highways england

POPE of LNMS

M6 to M62 Eastbound Merges Evaluation Report

January 2016

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This document has 59 pages including the cover.

Document history

Job number: 5107696		Document ref: N9071_POPE of Large LNMS Report_v2.0.docx				
Revision	**Purpose description**	**Originated**	**Checked**	**Reviewed**	**Authorised**	**Date**
Rev 1.0	First Draft	RG	JB	RD	AC	09/09/15
Rev 2.0	Final Report	RG	RG	AC	AC	05/02/16

Client signoff

Client	Highways England
Project	POPE of LNMS
Document title	POPE of LNMS Evaluation Report
Job no.	5107696

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Glossary

Term	a.k.a.	Definition
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
Annual Average Daily Traffic	**AADT**	The 24 hour total traffic flow for the average day of the year
Appraisal Summary Table	**AST**	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**
Asset Support Contractor	**ASC**	Responsible for the operation, maintenance, and improvement of the motorway and trunk road network of a Highways England area. First appointed in 2012, these replace **MAC**s
Automatic Traffic Count	**ATC**	An automated method of recording the volume (and sometimes classification) of vehicles passing a particular point on a road
Average Daily Traffic	**ADT**	The 24 hour total traffic flow on an average day over a certain time period (Monday – Sunday)
Average Weekday Traffic	**AWT**	The 24 hour total traffic flow on an average weekday over a certain time period (Monday – Friday)
Benefit Cost Ratio	**BCR**	Benefit Cost Ratio is a ratio identifying the relationship between cost and benefits of a proposed project
Capitalisation	**-**	The process by which benefits for a scheme are factored to give an estimate for the appropriate appraisal period
Department for Transport	**DfT**	A Government department whose objective is to oversee the delivery of a reliable, safe and secure transport system that responds efficiently to the needs of individuals and business whilst safeguarding our environment
Discounting	**-**	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
Dis-benefit	**-**	A negative benefit or something that detracts from the performance

Evaluation Summary Table	**EST**	In **POPE** studies, this is a summary of the evaluations of the **TAG** objectives using a similar format to the forecasts in the **AST**
First Year Rate of Return	**FYRR**	First Year Rate of Return is the ratio of money gained on an investment relative to the amount of money invested
Highways England	**-**	An Government-owned company**,** responsible for operating, maintaining and improving the strategic road network in England
Killed or Seriously Injured	**KSI**	A term used to describe the number of people killed or seriously injured as a result of **PIC**s
Local Network Management Scheme	**LNMS**	LNMS are improvement schemes where total overall estimated cost (including design, land, works, supervision, risk and VAT) is less than £10 million. They are categorised by the Government under Safety, Economy, Severance, Environment, Non-Appraisable and Non-NATA
Managing Agent Contractor	**MAC**	Responsible for the operation, maintenance, and improvement of the motorway and trunk road network of a Highways England area. These are being replaced by **ASC**s, the first of which was appointed in 2012
Optimism Bias	**-**	Is a demonstrated systematic, tendency for project appraisers to be overly optimistic, and in effect, results in an underestimation of scheme costs. The base cost estimate is adjusted to account for optimism bias in order to obtain more accurate cost estimates
Project Appraisal Report	**PAR**	A key document summarising the need for a project, plus its costs and benefits (including those that cannot be quantified in monetary terms)
Personal Injury Collison	**PIC**	A term commonly used to refer to road accidents
Post-Opening Project Evaluation	**POPE**	Before and after monitoring of all highway schemes in England
Present Value of Costs	**PVC**	Present Value of Costs is a term used in cost-benefit analysis and project appraisal that refers to the discounted sum, or Present Value, of a stream of costs associated with a project or proposal
Risk Allowance	**-**	**Risk** refers to identifiable future situations that could result in an over spend or under spend occurring. The base cost estimate is adjusted to account for risk in order to obtain more accurate cost estimates
Severance	**-**	Community severance is the separation of adjacent areas by road or heavy traffic, causing negative impact on non-motorised users, particularly pedestrians
-	**STATS19**	A database of injury accident statistics recorded by police officers attending accidents

Traffic Database System	**TRADS**	Traffic count database developed by Highways England, to hold data from traffic monitoring sites on the strategic network
Web-based Transport Analysis Guidance	**WebTAG**	The Department for Transport's transport appraisal guidance and toolkit, first issued in 2003

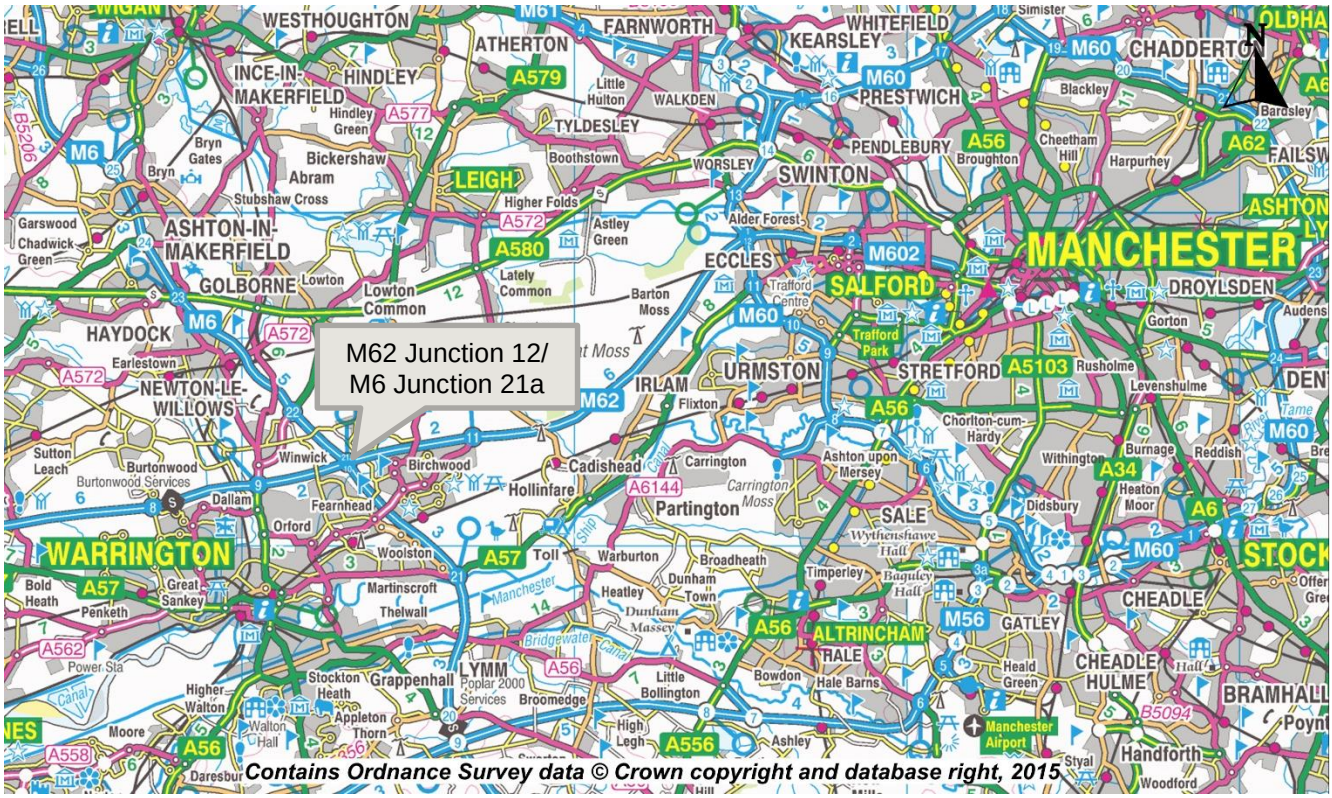
1. Introduction

Background

1.1. This report is the Post-Opening Project Evaluation (POPE) of the **M6 to M62 Eastbound Merges Improvements** Local Network Management Scheme (LNMS), produced by Atkins on behalf of Highways England.

1.2. The scheme makes alterations to Croft Interchange (M6 Junction 21a/ M62 Junction 10), which is situated to the north-east of Warrington. Croft Interchange is a key strategic junction for the motorway network in the north-west of England. It is formed between the M6, which is a north-south route in North West England, and the M62, which is the main strategic east-west route which connects the cities of Manchester and Liverpool. The location of the junction is indicated in **Figure 1.1**.

Figure 1.1 – Location Plan



1.3. The junction has a partially unrolled ‘cloverleaf’ layout, which is illustrated in detail through **Figure 2.1**. The scheme was developed to address issues with traffic queuing on the slip roads from the M6 to the M62 eastbound mainline during the AM and PM peak periods. These queues would affect the slip roads but at times also block back and create congestion on the M6 mainlines in both directions. The congestion was caused by traffic at the end of the slip roads merging with the M62 eastbound mainline flow, which carries large volumes of traffic at peak times.

1.4. As well as congestion, the queuing back to the M6 northbound mainline also caused a safety issue with fast moving vehicles approaching the rear of slow

moving traffic. Further safety problems would also arise with vehicles attempting to change lanes late at the head of the traffic queue to bypass slow or stationary vehicles. There was also a high frequency of side-swipe collisions with vehicles moving into the slow moving queue. The PAR reports that there were 39 Personal Injury Collisions (PICs) during a five year period prior to the scheme on the approaches to the junction on the M6 northbound, M6 southbound, and M62 eastbound.

