

- The forecast journey time savings for the AM peak were considerably more conservative than the outturn journey time savings. The forecast saving of 1 minute 12 seconds in the AM peak for vehicles travelling southbound was 61% lower than the outturn journey time saving of 2 minutes 45 seconds. The forecast saving of 1 minute 13 seconds in the AM peak for vehicles travelling northbound was 57% lower than the outturn journey time saving of 2 minutes 50 seconds.

- The forecast journey time saving for vehicles travelling southbound during the inter peak period was 1 minute 11 seconds, the observed journey time saving was 7% lower. The forecast journey time saving for vehicles travelling northbound during the inter peak period was within 5% of the outturn journey time saving.

- The forecast journey time impact for vehicles traveling southbound during the PM peak was an increase of 1 second. The outturn journey time impact was a saving of 2 minutes 59 seconds which was considerably higher than forecast. The forecast journey time saving for vehicles travelling northbound during the PM peak period was 28% higher than the outturn journey time saving.

Key Points – Traffic Impacts

Traffic Flow Impacts

- The A46 bypass has diverted a large proportion of A46 traffic away from M40 Junction 15 roundabout, with approximately 26,400 vehicles using the new link on an average weekday and 23,200 on an average day.
- Turning counts demonstrate that over a 12-hour weekday period, total inbound flow at M40 Junction 15 has decreased by around 7% from approximately 62,900 vehicles to 58,300 vehicles. This change is attributed to the large increase in vehicles joining the M40 westbound carriageway via the new A46 scheme bypass.

Traffic Forecasting

- The traffic forecasting process greatly over-estimated the level of traffic growth for the scheme with the total 2015 ADT Do-Something flows along the existing A46 exceeding observed post-opening flows by 22% and forecast flows along the new A46 scheme bypass exceeding observed post-opening flows by 31%.
- The reasons for the differences between forecast and observed traffic flows can be explained through forecasting assumptions. Firstly, it was impossible for the TEMPRO 4.3 dataset (used to determine the level of background traffic growth) to account for the impacts of economic recession which began in 2008. Secondly, trip rates for the Tournament Fields/Chase Meadow developments to the north of M40 Junction 15 were based on the construction of 1,100 dwellings and 66,000sqm of office space whereas only around 800 dwellings and 24,600sqm of office space were constructed by 2015.

Journey Time Impacts

- Vehicles which use the new scheme bypass experience the greatest journey time savings per vehicle, with most experiencing savings during all times of the day.
- For A46 through traffic, the greatest savings are experienced during the AM peak (0800 to 0900) with an average saving of 2 minutes and 45 seconds for vehicles travelling southbound and 2 minutes 50 seconds for vehicles travelling northbound. There were also considerable time savings for vehicles accessing the M40 westbound carriageway via the A46 scheme bypass, with an average saving of 3 minutes and 15 seconds per vehicle during the PM peak (1700-1800).
- Considerable improvements to journey reliability have also been demonstrated for A46 through movements, with all time periods demonstrating a reduction in the inter-quartile range for journey times in both directions.
- Savings at M40 Junction 15 as a result of reduced congestion are largely confined to a 12-hour period (0700 to 1900) with the greatest savings occurring during peak hours. In particular, all movements from the northern arm of the A429 (the only priority junction at the roundabout) experience average savings during the PM peak of over 2 minutes due to the reduction in conflicting traffic making it easier for traffic to join the circulatory carriageway.

3. Safety

Introduction

3.1. This section of the report evaluates the success of the M40 J15 scheme in addressing the safety objective outlined within the AST. The aim of the safety objective is to reduce the loss of life, injuries and damage to property resulting from transport collisions and crime. This is assessed by analysing the changes in the occurrence of Personal Injury Collisions (PIC's) in both the pre scheme and post scheme analysis periods.

Table 3-1 Scheme Safety Objective

Objective (AST, 2006)
To improve safety for road users at the junction through the various improvements to the roundabout

Data Sources

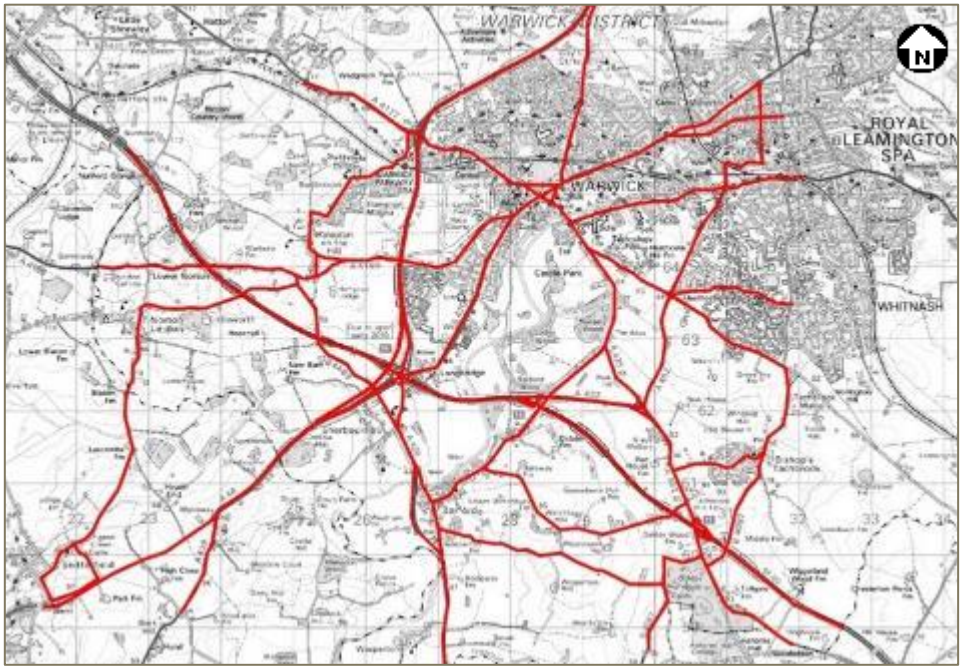
Forecasts

3.2. In order to appraise the safety objective of the M40 J15 scheme, accident saving forecasts were produced for the number of collisions the scheme was expected to save in addition to the associated number of casualties, and the monetary benefits associated with the predicted savings. Forecasts of the M40 Junction 15 scheme impacts have been obtained from the scheme Cost benefits Analysis (COBA) model.

3.3. It is important to note that collision records over a five year period from 2000 to 2005 were used to inform combined link and junction collision rates within the COBA models. This time period is largely based on collisions which occurred prior to the implementation of the M40 J15 Improvements LNMS, completed in September 2004. Consequently, given that the LNMS evaluation projected collision savings of approximately 17 incidents over a scheme life of 6 years, the use of this data may have had an influence on the accuracy of forecast collision savings for the M40 Junction 15 Longbridge Bypass scheme.

3.4. The extent of the COBA model area is shown in Figure 3-1. The COBA model area is based on the simulation network used for the SATURN model. It covers the main routes in both the immediate and wider vicinity of the scheme, where changes in traffic flows may occur as a result of the scheme measures and therefore the collision rate may change.

Figure 3-1 COBA Model Analysis Area



3.5. This section of the report only considers the changes in collision numbers, the economic impacts of the changes in collisions are evaluated in the Economy chapter of this report.

Observed Data

3.6. Collision Data has been obtained from Warwickshire County Council, the collision data is based on the records of PICs (i.e. collisions that may 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.

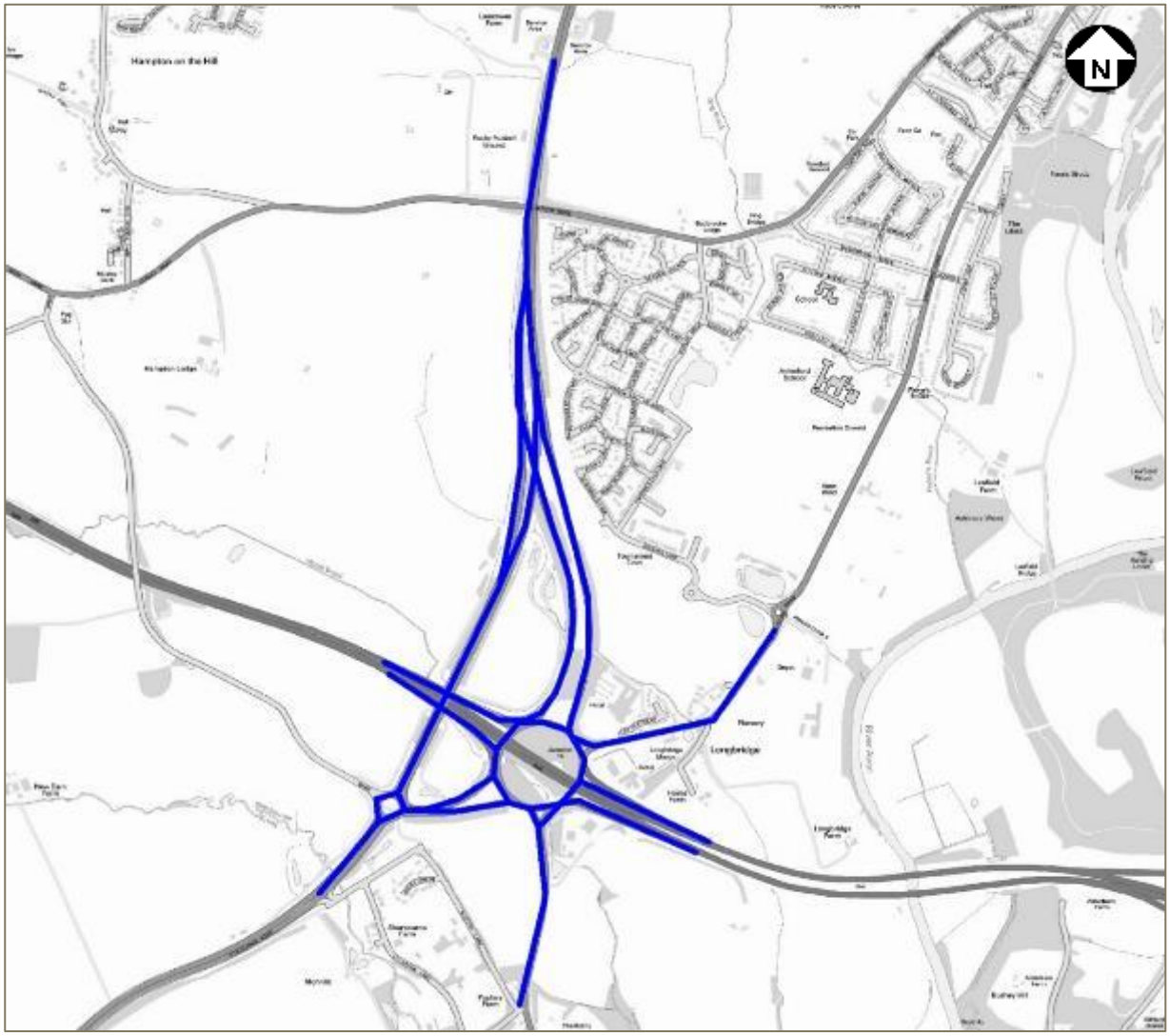
3.7. In order to negate the impact of the LNMS M40 J15 Improvements Scheme, the pre-scheme period used for direct comparison with post-opening incidents has been reduced to only include incidents following the completion of the LNMS on 29th September 2004. The collision analysis periods are:

- **Pre-Scheme:** 30th September 2004 to 16th March 2008
- **Construction:** 17th March 2008 to 17th June 2010
- **Post-Opening:** 18th June 2010 to 17th June 2015

3.8. The STATS19 data has been assessed at two levels:

- A wider scheme area based on the COBA model output area (see Figure 3-1); and
- A ‘key links’ area which is focused on the key network routes within the vicinity of the scheme. The ‘key links’ analysis area is outlined in Figure 3-2.

Figure 3-2 Key Links Collision Analysis Area



Collision Numbers

3.9. This section analyses the observed changes in PICs following the implementation of the scheme. One of the scheme objectives was to improve safety for road users at the junction through the various improvements to the roundabout. This section of the report examines the potential changes to the number of collisions and associated casualties, in addition to any changes in the relative severity. This section first considers the scheme impact on the wider COBA area and then evaluates the scheme impact on the key links.

Background Collision Reduction

3.10. 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 network, 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 features in vehicles and the reduced numbers of younger drivers on the road. This background trend needs to be taken into account when considering the changes in collision numbers in both the pre-scheme and post-scheme periods. If the scheme had not been built, collision numbers in the area are still likely to have been influenced by wider trends and consequently reduced.

3.11. When the number of collisions during the pre-scheme and post-scheme periods are compared, the background reduction in collisions needs to be taken into account. The background reduction is accounted for by assuming that, if the scheme had not been built, the number of collisions on the roads in the study area would have reduced at the same rate as the national average during the same time period. This is known as a counterfactual scenario. This is then compared to the counterfactual 'without scheme' scenario on a like-for-like basis with the observed post opening data which is the 'with scheme' scenario.

3.12. 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.

COBA Modelled Area

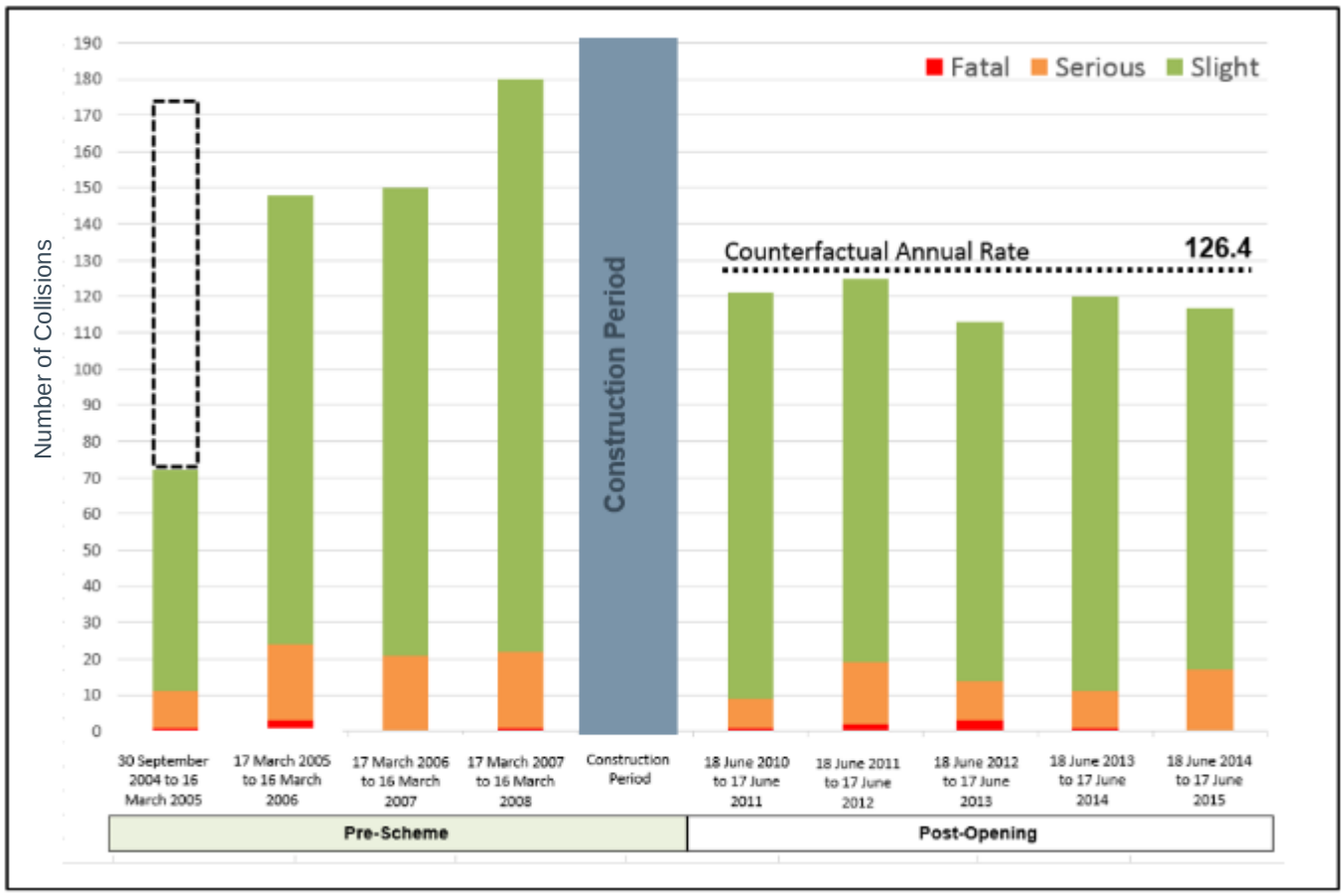
Evaluation of Collision Numbers and Severity

3.13. An evaluation of the before and after collision numbers by year for the COBA area (see Figure 3-1) is shown in Table 3-1. This enables a direct comparison between the observed collisions and those stated in the forecasting report. The severity of a collision is defined by the most serious injury incurred. Figure 3-3 shows the number of collisions on an Annual Basis for the COBA area, it should be noted that where a time period of less than 12 months is displayed, the relative proportion of accidents is projected for a complete 12 month period (represented by a dotted bar).

Table 3-2 Number of Collisions by Severity in the COBA Area

Period	Time Period		Number of Collisions by Severity			Total	Annual Average
	From	To	Fatal	Serious	Slight		All
Pre-Scheme	Sept/2004	Mar/2005	1	10	61	72	158.9
	Mar/2005	Mar/2006	3	21	124	148	
	Mar/2006	Mar/2007	0	21	129	150	
	Mar/2007	Mar/2008	1	21	158	180	
Without Scheme Counterfactual (adjusted for background reduction)[14]							126.4
Post-Opening	June/2010	June/2011	1	8	112	121	119.3
	June/2011	June/2012	2	17	106	125	
	June/2012	June/2013	3	11	99	113	
	June/2013	June/2014	1	10	109	120	
	June/2014	June/2015	0	17	100	117	

Figure 3-3 Number of Collisions on an Annual Basis for COBA Area



[14] Background reduction factor in collision numbers for 'All A Roads' was 0.795

3.14. From Table 3-2 and Figure 3-3 it can be seen that:

- The total number of collisions recorded over the post opening period was 596, resulting in an average annual average of 119.3 collisions per year. This represents a 6% (7.11 collisions) decrease per year when compared to the counterfactual without scheme value (taking the background reduction in collisions into account).
- The annual average number of fatal collisions has remained the same across the COBA area, from an average of 1.4 collisions per year in the pre-scheme and post-scheme periods.
- The annual average number of serious collisions has reduced by 40%, from an average of 21.1 per year in the pre-scheme period to an average of 12.6 per year in the post-scheme period.
- The annual average number of slight collisions has reduced by 22.8%, from an average of 136.4 per year in the pre-scheme period to an average of 105.3 per year in the post-scheme period.
- Please note that the observed changes over both the COBA area are not statistically significant. Therefore, the reduction in the number of collisions over the COBA area cannot be not directly attributed to the scheme measures.