1.5. The scheme involved the removal of hatching on the M6 northbound and M6 southbound links to the M62 eastbound to maintain two lanes for the entire length of the slip road, thereby increasing capacity. In addition, the merge layouts were also improved as part of the scheme, with the utilisation of a ghost island layout. Along with these improvements, there was also the upgrade of existing signing, street lighting and vehicle restraint systems, as well as works to the existing highway drainage.

1.6. The post-opening evaluation team are aware that traffic management was in place between Junctions 9 and 11 of the M62 between September 2011 and June 2012 to facilitate the works for this scheme, as well as other improvement schemes also implemented on the M62 around the same time. These other improvements include introducing street lighting upgrades between Junction 9 and 10 and vehicle restraint systems works between Junction 10 and 11.

1.7. The M6 to M62 Eastbound Merges Improvements scheme opened in February 2012. It is therefore considered that beyond this date, whilst works elsewhere on the J9-11 section may have been on-going, the traffic management around the Croft Interchange related to the M6 to M62 eastbound merges LNMS would have been removed with the scheme open and operational.

1.8. It is also considered that any traffic management which remained on adjacent sections of the motorway beyond February 2012 would not have had any discernible impact on the operation of the M62 eastbound merges LNMS and so this post-opening evaluation considers the scheme having opened from the start of February 2012 onwards.

Purpose of this report

1.9. As part of an ongoing programme, whereby Highways England (formerly Highways Agency) evaluates the impacts of trunk road schemes, Atkins is commissioned to undertake post-opening evaluations of LNMS with an implementation cost of less than £10m.

1.10. This report sets out the results of the POPE of the M6 to M62 Eastbound Merges Improvements LNMS. More specifically, this report examines the economic and safety impacts resulting from the improvements, with consideration also given to wider impacts on the environment and society.

1.11. It is intended that the findings from this report will feed into a wider summary of the outcomes of POPE. This is a document (namely the LNMS Annual Evaluation Report) produced in the 4th quarter of each year outlining the key messages from the entire POPE of LNMS process.

2. Scheme Detail

Introduction

2.1. This chapter of the report outlines the pre-scheme and post-scheme layout of the junction, using photos, diagrams and site observations to illustrate the changes made to the highway network. In addition, this chapter contains the views and feedback on the scheme from key stakeholders.

Background

2.2. The M6 to M62 Eastbound Merges Improvements LNMS removed hatching on the M6 northbound and southbound approaches, thereby maintaining two lanes for the entire length of the slip road. The merge layouts were also improved, along with the upgrade of existing signing, street lighting and vehicle restraint systems, as well as works to the existing highways drainage. **Table 2.1** summarises the scheme details.

Table 2.1 – Summary of M6 to M62 Eastbound Merges Improvements LNMS

Scheme name	M6 to M62 Eastbound Merges Improvement
Area	10
Opening date	February 2012
Category	Economy
Reason for scheme	The scheme was developed to address issues with delays and congestion on the slip roads from the M6 to the M62 eastbound mainline, which would sometimes lead to further queuing on the M6 mainline. The issues were most commonly observed during the AM and PM peak periods. Furthermore, there was a safety issue with 39 Personal Injury Collisions (PICs) recorded in the PAR during a five year period prior to the scheme.
Objectives	• To reduce AM and PM peak congestion and delay on the M6 links to the M62 Eastbound. • To reduce the annual accident rate.
Alternative options	The feasibility of the installation of a fully compliant layout at the junction was considered, but was rejected due to high construction costs. Alternative merge layouts were also considered.

Junction Details

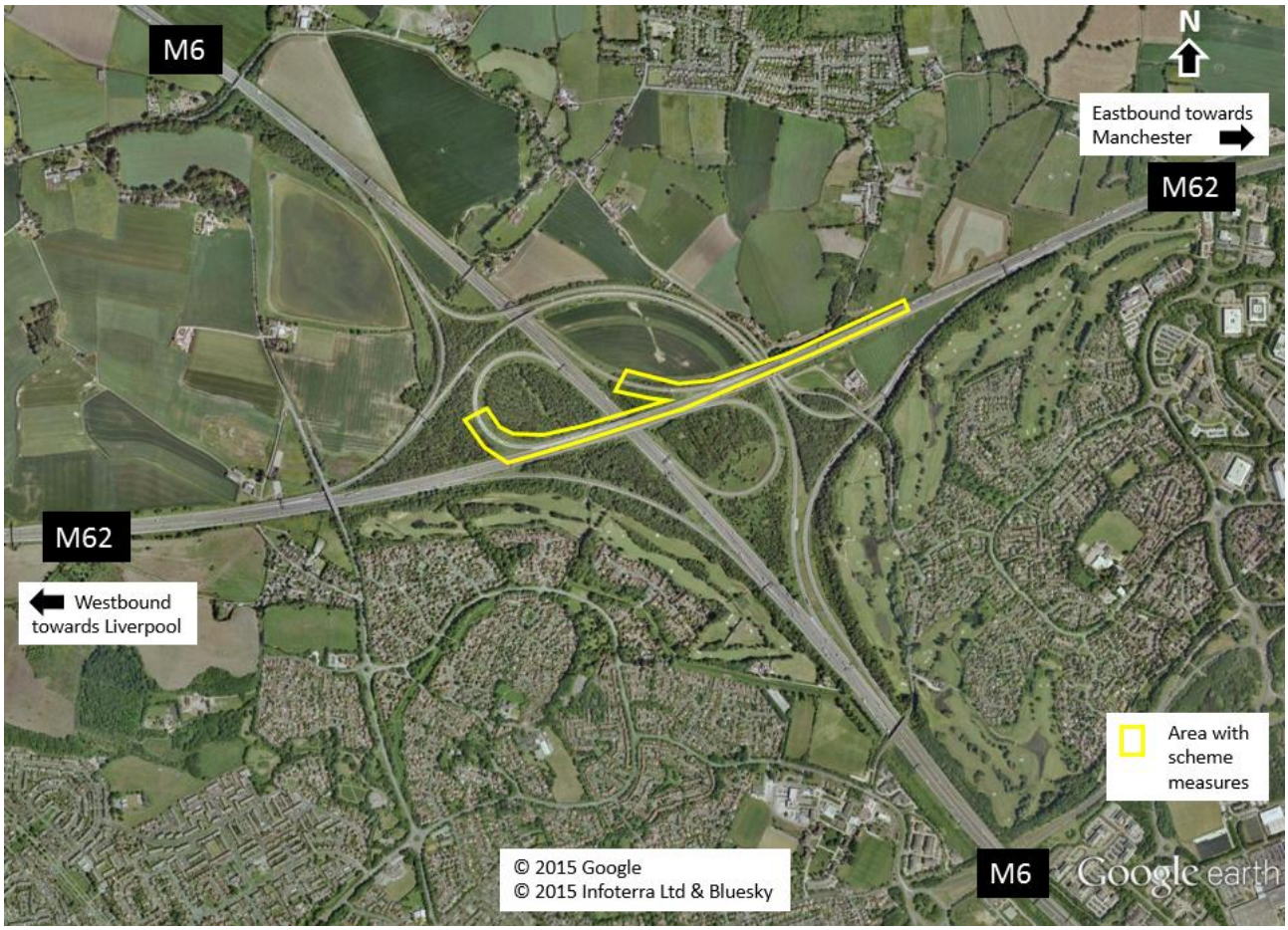
2.3. The scheme is located at the M6 Junction 21a/ M62 Junction 10; known as Croft Interchange. The junction consists of a grade-separated interchange in a partially unrolled ‘cloverleaf’ layout connecting the M62 and the M6 along free-flowing slip roads.

2.4. The M6 passes the junction in a north/south orientation. The M6 northbound carriageway has four lanes on the approach to Croft Interchange. The left hand lane is dedicated only to M62 eastbound traffic, and so the M6 northbound reduces to three traffic lanes beyond the diverge point. There is no access to the slip road from the second traffic lane. The M6 southbound carriageway has three lanes on the approach to Croft Interchange, with the movement to the M62 eastbound carriageway provided through a traditional diverge layout. To the south of Croft Interchange, the southbound carriageway widens with a lane gain provided by traffic joining the M6 southbound from the M62 westbound movement.

2.5. The M62 passes the junction in an east/west orientation. The M62 eastbound mainline carriageway has four lanes exiting Junction 9, but widens to provide five lanes on the approach to Croft Interchange. The two left lanes split from the M62, as the movement to join the M6 northbound carriageway. The other three lanes continue eastbound with a further lane drop meaning there are two eastbound traffic lanes at the location where the M6 northbound slip road meets the M62 eastbound. Through the merger with the traffic from the M6 northbound traffic, there is a lane gain meaning three M62 lanes are provided into the merge point with traffic from the M6 southbound. Beyond the merge point, the M62 eastbound continues as three traffic lanes.

2.6. **Figure 2.1** indicates the local context of the junction and highlights the sections altered by the scheme measures.

Figure 2.1 – Junction Location Context Plan



Pre-Scheme Junction Layout

2.7. The pre-scheme layouts of the merge from the M6 northbound and M6 southbound are shown in **Figure 2.2** and **Figure 2.3** respectively.

2.8. With this layout, the PAR states that traffic was backing up onto the M6 northbound and southbound during peak hours due to congestion at merges with the M62 eastbound.

2.9. An improvement options report (August 2011) was completed pre-scheme to assess potential interventions. The report noted that the large volumes of traffic on the M62 eastbound caused weaving problems, and that this was exacerbated by large volumes of traffic joining the M62 from the M6 northbound and southbound slip roads, leading to traffic 'blocking back' along the M62 to Junction 9. The traffic joining the M62 from the northbound direction 'blocked back' on the slip road to the M6 mainline, resulting in queuing in lanes 1 and 2.

2.10. The improvement options report also identified that the queuing on the M6 mainline was a safety concern, with fast moving vehicles approaching the rear of the slow moving traffic queue. Vehicles also attempted to bypass stationary vehicles by changing lanes at the head of traffic queue, leading to side-swipe accidents.

Post-Scheme Junction Layout

2.11. The post-scheme layouts of the merge from the M6 northbound and M6 southbound are shown in **Figure 2.4** and **Figure 2.5** respectively.

2.12. For both of the M6 to M62 eastbound slip roads, the markings on the slip roads are revised so that two traffic lanes are maintained for the whole length through to the M62 eastbound. This therefore provides additional capacity on the slip roads.

2.13. At the merge point with the M62 eastbound, the highway layout has also been altered with a ghost island merge now provided. The merge layout with the slip road originating from the M6 southbound carriageway has been extended by approximately 150 metres to the east.

2.14. The scheme has also included the upgrade of existing signing, street lighting, vehicle restraint systems, as well as works to the existing highway drainage.

2.15. A comparison of the pre- and post-scheme layouts is also demonstrated in a series of street level imagery presented in **Figure 2.6** for the merge from M6 northbound and **Figure 2.7** for the merge from M6 southbound.