M40 Junction 15 Key Links Section

Evaluation of Collision Numbers and Severity

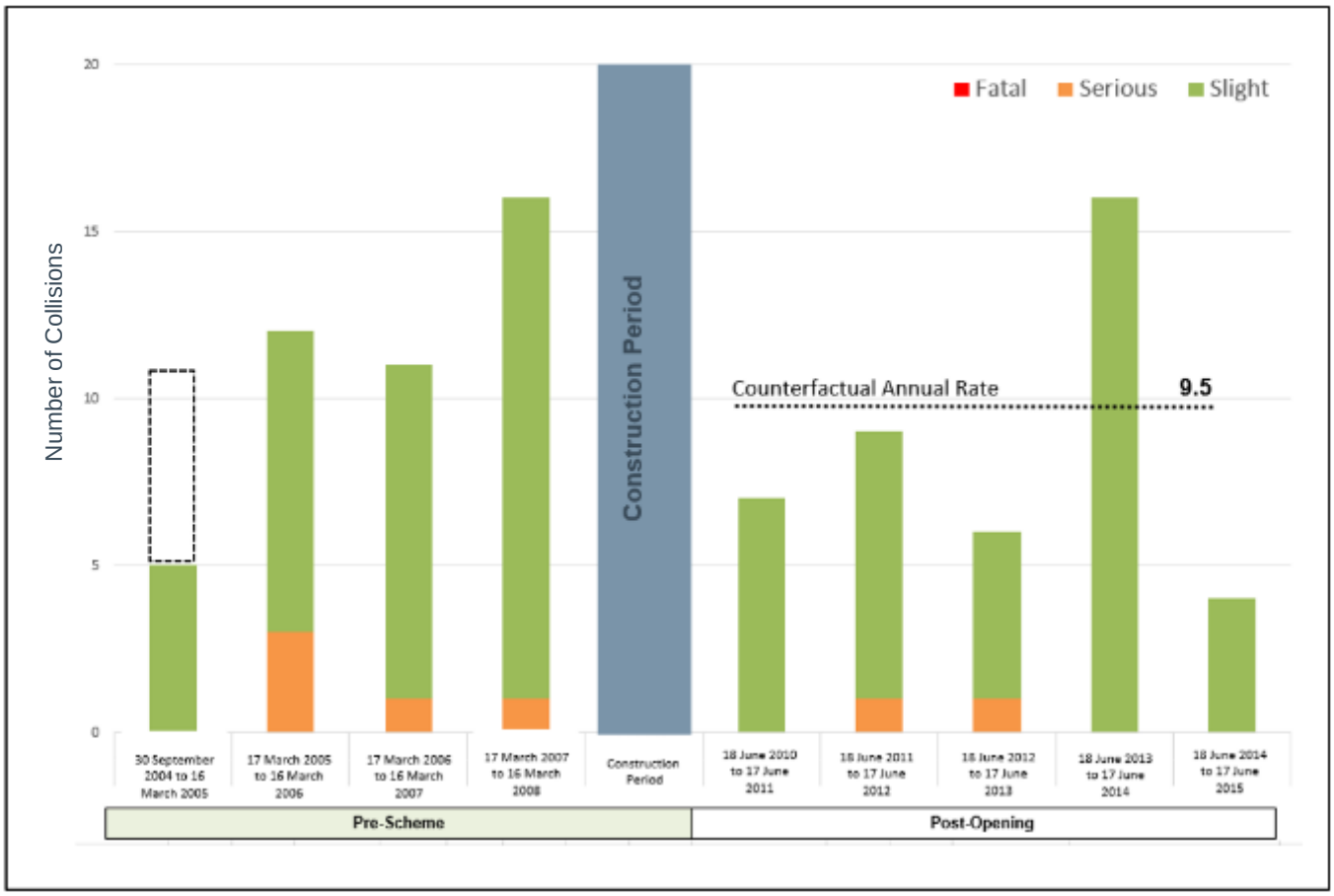
3.15. An analysis of PIC records has been undertaken within the Key Links Analysis Area (Figure 3-2) in order to determine the impact of the scheme measures on the collision rate within the immediate vicinity of the scheme. An evaluation of the before and after collision numbers by year for the Key Links Analysis area is shown in Table 3-3 3-3. Figure 3-4 shows the number of collisions on an Annual Basis for the Key Links area.

Table 3-3 Number of Collisions by Severity within the Key Links Analysis Area

Period	Time Period		Number of Collisions by Severity			Total	Annual Average
	From	To	Fatal	Serious	Slight		All
Pre-Scheme	Sept/2004	Mar/2005	0	0	5	5	**12.7**
	Mar/2005	Mar/2006	0	3	9	12	
	Mar/2006	Mar/2007	0	1	10	11	
	Mar/2007	Mar/2008	0	1	15	16	
Without Scheme Counterfactual (adjusted for background reduction)[15]							**9.5**
Post-Opening	June/2010	June/2011	0	0	7	7	**8.4**
	June/2011	June/2012	0	1	8	9	
	June/2012	June/2013	0	1	5	6	
	June/2013	June/2014	0	0	16	16	
	June/2014	June/2015	0	0	4	4	

[15] Background reduction factor in collision numbers for Rural A Roads was 0.744

Figure 3-4 Number of Collisions on an Annual Basis for Key Links Analysis Area



3.16. From Table 3-3 and Figure 3-4 it can be seen that:

- The total number of collisions recorded over the post opening period was 42, resulting in an average annual average of 8.4 accidents per year. This represents a 34% reduction when compared to the pre-scheme annual average of 12.7 accidents per annum. However, when compared to the counterfactual without scheme value (taking the background reduction in collisions into account) the average annual accident saving is 12%.

- There were zero fatal collisions recorded in either the pre-scheme or post-scheme Key Links analysis periods.

- The annual average number of serious collisions has reduced by 28%, from an average of 1.4 per year in the pre-scheme period to an average of 0.4 per year in the post-scheme period.

- The annual average number of slight collisions has reduced by 29%, from an average of 11.3 per year in the pre-scheme period to an average of 8.0 per year in the post-scheme period.

- It is evident from Figure 3-4 that there was a spike in the post-opening analysis period between 2013 and 2014. Further analysis of the accident locations and details during this time period reveals that almost half of the accidents occurred at the southern connector roundabout, however the contributory factors did not reveal any clear trends in the causation factors.

- Please note that the observed changes over both the Key Links area are not statistically significant. Therefore, the reduction in the number of collisions over the Key Links area cannot be not directly attributed to the scheme measures.

Evaluation of Collision Severity Index

3.17. The collision severity index is the ratio of the number of collisions classed as serious or fatal compared to the total number of collisions. A summary of the before and after opening collision severity indices for the whole of the COBA modelled area, and the M40 J15 key links analysis area is shown in Table 3-4.

Table 3-4 Collision Severity Index

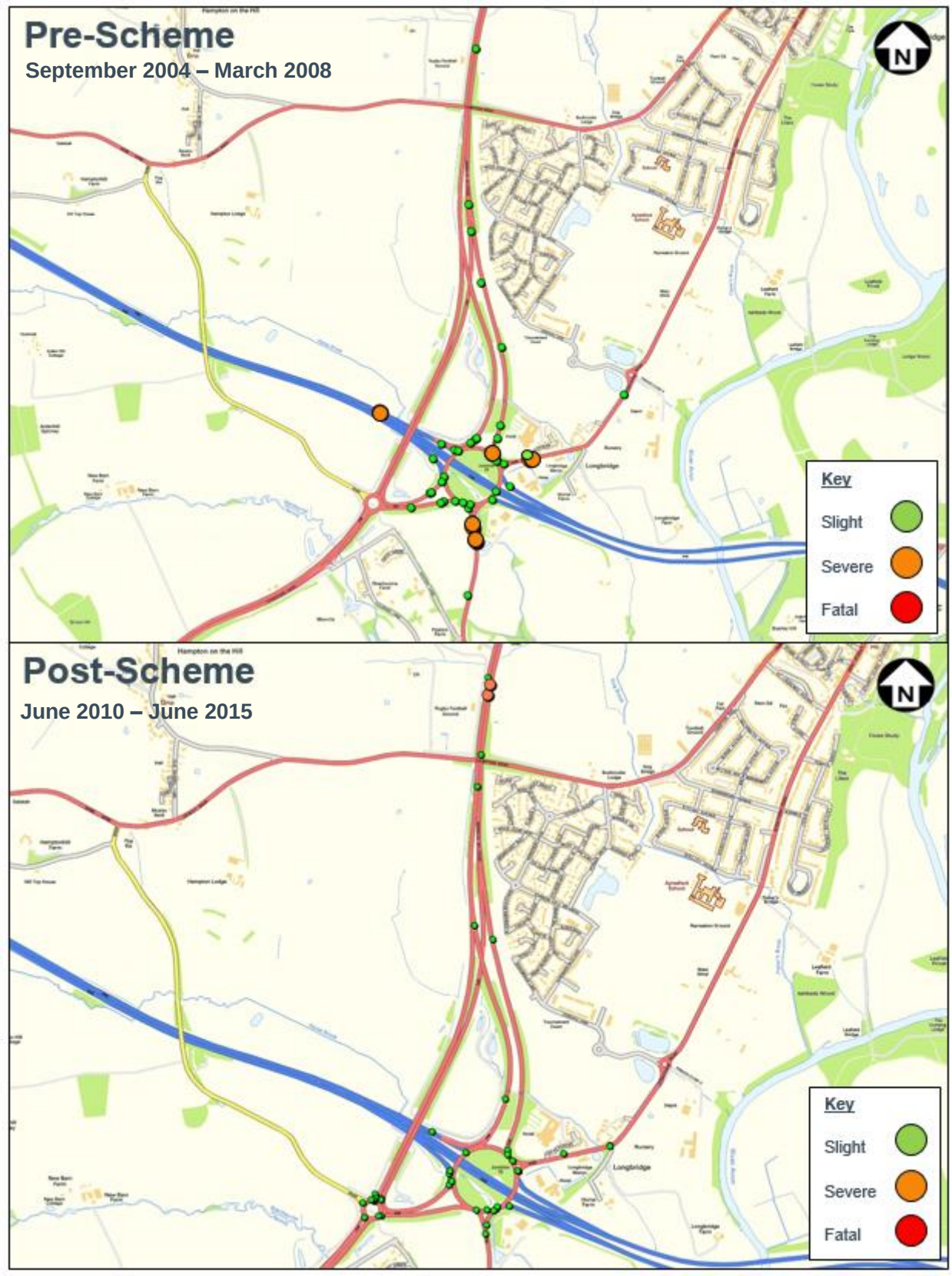
Period	COBA Area	Key Links
	Collision Severity Index	Collision Severity Index
Pre Scheme	0.14	0.11
Post Opening	0.12	0.05

3.18. The collision severity index has reduced significantly over the M40 J15 Key Links Analysis Area, however the severity index has only slightly reduced over the wider COBA area. As previously noted, the annual average number of fatal collisions has remained constant in both the pre-scheme and post-scheme analysis areas and therefore the decrease in the severity index is due to the reduction in both serious and slight collisions.

Location of Collisions

3.19. The location of the collisions recorded within the M40 J15 Key Links Analysis Area for both the pre-scheme and post-scheme periods are shown in Figure 3-5.

Figure 3-5 M40 J15 Key Links Analysis Area Collision Locations _ Pre-scheme (top), Post-scheme (bottom)



3.20. Figure 3-5 demonstrates that within the pre-scheme assessment period there was a cluster of 'slight' accidents at M40 J15. The majority of the collisions were located on the circulatory carriageway where the approach arms traverse the junction. During the pre-scheme analysis period several 'severe' or 'fatal' collisions were recorded at M40 J15, however in the post-opening period there have been no 'severe' or 'fatal' collisions recorded at either M40 J15 or the southern connector roundabout.

3.21. Post-opening, several collisions occurred at the southern connector roundabout, this was constructed as part of the scheme measures and has therefore increased the number of conflicting vehicle movements. Therefore, an increase in collisions would be expected. There is also a cluster of collisions on the A46 'free-flow' link which allows vehicles to access the M40 EB on-slip unopposed. The new layout introduced as part of the scheme measures may have promoted driver error/ confusion for those vehicles not familiar with the new layout.

3.22. Figure 3-5 also shows an increase in the number of collisions along the A46 north of J15 (before the merge/diverge with the new A46 scheme bypass) with two 'severe' accidents occurring. This increase in collisions could potentially be attributed to driver error with vehicles uncertain about the route choice and/ or new road layout. This is particularly relevant for vehicles trying to access the M40 WB carriageway via the A46 north, because the movement via the unopposed free flow link along the new A46 bypass is counter-intuitive for vehicles used to accessing the M40 WB carriageway via M40 J15. This issue was identified at OYA.

Casualties- M40 J15 Key Links Analysis Area

3.23. The number of casualties resulting from collisions occurring within the M40 J15 Key Links analysis area have been analysed. These statistics are summarised in Table 3-5.

Table 3-5 Number of Casualties by Severity on the M40 J15 Key Links

Time Period	Date		Number of Casualties				Annual Average (Total)	Severity Index (KSI)
	From	To	Fatal	Serious	Slight	Total		
Pre-Scheme	Sep 2004	Mar 2005	0	0	7	7	19.1	15%
	Mar 2005	Mar 2006	0	5	14	19		
	Mar 2006	Mar 2007	0	4	17	21		
	Mar 2007	Mar 2008	0	1	19	20		
Post-Scheme	June 2010	June 2011	0	0	8	8	10.8	6%
	June 2011	June 2012	0	1	13	14		
	June 2012	June 2013	0	2	6	8		
	June 2013	June 2014	0	0	19	19		
	June 2014	June 2015	0	0	5	5		

3.24. Table 3-5 shows that:

- The average annual number of casualties has fallen from 19.1 in the pre-scheme period to 10.8 in the post-opening period, a reduction of 43%. This suggests that the scheme has improved safety over the M40 J15 key links analysis area.

Road Safety Audit

3.25. The M40 Junction 15 Major Improvement Road Safety Audit Stage 4A Report was published in February 2012. The report identified concerns with the A46 new bypass, implemented as part of the scheme measures. The report identified the following concerns relating to the new scheme layout:

"Late braking and lane changes at the A46 southbound bifurcation to the A46 bypass southbound/ A46 link road may lead to serious shunt, sideswipe or loss of control and side swipe collisions"

The concerns outlined within the Road Safety Audit Stage 4A will be examined within the next section.

Causation Factors

3.26. Analysis of the collision data within the scheme cordon area shown in Figure 3-2, it has been possible to make some broad observations relating to the most common causes of collisions during the before and after period, and whether there have been any changes which may be attributed to the scheme.

3.27. Analysis of the collision contributory factors within the key links analysis area (see Figure 3-6) indicates that the most common causes of collisions in the vicinity of M40 J15 are classified within 2 primary categories: 'Injudicious Action' and 'Driver Error'. Analysis of the key contributory factors within each of these 2 categories is presented in Table 3-5. A more detailed breakdown of the all contributory factors within the 2 categories is provided in Appendix A.

Table 3-6 Summary of Key Contributory Factors within M40 J15 Key Links Analysis Area

Code	Type of Accident	Pre-Scheme		Post-Scheme		Saving
		Total	Rate (pa)	Total	Rate (pa)	
301-310	**Injudicious Action**	**9**	**2.6**	**7**	**1.4**	**1.2**
306	Exceeding speed limit	0	0.0	1	0.2	-0.2
307	Travelling too fast for conditions	3	0.9	0	0	0.9
308	Following too close	4	1.1	4	0.8	0.3
401-410	**Driver/Rider Error**	**16**	**4.6**	**25**	**5**	**-0.4**
403	Poor turn or manoeuvre	5	1.4	2	0.4	1.0
405	Failed to look properly	4	1.1	9	1.8	-0.7
406	Failed to judge other person's path or speed	4	1.1	4	0.8	0.3
410	Loss of Control	3	0.9	1	0.2	0.7

Note: A decrease in accidents is represented as a positive value.

3.28. The concerns outlined within the Road Safety Audit Stage 4A identified a potential problem with late braking and lane changes at the A46 southbound bifurcation. Collisions caused by late breaking/ lane changing could be attributed to vehicles 'following too close', making 'poor turns or manoeuvres', 'failing to look properly' or 'failing to judge another person's path or speed'. Table 3-8 demonstrates that there has been a reduction in the number of collision attributed to the majority of these factors, however, there has been an increase in the number of vehicles 'failing to look properly'. The RSA 4b was not available at the FYA stage, however further evaluation into the findings would identify if the concerns outlined within the RSA 4a are still present.

3.29. The total number of collisions involving injudicious action has decreased by around 50% from 2.6 incidents per annum in the pre-scheme period to 1.4 incidents in the post-scheme period. There has been a decrease in the number of collisions where drivers were following too close, suggesting that less 'shunt' type collisions have occurred during the post-scheme period. Furthermore, there are no incidents post-scheme which involve drivers travelling too fast for conditions (compared to average of 0.9 per annum during the pre-scheme period). However, one incident was recorded post-scheme where the driver was exceeding the speed limit. This may well be a result of vehicles trying to take advantage of the faster, unimpeded route along the A46 scheme bypass;

3.30. The total number of driver/rider error related incidents has marginally increased by 0.4 incidents per annum. However, there has been a reduction in the individual factors which typically relate to collisions in proximity of a junction. For example, the number of incidents involving vehicles making a 'poor turn or manoeuvre' has decreased by an average of 1.0 collisions per annum. Additionally, the number of vehicles failing to judge another person's path or speed has decreased from 1.1 incidents per annum to 0.8 incidents per annum which may indicate a decrease in the number of shunt-related collisions.

Statistical Significance

3.31. In order to determine whether the change in collision numbers observed during the pre and post opening analysis periods is statistically significant, Chi-Square (with a 95% confidence interval) tests have been undertaken. This test uses the before (counterfactual) and post scheme opening numbers of collisions to establish whether the changes are significant or likely to have occurred by chance. This test has been undertaken over both the wider COBA area and the key links area.

3.32. The results found that, when adjusted for a background reduction in collisions, the observed changes over both the COBA area and the key links area are not statistically significant. Therefore, the reduction in the number of collisions over both the COBA area and the key links area cannot be not directly attributed to the scheme measures.

Forecast vs. Outturn Collision Numbers

3.33. This section provides a comparison between the number of observed collisions presented within this section and the number of collisions that were forecast to occur. This section provides a comparison between the forecast collision savings and the observed collision savings across the wider COBA network and a comparison between the forecast collision savings and the observed collision savings across the M40 J15 Key Links section.

COBA Area

3.34. Table 3-6 presents the comparison between the forecast collision savings and the observed collision savings across the COBA network area.

Table 3-7 Comparison of Predicted and Observed Collisions across the COBA Network Area

COBA Area Predicted (Central Growth Opening Year)	**Do- Minimum (without scheme)**	**93.0**
	Do-Something (with scheme)	79.6
	Forecast Saving	**13.4**
	% Change	**14.4%**
COBA Area Observed (Pre-scheme vs post-opening annual average)	Before Opening Observed	158.9
	Without scheme (counterfactual for same period as after data)	126.4
	After Opening Observed	119.3
	Observed Saving	**7.1**
	% Change	**6%**

3.35. Table 3-6 demonstrates that:

- Across the wider COBA area, the observed collision saving is lower than forecast in the post-opening period. The post opening observed saving of 7.1 collisions is 6.3 collisions lower than forecast. The observed collision saving of 7.1 is compared to the scheme counterfactual in order to take into account the background reduction in collisions across the COBA area.

- The relative percentage change in the number of collisions is 6% in the observed post-scheme period compared to the forecast percentage change of 14.4%.

3.36. Table 3-7 presents the comparison between the forecast collision savings and the observed collision savings across the M40 J15 Key Links section.

Table 3-8 Comparison of Predicted and Observed Collisions over the Key Links section

Cordon Area Predicted (Central Growth Opening Year)	**Do- Minimum (without scheme)**	**15.7**
	Do-Something (with scheme)	13.7
	Forecast Saving	**2.0**
	% Change	**12.7%**
Cordon Area Observed (Pre-scheme vs post-opening annual average)	Before Opening Observed	12.7
	Without scheme (counterfactual for same period as after data)	9.5
	After Opening Observed	8.4
	Observed Saving	**1.1**
	% Change	**12%**

3.37. Table 3-7 demonstrates that:

- Unlike the comparison across the wider COBA area, the absolute number of observed accidents across the M40 J15 key links section is much more comparable, with an average of 12.7 accidents per annum during the pre-scheme period compared to an accident rate of 15.7 accidents in the Do-Minimum forecast.

- The observed accident reduction in the vicinity of the scheme remains lower than the forecast accident saving, with an observed saving of 1.1 per annum compared to the forecast saving of 2.0. However, the relative percentage change in the number of accidents is comparable, with an observed percentage change of 12% in the post-scheme period compared to the forecast percentage change of 12.7%.

Fatalities and Weighted Injuries

3.38. The collision rate discussed previously does not take into account the severity of collisions. To analyse this, the Fatalities and Weighted Injuries (FWI) metric which is a combined measure of casualties based on the number of fatal, serious and slight casualties is presented. The FWI for the pre-scheme and post-opening periods are shown in Table 3-9. It should however be noted that these figures do not take account for background reductions in casualties or collisions.

Table 3-9 FWI on the M40 J15 Scheme

	FWI/collision	FWI/year
Pre-scheme	0.036	0.45
Post-opening	0.019	0.16

3.39. From Table 3-9 it can be seen that each of the FWI metrics have reduced following scheme opening, indicating that the seriousness of injuries has reduced significantly despite overall traffic flows being higher.

Personal Security

3.40. The aim of this sub-objective is to reflect both changes in security and the likely number of users affected. In terms of roads, security includes the perception of risk from personal injury, damage to or theft of vehicles, and theft of property for individuals or from vehicles in the following areas:

- On the road itself (e.g. being attached whilst broken down).
- In service areas, car parks and so on (e.g. vehicle damaged while parked at a service stations, being attached whilst walking to a parked car).
- At junctions (e.g. smash and grab incidents while queuing at lights).

3.41. The primary indicators for personal security on roads include:

- Surveillance
- Landscaping
- Lighting and visibility
- Emergency call facilities
- Cyclists and pedestrian facilities

Forecast

3.42. The scheme appraisal identified that there are minimal pedestrian or cyclist movements in the vicinity of the scheme, but that a footway/cycleway/bridleway and underpass had been incorporated into the scheme design. Therefore, a 'beneficial' impact on security was predicted.

Evaluation

3.43. A site visit was undertaken during September 2015, this confirmed that the new footway and underpass implemented as part of the scheme measures (Figure 3-7) were still in operation.

3.44. There has been no change to the primary indicators for personal security since the scheme opened. The implementation of the footway/cycleway/bridleway and underpass reduces the potential for incidents involving non-motorised users crossing the carriageway. However, there remains a slight increase in the potential for crime related incidents to occur because pedestrians are required to walk through an unlit underpass.

3.45. As a result of the assessment above, the impact of the scheme on personal security is considered 'neutral' in line with the OYA.

Figure 3-6 New Footway and Underpass Implemented as Part of the Scheme Measures

3.46. The scheme was not deemed to have had an impact on the personal security of road users given the rural location of the M40 Junction 15 Scheme. Furthermore, there were no discernible changes to the lighting at the scheme location.

Key Points – Safety

Collisions

- Analysis of collision data has revealed an annual collision saving of 0.9 collisions per annum across the scheme cordon area (when compared to the scheme counterfactual in order to account for the background reduction in collisions). However, the observed change over both the COBA area and the key links analysis area is not statistically significant. Therefore, the reduction in the number of collisions over both the COBA area and the key links area cannot be not directly attributed to the scheme measures.

Locations of Collisions

- No 'serious' or 'fatal' collisions have taken place on either the M40 Junction 15 roundabout or the southern connection roundabout during the post-opening period.
- Collision clusters identified at M40 Junction 15 have seen significant reductions in collisions during the post-opening period. These reductions may well be attributed to reduced congestion and queuing.

Causation Factors

- The total number of collisions involving injudicious action has decreased by around 50% from 2.6 incidents per annum in the pre-scheme period to 1.4 incidents in the post-scheme period. There has been a decrease in the number of collisions where motorists were following too close, suggesting that less 'shunt' type collisions have occurred during the post-scheme period.
- The total number of driver/rider error related incidents has marginally increased by 0.4 incidents per annum. However, there has been a reduction in the individual factors which typically relate to collisions in proximity of a junction. Additionally, the number of motorists failing to judge another person's path or speed has decreased from 1.1 incidents per annum to 0.8 incidents per annum which may indicate a decrease in the number of shunt-related incidents.

Security

- The implementation of an underpass at the southern connection roundabout near Sherbourne is likely to improve security for a small number of NMUs by reducing the potential for incidents involving these users crossing the road.

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 achieve good value for money

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

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

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

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

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

Sources

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

- Figures presented in M40 Junction 15 (Longbridge) Economic Assessment Report (EAR) dated June 2006;
- Forecast costs of the scheme from the same EAR;
- COBA;
- AST; and
- TUBA model runs.

4.6. The outturn results are sourced from:

- Outturn costs from the Regional Finance Manager in March 2015; and

- Benefits based on the observed findings of the impacts on the traffic and collisions as detailed in the preceding traffic and safety sections of this report monetised to create re-forecasts of the long term impacts.

4.7. The reports provide forecasts of the benefits for a 60 year appraisal period. All costs presented in the EAR and this chapter are in 2002 prices discounted to 2002 unless otherwise stated.

Forecast Impact

4.8. The appraisal of the M40 J15 scheme considers the economic benefits associated with the scheme expressed in terms of present value (present value benefits - PVB). A summary of the predicted scheme impacts from the EAR is shown in Table 4-1. This table also sets out those aspects which will be considered within this post-opening evaluation report and the approach taken to evaluate the scheme benefits. Those aspects which have not been evaluated have been assumed as forecast in the EAR.

4.9. Only forecasts based on central growth estimates were presented in the EAR.

Table 4-1 Economic Benefits of Scheme (2002 prices)

Benefits in £m 2002 market prices, discounted	Forecast (EAR)	Evaluate ?	Evaluation Approach
Journey Time	£232.2m	✓	Outturn journey time impacts can be calculated from observed data and forecasts.
Vehicle Operating Costs (VOC)	£5.0m	×	The majority of the benefits were forecast to accrue through journey time savings, with only a small proportion resulting from VOC savings. In addition, it is difficult to accurately re-forecast the long term trends associated with savings in VOC, therefore outturn VOC is assumed to be as forecast in the EAR.
Net Construction & Maintenance Delay impact (60 years), From QUADRO (Journey time and VOC impacts during construction & future maintenance)	-£5.9m	×	Not known and not within the remit of POPE to evaluate, so assumed to be as forecast.
Safety	£37.6m	✓	Based on change in collision numbers.
Total PVB	**£268.9m**		
Indirect tax revenue impact as a benefit	+£4.0m	✓	Calculate net change in fuel consumption and use ratio against forecast change to re-forecast 60 year benefit
Total PVB including Indirect Tax Revenue	**£272.9m**		

Evaluation of Journey Time Benefits

4.10. The journey time benefits for this scheme have been evaluated using a Project Appraisal Report (PAR) approach, typically adopted by Highways England for appraisal of smaller schemes[16]. This evaluation is therefore subject to the following caveats and assumptions as listed below:

- The evaluation includes journey time savings for users of the new scheme bypass and for those at M40 Junction 15, incorporating both of the key potential sources of TEE benefits as forecast in the EAR;
- Journey time benefits for road users who travel via the scheme bypass are assessed over a full 24-hour, 7-day week period as all vehicles which use this route can be expected to experience delay savings by using the new free-flow link;
- Journey time benefits for road users who travel via the circulatory carriageway of M40 Junction 15 are only assessed over a 12-hour weekday period. This is due to the fact that little change in travel time has been observed for the majority of turning movements during the off-peak and weekend periods;
- Total vehicle hours saved for each individual time period and movement are based on the observed journey time saving per vehicle factored by the number of vehicles. Post-opening turning counts have been used to provide turning proportions for vehicles at each approach arm at M40 Junction 15 and the southern connection roundabout; and
- Vehicle hour savings for the opening year are monetised according to PAR6 values for 2011, which gives an average vehicle Value of Time (VoT) 1203 pence per hour. Savings are then capitalised over a 60 year assessment period. The PAR method provides capitalisation factors which depend only on forecast growth rate whereas modelling tools used for the appraisal consider the complexity of how traffic growth would affect future traffic behaviour in detail. For this scheme, future forecasts will be influenced by timing and severity of forecast congestion in the area around the junction rather than the generalised approach within the PAR methodology.

4.11. The outturn monetised journey time benefits are shown in Table 4-2.

Table 4-2 Outturn Monetised Journey Time Benefit

Scheme Area	Annual Vehicle Hours Saved	Monetary Benefit based on VoT saved	
M40 Junction 15	137,408	£1.6m	
A46 Bypass and Southern Connection	148,547	£1.8m	
Total	**285,955**	**£3.4m**	
Future Traffic Growth		**0% Traffic Growth**	**NRTF Traffic Growth**
2015 Monetary Benefit Capitalised over 60-year Assessment		**£96.12m**	**£127.54m**

[16] PAR Guidance Project Appraisal Report Guidance Notes Version 6.1

Vehicle Operating Costs (VOC)

4.12. For most highway schemes including this one, both the VOC and indirect tax impacts are closely linked to changes in fuel consumption which for the changes made by a scheme such as the M40 J15 bypass are primarily changes in speed. In economic terms this has similar magnitude of impacts, but from opposite sides of the benefits balance. That is, if there increased fuel consumption, VOC will be a dis-benefit due to users paying more for fuel and thus more indirect tax will be collected by the Treasury.

4.13. It has not been possible to undertake an accurate reforecast of vehicle operating costs for the outturn situation, as there is a lack of information available relating to forecast speeds etc. For the purpose of considering the total benefits and hence the outturn Benefit Cost Ratio (BCR), the forecasts made in the central growth scenario for the levels of VOC and construction/maintenance delay have been included in the outturn benefits.

Construction Delay

4.14 The DfT's QUADRO (Queues and Delays at Roadworks) programme was used to estimate the impact of the proposed scheme on road users in terms of vehicle journey times, operating costs and accidents during the construction phase. According to the EAR, the construction period was assumed to last for 2 years, taking place from summer 2007 to summer 2009. The assessment considered impacts along routes where works were scheduled to take place and along proposed diversion routes during each phase of construction.

4.15 The QUADRO assessment estimated the overall cost to road users as a result of the scheme's construction at a dis-benefit of £5.891m. The vast majority of this (95%) was predicted to arise from travel delays and vehicle operating costs (£5.653m), with only a small proportion being attributed to collisions (£0.299m). The costs would be offset slightly by an estimated increase in Government Tax Revenue of £0.061m.

4.16 It is not possible to undertake an evaluation of the monetary impact of construction and future maintenance as this would have required traffic surveys to have been undertaken during the construction phase and is outside the remit of POPE. The forecast level of construction and maintenance period dis-benefits estimated within the EAR are therefore used in the PVB calculation.

Evaluation of Safety Benefits

Forecast Safety Benefits

4.17 The forecast safety benefits for this scheme were derived from the COBA model (which also monetised the benefits), with the findings detailed in the scheme AST. A 60 year scheme saving of 580 collisions was forecast, with a corresponding 60 year monetary benefit of £37.6m over the appraisal period (2002 prices discounted to 2002). This represents 14% of total scheme benefits. These figures were based on a central growth forecast.

4.18 Table 4-3 outlines the forecast accident savings as presented in the scheme EAR.

Table 4-3 COBA Forecasts for 60-Year Scheme Appraisal

Do Minimum (DM)	**Number of Collisions**	**5,872**
	Number of Casualties Fatal Serious Slight	 149 928 8,267
	Collision Costs	**£330.9m**
Do Something (DS)	**Number of Collisions**	5,291
	Number of Casualties Fatal Serious Slight	 131 822 7,489
	Collision Costs	**£293.3m**
Net (DM-DS)	**Collision Saving**	**£37.6m**

*Monetary Values in 2002 Prices Discounted to 2002

Monetised Safety Benefits

4.19 The POPE methodology for the evaluation of the outturn economic benefit value arising from safety improvements is based on the comparison between the forecast change in collision numbers and the observed change at the evaluation stage (in this case five years after opening, and using the pre scheme counterfactual scenario to take background decline in collisions into account). This is then combined with the assumption that the observed safety impact reported in Chapter 3 at this stage can be taken as indicative of that likely over the whole 60 year period.

4.20 Monetisation of the input is calculated by:

- Calculating the net difference between the forecast opening year saving and the observed annual average collision savings in both the COBA study area and the M40 J15 Key Links area over the first five years (as shown in Chapter 3).
- Monetising the net difference in the number of collisions using the PAR method which values collisions by road type and enables capitalisation over 60 years based on expected traffic growth.
- Calculating the 60 year outturn benefits for the whole area by combining the forecast from COBA (for the whole study area) with the outturn assessment of the net difference.

4.21 The evaluation of the monetary safety benefits is shown in Table 4-3. All monetary values are in 2002 prices discounted to 2002.

Table 4-4 Forecast vs. outturn collision benefits

Monetary benefits in £m 2002 prices, discounted	Forecast COBA		Outturn	
Opening year collision saving on key links	(a)	2.0	(b) Five year annual average	1.1
Difference from forecast			(c) =(b) - (a)	-0.9
Value of a Dual Carriageway collision in opening year (2010) presented in 2002 prices			(d)	£89,180
60 year benefits of difference in opening year collisions, capitalised and discounted to 2002 prices			(f)=(d) x (e) x factors	-£3.3m
60 year monetary (present value benefits) over COBA area	(g)	£37.6m	(f) + (g)	**£34.3m**

4.22 Table 4-4 demonstrates that the re-forecast 60 year monetary safety benefits for the COBA area are 9% lower than originally forecast at a £34.3m saving over 60 years.

4.23 However, it is important to note that the analysis undertaken in Section 3 identified that the reduction in collisions across both the COBA area and the Key Links analysis area is not statistically significant and therefore cannot be confidently attributed to the scheme. Therefore, the monetised safety value calculated in Table 4-4 is not included in the BCR calculation for the scheme.

Scheme Costs

Investment Costs

4.24 This section compares the forecast cost of the scheme with the outturn cost. Scheme costs include the cost to Highways England of constructing the scheme and purchasing the land.

4.25 Forecast costs are taken from the Economic Assessment Report (June 2006). The outturn cost (obtained from the Highways England (at time of request) Regional Finance Manager) presented in Table 4-5 includes the cost of the scheme as of 2015.

Table 4-5 Summary of Investment Cost (2002 Prices)

Cost Element	Forecast Cost	Outturn Cost	Difference
Works, Prep and Supervision	£57.4m	£61.7m	+4.5%
Land	£1.5m		
Total	**£58.9m**	**£61.7m**	

Present Value Costs (PVC)

4.26. Cost benefit of a major scheme requires the costs to be considered for the whole of the appraisal period and they need to be expressed on a like-for-like basis with the benefits. This basis is termed Present Value. Present Value is the value today of an amount of money in the future. In cost-benefit analysis, values in differing years are converted to a standard base year by the process of discounting giving a present value.

4.27. For consistency with the published Benefit Cost Ratio (BCR) detailed in the EAR (2006) the forecast costs shown in , and used in the BCR calculation are based on the figures in the EAR, rather than the revised cost shown in the previous table, and hence the forecast PVC is shown as lower than the investment cost in 2002 prices.

Table 4-6 Investment costs as present value

Costs in 2002 market prices, discounted	Forecast	Outturn
Scheme cost	£57.0m	£60.1m

Monetary Values in 2002 Prices Discounted to 2002 – Expressed in terms of Market Prices

Indirect Taxation

4.28. 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 monetisation of forecast of the changes in fuel consumption over the 60 years period. A scheme may result in changed fuel consumption due to:

- 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.

Forecast

4.29. At the time of appraisal, the impact of indirect tax was included as part of the costs, however, current appraisal guidance includes the impact of indirect tax revenue changes as part of the benefits of a scheme; therefore both methods are presented later in this section when calculating the Benefit Cost Ratio (BCR).

4.30. The schemes forecast impact on Indirect Tax revenue was derived from the TUBA and QUADRO assessments which show increases in tax revenue of £3.960m and £0.061m respectively. Consequently, forecast indirect tax was calculated as £4.021 million.

Evaluation

4.31. In order to provide an indication of the observed scheme impact on indirect tax, this post-opening evaluation has calculated the estimate change in fuel consumption (based on traffic volumes, proportions and average speeds pre-scheme and post-opening) for an annual average, using figures provided in WebTAG. Following this, an NRTF capitalisation factor was applied to provide the cost over a 60-year period. The outturn indirect tax revenue element during the post-opening period was calculated to be £0.27m over 60 years. This was combined with the assumed tax revenue during the construction period to give a total indirect tax estimation of £0.24m.

Benefit Cost Ratio

4.32. The benefit-cost ratio (BCR) is an indicator used in the cost-benefit analysis of a road scheme that attempts to summarise the overall value for money of a project or proposal. The BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. All benefits and costs are expressed in present values. Projects with a BCR greater than 1 have greater benefits than costs, thus providing positive net benefits.

4.33. At the time of scheme appraisal, Treasury guidance was to include indirect tax impact as part of the cost. However, the most recent guidance on indirect tax impacts recommends that it is included as part of the benefit. This means that when a scheme such as this which leads to increased fuel consumption and hence increases indirect tax revenue, the PVB is increased rather than the PVC being decreased.

4.34. Table 4-7 presents the BCR of the scheme, with indirect tax included as both a cost and a benefit. All figures are presented in 2002 prices discounted to 2002.

Table 4-7 Forecast vs. Outturn Re-forecast Benefit Cost Ratio

All in 2002 prices, discounted to 2002		Forecast Central Growth	Outturn
Costs	Investment Cost	£57.0m	60.1m
Benefits	Journey time benefits	£232.2m	£127.54m
	Vehicle operating costs[17]	£5.0m	£5.0m
	Safety benefits[18]	£37.6m	-
	Construction delay and maintenance[19]	-£5.9m	-£5.9m
	PVB subtotal	**£268.9m**	**£126.6m**
	Indirect tax	£4.0m	£0.24m
BCR (with indirect tax in PVC)		**4.8**	**2.1**
BCR (with indirect tax in PVB)		**5.1**	**2.1**

4.35. Overall, the outturn BCR of 2.1 is lower than the forecast BCR of 5.1, however a BCR of 2.1 still represents high value for money according to Department for Transport criteria.

4.36. It should be noted that the Safety Benefits calculated in Section 3 of this report are not included in the BCR calculation because they were not statistically significant across either the wider COBA area or the M40 J15 key links area and therefore could not be directly attributed to the scheme measures. Therefore, the PVB presented within the BCR calculation is considerably lower than the forecast scheme benefits.

4.37. It should also be noted that the BCR ignores non-monetised impacts. Guidance states that the impacts on wider objectives must be assessed but are not monetised. The evaluations of the wider economic impacts, environmental, accessibility and integration objectives are covered in the following sections of this report.

[17] VOC assumed as forecast.
[18] Note that the outturn safety benefits are not included in the BCR calculation because the benefits are not statistically significant and therefore the benefit cannot be directly attributed to the scheme measures.
[19] Construction maintenance and delay assumed as forecast.

Wider Economic Impacts

Forecast

4.38. According to the Appraisal Summary Table (AST), an Economic Impact Report was not required. Consequently, the Wider Economic Impacts sub-objective was scored as 'neutral'.

Evaluation

4.39. As discussed in Chapter 2 of this report, the observed post-scheme traffic flows in the immediate vicinity of the scheme are considerably lower than those presented within the traffic forecasting report. In addition, the level of development at Tournament Fields Business Park immediately to the north of the junction is considerably lower than forecast.

4.40. These observations provide an indication that the scheme has not had an immediate influence in terms of stimulating economic activity and thus the impact must be considered neutral. However, given the positive impact the scheme has had on TEE benefits, it seems plausible that the scheme will help to facilitate increased economic activity over the 60 year scheme life.

Key Points – Economy

Benefits

- Outturn journey time benefits of £127.54m are lower than the forecast benefits of £232.2m. This can be largely attributed to the over-estimated level of traffic growth for the scheme.
- It should be noted that the Safety Benefits calculated in Section 3 of this report are not included in the BCR calculation because they were not statistically significant across either the wider COBA area or the M40 J15 key links area and therefore could not be directly attributed to the scheme measures. Therefore, the PVB presented within the BCR calculation is considerably lower than the forecast scheme benefits.
- Overall including both journey time and safety, the outturn total benefits are 53% lower than forecast.

Costs

- Outturn investment costs were 5% higher than forecast.

Benefit Cost Ratio

- Using the reforecast benefits, the scheme achieves a BCR of 2.1 which shows the scheme has delivered high value for money.

Wider Economic Impacts

- At five years after opening, the scheme has not had an immediate influence in terms of stimulating economic activity and thus the impact must be considered neutral. However, given the positive impact the scheme has had on TEE benefits, it seems plausible that the scheme will help to facilitate increased economic activity over the 60 year scheme life period.