Figure 2.2 – Pre-Scheme Layout: M6 Northbound to M62 Eastbound Slip Road

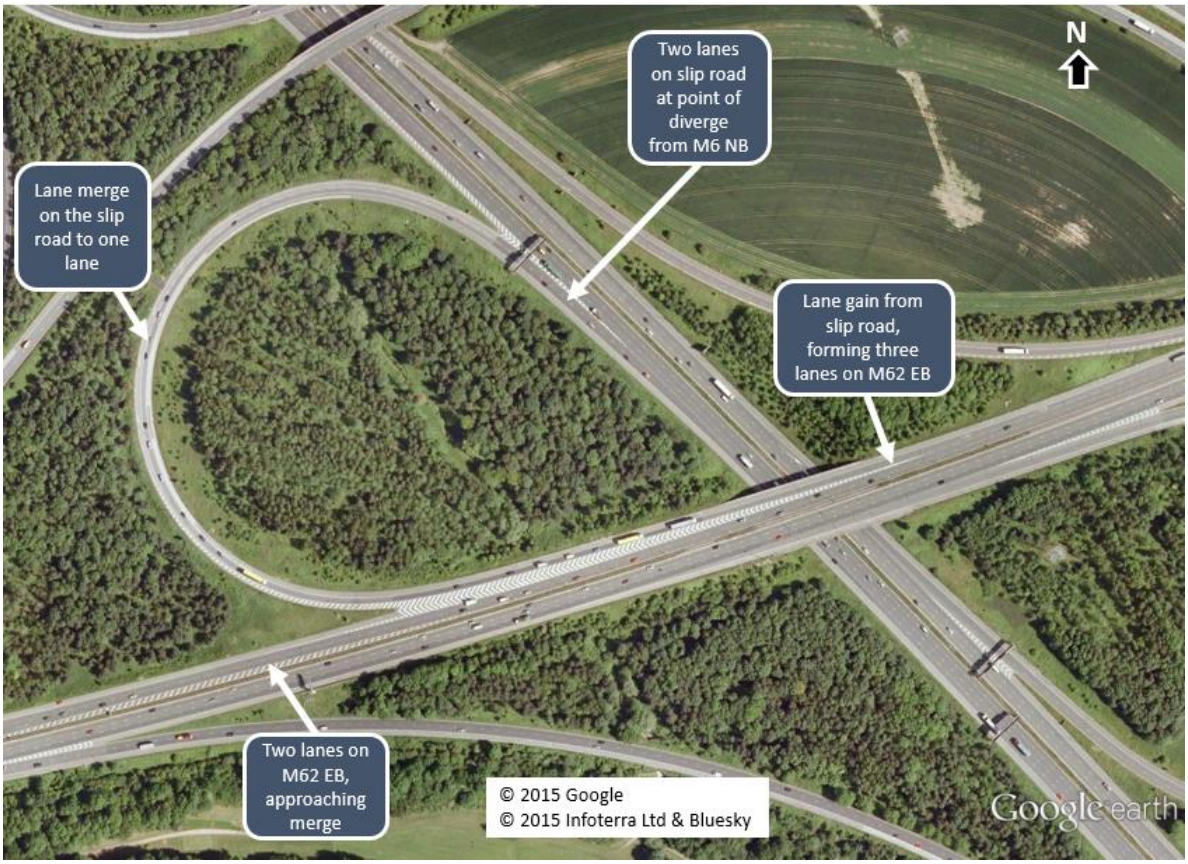


Figure 2.3 – Pre-Scheme Layout: M6 Southbound to M62 Eastbound Slip Road

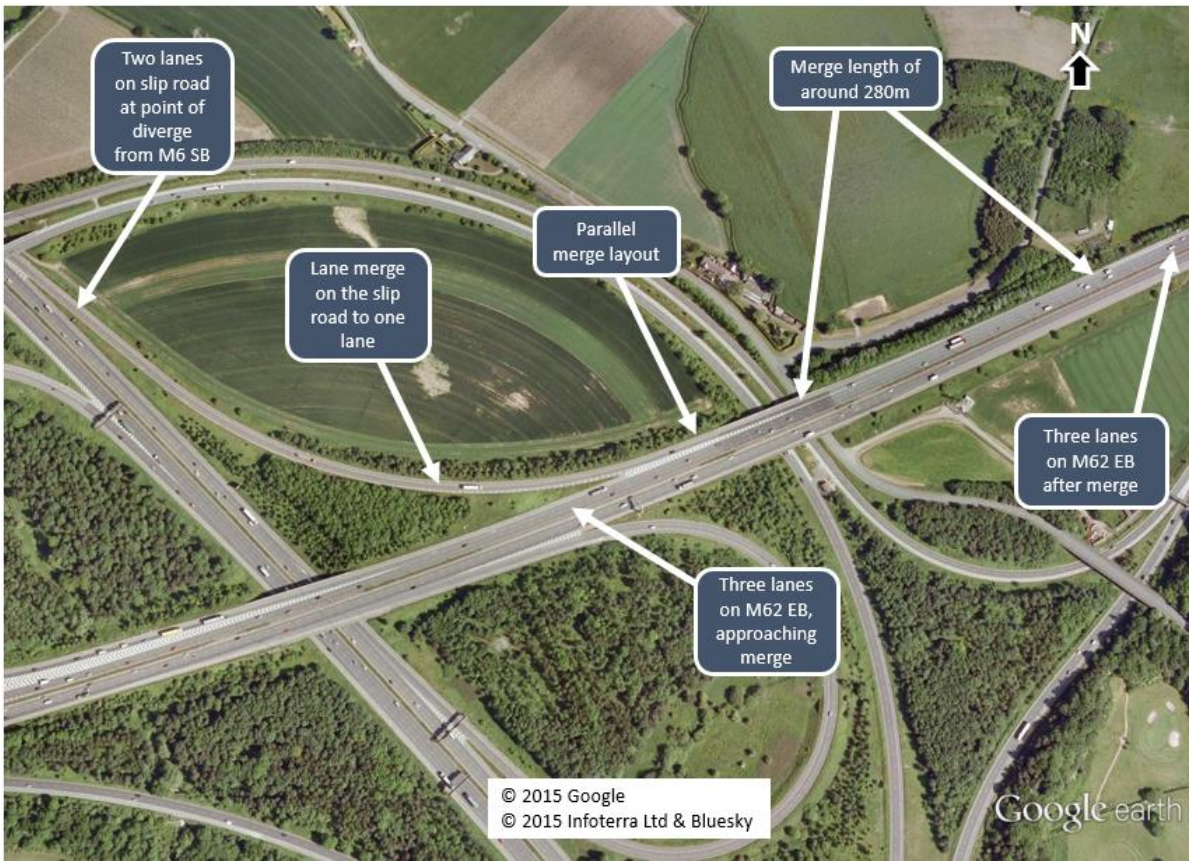


Figure 2.4 – Post-Scheme Layout: M6 Northbound to M62 Eastbound Slip Road

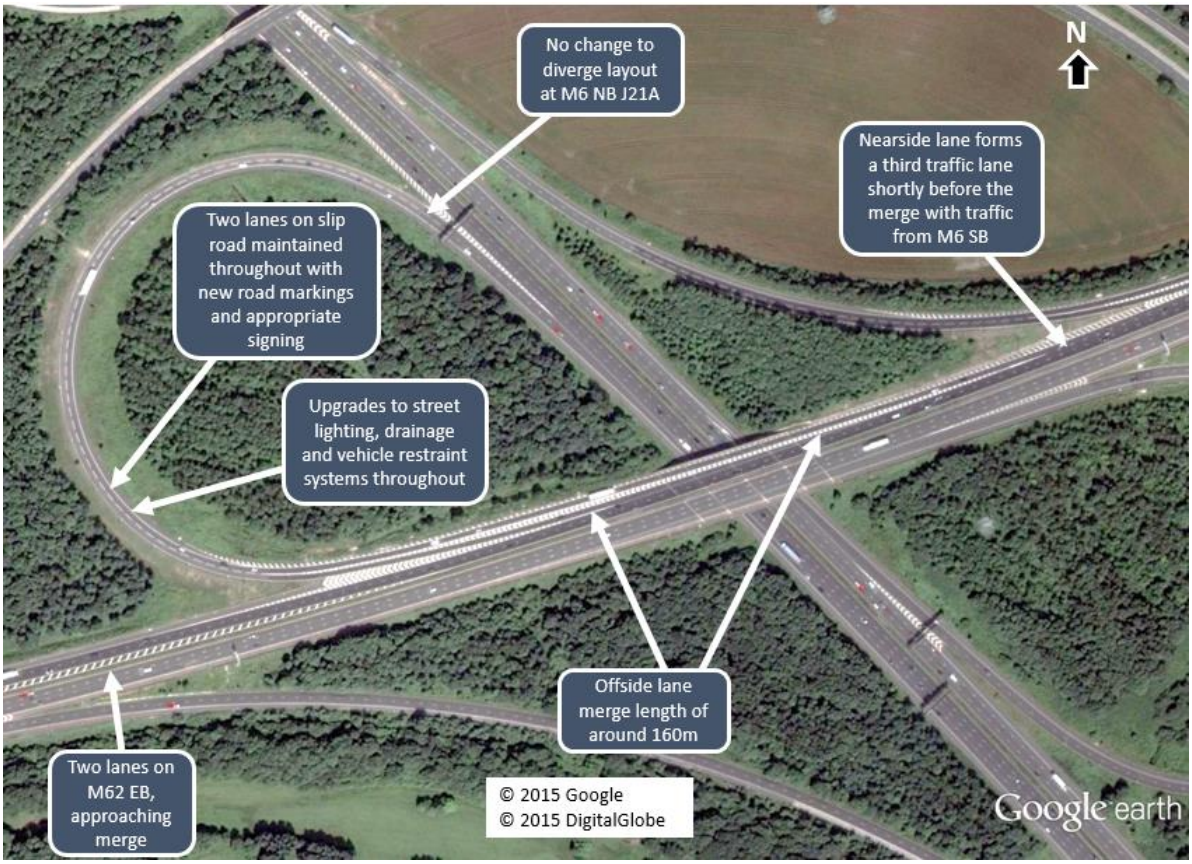


Figure 2.5 – Post-Scheme Layout: M6 Southbound to M62 Eastbound Slip Road

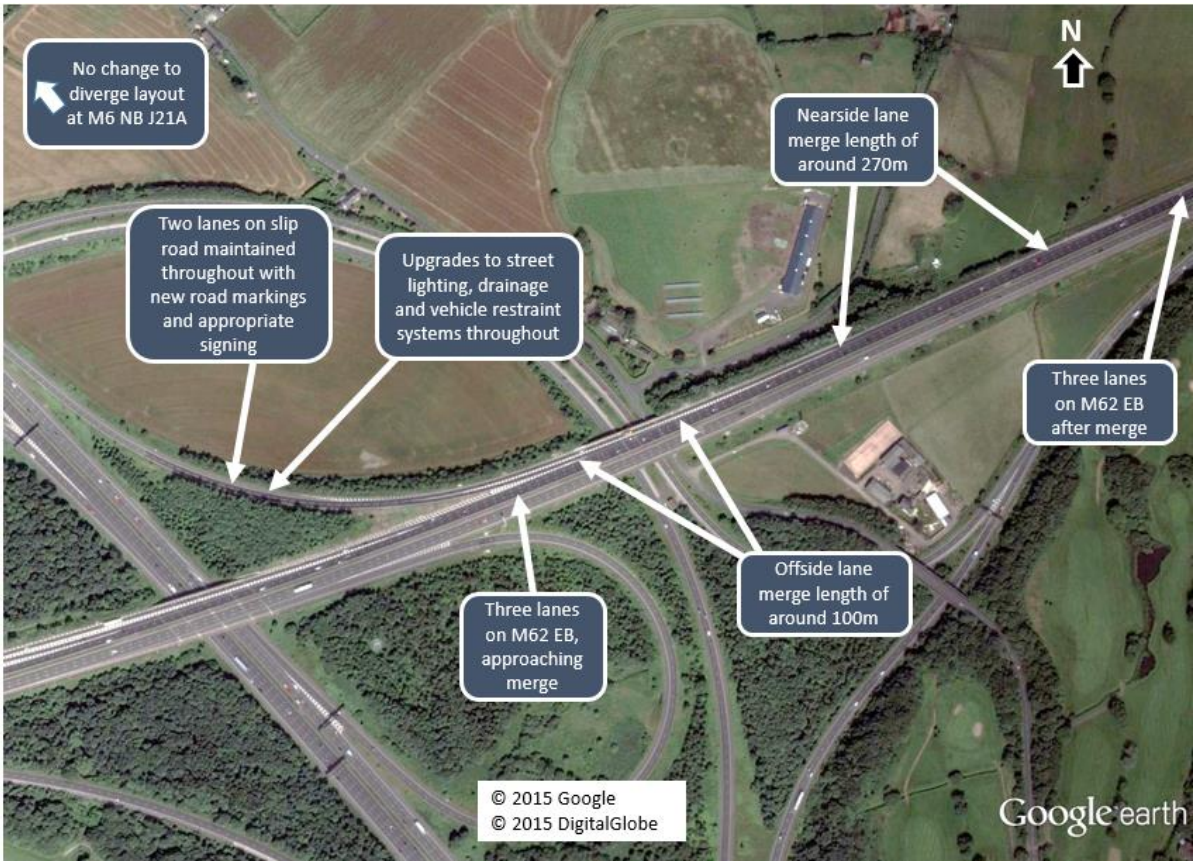


Figure 2.6 – Comparison of Pre- and Post-Scheme Views: M6 Northbound to M62 Eastbound Slip Road

Pre-Scheme	Post-Scheme
	
Updated street lighting, chevrons, and the removal of pre-scheme signing	
	
Updated road layout, updated signing, new vehicle constraint barriers	
	
Updated merge layout onto M62 Eastbound mainline	
	
Updated merge layout on M62 Eastbound mainline	

Figure 2.7 – Comparison of Pre- and Post-Scheme Views: M6 Southbound to M62 Eastbound Slip Road

Pre-Scheme	Post-Scheme
	
Updated signing, new street lighting	
	
Updated road layout	
	
Updated ghost island merge onto the M62 Eastbound mainline	
	
Updated merge layout onto the M62 Eastbound mainline	

Post-Scheme Site Observations

2.16. A site visit was undertaken during the AM peak (07:30-08:30) on Monday 30th June 2015. This is considered to be a neutral month and day for traffic flows, and is outside of the school holidays. The weather was dry and sunny. There were no known incidents or roadworks close by on the network which would mean that traffic was atypical.

2.17. All of the scheme elements were seen to be in place and operational. The signing was in good condition, and was clearly visible. Some of the road markings were beginning to fade; a result of the high level of traffic which uses the area.

2.18. The report will now look in detail at observations made at the following locations:

M62 eastbound mainline;
M6 northbound to M62 eastbound movement; and
M6 southbound to M62 eastbound movement.

M62 Eastbound Mainline

2.19. There was a variable speed limit of 40mph in place on the M62 eastbound through the junction, as was observed through gantry signing. This was in place to manage congestion, as opposed to any incidents on the highway.

2.20. Traffic conditions were observed to be very slow-moving throughout with all traffic lanes busy. The delays started around 500 metres back from where the M6 northbound starts to merge onto the carriageway (**Figure 2.8**).

2.21. The delays continued through the sections where the two slip roads merge to join the M62 eastbound, with conditions improving back to free-flow conditions around 700 metres after the carriageway reverted to three traffic lanes.

2.22. **Figure 2.9** and **Figure 2.10** show the conditions through the merge points with the slip road from the M6 northbound carriageway. **Figure 2.9** is immediately after the point at which traffic from the slip road becomes parallel with the M62 eastbound, and is just in advance of the merge point of the inside lane. Here, the traffic was slow but free-flowing. **Figure 2.10** is after merge of the inside lane, and just in advance of the offside lane merge point, where there was queuing in all lanes. It was observed on the slip road from the M6 northbound that there was a tendency for more traffic to use the offside lane, rather than the inside, and this is reflected by the higher congestion levels in this location.