5. Environment

Introduction

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

5.2. The Environmental Statement (ES) (July 2006) states that the key objectives pertinent to the environment were to reduce congestion and provide improved levels of safety for both the travelling public and Non-Motorised Users (NMUs) in the area. Scheme proposals, including cross sections are illustrated in Figure C-17 and Figure C-18 in Appendix B.

Scheme Objectives

5.3. The principal aims of the scheme were as follows:

- To reduce congestion at M40 Junction 15 and improve travel times by reducing the amount of A46 traffic travelling through the junction; and
- To improve safety for road users at the junction through the various improvements to the roundabout.

5.4. These aims relate to the environmental topic of journey ambience. Environmental mitigation was included within the scheme to minimise the predicted environmental effects.

Summary of OYA Evaluation

Noise Impacts

5.5. The AST predicted that there would be a decrease in the number of people annoyed by noise with the scheme. Lower than forecast traffic flows at OYA suggested there were likely to be better than expected noise impacts, but this was not supported by consultation with parish councils.

Local Air Quality Impacts

5.6. The AST predicted there would be an overall improvement in air quality with the scheme. The change with the scheme was likely to be better than expected as OYA observed traffic flows were lower than forecast.

Greenhouse Gas Impacts

5.7. The AST predicted a 2,564 tonne increase in CO^2 levels with the development of the scheme. However, in the OYA a decrease in CO^2 levels of 1,023 tonnes had been calculated with benefits from reduced congestion at M40 Junction outweighing the increases in CO^2 resulting from traffic travelling at high speeds along the bypass.

Landscape Impacts

5.8. Overall, landscape impacts were considered to be moderate adverse in line with the ES OYA assessment. Scheme mitigation had largely been implemented as expected and as planting matures impacts could reduce to slight adverse as predicted in the AST and ES for year 15. The scheme adds a strong vertical element to the landscape that was not previously there that will take time to soften in appearance. Ongoing establishment of landscape planting should be revisited at FYA. Lighting had not been assessed at OYA, although there had been complaints from Parish Councils.

Biodiversity Impacts

5.9. Scheme impacts were considered to be slight adverse, as expected, at OYA. Mitigation had generally been implemented as expected and significant effects on biodiversity had been avoided or mitigated, although adverse effects on over-wintering lapwing had been noted by the County Ecologist. Establishment of mitigation should see slight benefits in future years. However, survey or monitoring information (which the scheme consent did not require) would be required in order to fully evaluate this sub-objective.

Cultural Heritage Impacts

5.10. The overall impact of the scheme on heritage was considered to be slight adverse at OYA, as predicted. However, some individual impacts on built heritage identified as being slight adverse in the Sherbourne area were considered to be worse than expected – moderate adverse – at OYA.

Water Impacts

5.11. Scheme drainage, attenuation and pollution control measures had been provided and based on the information available to POPE the overall scheme impacts were considered to be neutral as expected.

Physical Fitness Impacts

5.12. One footpath was diverted as a result of the scheme, as predicted. The new path is longer than before, and more urban in nature. Overall the scheme's impact on physical fitness was considered to be neutral, as expected.

Journey Ambience Impacts

5.13. Impacts on journey ambience were beneficial, as expected. Reduction in congestion and improved traffic flows had reduced driver stress. Collision numbers had fallen and driver information had also been improved

FYA Evaluation Methodology

5.14. The environmental assessment focuses on those aspects that were unable to be fully appraised at OYA, or where OYA made recommendations for further study. Any issues that have arisen since OYA have been incorporated in this report. The detail of the OYA is not repeated, and reference should be made to the OYA report where required, although key points are incorporated into the FYA where appropriate to provide context.

5.15. No new modelling or survey work has been undertaken for this FYA environmental evaluation.

Data Collection

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

- AST, June 2006
- Environmental Statement (ES) Volumes 1 (main text), 2 (detailed assessment), 3 (figures) and Non-Technical Summary (July 2006)
- Environmental Statement Addendum (November 2006)
- Landscape Maintenance Programme (years 1-5) (2010)
- As Built drawings (February 2011)
- Proposed planting plans (April 2009)
- Handover Environmental Management Plan (HEMP) (June 2010)
- Post-Excavation Archaeology Assessment (December 2010)
- Project Environmental Plan (April 2010)

5.17. A full list of the background information requested and received to help with the compilation of this report is included in Table C-1 of Appendix B.

Site Inspections

5.18. A FYA site visit was undertaken on 2nd September 2015. This was limited to safe, accessible areas and included photographs which are used to illustrate the report where appropriate.

Consultations

5.19. 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	Topic	Comments
Warwickshire County Council	General, with specific queries to county ecologist and county archaeologist	No air quality or noise data available to make comment. County ecologist referred to lack of mitigation for lapwings as noted at OYA
Environment Agency	Water	Comprehensive comments received on water (Inc. biodiversity aspects) aspects of scheme
Natural England	Ecology and landscape, but specifically following up comments at OYA relating to data that may be available for Sherbourne Meadows SSSI	Confirmed OYA comments; provided monitoring data for Sherbourne Meadows SSSI
Warwickshire Wildlife Trust	Ecology	Unable to comment
Historic England	Heritage	Generic comments only
Warwick District Council	General	EHO noted that they had no noise or air quality monitoring data No response received
Warwick Town Council	General	No response received
Budbrooke Parish Council	General	General comments received
Sherbourne Parish Council	General	Detailed response received reiterating concerns made at OYA, in particular regarding noise, air quality and landscape / visual screening
Barford, Sherbourne and Wasperton Joint Parish Council	General	Response from Chairman on queuing, signage and line marking, and landscaping. No other responses received.

Scheme Amendments

5.20. The published ES (2006) was based on the highway alignment design using the Light Distance and Ranging (LiDAR) survey data. Results from a topographical proof survey in July 2006 showed that the original LiDAR ground survey was flawed, in that it had defined the ground level in the fields as the top of crops rather than the actual bare earth level. Though the scheme profile was unaltered, the depth of the embankments carrying the road increased by between 0.3m and 1.3m in relation to heights of arable fields. This discrepancy only affected the level of fields and not the level of the roads or houses and so the assessment of the environmental topics in the ES was not affected.

5.21. However, additional survey and review of the new field levels identified a number of changes to the published ES text. The lower field levels resulted in increased earthwork quantities but did not significantly alter the findings of the ES.

Traffic Forecasts and Evaluation

5.22. 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.

5.23. The traffic forecasts and observed flows used in the noise and air quality appraisals are shown in Table 5-2.

Table 5-2 Traffic Flows: Observed vs Forecast

Link	Forecast (2015)	Observed (2015)	Difference (%)
A46 Warwick Bypass	37,600	29,300	-8,300 (-22%)
A429 Stratford Road North of Junction	27,500	11,100	-16,400 (-60%)
M40 EB on-slip	22,000	15,100	-6,900 (-31%)
M40 WB off-slip	15,800	16,600	800 (5%)
A429 South of Junction	23,500	16,200	-7,300 (-31%)
A46 South of Junction	33,200	22,200	-11,000 (-33%)
M40 WB on-slip	10,000	10,100	100 (1%)
M40 EB off-slip	6,900	10,300	3,400 (49%)
A46 Bypass	33,600	23,200	-10,400 (-31%)
A46	43,900	33,200	-10,700 (-24%)

All flows are rounded to the nearest 100.
Adjusted for Seasonality

5.24. The final column in Table 5-2 shows the difference between the 2015 forecast and observed figures, not the difference before and after the scheme. Table 5-2 shows that for the majority of measured locations, traffic levels are significantly lower than predicted, with two about the same, and one significantly higher. In particular, the bypass itself has seen 22% less traffic at FYA than was predicted, although this may be a reflection of the more general reduction in traffic flows around the junction relative to predictions.

5.25. Reliable HGV flows are not available for comparison as pre-scheme observed counts were only available in a volumetric format whilst classification of forecast HGVs was not suitably defined in the Traffic Forecasting Report. Therefore the air quality and noise assessments in this report do not use them as a parameter.

5.26. No predictions were made for speeds in FYA year 2015. Whilst it is possible to interpolate traffic flows to years not directly modelled, this is not the case with traffic speeds. As such there are no valid comparisons to be made so speed is not considered in this report.

Noise

Forecast

5.27. The AST stated that "*overall, there would be 3,172 fewer people annoyed as a result of the scheme. The scheme would move traffic flows away from a large proportion of properties. Increases in traffic flows on other roads would result in increases at some properties*".

5.28. The ES stated that the assessment of individual receptors in the study area indicated that the introduction of the scheme would lead to increases and decreases in noise levels at individual properties. The overall effect of the scheme was predicted as a net benefit, with fewer dwellings experiencing increases in noise levels and noise nuisance with the introduction of the scheme than in the Do-Minimum situation without the scheme.

5.29. The changes would be largely due to the physical movement of traffic flows using the A46 further away from residential properties. Other influences were changes in traffic flows, both increases and decreases, on the wider road network, the use of low noise surfacing on the scheme and the addition of noise screening at South Warwick and Sherbourne.

5.30. There were no properties predicted to experience increases in noise levels that would make them eligible for noise insulation.

5.31. The following mitigation was included in the scheme and assessed in the noise assessment:

- A 2 metre noise fence extending from the northern end of the existing bund adjacent to Tournament Fields to the A4189;
- The existing gap in the Tournament Fields bund would be close to the level of the existing bund;
- A 2 metre noise fence adjacent to the carriageway edge along a 325 metre stretch of the elevated section of the A46 (Northbound) from chainage 625 to chainage 950;
- A bund at Sherbourne 1.5 metres above the level of the new road from south of Sherbourne Brook around the east side of the Sherbourne Roundabout up to the existing M40 Junction 15 roundabout with a total length of 650 metres. The two gaps in the bund, at the Sherbourne Brook bridge and the underpass access at the Sherbourne Roundabout, would be filled with a 1.5 metre high noise fence; and
- All parts of the scheme would be constructed using low noise road surfacing.

5.32. With regard to ground-borne vibration, the ES considered that no dwellings within 40 metres of the scheme were predicted to have any increase in traffic induced vibration, and 19 dwellings would experience a decrease in vibration with the scheme

Conclusions at One Year After

5.33. Noise mitigation had been implemented as expected as confirmed by as built drawings and a site visit. Traffic flows and speeds were generally lower than expected and on this basis it was considered likely that the noise emissions associated with the scheme were lower than predicted at OYA. However responses from consultees in particular Sherbourne and Budbrooke Parish Councils suggested that the scheme had worse than expected effects and that mitigation was insufficient. There was an impression from consultees that landscape planting was intended as noise barriers, this was not the case – acoustic barriers have been installed as part of the scheme but these were judged by Parish Council consultees to be either too short or not in the right place. Also it was thought that the nature of the earthworks has made the noise environment worse by creating '*rebound noise from the 'arena' hollow area and the noise fencing opposite this on the Chase Meadow side'.*

5.34. The overall assessment at OYA was that the noise environment was likely to be better than expected based on observed traffic flows and speeds.

Consultation

5.35. Warwick District Council was unable to comment due to not holding relevant noise data.

5.36. The following comments were made by Sherbourne Parish Council:

There is a substantial increase in noise generated by much more traffic, travelling at far greater speeds, on the A46, particularly from traffic going up Sherbourne Hill. The re-alignment of the road has thrown back this noise onto the Village to a significant degree that was not there before, which particularly affects all the homes in the Vicarage Lane area. The incessant vehicle road noise is added to by the higher-pitched noise from motorbikes, as they 'open-up' to speed up the hill on this faster road

5.37. Budbrooke Parish Council noted that:

…noise and disturbance continue to be experienced by residents of Hampton Magna as a result of the new junction layout. The noise problem reported at the one year consultation has not dissipated, in fact higher noise levels are being experienced

Evaluation

5.38. No noise surveys are undertaken as part of POPE at OYA or FYA (although further investigation was recommended following OYA); instead the approach is to determine if traffic levels are significantly different (25% higher or 20% less) than what was expected. If traffic levels are significantly lower, it is assumed that noise effects will be better than expected i.e. quieter. Similarly, significantly higher levels imply that noise levels will be worse than expected i.e. higher.

5.39. Traffic data indicates that in general traffic flows on and around the junction and bypass were lower than predicted. The majority of locations saw lower than expected results (-22% to -60%), with two locations showing minor increases relative to the prediction (M40 west bound on slip, 1%; and M40 west bound off slip, 5%). Only the eastbound M40 off slip saw a significant increase above predicted, at 49%.

5.40. The above data suggests that noise levels are likely to be lower than anticipated at a number of locations given the falls of greater than 20%.

5.41. Both Sherbourne and Budbrooke Parish Councils noted the substantial increase in noise levels at the merge of the new A46 bypass with the existing road at Sherbourne Hill, and near to the widened section of the Longbridge Roundabout near Sherbourne. Average daily traffic flows along the A46 south of the junction have increased by 7% between the pre-scheme and post-scheme periods (approximately 30,900 to 33,200). Flows at this location were forecast to be 43,900 per day, showing that observed flows are around 24% lower than forecast. Local residents are more interested in how actual traffic levels have changed over time, rather than how those changes compare to predicted levels; because POPE focusses on the latter it is difficult to incorporate this observation in the conclusions.

5.42. No information was provided to POPE regarding RSI value of road surfaces.

5.43. Based on the information available overall the noise environment is likely to be better than expected given the variance of observed levels to predicted levels,

Table 5-3 Summary of Noise Evaluation

Origin	Summary	Assessment
AST (Forecast)	Overall, there would be 3172 fewer people annoyed as a result of the scheme. The scheme will move traffic flows away from a large proportion of properties. Increases in traffic flows on other roads would result in increases at some properties	Change in population annoyed (year 15) = -3,152 PVB (residential) = £1,160,749.53
EST (FYA Evaluation)	Most traffic measuring points recorded traffic levels more than 20% lower than predicted	Better than expected overall although M40 Eastbound worse than expected and residents feeling that there is an adverse effect

Local Air Quality

Forecast

5.44. The AST stated that there were no Air Quality Management Areas (AQMAs) along the route; and the scheme would not result in the creation of a new AQMA. There was an AQMA in Warwick Town Centre approximately 1.5km from the scheme. Overall there would be a net improvement in air quality with the scheme. Nitrogen oxide (NO_x) emissions would increase by 10.5 tonnes per year and Particulate matter (PM_{10}) emissions by 4 tonnes per year in the Do-Something compared to the Do-Minimum scenarios.

- PM_{10} levels improve 1,378 properties
- PM_{10} levels no change 0 properties
- PM_{10} levels made worse 1,683 properties
- NO_2 levels improve 1,410 properties
- NO_2 levels no change 0 properties
- NO_2 levels made worse 1,651 properties

5.45. The ES localised air quality assessments, DMRB and detailed air quality modelling found that that none of the receptors assessed would experience concentrations above the Air Quality Standards objectives or EU Limit Values for any years assessed.

5.46. The generalised assessment reported in the ES indicated that the scheme would result in an overall improvement in Nitrogen dioxide (NO_2) and PM_{10} concentrations.

5.47. The regional assessment reported in the ES indicated that there would be an increase in emissions as a result of the scheme. However, this figure may have been slightly distorted as the regional modelling did not account for any congestion effects and slow moving traffic through the study area, and hence higher emissions. The ES concluded that as the scheme was likely to reduce congestion the difference in emissions between the Do-Minimum and Do-Something was not likely to be as high as calculated.

Conclusions at One Year After

5.48. Based on traffic flows and speeds it was judged likely that the scheme would be better than expected with regard to air quality. In general, traffic flows were well below expectations and speeds also lower than expected. However Sherbourne Parish Council referred to a '*noticeable increased level of dust fall within the area'*; they also noted a lack of availability of monitoring data on this issue from the HA.

Consultation

5.49. Warwick District Council was unable to comment due to not holding relevant data.

5.50. Sherbourne Parish Council noted that:

There is continued evidence of dust/particulates falling on paintwork and outside tables etc. which was not seen before the A46 alterations. This is not 'agricultural dust' as suggested in the OYA report, as it was not there beforehand; also, there is less arable farming activity in the area, as there is less farm land and dairy and equestrian uses now predominate

Evaluation

5.51. Air quality measurements are not taken at OYA or FYA; instead the approach is to determine if traffic levels are significantly different (a change of +/-1000 AADT) than expected. If traffic levels are significantly lower, it is assumed that air quality will be better than expected. Similarly, significantly higher levels imply that air quality will be worse than expected.

5.52. The available traffic data (flows only, no information was available on HGVs or speeds) indicated that at several locations daily traffic counts (AADT) were lower than predicted by more than 1,000, suggesting that air quality would be better than expected. The M40 east bound off slip, where traffic was higher than predicted is, based on this, likely to be worse than expected although there are no sensitive receptors nearby.

5.53. Consultation responses from Sherbourne Parish Council noted dust deposition believed to have started since the scheme opened. Whilst the POPE methodology for assessing air quality concludes that air quality is better than expected, no information is available to POPE relating to dust deposition to allow comments to be made.

Table 5-4 Summary of Local Air Quality Evaluation

Origin	Summary	Assessment
AST (Forecast)	There are no current Air Quality Management Areas along the route; the scheme will not result in the creation of a new Air Quality Management Area. There is an AQMA in Warwick Town Centre approximately 1.5 km from the scheme. Overall there is a net improvement in air quality with the scheme. NO_x emissions increase by 10.5 tonnes per year and PM_{10} emissions by 0.4 tonnes per year in the Do-Something compared to the Do-Minimum	PM_{10} levels improve 1,378 properties PM_{10} levels no change 0 properties PM_{10} levels made worse 1,683 properties NO_2 levels improve 1,410 properties NO_2 levels no change 0 properties NO_2 levels made worse 1,651 properties
EST (FYA Evaluation)	Based on information available traffic levels suggest improvement over predicted levels at several traffic measurement locations, although Parish Councils noted concern over dust deposition	Better than expected overall, the exception being M40 eastbound off slip (which has no sensitive receptors nearby)

Greenhouse Gases

5.54. 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

5.55. The scheme AST predicted that the greenhouse gas emission benefits of relieving congestion would be outweighed by an increase in average speeds, particularly along the new A46 junction bypass; resulting in an increase in carbon emissions of 2.8%. The assessment predicted a total change in CO^2 emissions of 2,564 tonnes during the opening year, equivalent to an increase of 699 tonnes of Carbon.

FYA Evaluation

5.56. In order to provide an indication of the outturn changes in Carbon due to the implementation of the scheme, it has been possible to calculate the change in emissions based on observed traffic flows. This calculation uses current DMRB Air Quality Assessment guidance, and is based on the changes in traffic volumes, speeds and HGVs in vicinity of M40 J15.

5.57. A re-forecast calculation has also been undertaken based on forecast traffic information from the ES, this calculation replicated the methodology outlined above. The results of this exercise are provided in Table 5-5.

Table 5-5 Change in Reforecast and Outturn Annual Carbon Emissions in Vicinity of M40 J15

Link	Change in Carbon (Tonnes)	
	Re-Forecast	Observed
A46 North	-474	-725
A429 North	73	-67
M40 EB On-Slip	7	4
M40 WB Off-Slip	-3	-3
A429 South	131	38
A46 South	-147	-469
M40 WB On-Slip	-25	17
M40 EB Off-Slip	-21	7
A46 Bypass	1,042	732
Total	**583**	**-467**

5.58. Table 5-5 demonstrates that carbon emissions in the immediate vicinity of the scheme actually appear to have decreased during the post-opening period by 467 tonnes (equating to 1,712 tonnes of CO^2) compared to re-forecast increase of 583 tonnes (this figure is lower than in the AST as it only considers links joined to M40 Junction 15 rather than the wider study area). This represents a 14% reduction in carbon emissions.

5.59. This observation can be attributed to the decrease in emissions caused by reduced congestion at M40 J15 being greater than expected with a reduction of 1,219 tonnes observed for all arms compared to 440 tonnes in the re-forecast. Additionally, the increase in emissions generated by vehicles travelling at greater speeds along the new scheme bypass is lower than expected, with an increase of only 732 tonnes compared to a reforecast prediction figure of 1,042 tonnes.

5.60. The savings at M40 Junction 15 outweigh the increases evident along the new scheme bypass. This can be attributed to the lower than forecast traffic flows in the vicinity of the scheme. Therefore, it is possible that emissions will increase in future years if traffic levels gradually increase.

Table 5-6 Summary of Greenhouse Gases Evaluation

Origin of Assessment	Summary of Greenhouse Gas Impacts	Assessment
AST (Forecast)	Increase in predicted CO^2 with the development of the scheme from current and future Do-Minimum.	Do-Something as % Present Do-Minimum: 109.5% Do-Something as % Future Do-Minimum: 102.8% +2,564 tonnes of CO^2
EST (5YA Evaluation)	A decrease in carbon emissions has occurred as benefits from reduced congestion at M40 Junction 15 outweigh the increased emissions caused by vehicles travelling at faster speeds along the A46 bypass.	Decrease of 1,712 tonnes of CO^2 (14% reduction) Better than expected

Landscape and Townscape

Forecast

5.63. The landscape AST entry stated that the scheme lies within the Green Belt. The proposed bypass and associated structures would affect certain local views, some of which could be fully mitigated. An overall slight adverse impact was predicted.

5.64. Due to the rural nature of the scheme, a townscape assessment was not required.

5.65. The ES stated that the M40 Junction 15 roundabout was already a prominent feature on the landscape, and the resultant changes to landscape character by constructing the new bypass would represent an incremental increase, rather than a fundamental change in the character of the landscape. The scheme sits within the Arden Special Landscape Area (SLA) and Green Belt. The landscape also comprises undulating farmland with a number of hilltop woodlands, field patterns consist of clipped hedgerows with occasional trees, open arable and alluvial pastoral farmland and the Longbridge and southwest Warwick area comprising built development at Longbridge including commercial property, a maintenance depot and secluded residential areas.

5.66. The scheme would result in an increase to the existing urban character provided by the existing M40, M40 Junction 15 and A46 corridor and would impact on the local landscape through the introduction of raised embankments, overbridges and Sherbourne Roundabout, together with associated lighting and signage. However, visual impacts would be limited by the visual envelope for the scheme, which was reported to be constrained by mature field boundary vegetation, woodland blocks and undulating topography together with built form at the south-western edge of Warwick, Hampton-on-the-Hill, Hampton Magna and Sherbourne.

5.67. Moderate adverse visual impacts would occur for several residential properties in Sherbourne that had direct views towards the proposed roundabout and bypass. Although the scheme would result in realignment of the A46 further away from Sherbourne, moderate adverse impacts would occur due to the earthworks and associated structures and street furniture, including lighting and signage. Other properties in Sherbourne would also experience slight adverse visual effects at Year 1.

5.68. In addition, properties located at the western edge of the new residential development area to the south-western edge of Warwick and Hampton Lodge to the west of the scheme would also experience a moderate adverse impact in Year 1. Residential and commercial properties at Longbridge would also experience slight adverse visual impacts at Year 1 due to views towards the realigned embankment at the edge of the Junction 15 roundabout.

5.69. A footpath (PRoW WB16) near Sherbourne was the only footpath directly affected by the scheme, and would experience a substantial adverse impact at Year 1 due to realignment and views of new scheme infrastructure and furniture.

5.70. In Year 1, following construction, mitigation planting would be complete, although not established. It was anticipated that the overall impact on landscape character and visual amenity would be moderate adverse. By Year 15, with the landscape mitigation planting established; it was anticipated that the scheme would result in an overall slight adverse impact on landscape character and visual amenity.

5.71. The ES considered night-time lighting effects, which were anticipated for several residential properties on the western edge of Sherbourne village due to the proposed lighting on the Sherbourne Roundabout and the Sherbourne Link Roads.

5.72. Measures incorporated into the design to mitigate landscape and visual impacts were:

- Minimise vegetation loss during construction and give due regard to a Tree Preservation Order at Longbridge;
- At the southern edge of the scheme, proposed linear belts of trees and shrubs, woodland edge planting and native hedgerow would reinstate vegetation lost and assist in screening and filtering views from the surrounding undulating farmland;
- Proposed planting and environmental barriers adjacent to the scheme would screen views;
- A sculpted earth bund and fencing adjacent to the road corridor would reduce the extent of views of the proposed roundabout, traffic and associated signage at Sherbourne;
- Wetland planting and species rich grassland planting to soften storm water attenuation; and
- Land would be acquired off site to the west of the scheme at Sherbourne to provide appropriate landscaping.

5.73. Reference was also made in the ES to use of evergreen species at Sherbourne to help filter views.

Conclusions at One Year After

5.74. It was concluded that the scheme area is generally dominated by the M40 and while the new bypass is an incremental change to the landscape, it comprised a strong vertical feature which changes the character and views of the area which lies within the Arden Special Landscape Area. While the new alignment of the A46 is moved away from Sherbourne, the vertical nature of new embankments and lighting has had a moderate adverse effect on the village, as predicted in the ES.

5.75. Mitigation had largely been implemented as expected in the ES but was yet to mature and soften the effects of the scheme.

5.76. Budbrooke Parish Council stated the following:

The impact of the finished project is totally out of character visually within the area due to the elevated road structure which now impacts significantly more dwellings within the area both visually and acoustically. A considerable area of land (totally disproportionate to the benefits gained) has been lost to the local area and must have a significant blighting effects on the dwellings on Chase Meadow which are now overlooked by elevated traffic flows.

The scheme was never going to blend into its environment from its conception due to such a large swathe of land being used therefore the visual impact integration has failed… Tree planting is too immature… What plans are in place for the reduction of lighting requirements on the island overnight?

5.77. Sherbourne Parish Council stated the following:

The tree planting is pathetic in the extreme, viz:
- no effective mitigating belt of trees has been planted
- large areas of exposed road views have not been planted at all
- none of the agreed semi-mature trees have been planted
- there is no indication of a mix with evergreen trees, that was specifically requested
- no attempt has been made to reduce the intrusive nature of the concrete underpasses with trees
- an estimate of some 5% of the planted trees are dead or dying
The agreed plan was that mixed woodland trees would be planted in abundance to … gradually eliminate the ugly visual intrusion of all these major road works. None of this is apparent. All these mitigation measures require to be comprehensively reviewed and significantly improved.

Consultation

5.78. Natural England made no comment on landscape, and Historic England did not provide any comment as to its view on how the scheme at affected the setting of heritage assets.

5.79. Barford, Sherbourne and Wasperton JPC commented that *'Landscape planting is perhaps disappointing but does have some softening effect'*.

5.80. Sherbourne Parish Council noted that:

1. …This scheme planned thick planting on all the southern embankments to shield the Village from the traffic and planting on the redundant field to form a woodland of mixed and deciduous trees; this scheme has been ignored. Everywhere the planting is visibly minimal with large areas left bare; a few bare root trees have been planted but no attempt has been made to plant the new woodland area; many of the planted whips and trees are now dead.

2. The planting on the embankments is sparse, often non-existent, and largely shrubs and bushes. No fast growing trees have been planted to visibly soften the harsh concrete abutments to the bridges and to deter graffiti vandals.

3. The line of existing trees beside the Old Stratford Road has not been continued, in either direction, as had been planned.

4. The large number of very tall lighting columns has created an ugly, alien feature in the countryside; the local Sherbourne Roundabout does not need to be lit to the level of a motorway junction. The continual night-time glare and the multiple blinking traffic lights produce an unacceptable urban intrusion into the rural environment.

Evaluation

5.81. During the site visit the progress of scheme planting was assessed. Planting on the embankment facing Sherbourne is shown in Figure 5-1, this shows a mix of planting ages which generally appears to have developed well since OYA. Some patchiness in the growth can be attributed to dry summers shortly after they were planted. Some of the plants were thinned out in 2015 in order to allow remaining plants to continue to grow. This contributes to a softening in the appearance of the scheme although the raised nature of the new road making it stand out in the landscape remains. However consultation with the Parish Councils has identified dissatisfaction with the amount and nature of landscape planting and the lack of semi-mature trees in the original planting scheme.

Figure 5-1 Mitigation planting on embankment facing Sherbourne

5.82. Hedgerow planting near Sherbourne roundabout is shown in Figure 5-2. As can be seen in the different pictures there has been vigorous growth in some stretches but much less so in others, with one area where shelters have not been maintained upright.t.

5.83. The ES assessment takes into account the expected maturation of landscape planting. One year after scheme opening the effect was expected to be moderate adverse; whilst 15 years after scheme opening it is expected to have reduced to slight adverse. At five years after there is therefore no direct assessment in the ES with which to make a comparison. However what can be assessed is whether the landscape planting can be considered to be developing as expected. Given the continued growth of planting, albeit with some stretches of hedgerow (which are not critical to screening views of the scheme) not entirely flourishing, it can be concluded that the scheme is broadly developing as expected.

5.84. However, concerns raised by the Parish Councils reflect the fact that they consider the planting to be insufficient and not as originally promised (specifically the lack of semi-mature trees), and that light spill is also significant. These were strong themes from the same consultees at one year after. Nevertheless it was concluded at OYA that the scheme was constructed as designed and at FYA that vegetation was generally developing satisfactorily. As such it is considered that the landscape effects are as expected. However given the uncertainty regarding whether at five years after the effect would have been assessed as slight adverse or moderate adverse it is not considered appropriate to determine a category effect, merely to state that the outcome is as expected.

5.85. Photomontages comparing FYA, OYA and pre-scheme views are included in Appendix B.

Figure 5-2 Hedgerow Planting

Table 5-7 Summary of Landscape and Townscape Evaluation

Origin	Assessment	Summary
AST (Forecast)	The scheme lies within the Green Belt. The proposed bypass and associated structures will affect certain local views, some of which cannot be fully mitigated	Slight adverse, although ES would suggest it is somewhere on a spectrum between moderate adverse in year 1 and slight adverse in year 15
ES	The scheme would result in an increase to the existing urban character provided by the existing M40	Assessed as moderate adverse at year one and slight adverse at year fifteen, so no direct comparison available at FYA
EST (FYA Evaluation)	The scheme was built as designed and whilst landscape planting has generally developed satisfactorily Parish Council consultees claim that mitigation planting was not as promised and that light spill is a problem	As expected, although given the uncertainty as to whether at FYA the expected effect is slight adverse it is not possible to specify an effect category

Cultural Heritage and Archaeology

Forecast

5.86. The AST predicted a slight adverse impact on cultural heritage; the scheme would cross three areas of alluvium which had the potential to mask prehistoric and Romano-British activity. Finds of Iron Age and Roman date had been recovered from one location which might be associated with an archaeological site. Disturbance to any archaeological sites would be mitigated by a programme of excavation and recording. The AST did not report any impacts to built heritage or historic landscape.

5.87. The ES reported that the impact of the construction of the proposed scheme on the areas with potential for prehistoric, Roman and post-medieval remains and palaeochannels was uncertain, and that all other potential impacts to buried archaeology due to temporary and permanent scheme land-take were of neutral significance.

5.88. No significant effects were identified to historic landscape or to built heritage, and the scheme would not directly affect any listed buildings, conservation areas or historic parks and gardens. Historic landscape effects would be minor or slight, and caused by removal of historic hedgerows and loss of farmland. These impacts would reduce over time as mitigation matured.

5.89. Due to the construction of new infrastructure and street furniture there would be slight and minor adverse effects on the setting of built heritage at scheme opening on:

- Hampton Lodge Grade II Listed Building (reducing to neutral by Year 15); and
- Sherbourne Conservation Area and Sherbourne House Grade II Listed Building (reducing to neutral by Year 15).

5.90. Impacts of the scheme on other historic assets near the scheme, including the Warwick Conservation Area and Longbridge Manor Garden would be neutral at scheme opening.

5.91. In the short term the overall effect of the scheme on cultural heritage was considered by the ES to be of minor adverse significance, improving to minor beneficial over time as vegetation matures, particularly where there are historic assets in the Sherbourne and Longbridge areas.

The settings of heritage assets was also expected to benefit from a general improvement in the noise climate with the scheme, as reported in the noise and vibration chapter of the ES.

5.92. The ES set out the following mitigation strategy for cultural heritage:

- Minimise the detrimental physical effects of the proposed scheme upon buried archaeology, standing structures and the historic landscape, as far as is reasonably practicable;
- Minimise the effects of the scheme on built heritage and the historic landscape in terms of detrimental impact through visual intrusion, noise and ambience;
- Maximise the gains in knowledge and research benefits that would accrue from a programme of archaeological investigation, where sites of archaeological interest were to be disturbed by the scheme.
- Specifically, archaeological impacts would be mitigated through a programme of archaeological monitoring and investigation ahead of construction. A watching brief would also be undertaken during key construction activities and where possible, archaeology preserved in situ. The data produced by any archaeological fieldwork would be subject to post-excavation assessment and analysis leading to dissemination of the results by the production of academic and popular reports.
- Scheme impacts on built heritage and historic landscape would be mitigated as set out in the landscape section.

One Year After

5.93. The impacts described in the ES and AST were generally considered to be as expected overall, but the slight adverse impacts predicted at Sherbourne's listed buildings and conservation area were considered to be worse than assessed in the heritage chapter of the ES, and more in line with the assessments made in the landscape chapter – i.e. moderate adverse.

5.94. Archaeological study associated with the scheme has uncovered some valuable information on the local area's history.

Consultation

5.95. Historic England responded in broad terms, identifying nearby heritage assets that might be affected by the scheme and recommended consultation with the local authority (from whom no response was received)

5.96. Sherbourne Parish Council stated:

The valued rural nature of the area which provides the setting for the village of Sherbourne and the Listed properties, has been severely damaged, both visually and audibly

Evaluation

5.97. Given that the landscape screening is generally seen as establishing sufficiently and that the scheme was built as designed, the conclusion is that the effects are as predicted – minor adverse. The ES anticipated an eventual change to minor beneficial as landscape planting matured, but it is not considered that this stage as yet been reached.

5.98. It is noted that Sherbourne Parish Council are likely to consider that the effects are worse than minor adverse, although given the scheme was built as planned and planting is establishing, this view cannot be supported within the POPE methodology, although it does merit consideration when taken in the wider context of their concerns around noise and visual setting.

5.99. A paper has been recently published on the archaeological findings made during the construction of the scheme[20], this was outstanding at the time of OYA.

Table 5-8 Summary of Cultural Heritage and Archaeology Evaluation

Origin	Assessment	Summary
AST (Forecast)	The scheme crosses three areas of alluvium which have the potential to mask prehistoric and Romano-British activity. Finds of Iron Age and Roman date have been recovered from one location which might be associated with an archaeological site. Disturbance to any archaeological sites will be mitigated by a programme of excavation and recording.	Slight adverse
EST (FYA)	Scheme and landscape planting as planned, with planting establishing reasonably well. Archaeological findings published	As predicted, slight adverse

Biodiversity

Forecast

5.100. The AST noted direct impacts to two designated non-statutory nature conservation sites and commuting / foraging habitat used by bats. However, the replacement of arable land by neutral grassland, wetland, scrub and woodland habitats as well as provision of underpasses and protected species fencing would offset many initial impacts, and overall the scheme would have a slight adverse impact on biodiversity.

5.101. The ES summarised that overall the scheme would have a slight adverse effect on biodiversity due to construction, but slight beneficial effects long term.

5.102. The ES reported a number of designated sites within 2km of the scheme. Only one of these is nationally designated (although it would not be affected by the scheme) – Sherbourne Meadows Site of Special Scientific Interest (SSSI) comprises the largest area of unimproved neutral grassland in Warwickshire and is centred upon the Sherbourne Brook approximately 1.5km upstream and west of the scheme. Only two designated sites would be directly affected by the scheme – Sherbourne Meadows Stream potential Site of Interest for Nature Conservation (pSINC) and Horse Brook Ecosite.

5.103. The habitat types listed in Table 5-9 were also identified as being affected by the scheme, and mitigation would be incorporated into the scheme design to reduce the impacts or enhance biodiversity.

[20] Joyce, S. and Mudd, A. 'Prehistoric and Roman occupation near Sherbourne: excavations at junction 15 of the M40 motorway with the A46 trunk road, 2008/9', Trans Birmingham Warwick's Archaeol. Soc. (January 2016)

Table 5-9 Residual Effects on Habitats

Habitat Type	Overall Loss/Gain in Hectares	Comments
Semi-natural broad leaved woodland	-0.6	Slight adverse
Broadleaved plantation woodland	+2.8	Slight beneficial
Mixed plantation woodland	+0.3	Slight beneficial
Dense, continuous scrub	+4.9	Slight beneficial
Semi-improved neutral grassland	+7.2	Slight beneficial
Improved grassland / arable	-19.4	Neutral
Watercourses and standing water	+0.9	Slight beneficial
Tall herbs	+0.5	Neutral

5.104. Notable plant species were also recorded in the ES; in particular, those indicative of species-rich semi-natural grassland habitat of note and included Bee Orchid, Ladies Bedstraw, Harebell and Pignut. Most of these species were said to be associated with the corridor of the Sherbourne Brook.

5.105. With regard to fauna, the ES noted that no great crested newts, white-clawed crayfish or water voles were found to be present in the study area, and no badger setts would be affected; with the closest sett being 160m from the scheme. The ES reported otter sightings on Sherbourne Brook and slow worm and grass snake were suspected within the study area.

5.106. A number of bat species were recorded in the ES, largely around the Sherbourne Brook corridor and hedgerows – common and soprano pipistrelle, noctule, brown long-eared and a number of unidentified myotid bats. A maternity roost of noctule bats was also found to be present, but the scheme would avoid disturbing this.

5.107. A number of species of notable and breeding birds were reported in the ES as being present, and large numbers of overwintering lapwings were also recorded in an area to be lost to scheme land-take. The scheme's expected impacts on these species are detailed in Table 5-8.

Table 5-10 Residual Effects on Species Taken From the ES

Species	Comments and Mitigation	Assessment
Notable plants	Creation of new habitat/disturbance provides potential for colonisation by existing/new species.	Neutral
Amphibians	Enhancement of potential foraging/breeding habitat through creation of roadside verges and new wetlands.	Slight Beneficial
Badgers	Existing setts retained Protected species fencing and mammal underpasses may reduce road casualties. Reduction in potential foraging habitat.	Neutral
Bats	Enhancement of potential foraging habitat through creation of new treatment and attenuation ponds. Local increase in potential connectivity through planting of shrubs and trees.	Slight Beneficial

Species	Comments and Mitigation	Assessment
	Larger dimension of proposed Sherbourne Brook culvert likely to encourage some bat species to cross beneath the new road. Dissection of field boundaries by the scheme may disrupt commuting routes and lead to an increase in road mortality. Local removal of scrub/trees may reduce interconnectivity through creation of gaps in cover. Proximity of new road to roosts may lead to abandonment of roosts.	
Brown Hare	Slight/negligible reduction in available habitat through loss of open agricultural land.	Neutral
Deer	Slight/negligible reduction in available habitat through loss of open agricultural land.	Neutral
Otters	Enhancement of potential foraging/breeding habitat through creation of new treatment and attenuation ponds. Protected species fencing and mammal underpasses may reduce road casualties.	Slight Beneficial
Other mammals	Overall increase in net habitat through creation of neutral grassland verge habitat.	Slight Beneficial
Birds	Enhancement of potential foraging/breeding habitat through creation of new treatment and attenuation ponds.	Neutral

One Year After

5.108. The site visit, as built drawings and HEMP confirmed that mitigation planting had largely been implemented and maintained as expected but was yet to mature and therefore offer the long-term benefits predicted in the ES, as also predicted by the County Ecologist. Once mature, and assuming maintenance as set out in the HEMP and maintenance programme is undertaken, the effect on habitats predicted in the ES should be realised.

5.109. Other than planting, additional mitigation had been provided to enhance biodiversity. The as built drawings and HEMP confirmed that mammal ledges had been installed on culverts to encourage otters and a mammal tunnel incorporated into the scheme adjacent to the culvert at Sherbourne Brook. Species rich/conservation grassland had also been seeded across large areas of the scheme.