Figure 2.8 – M62 Eastbound Mainline Conditions

Figure 2.9 – M62 Eastbound Mainline (in advance of merge with the inside lane of M6 Northbound Slip Road)

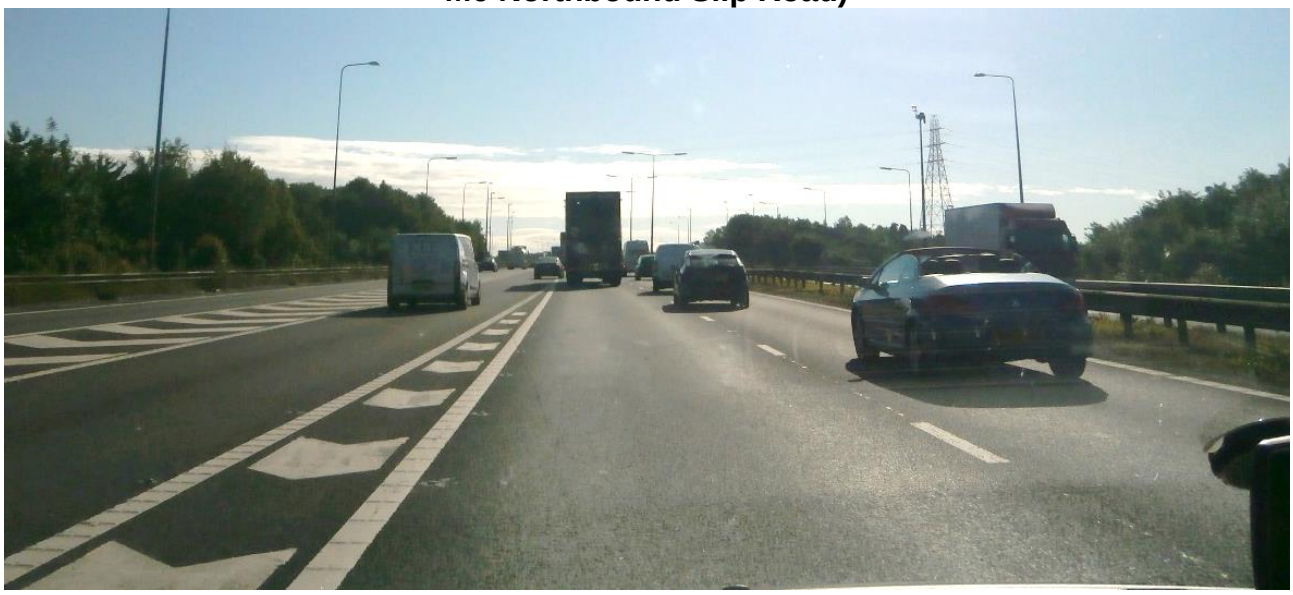


Figure 2.10 – M62 Eastbound Mainline (in advance of merge with the offside lane of the with M6 Northbound Slip Road)

M6 Northbound to M62 Eastbound Movement

2.23. The M6 northbound mainline had a temporary speed limit of 50mph in place, which ended (meaning the restriction returned to national speed limit) at the start of the slip road to the M62 eastbound. The M6 northbound, on approach to the diverge point, was busy but free-flowing. Conditions were observed at both 07:30 and 08:00, and at each time there were no queues observed on the M6 or the slip road as the road diverges as shown in **Figure 2.11**.

2.24. On the slip road, there was a 40mph speed limit in place to manage congestion, as was displayed through gantry signing. Travelling along the slip road, both traffic lanes were in use (see **Figure 2.12**) although it was observed that traffic tended to use the offside merge lane more than the inside lane. There was then some slow-moving traffic as traffic merged with the slow-moving M62 mainline. The queues were in the offside merge lane.

Figure 2.11 – M6 Northbound at the Diverge Point to M62 Eastbound

Figure 2.12 – M6 Northbound to M62 Eastbound Slip Road

Figure 2.13 – M6 Northbound to M62 Eastbound Slip Road

M6 Southbound to M62 Eastbound Movement

2.25. The M6 southbound was busy but free-flowing on the approach to the M62 eastbound slip road. There was no queuing observed on the M6 mainline or at the slip road diverge point. On the slip road conditions were initially clear (**Figure 2.14**) but queuing started approximately 150m back from the merge point with the M62 (**Figure 2.15**). This congestion continued on through the merge onto the M62 mainline with slow-moving conditions throughout. There was some weaving between lanes on the M62 eastbound as traffic joined from the slip road.

Figure 2.14 – M6 Southbound to M62 Eastbound Slip Road

Figure 2.15 – M6 Southbound to M62 Eastbound Slip Road

Stakeholder Feedback

2.26. While the analysis in this report can consider the quantifiable impact of this scheme based on empirical data, it is important to consider the opinions of major stakeholders of the scheme. For example, a scheme may save journey times in practice, but if this saving isn't perceived, the scheme may not be as successful as first thought.

2.27. The major stakeholders contacted for feedback on the M6 to M62 Eastbound Merges Improvements scheme are:

- Balfour Beatty Mott MacDonald (Area 10); and
- Highways England.

2.28. While there was not a response from Highways England, a response was received from a representative of Balfour Beatty Mott MacDonald. In summary, this was as follows:

"I can speak as a regular user of the M62 both directions, travelling from Rainhill to Birchwood, and the effect, in my opinion, of this scheme has been increased congestion on the M62 EB approach to Croft Interchange with traffic often queuing as far back as Junction 8, which to my recollection was rarely ever the case."

"Having entered the motorway at Junction 7 with my ideal exit point being Junction 11 at Birchwood I find myself leaving at Junction 8 to use local roads and I would be interested to know if this applies at Junction 9 and also whether the local roads in the area now have increased usage."

"Clearly the increased traffic flows coming off the M6 have had a detrimental impact on the M62, which was already hampered by the loss of lane 3 on the approach to the interchange."

3. Traffic Volumes

Introduction

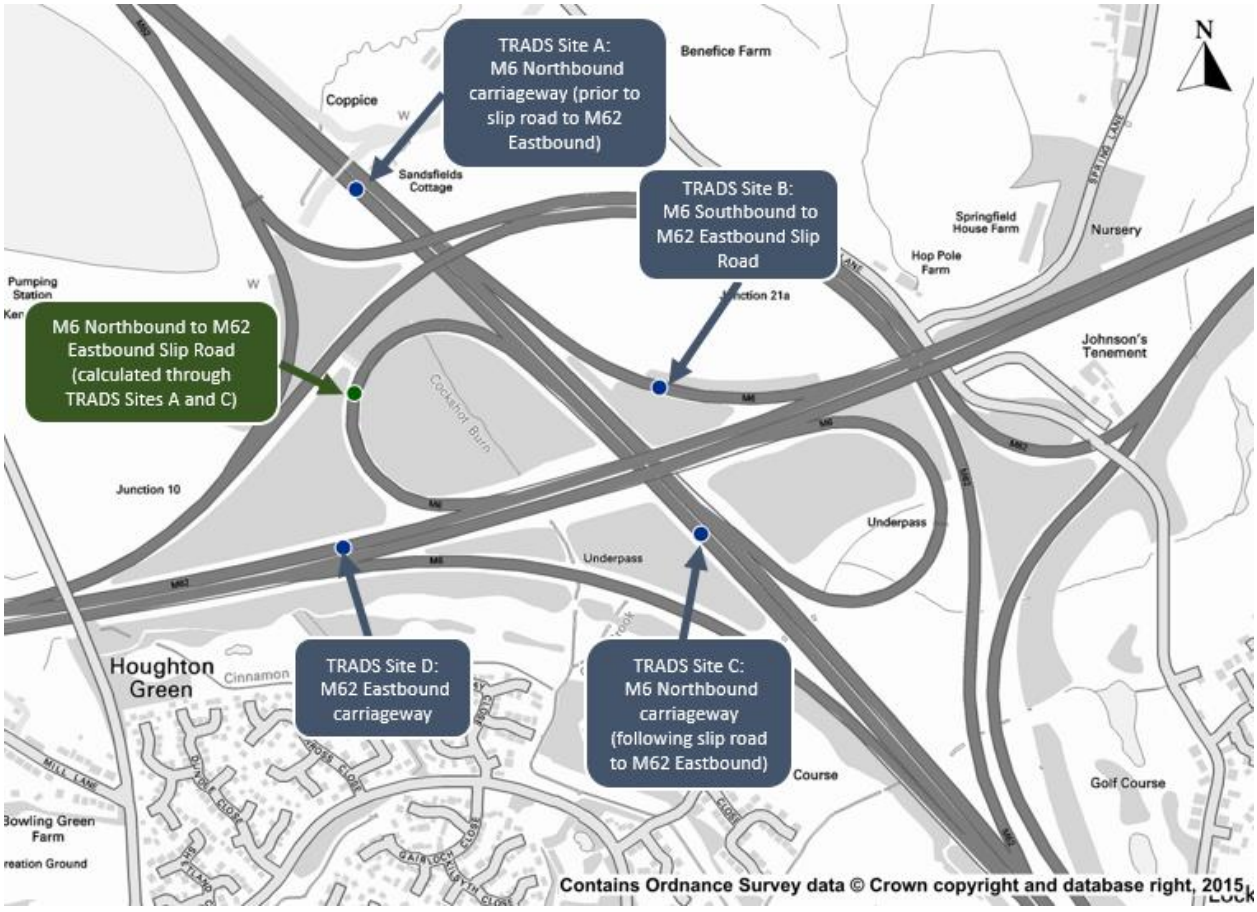
3.1. This chapter of the report considers the impact that the M6 to M62 Eastbound Merges Improvements LNMS has had on traffic volumes.