5.110. It was considered that the overall impacts of the scheme on biodiversity at OYA were slight adverse, as predicted by the AST. Following establishment of the habitats provided by the scheme, it was expected that overall, a slight benefit (as predicted by the ES) would be achieved

Consultation

5.111. Natural England confirmed that their comments at OYA still stood, and also provided site assessment data from 2012 for Sherbourne Meadows SSSI. The assessment indicated that the status of the SSSI was favourable, that it passed on all variables, and no indication was made of any adverse consequences of the remodelling of Sherbourne Brook as part of the scheme.

5.112. Warwickshire Wildlife Trust were unable to comment on the scheme.

The Environment Agency made a number of comments relevant to biodiversity:

'SUDs on the highway improvements were very good. The feature between the old and new A46 is particularly impressive, with several outfalls discharging into a further pool that is connected to the brook. This acts as both a tertiary SUDs feature and as a fish fry refuge and means that hard concrete outfalls are not directly on the river bank'

'The ability to contain the bulk of a spill in a concrete pre-basin is a good feature of the SUDs as it means that the natural flora and fauna of the SUDs are less likely to be wiped out by a pollution event'

'The new culvert over Sherbourne Brook includes measures to allow safe otter passage'

'The new culvert on the Sherbourne included a natural bed with two stage channel, which prevented unwanted sediment deposition and allowed a natural depth of flow for fish movement'

'The material required to construct the scheme made use of local borrow pits. This could have resulted in the creation of some significant habitat. However the bare minimum in mitigation was implemented – a couple of ponds were lost and although one was replaced as mitigation, a great deal more could have been achieved'

'Loss of unimproved meadow – the wet meadow to the north-east of Sherbourne Brook was significantly reduced in size as a result of the diversion of the A46. Whilst this was unavoidable, it would have been possible to ensure that this was properly mitigated for, possibly by implementing the above measure'

'There is a weir associated with the Motorway junction depot that is a barrier to the movement of fish. We had tried to get the HA to modify this to allow fish passage as part of the mitigation, but they were unwilling to do this'

'The culvert on the Horse Brook was extended. We wanted the HA to incorporate safe otter passage on this culvert and the one immediately downstream, but they were unwilling to accommodate this'

5.113. Whilst the majority of the comments above are positive, there are some "missed opportunities" identified such as doing more than the bare minimum of borrow pit mitigation and modifying a nearby weir to allow fish passage.

5.114. Warwickshire's county ecologist confirmed that the "worse than expected impact on overwintering lapwing" was still considered an issue at FYA.

5.115. Sherbourne Parish Council stated the following:

The bat population appears to be significantly reduced. The nightingales have totally disappeared. The owls are now rarely heard. The kingfisher is no longer seen. Wild duck and herons have been witnessed trying to move along Sherbourne Brook, but are unnerved by the concrete tunnelling of the river and make a dangerous 'eleventh hour' low, overfly of the roadway. Casual field and open garden surveys indicate that the loss of old trees and hedgerows means that woodpeckers and hedgerow birds are considerably less frequently heard or seen, although garden bird-table surveys report no great change in the arrival of small birds. The decline of butterflies and bees continues. The rare polecat sightings are now never seen

Evaluation

5.116. Data from Natural England confirmed that the nearby Sherbourne Meadows SSSI was of favourable status. The Environment Agency made a number of positive comments on biodiversity particularly with relevance to water and pollution control, and the presence of otter ledges.

5.117. The county ecologist noted the worse than expected impact on over-wintering lapwing, a point that was originally made at OYA. Sherbourne Parish Council note that anecdotally there appears to have been a significant reduction in bat and bird populations (although POPE has no data with which to refute or support this).

5.118. During the site visit the bank on the western side of Sherbourne Brook had a small track in the vegetation suggesting some kind of animal use, although it could not be confirmed if this led to the otter ledge or badger tunnel (or both or neither).

5.119. The drainage ponds on the eastern side of the road appeared to be in good condition, which is likely to be of benefit to wildlife.

5.120. POPE is not aware whether any ecological monitoring was proposed as part of the scheme and no post opening information has been provided which would enable biodiversity to be fully evaluated at FYA. Based on as built information and observations of mitigation and infrastructure (e.g. mammal ledges, drainage ponds etc.)

Table 5-11 Summary of Biodiversity Evaluation

Origin	Assessment	Summary
AST (Forecast)	Direct impact to two designated non-statutory nature conservation sites and commuting / foraging habitat used by bats. However, the replacement of arable land by neutral grassland, wetland, scrub and woodland habitats as well as provision of underpasses and protected species fencing will offset many initial impacts.	Slight adverse
EST (FYA)	The scheme and mitigation has been implemented as expected, including wetland habitat, mammal ledges and mitigation planting. Consultation revealed concerns from the county ecologist regarding lapwing, and Sherbourne PC regarding birds and bats.	As expected, slight adverse overall; although the impacts on bird species could be worse than expected (monitoring data would be required to confirm this)

Water Quality and Drainage

Forecast

5.121. The AST stated that minor negative effects on ground water and surface water during construction would be balanced by improvements to drainage and water quality by pollution control measures and that overall the scheme would have a neutral effect on the water environment.

5.122. The ES stated that overall, the operational scheme would have a slightly beneficial effect on the water environment due to improved flood attenuation of Sherbourne Brook and the balancing and pollution control of newly implemented wetlands. The existing road network affected by the scheme did not have drainage to DMRB standards (including features such as spill control, flood attenuation and oil interceptors) and the proposed works would improve this drainage and bring it up to standards, where affected, improving the quality of existing outflow.

5.123. The scheme would discharge road surface runoff via storm water wetland areas, into Sherbourne Brook, Horse Brook, and an unnamed watercourse, which all converge with the River Avon to the southeast of J15. Taking into account mitigation, the contribution to the watercourses in terms of flow, volume and contaminants would be relatively small.

5.124. The scheme would have the following physical effects on existing surface water:

- New Sherbourne Brook culvert and works to an existing culvert on the brook;
- New culverts to an unnamed watercourse;
- Existing M40 Junction 15 Horse Brook culvert extension;
- New meander and flood plain compensation for Sherbourne Brook;
- Widening and realignment of Horse Brook culvert; and
- Realignment of unnamed watercourse around new storm water wetlands.

One Year After

5.125. Based on the as-built drawings, the scheme drainage, ponds and flood attenuation was considered to have been constructed as expected. The scheme provided a new drainage, attenuation and spill control regime, improving the pre-scheme drainage design. The HEMP for the scheme did not include the requirement to undertake water quality monitoring with regard to the scheme and no water quality monitoring data was made available to POPE at OYA to confirm whether the new drainage regime had led to any improvement in local surface water quality.

5.126. Another key mitigation provided by the scheme was the realignment of Sherbourne Brook by creating new meanders off-site from the main area of scheme works. As built drawings confirmed that this was undertaken, and the site visit confirmed that the site was becoming re-vegetated.

5.127. Mitigation measures had been provided and no information was provided to POPE that would indicate that it was performing other than as expected. POPE was not aware that there have been any pollution incidents during operation and the predicted overall neutral impact of the scheme was considered to be as expected.

Consultation

5.128. The Environment Agency made a number of comments relevant to water quality and drainage:

'A meander had to be removed as part of the A46 diversion. In order to retain the length of the brook a new meander was created upstream of the road diversion

'SUDs on the highway improvements were very good. The feature between the old and new A46 is particularly impressive, with several outfalls discharging into a further pool that is connected to the brook. This acts as both a tertiary SUDs feature and as a fish fry refuge and means that hard concrete outfalls are not directly on the river bank'

'The ability to contain the bulk of a spill in a concrete pre-basin is a good feature of the SUDs as it means that the natural flora and fauna of the SUDs are less likely to be wiped out by a pollution event'

'Part of the Horse Brook was improved as part of the mitigation. The previous channel [was] straight and contained a large amount of exposed Enka-mat geo-textile on the bed and banks. In contrast the new channel is sinuous and did not use any artificial bank protection'

'The new culvert on the Sherbourne included a natural bed with two stage channel, which prevented unwanted sediment deposition and allowed a natural depth of flow for fish movement'

'The diversion of the un-named tributary of the Longbridge Brook between the A46 to the north-east of the roundabout was designed to replicate natural bank and bed profiles. In reality this was still quite engineered in appearance, but there was an attempt to naturalise it'

'We asked for all SUDs to discharge into watercourses via set back outfalls to minimise the impact upon the watercourse and to provide added bankside habitat and a final SUDs treatment. This was carried out w[h]ere feasible, the best example being the feature between the old and new A46 at Sherbourne'

'The Horse Brook has been massively modified through the roundabout, with concrete paving slab banks and bed. We had tried to get the HA to naturalise this as it could have been a relatively easy job – i.e. removal of the slabs, but they were not willing to do this'

'The SUDs associated with the junction improvements should help to improve the local water quality, compared to prior improvements'

5.129. No other consultees referred to the water environment in their responses.

FYA Evaluation

5.130. The Environment Agency made a number of comments praising the mitigation from a water perspective, and Natural England has confirmed that Sherbourne Meadows SSSI was of favourable status. As noted at OYA, the scheme and all hydrological mitigation – including ponds, drainage and flood attenuation – appear to have been implemented as planned. Nothing was seen on site that would suggest any deterioration in any of this mitigation and POPE has not been made aware of any issues relating to the local water environment.

5.131. It was noted at OYA that the HEMP includes the requirement for inspections of waterbodies twice a year, to include silt and debris clearance, inspection of vegetation and recording of notable species, and twice yearly inspections will also be undertaken at outfalls. No information has been provided to POPE as to whether this is occurring.

5.132. As such the assessment is deemed to be neutral, as expected.

Table 5-12 Summary of Water Quality and Drainage Evaluation

Origin	Assessment	Summary
AST (Forecast)	Minor negative effects on ground water and surface water during construction will be balanced by improvements to drainage and water quality by pollution control measures.	Neutral
EST (FYA)	Mitigation measures implemented as expected, no evidence during site visit to suggest deterioration. Sherbourne Meadows SSSI confirmed to be of favourable status	Neutral, as expected

Physical Fitness

Forecast

5.133. The AST stated that providing easier access to the public rights of way network, including Footpath WB16 via a new underpass, would encourage greater fitness for a small number of pedestrians and suggested an assessment score of neutral as the changes in the total number of people walking or cycling for more than 30 minutes per day was likely to be low.

5.134. The ES assessed that only one right of way – WB16 – was directly affected by the scheme. This footpath would be diverted through two underbridges under the new Sherbourne roundabout. The amenity value of other rights of way near the scheme would not be significantly affected by the scheme.

5.135. The ES also stated that a new section of bridleway approximately 300m long would be created. This would follow the route of WB16 and pass under the Sherbourne roundabout. The ES stated the scheme would have an overall slight benefit to pedestrians, cyclists and equestrians.

One Year After

5.136. As predicted there has been an adverse effect on WB16, which had been diverted and had its amenity value affected by the inclusion of new underpasses and proximity to traffic. Consultation reports noted that this was worse than prior to the scheme, but as expected in the ES, with longer journeys required to negotiate the path.

Consultation

5.137. Sherbourne Parish Council noted the following:

One of the main problems of the re-routed footpath (W16B) is the open exposure to noise, fumes and headlights from the traffic on the A46 travelling northwards towards the new roundabout. This particular point concerning traffic exposure was raised at the Public Inquiry and clear assurance was given that all the re-aligned footpath would be totally shielded from the traffic by dense hedgerow planting and/or acoustic boarding. None of this has been done. The single hedge planting that has been done is on the field-side, not the road-side, affording pedestrians no protection at all. There is ample space between the roadway and the footpath to plant a hedgerow and add acoustic boarding.

The field-side hedgerow planting is deficient, with large gaps that need to be planted up.

Where the footpath runs through the middle of Sherbourne Roundabout, NMU's are seriously exposed to traffic noise, fumes, lights and piles of tossed out litter; frequently pieces from vehicles involved in accidents above, including dangerous broken glass, fall onto the pathway below, to the danger of walkers and riders. Only a few token trees have been planted on the internal embankments.

The concrete abutments to the two bridges over the footpath and the underpasses are becoming covered in ugly graffiti.

The concrete surface of the re-routed footpath is ok except under frosty conditions, when it becomes too dangerously icy to walk, or ride, or cycle, on.

Evaluation

5.138. As expected the WB16 PRoW has been diverted through two underpasses under the new Sherbourne roundabout, it is a combined farm access and bridleway which belongs to the farmer whose land they cross. The paths were observed to be in good condition and free from debris although there was graffiti on one of the underpasses which could deter people from using the paths in some circumstances. Gaps were noted in the field-side hedgerow referred to by Sherbourne Parish Council. Figure 5-3 shows the graffiti and the otherwise good condition of the footpath. However as per the comments from Sherbourne Parish Council footpath users are not shielded from the visual and noise impacts of the road, which makes it a functional but not particularly pleasant route to walk along. It is understood that this was one of the areas that experienced some poor growth in landscape planting, although all planting that was committed to was undertaken. No other users were noted during the hour or so on this part of the site. It is understood that the graffiti was removed from the underpass in March 2016.

Figure 5-3 Footpath Condition and Graffiti at Sherbourne Roundabout

Table 5-13 Summary of Physical Fitness Evaluation

Origin	Assessment	Findings
AST (Forecast)	Providing easier access to the public rights of way network, including Footpath WB16 via a new underpass, will encourage greater fitness for a small number of pedestrians.	Total number of people walking or cycling for more than 30 minutes per day is likely to be low. Neutral
EST (FYA Evaluation)	The WB16 underpass remains open and the paths are in good condition (other than some graffiti),	Neutral, as expected

Journey Ambience

Forecast

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

5.140. The AST stated that the scheme would have a moderate beneficial effect on journey ambience. Between 500 and 10,000 travellers a day would be likely to benefit from better information and increased route certainty, better views and reduced frustration and risk of accidents provided by the scheme.

5.141. The ES predicted that:

- Traveller views would be better with the scheme because much of the bypass would be on embankment, increased views of the surrounding landscape would be possible, though these might sometimes be intermittent or restricted;
- Driver stress would be better with the scheme as it would reduce disruption and queuing at the M40 Junction 15. Improved signage would also alleviate driver stress and uncertainty;
- Emergency telephones lost as a result of construction would be replaced with new telephones placed in the petrol stations (by agreement). Lay-bys near Sherbourne would be improved and the bus stop would be relocated in a new bus lay-by. The scheme would have a neutral impact on traveller care in terms of driver facilities in comparison with the existing road network; and
- An improved new road surface would also provide a smoother, more comfortable ride than the surface on the existing road network, and with the improved scheme signage, the scheme would have a ‘better’ impact than the Do Minimum scenario. As traveller care is a component of driver stress, effective signage would contribute to the alleviation of driver stress. Overall the ES considered that scheme would improve traveller care.

One Year After

5.142. It was determined based on the opening up of views, provision of new signage, lighting and traveller information, and better traffic speeds and lower accident rates that the scheme had delivered the expected moderate beneficial changes as expected.

Consultation

5.143. The Joint Parish Council noted the following with regard to road condition:

The white line lane markings on the roundabout are almost worn out and need re-painting

There are no traffic lights on the Stratford Road A429 from Warwick for traffic joining the roundabout. This means traffic exiting Warwick has to wait for the lights on the roundabout to be red AND the lights at the bottom of the A46 to be red at the same time, which covers a very short period. As soon as these lights change, traffic speeds away from the A46 lights, mostly heading for the M40 S as fast as possible making it difficult for traffic from Warwick that is not taking the M40S exit.

Traffic on the Longbridge roundabout routinely jumps red lights at virtually every set of lights, normally at speed.

The high speed on the roundabouts and the approach roads continues onto the A429 South towards Sherbourne and Barford and is the cause of regular accidents at the A429, Fulbrook Lane junction. Vehicles either turn right into Sherbourne, or do complete U turns to head back to Longbridge Island, having taken the wrong exit from the roundabout. The accidents are invariably caused by a car coming down the A429 S too fast and hitting the rear of a car that is either turning right or stationery waiting to turn. While some of these have resulted in injury with police and ambulances being called, many are just minor shunts and the police aren't informed so I do not believe the police will have accurate statistics on the problems with this junction

Evaluation

5.144. Whilst signage has been improved along with the junction as a whole, the consultation response above suggests that there are problems with the layout of the scheme that can lead to accidents given the prevailing speeds and traffic light timings. However analysis earlier in this report shows that the number of accidents had decreased since before the scheme opened. It is understood that Highways England are due to refresh the lane markings on the roundabout in the 2016/17 financial year.

Table 5-14 Journey Ambience Evaluation

Traveller Factor	Prediction	FYA Evaluation
Views	Beneficial	As at OYA, traveller views are generally as expected at FYA. More open views have been provided for drivers using the new bypass, but some views are restricted by cuttings and environmental barriers.
Stress – frustration	Beneficial	Whilst traffic speeds are not available the overall reduction in traffic flows is likely to have led to a reduction in driver frustration
Stress – fear of potential collisions	Beneficial	The number of collisions has reduced since the scheme opened, so this fear is likely to be less than previously, although as noted above this is not necessarily the perception of local residents
Stress – route uncertainty	Beneficial	As at OYA, new signage and lighting has improved route certainty, as expected; although consultees do note that line markings are deteriorating which could lead to uncertainty at times.
Traveller Care	Beneficial	As at OYA, traveller information has improved, and a new bus lay-by has been created in Sherbourne, as expected.
Summary Score	Beneficial	As expected

Table 5-15 Summary of Journey Ambience Evaluation

Origin	Assessment	Summary
AST (Forecast)	Between 5,000 and 10,000 travellers a day are likely to benefit from better information and increased route certainty, better views and reduced frustration and risk of accidents	Moderate beneficial, although note that the number of travellers has generally fallen
EST (FYA Evaluation)	New signage has improved route certainty. Traveller information has improved and new bus lay-bys provided. Collision data has improved, although anecdotal observations from consultees suggest that the scheme is not optimally laid out for safety and lane markings are degrading making navigation more difficult	As expected, moderate beneficial, although with the caveat that the view of local residents is that collisions are more frequent (data suggest otherwise)

Key Points from Environmental Evaluation

5.145. Some negative consultation responses have been received, in particular from Sherbourne Parish Council. The Parish Council reiterated the points they had initially made at OYA, noting that nothing appeared to have changed in the interim, nor had they been contacted in any kind of follow up exercise to the OYA.

Noise

5.146. Traffic levels were significantly lower than predicted at FYA, on which basis it is likely that noise levels were better (lower) than expected. Only one location was likely to be worse than expected, and that was the east-bound M40 off slip, although there are no sensitive receptors nearby. However no data were available regarding HGVs or speeds relative to predictions. Responses from Parish Councils reported that they considered noise levels to have substantially increased.

Air Quality

5.147. Traffic levels were significantly lower than predicted at FYA, on which basis it is likely that air quality was better than expected. Only one location was likely to be worse than expected, and that was the east-bound M40 off slip, although there are no sensitive receptors nearby. Sherbourne Parish Council believe that observed dust and particulates settling on some outdoor surfaces are from road traffic (the OYA report suggested this was from agricultural sources, which the Parish Council dispute).

Greenhouse Gases

5.148. The AST predicted a 2,564 tonne increase in CO^2 levels with the development of the scheme. However, in the OYA a decrease in CO^2 levels of 1,712 tonnes has been calculated with benefits from reduced congestion at M40 Junction outweighing the increases in CO^2 resulting from traffic travelling at high speeds along the bypass.

Landscape and Townscape

5.149. The scheme was built as designed, including mitigation, and planting was generally established although has been somewhat patchy. Responses from Parish Councils indicate that they consider the landscape planting to be insufficient and not what was originally indicated to them would be planted. It was considered that despite the patchy nature of some planting the outcome was as expected, although there was no explicit prediction of landscape amenity at five years, only one year/ year fifteen.

Cultural Heritage and Archaeology

5.150. Given the landscape planting had been implemented as planned and was generally establishing sufficiently, and the recent publication of archaeological findings, the impact on heritage was deemed to be as predicted, slight adverse.

Biodiversity

5.151. The scheme and mitigation has been implemented as expected, including wetland habitat, mammal ledges and mitigation planting. Consultation revealed concerns from the county ecologist regarding lapwing, and Sherbourne Parish Council regarding birds and bats. Sherbourne Meadows SSSI has recently been assessed as being of favourable status by Natural England, and the Environment Agency were positive about many aspects of the scheme's mitigation. The conclusion was that the scheme remains "slight adverse" overall for biodiversity.

Water Quality and Drainage

5.152. Mitigation measures had been implemented as expected, and the EA had made several positive remarks with regard to these. Natural England confirmed that Sherborne Meadows SSSI was of favourable status. Overall the effect on water quality and drainage was considered to be neutral, as expected.

Physical Fitness

5.153. The footpath WB16 remains open and in generally good condition, although there is graffiti on the underpass and the Parish Council note that pedestrians are exposed to road noise and fumes. Considered to be neutral, as expected.

Journey Ambience

5.154. New signage has improved route certainty. Traveller information has improved and new bus lay-bys provided. Accident data has improved, although anecdotal observations from consultees suggest that the scheme is not optimally laid out for safety and lane markings are degrading making navigation more difficult. Considered to be moderate beneficial, as expected.

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 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 facility, using any mode of transport. The accessibility objective consists of three sub-objectives. These are:

- Option values
- Access to the transport system
- Severance

Option Values

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

6.4. The AST does not include any qualitative assessment regarding this sub-objective. Given that the primary purpose of this scheme is to address vehicle delays at a major highway junction (located away from residential areas), this appraisal can be considered correct in its assumption.

Access to the Transport System

6.5. The AST does not include any qualitative assessment regarding this sub-objective. Given that the primary purpose of this scheme is to address vehicle delays at a major highway junction (located away from residential areas), this appraisal can be considered correct in its assumption.

Severance

Forecast

6.6. The aim of the severance sub-objective is to reflect both changes in severance and the likely number of users affected. With regards to roads, severance includes the length and ease of pedestrian movements. The primary indicators for roads include footpaths, diversions of rights of way, and formal crossing facilities.

6.7. The AST states:

"The new road will bisect PROW Wb16 and have a minor impact on W91b and W94a. However a small number of pedestrians will benefit from improvements including a new underpass and footway/cycleway/bridleway alongside the road".

6.8. The AST did not provide a score for this sub-objective.

Evaluation

6.9. A site visit was undertaken on the 2nd September 2015, this confirmed that the new footpath and underpass (leading underneath the A46 southern connection roundabout) implemented as part of the scheme measures (See Figure 6-1) were still in operation. No pedestrians were

observed using either the footpath or the underpass on the day that the site visit was undertaken.

6.10. This sub-objective is scored as 'slight beneficial' as the scheme measures have reduced severance with the implementation of the new footpath and underpass under the A46 southern connection roundabout.

Figure 6-1 New Footway and Underpass Implemented as Part of the Scheme Measures

Integration

6.11. The integration objective consists of two main elements:

- **Interchange with other transport modes**: how the scheme assists different modes of transport in working together and the ease of people moving between them to choose sustainable transport choices.

- **Land Use Policy and Other Government Policies**: how the scheme integrates with local land use and wider government objectives.

Transport Interchange

Forecast

6.12. The AST for the scheme states:

> *"There is provision for the improvement of the bus stop within Sherbourne. No other passenger interchanges are provided."*

6.13. As such the AST forecast a neutral impact for the transport interchange objective.

Evaluation

6.14. As part of the scheme measures, improvements were made to the bus stop located along the A46 near Sherbourne (see Figure 6-2). The improvements were observed during the site visit undertaken on the 2nd September 2015.

6.15. The improvements implemented comprise of a dedicated bus lane to allow buses to stop along the A46 near Sherbourne without impeding traffic flows along the A46 trunk road. There are two bus services in operation at this stop, both offering an hourly service between Stratford, Warwick and Coventry.

6.16. This sub-objective is scored as 'slight beneficial' due to the implementation of an improved bus stop along the A46, near Sherbourne.

Figure 6-2 Improvements to Bus Stop along A46 Southbound near Sherbourne

Land Use Policy and Other Government Policies

Forecast

6.17. The AST scored the impact of the scheme on land use policy as 'neutral' reasoning that:

> *"Some policies are supported (e.g. those relating to transport), but there is conflict with others (e.g. policies relating to sustainable development and biodiversity). Overall the scheme is neutral regarding land use policy."*

6.18. The AST also scored other Government policies as 'beneficial' and states:

> *"Key policies positively affected relate to transport and the economy, which emphasise the need for a safe and efficient trunk road network, which would benefit the economy and alleviate congestion, severance and other adverse environmental impacts associated with traffic in settlements. Other environmentally related policies would be hindered by the Scheme, including those related to the countryside, heritage and biodiversity issues. The overall rating in terms of compliance with other government policy is beneficial."*

Evaluation

6.19. An evaluation of the scheme in relation to policy at the time of appraisal and opening has been undertaken and is summarised in Table 6-1 The evaluation shows that, as forecast, the scheme has had a beneficial impact on other government policies and land use policies. Given the findings presented, it is considered that the forecast assessment of the scheme on land use policy and other government policies is 'beneficial', as expected.

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

	Policy/Document	Relevant Policy Objective/Reference	Relevant Scheme Impacts	Alignment
Local Policies	**Warwickshire Local Transport Plan 2** **(2006-2011)**	• The key LTP2 objectives include: • To improve accessibility to health and educational facilities. • To maintain a special focus on improving road safety for children, particularly in disadvantaged areas • To discourage traffic growth during peak periods in urban areas. • To tackle the declared Air Quality Management Areas (AQMAs) and prevent any further areas being declared.	• The scheme does not address any of the key objectives outlined in LTP2. Regarding traffic growth during peak periods, traffic levels were in fact forecast to increase as a result of the scheme although observed data shows no considerable increase.	N/A
	Warwickshire Local Transport Plan 3 **(2011-2026)**	• Relevant LTP3 objectives include: • To reduce the impact of transport on people and the (built and natural) environment and improve the journey experience of transport users. • To improve the safety, security and health of people by reducing the risk of death, injury or illness arising from transport; and by promoting travel modes that are beneficial to health.	• Improvements to journey times and reliability are likely to significantly improve the journey experience for the vast majority of transport users. The scheme has also improved safety through a reduction in KSI's at M40 J15 and the southern connector roundabout and promoted travel modes which are benficial to health through the implementation of the scheme underpass and the provision of improved NMU routes.	✓
Regional Policies	**Regional Spatial Strategy for the West Midlands (2008)**	• Relevant policies from the Regional Spatial Strategy include: • **T1 Developing accessibility and mobility** within the region to support the spatial strategy – this includes implementation of measures to improve national road and rail networks to ensure that strategic links to external markets are maintained and the region does not become a transport bottleneck undermining national economic growth. The policy also supports measures which improve the safety and security of the transport system. • **T3 Walking and cycling** – ensuring that new developments and infrastructure proposals improve walking and cycling access. • **T9 The management and development of national and regional transport networks** – this policy states that local authorities and the Highways Agency will give high priority to investment in the maintenance and selective improvement of the network in order to maintain accessibility for essential movements, including freight, within and through the region. The aim is to provide a strategic transport system which: • Enhances the competitiveness of the region by providing journey time reliability; • Provides improved links and accessibility both with the region and to other UK and European regions and beyond; and • Ensures that motorways and trunk roads are managed and improved to operate effectively as part of the national transport network, including the use of appropriate demand management techniques to improve journey time reliability.	• T1 – the scheme has reduced high levels of congestion on trunk roads around M40 Junction 15, particularly during peak periods. The average annual accident rate has also reduced (when compared to the background reduction in accidents), however this was not seen to be statistically signifcant and therefore the reduction in accidents cannot be directly attributed to the scheme measures. • T3 – the provision of an underpass at the southern connection roundabout near Sherbourne has improved access for pedestrians and cyclists. • T9 – considerable improvements to journey reliability have been demonstrated along the A46 trunk road where motorists now have the option of using the free-flow bypass. Journey time's savings along the bypass and at M40 Junction 15 itself also demonstrate how the scheme has improved the operational efficiency of several key strategic links.	✓
National Policies	**A New Deal for Trunk Roads in England** **(1998)**	• The Government's overarching objectives for transport at the time of the appraisals were set out in this document: • To protect and enhance the built and natural environment. • To improve safety for all travellers • To contribute to an efficient economy, and to support sustainable economic growth in appropriate locations. • To promote accessibility to everyday facilities for all, especially those without a car. • To promote the integration of all forms of transport and land use planning, leading to a better, more efficient transport system	• The scheme has improved journey times and journey time reliability for trunk road traffic. • The scheme has improved accessibility for NMUs at the new southern connection roundabout through the provision of a segregated footway/cycleway/bridleway.	✓

7. Appraisal Summary Table (AST) & Evaluation Summary Table (EST)

Appraisal Summary Table (AST)

7.1. The Appraisal Summary Table (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 M40 Junction 15 (Longbridge) Bypass 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 schemes predicted qualitative and quantitative impacts against the following core NATA (New Approach to Appraisal) 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.
- **Integration** – A description of how a scheme is integrated with wider local planning, regional and national policy objectives.

Evaluation Summary Table (EST)

7.3. The Evaluation Summary Table (EST) was devised for the POPE process to record a summary of the outturn impacts against the NATA 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 M40 Junction 15 (Longbridge) Bypass scheme. An assessment of each of the objectives at the five year after stage is given. Where possible, the format of the EST mirrors the appearance and process of the AST to enable direct comparison between the two.

Table 7-1 Appraisal Summary Table (14/06/2006)

Scheme:	Description:	Problems:	Present Value Cost £m:
M40 Junction 15 (Longbridge) Bypass	New A46 off-line road to the west of M40 Junction 15 with bridge crossing over M40	Existing extensive peak period congestion predicted to increase with new developments in area	Central £42.8m

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
Environment	Noise	Overall, there would be 3,172 less people annoyed as a result of the scheme. The scheme will move traffic flows away from a large proportion of properties. Increases in traffic flows on other roads would result in increases at some properties.	Estimated Population Annoyed Do-Minimum: 90,299 Estimated Population Annoyed Do-Something: 87,127	Change in population annoyed (Yr 15) = -3,172 PVB (Residential) = £1,160,749.53
	Local Air Quality	There are no current Air Quality Management Areas along the route; the scheme will not result in the creation of a new Air Quality Management Area. There is an AQMA in Warwick Town Centre approximately 1.5km from the scheme. Overall there is a net improvement in air quality with the scheme. NOx emissions increase by 10.5 tonnes per year and PM_{10} emissions by 0.4 tonnes per year in the Do-Something compared to the Do-Minimum.	PM_{10} levels improve by 1,378 properties PM_{10} levels no change 0 properties PM_{10} levels made worse 1,683 properties NO_2 levels improve 1,410 properties NO_2 levels no change 0 properties NO_2 levels made worse 1,651 properties	PM_{10} -1,292.86 NO_2 -1,538.93
	Greenhouse Gases	There is an increase in predicted CO_2 with the development of the scheme from current and future Do-Minimum.	Do-Something as % Present Do-Minimum 109.5% Do-Something as % Future Do-Minimum 102.8%	+2,564 tonnes of CO_2
	Landscape	The scheme lies within the Green Belt. The proposed bypass and associated structures will affect certain local views, some of which cannot be fully mitigated.		Slight adverse
	Townscape	Rural scheme – not applicable		Not applicable
	Heritage of Historic Resources	The scheme crosses three areas of alluvium which have the potential to mask prehistoric and Romano-British activity. Finds of Iron Age and Roman date have been recovered from one location which might be associated with an archaeological site. Disturbance to any archaeological sites will be mitigated by a programme of excavation and recording.		Slight adverse
	Biodiversity	Direct impact to two designated non-statutory nature conservation sites and commuting/foraging habitat used by bats. However, the replacement of arable land by neutral grassland, wetland, scrub and woodland habitats as well as provision of underpasses and protected species fencing will offset many initial impacts.		Slight adverse
	Water Environment	Minor negative effects on ground water and surface water during construction will be balanced by improvements to drainage and water quality by pollution control measures.		Neutral
	Physical Fitness	Providing easier access to the public rights of way network, including Footpath WB16 via a new underpass, will encourage greater fitness of a small number of pedestrians.	Changes in number of cyclists and pedestrians making journeys longer than 30 minutes is not quantified, but likely to be low.	Total number of people walking or cycling for more than 30 minutes per day is likely to be low. Neutral.
	Journey Ambience	Between 500 and 10,000 travellers a day are likely to benefit from better information and increased route certainty, better views and reduced frustration and risk of accidents.		Moderate beneficial
Safety	Accidents	The improvements to M40 Junction 15 will have a positive net accident benefit in all scenarios.	Wide area savings in No. accidents: 580 Wide area savings in casualties Fatal = 18, Serious = 107, Slight = 778 Wide area accidents PVB = £37.561m Increase No. accidents during maintenance/construction PVB = -£0.299m	PVB £m Central Growth = £37.262m
	Security	There are few pedestrian/cycle movements. A footway/cycleway/bridleway has been incorporated		Beneficial

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT			ASSESSMENT
Economy	Public Accounts	Scheme will require significant public capital expenditure; split of capital cost (2002 discounted) will be: 82% construction, 4% land, 10% preparation, 4% supervision.	Central Government Capital PVC (discounted) = -£3.960m Central Government lost tax revenue from maintenance/construction PVC -£0.061m	Local Government PVC = N/A		PVC £m Central Growth = £42.811m
	Transport Economic Efficiency: Business Users & Transport Providers	Business users will gain journey time and vehicle operating cost benefits through the removal of junction delays at M40 Junction 15. Freight and public transport operators will also benefit.	Business Users PVB CG = £1534.522m Business Users Delay from Maintenance and Construction = -£2.506m	Providers PVB = N/A	Other PVB = N/A	PVB £m Central Growth = £132.016m
	Transport Economic Efficiency: Consumers	Consumer users will also gain journey time and vehicle operating cost benefits, through removal of junction delays at M40 Junction 15.	Consumer Users PVB Central Growth = £102.719m Consumer Users Delay from Maintenance and Construction Central Growth = -£3.147m			PVB £m Central Growth = £99.572m
	Reliability	Reduced conflict for through movements. Improved M40 Junction 15 capacity will provide better speed/flow characteristics and more consistent journey times.	No quantitative assessment of reliability benefits has been made.			
	Wider Economic Impacts	An Economic Impact Report is not required.	Not applicable			Not applicable
Accessibility	Options Values	Not applicable	Not applicable			Not applicable
	Severance	The new road will bisect PROW Wb16 and have a minor impact on W91b and W94a. However, a small number of pedestrians will benefit from improvements including a new underpass and footway/cycleway/bridleway alongside the road.				
	Access to the Transport System	Not applicable	Not applicable			Not applicable
Integration	Transport Interchange	There is provision for improvement of the bus stop within Sherbourne. No other passenger interchanges are included with the scheme.	Not applicable			Neutral
	Land-Use Policy	Some policies are supported (e.g. those relating to transport), but there is conflict with others (e.g. policies relating to sustainable development and biodiversity). Overall the scheme is neutral regarding land use policy.	Not applicable			Neutral
	Other Government Policies	Key policies positively affected relate to transport and the economy, which emphasise the need for a safe and efficient trunk road network, which would benefit the economy and alleviate congestion, severance and other adverse environmental impacts associated with traffic in settlements. Other environmentally related policies would be hindered by the scheme, including those related to the countryside, heritage and biodiversity issues. The overall rating in terms of compliance with other government policy is beneficial.	Not applicable			Beneficial

Table 7-2 Evaluation Summary Table

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
Environment	**Noise**	Traffic levels and speeds are significantly lower than predicted at FYA, on which basis it is likely that noise emissions associated with the scheme are lower than expected. Only one location was likely to be worse than expected, and that was the east-bound M40 off slip, although there are no sensitive receptors nearby. However no data were available regarding HGVs or speeds relative to predictions. Responses from Parish Councils reported that they considered noise levels to have substantially increased.	Not applicable	Better than expected at FYA based on observed traffic flows and speeds.
	Local Air Quality	Traffic levels are significantly lower than predicted at FYA, on which basis it is likely that air quality is better than expected. Only one location was likely to be worse than expected, and that was the east-bound M40 off slip, although there are no sensitive receptors nearby. Sherbourne Parish Council believe that observed dust and particulates settling on some outdoor surfaces are from road traffic (the OYA report suggested this was from agricultural sources, which the Parish Council dispute).	Not applicable	Likely to be better than expected.
	Greenhouse Gases	A decrease in carbon emissions has occurred as benefits from reduced congestion at M40 Junction 15 outweigh the increased emissions caused by vehicles travelling at faster speeds along the A46 bypass.	Decrease of 1,712 tonnes of CO^2 (14% reduction)	Better than expected
	Landscape	The scheme was built as designed, including mitigation, and planting was generally established although has been somewhat patchy. Responses from Parish Councils indicate that they consider the landscape planting to be insufficient and not what was originally indicated to them would be planted. It was considered that despite the patchy nature of some planting the outcome was as expected, although there was no explicit prediction of landscape amenity at five years, only one year and fifteen.	Not applicable	Worse than expected (slight adverse) for the AST score, but as expected (moderate adverse) in the ES
	Townscape	Rural scheme – not applicable	Not applicable	Not applicable
	Heritage of Historic Resources	Given the landscape planting had been implemented as planned and was generally establishing sufficiently, and the recent publication of archaeological findings, the impact on heritage was deemed to be as predicted, slight adverse.	Not applicable	Slight adverse overall, as expected though some individual impacts on built heritage assets are worse than expected in the Sherbourne area.
	Biodiversity	The scheme and mitigation has been implemented as expected, including wetland habitat, mammal ledges and mitigation planting. Consultation revealed concerns from the county ecologist regarding lapwing, and Sherbourne Parish Council regarding birds and bats. Sherbourne Meadows SSSI has recently been assessed as being of favourable status by Natural England, and the Environment Agency were positive about many aspects of the scheme's mitigation. The conclusion was that the scheme remains "slight adverse" overall for biodiversity.	Not applicable	As expected (slight adverse)

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
	Water Environment	Mitigation measures had been implemented as expected, and the EA had made several positive remarks with regard to these. Natural England confirmed that Sherbourne Meadows SSSI was of favourable status. Overall the effect on water quality and drainage was considered to be neutral, as expected.	Not applicable	As expected (neutral)
	Physical Fitness	The footpath WB16 remains open and in generally good condition, although there is graffiti on the underpass and the Parish Council note that pedestrians are exposed to road noise and fumes. Considered to be neutral, as expected.	Not applicable	As expected (neutral)
	Journey Ambience	New signage has improved route certainty. Traveller information has improved and new bus lay-bys provided. Accident data has improved, although anecdotal observations from consultees suggest that the scheme is not optimally laid out for safety and lane markings are degrading making navigation more difficult. Considered to be moderate beneficial, as expected.	Not applicable	As expected (moderate beneficial)
Safety	**Accidents**	The number of accidents has reduced within the near vicinity of the scheme as well as over the wider study area considered in the appraisal. However, the results of a statistical significance test found that, when adjusted for a background reduction in collisions, the observed changes over both the COBA area and the key links area were not statistically significant. Therefore, the reduction in the number of collisions over both the COBA area and the key links area cannot be not directly attributed to the scheme measures.	Scheme area average annual accident saving in no. accidents: 1.1 Scheme area accidents PVB = Monetised Safety Benefits not included in BCR calculation.	Worse than expected
	Security	Implementation of underpass leading under southern connection roundabout is likely to reduce incidents involving NMUs crossing the road. However, there is also a slightly increased possibility of crime related incidents occurring.	Not applicable	Worse than expected
Economy	**Public Accounts**	Scheme construction costs were approximately 5% higher than expected (in relation to agreed target costs in February 2008 as opposed to originally forecast costs in 2006 EAR). At the time of appraisal, the impact of indirect tax was included as part of the costs, however, current appraisal guidance includes the impact of indirect tax as part of the benefits of a scheme. Indirect Tax was lower than forecast.	Scheme cost: £60.1m Indirect tax revenue: £0.24m Total PVB (including Indirect Tax): £126.6m	Better than expected
	Transport Economic Efficiency:	Scheme achieves considerable journey time benefits for those using the new A46 bypass and those who travel through M40 Junction 15. However, total savings are lower than expected as traffic flows have not reached the levels forecast.	TEE benefit 0% Traffic Growth: £96.12m TEE benefit NRTF Traffic Growth: £127.54m	Worse than expected
	Reliability	Considerable improvements to journey time reliability have been demonstrated for A46 through traffic. Motorists using M40 Junction 15 can also be expected to experience significant reliability improvements.	No quantitative assessment of reliability benefits has been made.	As expected
	Wider Economic Impacts	Scheme has had limited immediate impact in terms of stimulating economic growth in the vicinity of M40 J15. However, may facilitate future growth in later years.	Not applicable	Neutral
Accessibility	**Option Values**	Not applicable	Not applicable	Not applicable