Data Source

3.2. As scheme planning and construction is a process that takes a number of years, it is important to understand how traffic volumes have changed over time and whether this will impact the way the scheme performs. To understand this, traffic data has been assessed from continuous ATC data, as collected by Highways England (TRADS).

3.3. The locations of the TRADS sites are shown in **Figure 3.1**. As indicated, the M62 eastbound TRADS site is located after traffic travelling to M6 has diverged from the M62, but before the flows joining the M62 from the M6 have merged. There is a TRADS site located on the slip road from the M6 southbound recording flows for this movement. For the flow travelling from the M6 northbound to M62 eastbound, the post-opening evaluation team have calculated an appropriate flow based on the observed difference between the M6 mainline flows before and after the diverge point. In **Figure 3.1**, the blue points represent the actual TRADS sites, while the green point denotes the site where traffic flows have been calculated.

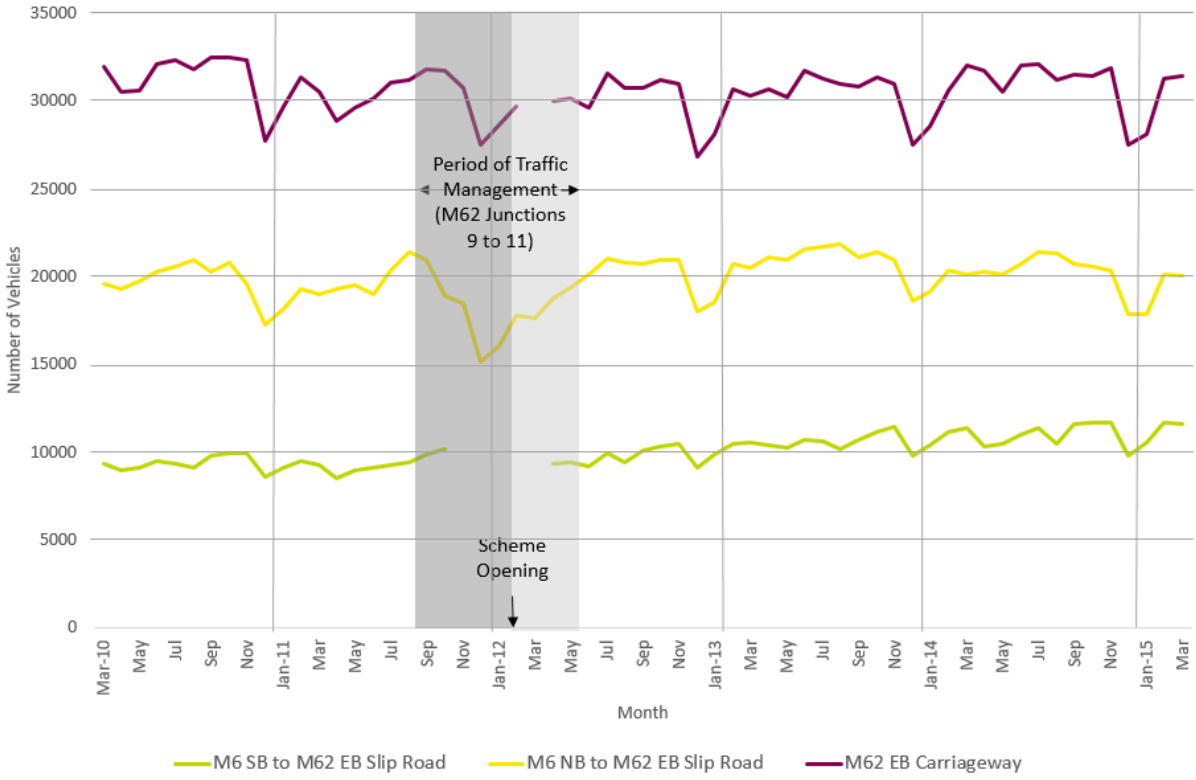
Figure 3.1 – Traffic Flow Data Locations



Traffic Volumes

3.4. The Average Weekday Traffic (AWT) on a monthly basis is shown in **Figure 3.2**. The period of traffic management which occurred to facilitate this scheme as well as other improvement works is marked, alongside the opening date for the M6 to M62 Merges Improvements LNMS.

Figure 3.2 – Monthly AWT on the M62 Eastbound Mainline and M6 to M62 Eastbound Slip Roads



3.5. The data shows that traffic flow patterns have remained relatively consistent before and after the implementation of the scheme, with a small increase in flow on the M62 mainline and the slip roads observed since the scheme opened.

3.6. The chart demonstrates that the M6 northbound to M62 eastbound slip road carries around twice as much traffic as the M6 southbound to M62 eastbound slip road.

3.7. Vehicle flow on the M62 eastbound mainline and the slip roads linking it to the M6 are relatively constant through spring to autumn, but with a reduction each winter. Lower traffic levels through winter are considered to be typical across the highway network as the comparatively poor weather tends to reduce traffic on the network.

3.8. Only a minimal increase in flow since 2010 is evident from the graph. To understand how the gradual increase in traffic flows compares to the national growth, **Table 3.1** presents DfT statistics on Great British road traffic on motorways between 2010 Q3 and 2015 Q1, adjusted for seasonality.

Table 3.1 – Changes in Average Annual Traffic on Motorways since 2010 Q2

Period		Variation from 2008 Q1 (billion vehicle miles)	% change from 2010 Q2
2010	Q2	0	0.0%
	Q3	0	0.0%
	Q4	-0.3	-1.9%
2011	Q1	0.1	0.6%
	Q2	0	0.0%
	Q3	0	0.0%
	Q4	0.2	1.3%
2012	Q1	0.2	1.3%
	Q2	0.1	0.6%
	Q3	0.2	1.3%
	Q4	0.3	1.9%
2013	Q1	0.2	1.3%
	Q2	0.5	3.2%
	Q3	0.5	3.2%
	Q4	0.5	3.2%
2014	Q1	0.6	3.9%
	Q2	0.6	3.9%
	Q3	0.8	5.2%
	Q4	0.7	4.5%
2015	Q1	0.8	5.2%

3.9. **Table 3.1** shows that the increase in traffic flows on the M62 in proximity to the scheme are relatively in line with the national growth trends in traffic flows on motorways. Table 3.2 provides further evidence of this. The small changes, of less than 10% in each location, are not sufficient to conclude that the M6 to M62 eastbound merges LNMS has had any effect on traffic levels.

Table 3.2 – Pre and Post-Scheme Change in Average Daily Traffic on M6 Slips to M62 EB at Croft Interchange

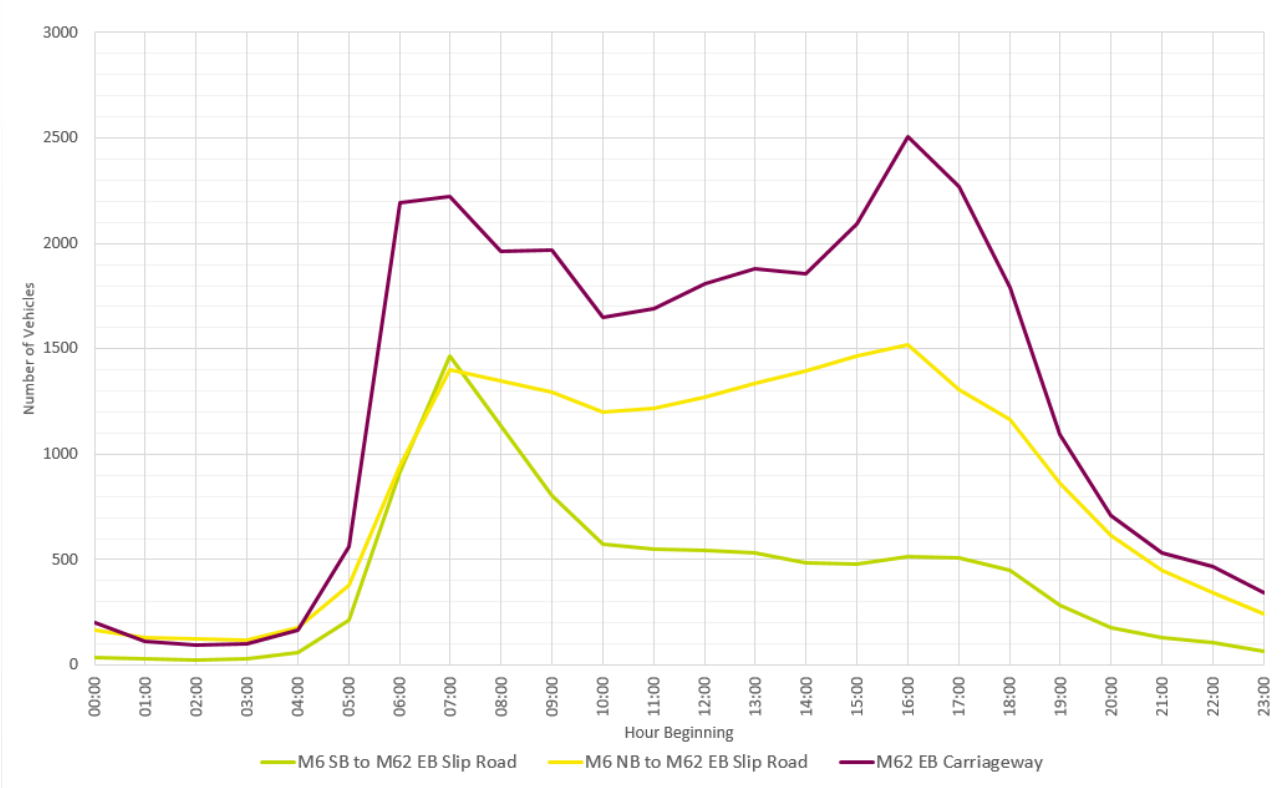
Period	M6 SB to M62 EB Slip Road ADT	M6 NB to M62 EB Slip Road ADT	Total
July 2010 – June 2011	8,158	18,366	26,524
July 2012 – June 2013	8,843	19,079	27,921
Difference	+685	+713	+1,397
% Change Before and After Scheme	+8.4%	+3.9%	+5.3%

Daily Traffic Patterns

3.10. By studying the daily traffic patterns, it is possible to identify peak periods during which the junction is subject to high demand. This will help to understand journey times around the junctions and when delays might be expected.

3.11. The Highways England TRADS sites have been interrogated to gain an appreciation of the daily flow profile of traffic on the M62 eastbound mainline and M6 to M62 eastbound slip roads. In considering the operation of the scheme, the scale of the M62 eastbound mainline flow will have a direct impact on how easy it is for slip road traffic to merge, and hence how likely congested conditions are to develop. **Figure 3.3** shows diurnal profiles for an average weekday across a 12 month period following the opening of the scheme (July 2012 to June 2013).

Figure 3.3 – Average Weekday Hourly Traffic Flow into the Junction



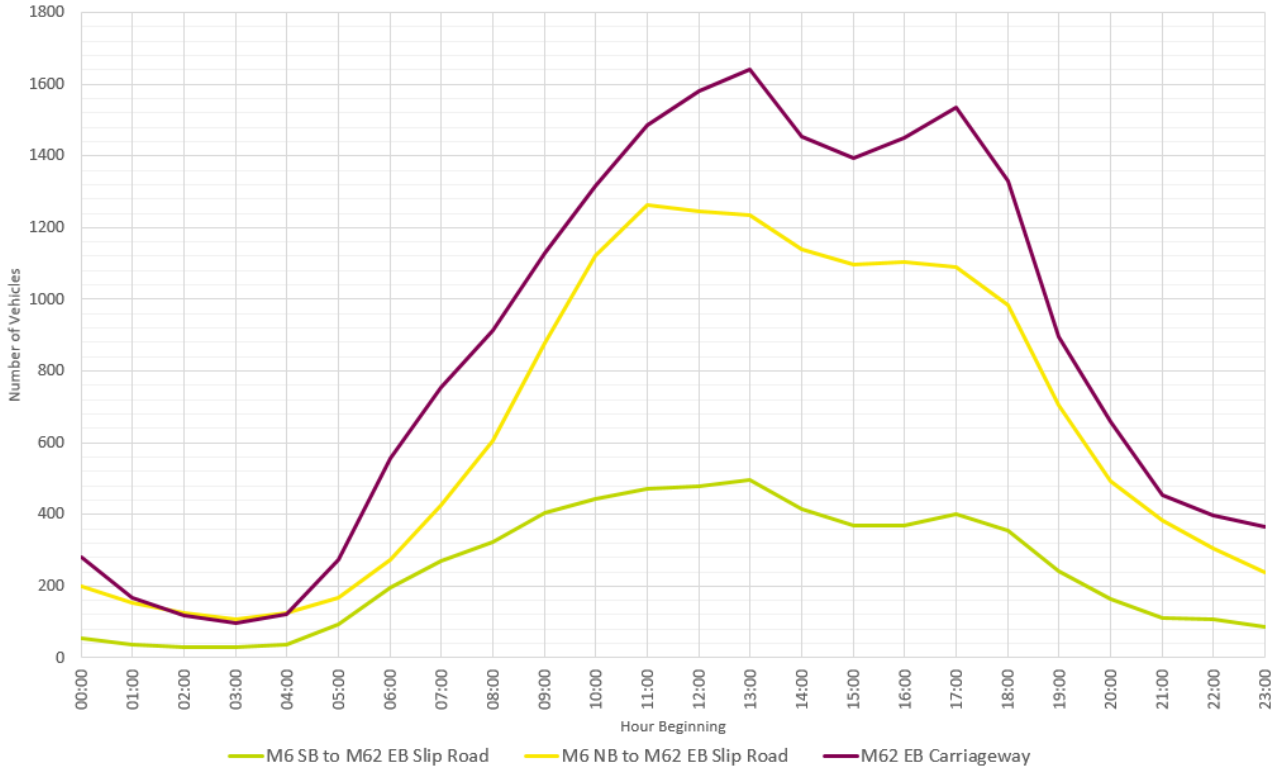
3.12. In summary:

- The AM peak for both slip roads is observed between 07:00 and 09:00. A similar level of flow is observed at 07:00 although volume falls away faster for the slip road from the M6 southbound. On the M62 eastbound mainline approach, the morning peak is observed earlier with the largest flows between 06:00 and 08:00;
- In the PM peak, there is a pronounced increase in traffic flows between 16:00 and 17:00 on the M62 eastbound carriageway, with high flows also observed between 17:00 and 18:00. For the movement from the M6 northbound to the M62 eastbound, peak conditions are between 16:00 and 17:00 for the movement from the M6 northbound, but also high between 15:00 and 16:00. The slip road from the M6 southbound has a less distinct peak, with flows relatively consistent throughout the Inter Peak and PM peak, between 13:00 and 18:00;

- The slip road from M6 southbound to M62 eastbound has its highest traffic demand during the AM peak with flows during this period almost three times higher than at other parts of the day including during the PM peak;
- Traffic on the slip road from the M6 northbound to the M62 eastbound is highest during the PM peak; around 100 vehicles higher than during the morning. There is a gradual decrease from the AM peak until 10:00, but then rises consistently through the PM; and
- On the M62 eastbound mainline approaching the merges traffic is greatest in the PM peak, with the busiest hour between 16:00 and 17:00. Flow in excess of 2,000 vehicles per hour are observed from 06:00 to 08:00 and from 15:00 to 18:00.

3.13. **Figure 3.4** and **Figure 3.5** presents the same diurnal profiles for an average Saturday and Sunday respectively across a 12 month period following the opening of the scheme (July 2012 to June 2013).

Figure 3.4 – Average Saturday Hourly Traffic Flow into the Junction

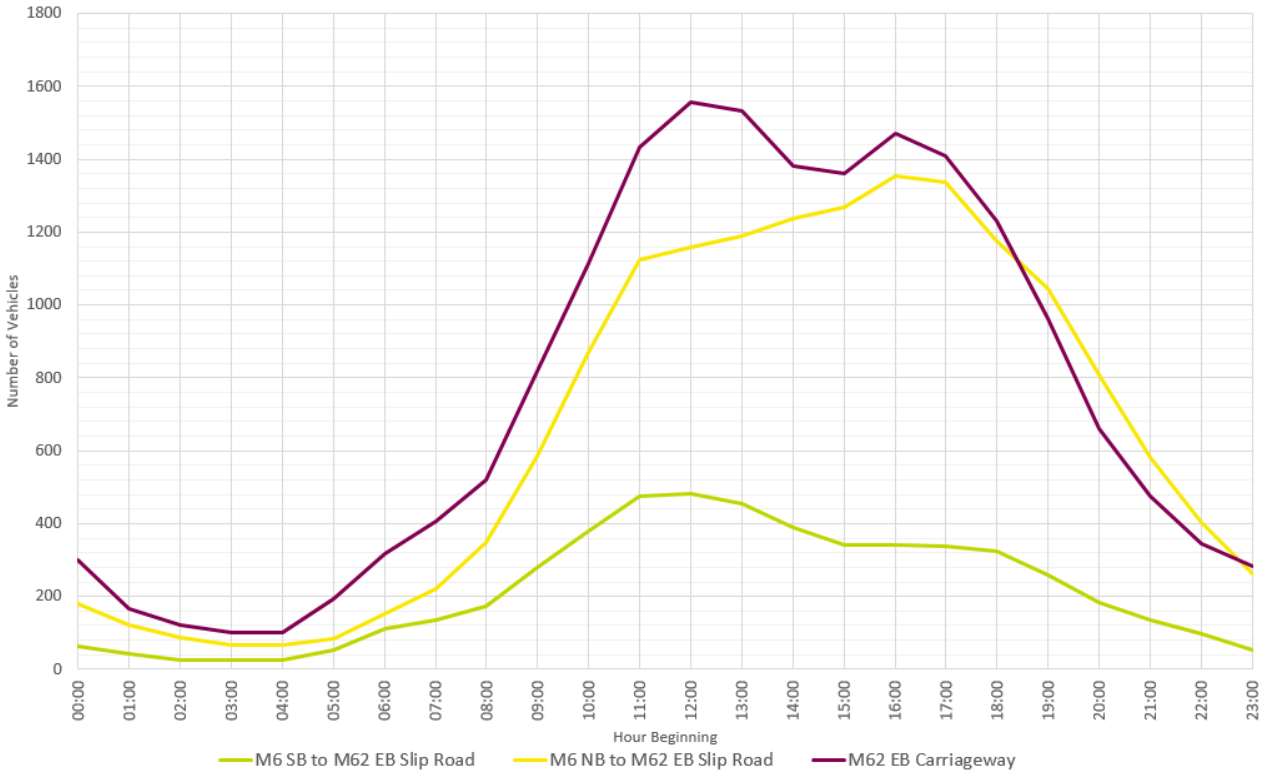


3.14. On Saturdays, traffic flows increase through the morning. On the slip road from the M6 southbound, the largest flows are observed from 13:00 to 14:00, but are of a relatively consistent volume through the daytime period (between approximately 300 and 500 vehicles per hour from 08:00 until 19:00. Flows on the slip road from the M6 northbound are substantially higher and rise to a peak between 11:00 to 12:00 of around 1,250 vehicles.