OBJECTIVE	SUB-OBJECTIVE	QUALITATIVE IMPACTS	QUANTITATIVE IMPACT	ASSESSMENT
	Severance	Accessibility is improved for a small number of pedestrians following implementation of new underpass under southern connection roundabout. Wheelchair users also benefit from the provision of dropped curbs to facilitate access to bus stop on A46 southbound near Sherbourne.	Not applicable	As expected
	Access to the Transport System	Not applicable	Not applicable	Not applicable
Integration	**Transport Interchange**	New dedicated bus lane at Sherbourne bus stop (southbound) allows buses to stop without impeding flow on A46 trunk road. Bus services are not frequent therefore impact is only considered slightly beneficial.	Not applicable	Better than expected
	Land-Use Policy and Other Government Policies	The scheme aligns with national, regional and local policies, improving journey times and reliability as well as improving safety and improving accessibility for a small number of NMUs.	Not applicable	As expected

8. Conclusion

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

Table 8-1 Success against Scheme Objectives

Objective	Has the scheme objective been achieved?	
To reduce congestion at M40 Junction 15 and improve travel times by reducing the amount of A46 traffic travelling through the junction.	Journey time savings recorded for vehicles along the new A46 scheme bypass and for vehicles using M40 J15. Reliability has also improved for vehicles during the post opening assessment period.	✓
To improve safety for road users at the junction through the various improvements to the roundabout	Collisions have decreased over both the wider COBA scheme area and the M40 J15 key links area. There has been a saving of 7.1 collisions per annum over the COBA area, and a saving of 1.1 collisions per annum over the M40 J15 key links analysis area (compared to the scheme counterfactual). However, it is important to note that the reduction in collisions across both the COBA area and the Key Links analysis area is not statistically significant and therefore cannot be directly attributed to the scheme measures. However, no KSI's were recorded in the immediate vicinity of M40 Junction 15 or the A46 southern connector roundabout during the post-opening period, suggesting that road users are experiencing an improvement in safety at the junction. Analysis of the accident contributory factors indicates that there has been a reduction in the number of accidents involving vehicles 'failing to judge another person's path or speed' and 'following too close' to another vehicle, indicating that the scheme measures have improved driver safety.	✓

Appendix A. Accident Contributory Factors for M40 J15 Cordon Area

Figure B-1 Contributory Factors for M40 J15 Cordon Area

Code	Type of Accident	Pre-Scheme		Post-Scheme		Saving
		Total	Rate (pa)	Total	Rate (pa)	
301-310	**Injudicious Action**	**9**	**2.6**	**7**	**1.4**	**-1.2**
301	Disobeyed automatic traffic signal	1	**0.3**	1	**0.2**	-0.1
302	Disobeyed 'Give Way' or 'Stop' sign or markings	0	**0.0**	1	**0.2**	0.2
303	Disobeyed double white lines	0	**0.0**	0	**0**	0.0
304	Disobeyed pedestrian crossing facility	0	**0.0**	0	**0**	0.0
305	Illegal turn or direction of travel	1	**0.3**	0	**0**	-0.3
306	Exceeding speed limit	0	**0.0**	1	**0.2**	0.2
307	Travelling too fast for conditions	3	**0.9**	0	**0**	-0.9
308	Following too close	4	**1.1**	4	**0.8**	-0.3
309	Vehicle Travelling along pavement	0	**0.0**	0	**0**	0.0
310	Cyclist Entering road from pavement	0	**0.0**	0	**0**	0.0
401-410	**Driver/Rider Error**	**16**	**4.6**	**25**	**5**	**0.4**
401	Junction overshoot	0	**0.0**	2	**0.4**	0.4
402	Junction restart (moving off at junction)	0	**0.0**	1	**0.2**	0.2
403	Poor turn or manoeuvre	5	**1.4**	2	**0.4**	-1.0
404	Failed to signal or misleading signal	0	**0.0**	2	**0.4**	0.4
405	Failed to look properly	4	**1.1**	9	**1.8**	0.7
406	Failed to judge other person's path or speed	4	**1.1**	4	**0.8**	-0.3
407	Passing too close to cyclist, horse rider or pedestrian	0	**0.0**	0	**0**	0.0
408	Sudden braking	0	**0.0**	2	**0.4**	0.4
409	Swerved	0	**0.0**	2	**0.4**	0.4
410	Loss of Control	3	**0.9**	1	**0.2**	-0.7

Appendix B. Environment Sources

Table C-1 Responses to Environment Source Requirements

Environment Specific Requirements	Response
Environment Statement (ES) or if not a scheme requirement the latest Scheme Assessment Report (SAR).	Non-Technical Summary, Environment Statement and Appendices July 2006 Volumes 1 (main text), 2 (detailed assessment) and 3 (figures).
Any amendments, updates or addendums to the ES SAR or any relevant further studies or reports. Any significant changes to the scheme since the ES.	Environmental Statement Addendum (Nov 2006)
As built drawings for landscape biodiversity environmental mitigation measures drainage fencing earthworks etc.	Complete as-built drawings provided (2011)
Construction Environment Management Plan (CEMP)	Project Environmental Plan (April 2010)
Landscape and Ecology Aftercare Plan (LEAP).	Landscape maintenance programme provided only.
H& S File – environment information	Not provided
Handover Environmental Management Plan (HEMP).	Handover Environmental Management Plan (June 2010)
Relevant Contact Names for: the Statutory Consultees (EA, EH and NE); the local authorities (at county and district level); the Parish or Town Councils; Employer's Agent and Designers or environmental coordinators for scheme; the MAC; and Other relevant specialist consultees.	All consultees contacted via generic inboxes in the first instance (Parish Council contacts from district council website)
Archaeological Reports (popular and academic).	Post-excavation Archaeological Assessment (Dec 2010)
The Road Surface Influence (RSI) value of any low noise surface installed	Not provided
The insulation performance properties of any noise barriers installed (The BS EN 1794-2 result provided by the noise barrier manufacturer)	Not provided
List of properties eligible for noise insulation.	No properties predicted to require noise insulation in ES

Environment Specific Requirements	Response
Reports for any pre post opening survey and monitoring work e.g. for noise, biodiversity, water quality).	Not provided
Animal mortality data	Not provided
Post opening Non-motorised User (NMU) Audit or Vulnerable User Survey	Not provided
Any information regarding environmental enhancements to streetscape townscape for bypassed settlements.	Not provided
Employers Requirements Works Information – environment section	Not provided
Scheme Newsletters or publicity material for the scheme.	Not provided

Figure C-1 Photoview 1 from ES Existing - corner of Watery Lane; Sherbourne towards A46

Figure C-2 Photoview 1 from ES Predicted Year 1 – corner of Watery Lane, Sherbourne towards new Sherbourne Roundabout

Figure C-3 Recreation of Photoview 1 taken in autumn 2015 – Corner of Watery Lane, Sherbourne, towards new Sherbourne Roundabout

Figure C-4 Recreation of Photoview 1 taken in summer 2012 – corner of Watery Lane, Sherbourne, towards new Sherbourne Roundabout

Figure C-5 Photoview 2 from ES Existing – from footpath WB16 towards Sherbourne and A46

Figure C-6 Photoview 2 from ES. Predicted Year 1 – from Footpath WB16 towards new Sherbourne Roundabout

Figure C-7 Recreation of Photoview 2 taken in autumn 2015- from footpath WB16 towards new Sherbourne Roundabout

Figure C-8 Recreation of Photoview 2 taken in summer 2012 from footpath WB16 towards new Sherbourne Roundabout

Figure C-9 Photoview 3 from ES. Existing – from corner of Vicarage Road, Sherbourne, towards A46

Figure C-10Photoview 3 from ES. Predicted Year 1 – from corner of Vicarage Road, Sherbourne, towards A46

Figure C-11 Recreation of Photoview taken in autumn 2012 – from corner of Vicarage Road, Sherbourne, towards realigned A46

Figure C-12Recreation of Photoview 3 taken in summer 2012 – from corner of Vicarage Road, Sherbourne, towards realigned A46

Figure C-13 Photoview 5 from ES Existing – from B4463 over M40 towards A46

Figure C-14 Photoview 5 from ES Predicted Year 1- from B4463 over M40 towards realigned A46

Figure C-15 Recreation of Photoview 5 taken in autumn 2015 – from B4463 over M40 towards realigned A46

Figure C-16 Recreation of Photoview 5 taken in Summer 2012- from B4463 over M40 towards realigned A46

Figure C- 17 Scheme Proposals from ES Non-Technical Summary

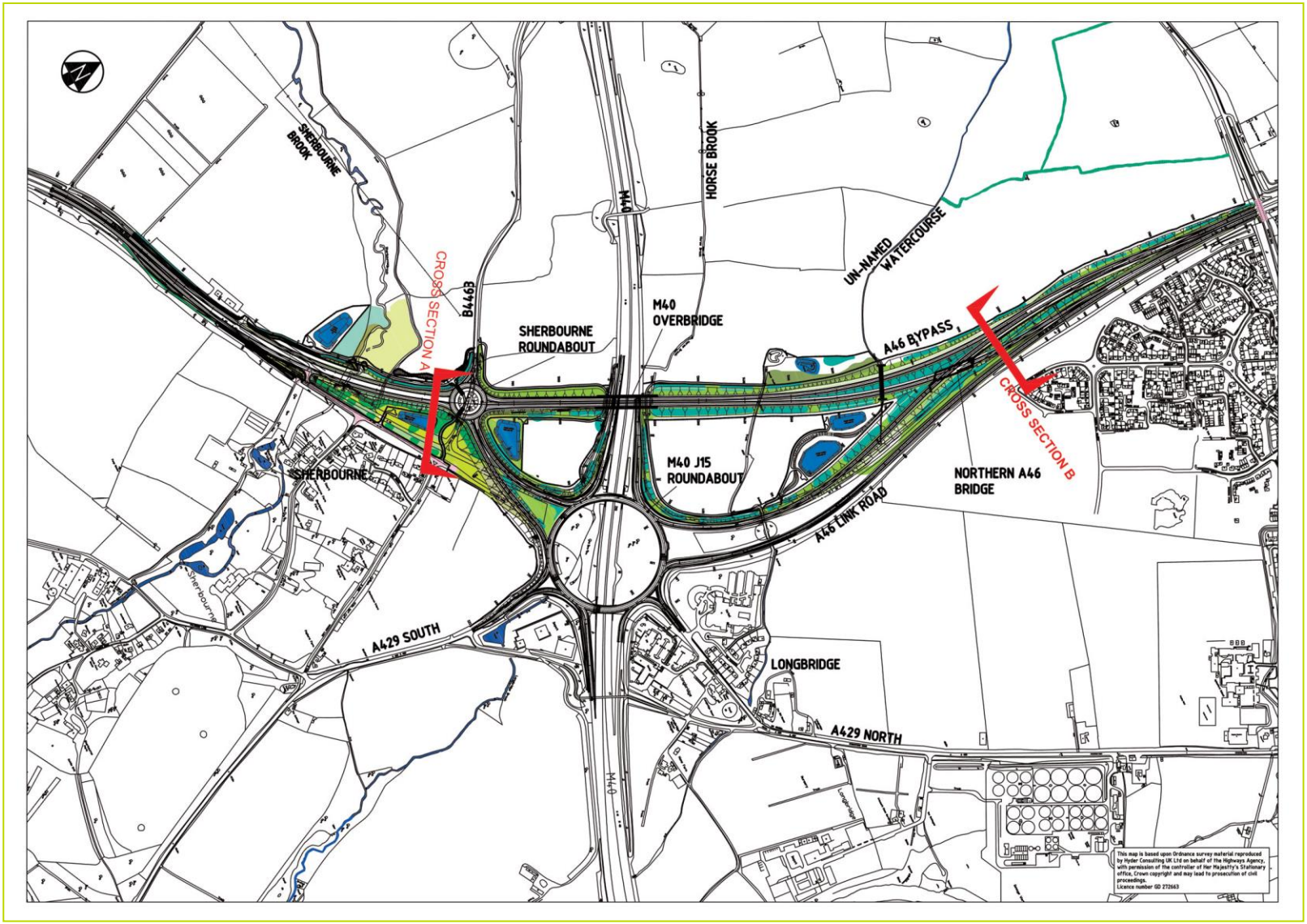
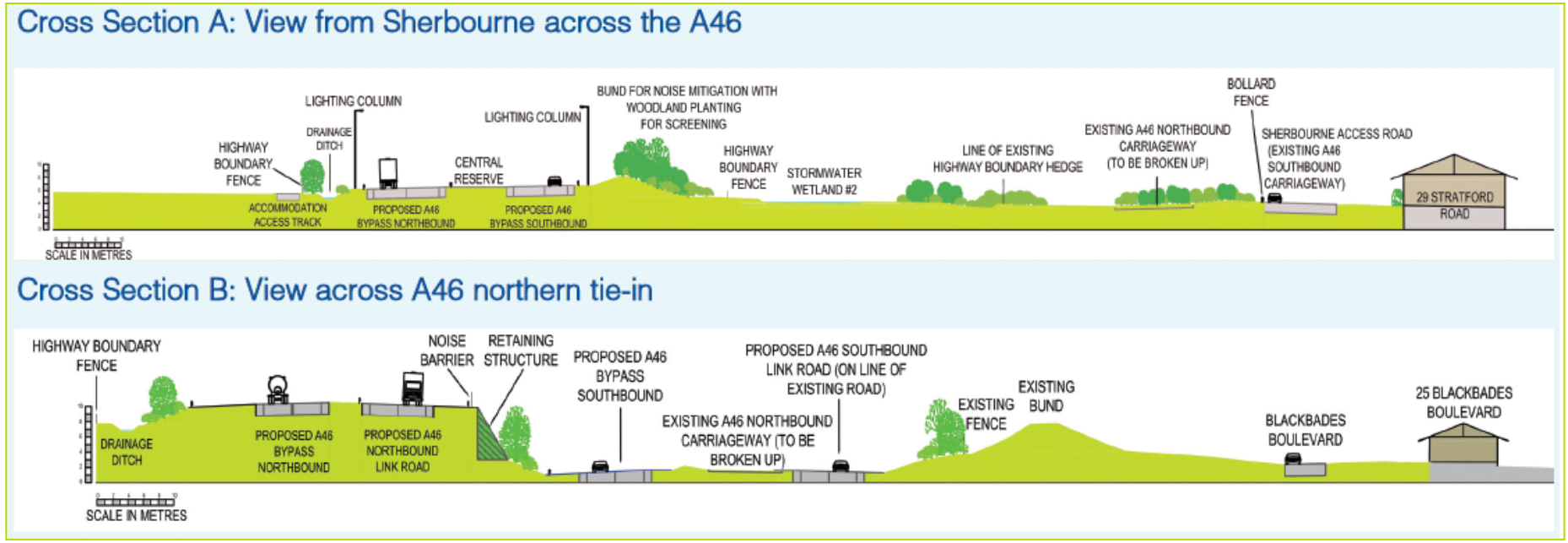


Figure C-18- Scheme Proposals from ES Non-Technical Summary



Appendix C. Tables and Figures

Appendix D. Glossary

Term	Meaning
ADT	**Average Daily Traffic.** Average of 24 hour flows, seven days a week, for all days within the year.
AWT	**Average Weekday Traffic**. As ADT but for five days, (Monday to Friday) only.
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.
AQMA	Air Quality Management Area
AST	**Appraisal Summary Table**. This records the impacts of the scheme according to the Government's five key objects for transport, as defined in DfT guidance contained on its Transport Analysis Guidance web pages, WebTAG
ATC	**Automatic Traffic Count**
AWT	**Average Weekday Traffic.** Average of Monday to Friday 24 hour flows.
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
CO^2	Carbon Dioxide, for transport, this is the main greenhouse gas
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.
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.
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
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
EN	English Nature
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.

Term	Meaning
FYA	**Five Years After**
HA, Highways Agency	An Executive Agency of the Department for Transport, responsible for operating, maintaining and improving the strategic road network in England.
HATRIS	**Highways Agency Traffic Information System** The Highways Agency (HA) currently maintains, operates and develops three traffic databases and associated applications. The Traffic Flow Data System (TRADS) holds information on traffic flows at sites on the network. The Journey Time Database (JTDB) system holds information on journey times and traffic flows for links of the network. These two databases are known collectively as the HA Traffic Information System (HATRIS).
HEMP	**Handover Environmental Management Plan**
HGV	**Heavy Goods Vehicle**. In the context of this report, the precise definition of the term is dependent on the way that traffic is being measured. Currently, traffic flow data as measured by ATCs uses a length based classification – the term HGV is used to refer to vehicles greater than 5.2m. Shorter vehicles are classified as 'light'.
JPC	**Barford, Sherbourne & Wasperton Joint Parish Council Joint Parish Council**
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
LTP	**Local Transport Plan**
MAC	**Managing Agent Contractor –** organisation normally contracted in 5-year terms for undertaking the management of the road network within a HA area.
NATA	**New Approach to Transport Appraisal** was the basis of the standard DfT appraisal approach when this scheme was appraised.
NE	**Natural England**
NMU	**Non-Motorised User**. A generic term covering pedestrians, cyclists and equestrians
NRTF	**National Road Traffic Forecast.** 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.
OYA	**One Year After**
PAR	Project Appraisal Report
Part 1 claims	This is financial compensation which can be claimed by people who own and also occupy property that has been reduced in value by physical factors caused by the use of a new or altered road.
PIA	**Personal Injury Accident**. A road traffic accident in which at least one person required medical treatment.
POPE	**Post Opening Project Evaluation**, before & after monitoring of all major highway schemes in England.
Present Value	**Present Value** is the value today of an amount of money in the future. In cost-benefit analysis, values in differing years are converted to a standard base year by the process of discounting giving a present value.
PROW	**Public Right of Way**

Term	Meaning
PVB	**Present Value Benefits** Value of a stream of Benefits accruing over the appraisal period of a scheme expressed in the value of a Present Value
PVC	**Present Value Cost** As for PVB but for a stream of costs associated with a project
SATURN	**Simulation and Assignment of Traffic to Urban Road Networks –** A strategic transport modelling software programme.
SUD	**Sustainable Urban Drainage –** A sustainable drainage system designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges.
QUADRO	**Queues and Delays at Roadworks –** A software programme for calculating the monetary impacts of delays at roadworks.
STATS19	A database of injury accident statistics recorded by police officers attending accidents
TEE	**Transport Economic Efficiency**
TEMPRO	**Trip End Model Program** This is a PC program which provides access to the Department for Transport's national Trip End Model projections of growth in travel demand, and the underlying car ownership and planning data projections.
TPI	**Targeted Programme of Improvements**. Formerly, this was the title of Highways Agency's programme of investment in improvements to the Trunk road and Motorway road network comprised of a number of major schemes each costing more than £5m. Now called Major Schemes and is for schemes over £10m.
TRADS	**Traffic Flow Data System.** Part of HATRIS
TUBA	**Transport Users Benefit Analysis**. A computer system issued and maintained by the Highways Agency. The program calculates the costs and benefits that would accrue to users of a transport system, companies, national and local government as a result of making improvements to a transport network.
vpd	**Vehicles Per Day**
VOC	**Vehicle Operating Costs** For highway schemes these are costs to the user of the fuel and maintaining the vehicle.
VOT	**Value of Time**
webTAG	Department for Transport's website for guidance on the conduct of transport studies at http://www.webtag.org.uk/