3.15. The M62 eastbound mainline carriageway reaches a peak of around 1,650 vehicles between 13:00 and 14:00. Traffic volumes then decrease slightly into the afternoon but increase again to form a Saturday PM peak from 17:00 to 18:00.

3.16. The peak flows are lower than observed on a weekday for all three movements.

Figure 3.5 – Average Sunday Hourly Traffic Flow into the Junction



3.17. On Sundays, the flow profile is similar to the Saturday with the lowest flows on the slip road from the M6 southbound, and higher flows on the other two routes. Peak conditions for the slip road from the M6 southbound are between 11:00 and 14:00 with around 500 vehicles per hour making the movement. In contrast, flows on the slip road from the M6 northbound are over twice as large. For that slip road, traffic volume rises throughout the morning from 08:00 to 11:00, and continues to grow more incrementally through the afternoon to reach peak conditions between 16:00 to 17:00.

3.18. Flows on the M62 eastbound mainline increase throughout the morning, reaching a peak between midday and 13:00. As with the Saturday, there is a reduction in flow into the afternoon but a further increase to form a Sunday PM peak between 16:00 and 17:00. Traffic volume then falls away and after 19:00, the flow joining onto the M62 eastbound from the M6 northbound slip road are actually larger than are already flowing on the M62 eastbound towards the merge point.

3.19. The peak flows are lower than observed on a weekday for all three movements.

Summary

- Traffic flows on the junction before and after have remained at a similar volume, and show a consistent small increase through time, which is in line with trends on motorways through Great Britain across this period;
- The M6 northbound to M62 eastbound slip road carries around twice as much traffic as the M6 southbound to M62 eastbound;
- The weekday AM peak through the junction is experienced between 0700 and 0900 on the M6 slip roads to the M62 eastbound. This is, however, at between 0600 and 0800 on the M62 eastbound;
- The PM peak on the M62 eastbound, as well as the M6 southbound slip road to the M62 is between 1600 and 1700, while this is between 1500 and 1700 on the M6 northbound to M62 eastbound link; and
- Traffic profiles on the M62 eastbound and the slip road from the M6 southbound on Saturdays and Sunday are similar to each other, and are of a lower level than the weekdays. On the slip road from the M6 northbound, peak traffic is observed earlier on a Saturday than a Sunday. At the weekends the slip road traffic is closer to the level of the M62 eastbound.

4. Journey Time Analysis

Introduction

4.1. As an economy scheme, the key justification for this LNMS is a journey time benefit for road users. The scheme has increased capacity on the M6 to M62 eastbound slip roads at Croft Interchange, and has improved the merge layouts onto the M62. These measures were designed to improve journey times for vehicles moving through the junction, particularly during peak periods.

4.2. To assess the impact, this report considers evidence from before and after the scheme to ascertain whether there has been a journey time benefit experienced due to the implementation of the M6 to M62 eastbound merges LNMS.

Data Source

4.3. For the journey time analysis, Sat Nav data has been used to inform pre- and post-scheme journey times. This data is available from some motorists who use satellite navigation devices and allow their data to be used anonymously for the purpose of generating travel statistics. The data also has the benefit of being historic, so that it is possible to retrieve pre-scheme journey time data after the scheme has opened.

4.4. In order to conduct the analysis, seven time periods have been defined using the diurnal flow profiles presented in Chapter 3 as a guide. The time periods have been defined to combine similar hours in terms of flow levels and trip purposes (commuting/leisure etc). The seven time periods used are listed in **Table 4.1**.

Table 4.1 – Journey Time Analysis: Time Period Splits

24 Hour Flow	Mon-Fri	Saturday	Sunday
Weekday AM Peak	07:00-09:00		
Weekday PM Peak 1	15:00-17:00		
Weekday PM Peak 2	17:00-18:00		
Inter Peak	09:00-15:00 18:00-19:00		
7-Day Overnight	19:00-07:00	19:00-09:00	19:00-09:00
Saturday Daytime		09:00-19:00	
Sunday Daytime			09:00-19:00

4.5. As shown in **Table 4.1**, the PM peak is split into two analysis periods. This is because the flow profiles (presented in Chapter 3) showed that the peak flow for the M6 northbound to the M62 eastbound movement was between 1500 and 1700, while the flow from the M6 southbound to M62 eastbound is greater later

in the afternoon, with a peak between 1600 and 1800. The analysis will therefore identify whether the scheme's impact are different during these two periods.

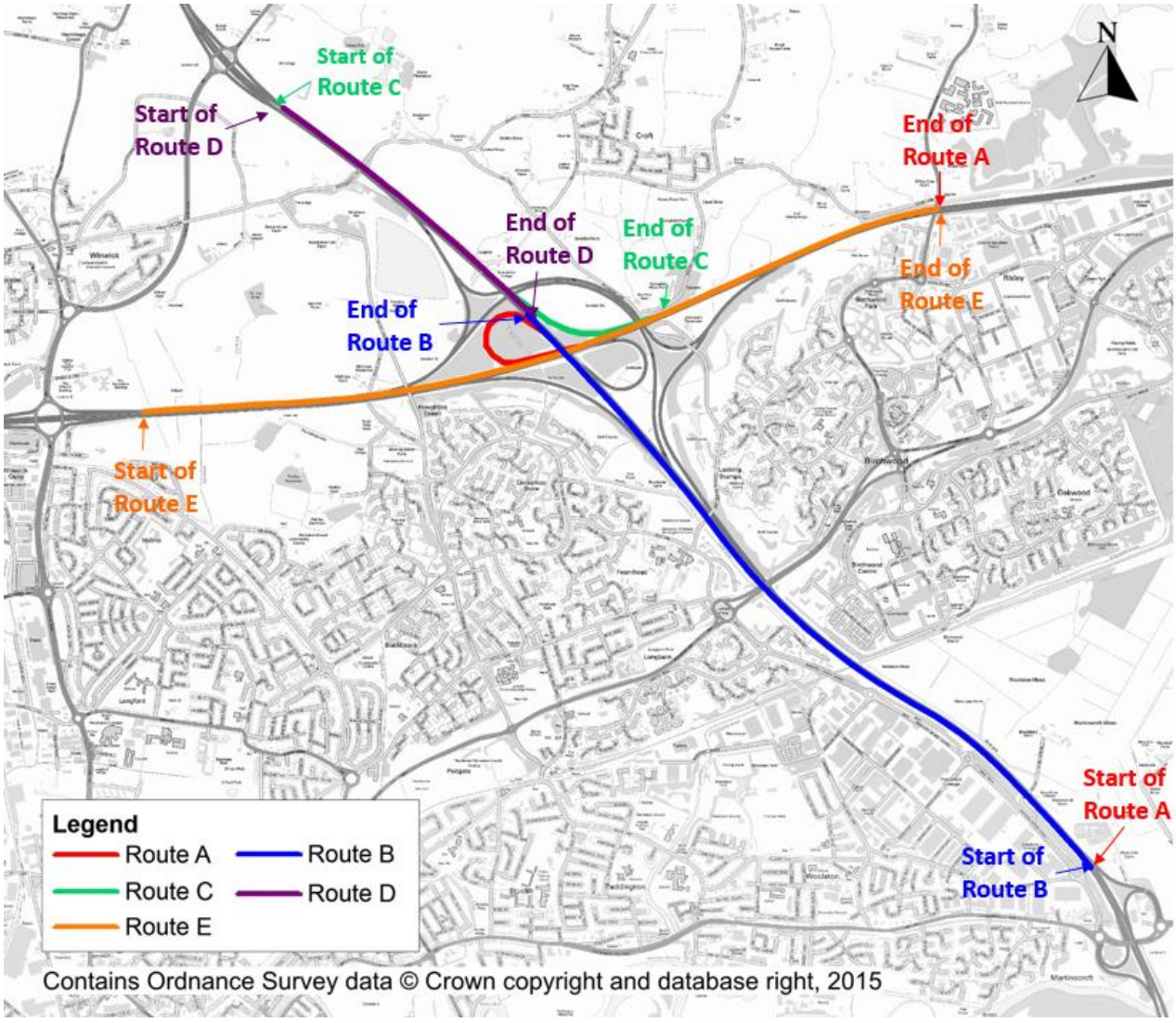
4.6. Sat Nav data has been acquired for these time periods over a one year period before and after the scheme. These periods are defined as:

- Pre-scheme: 1st July 2010 – 30th June 2011; and
- Post-scheme: 1st July 2012 – 30th June 2013.

4.7. While the construction period for this scheme has not been confirmed, the post-evaluation team understands that traffic management was in place within the section M62 Junctions 9 to 11 from September 2011 until June 2012 (for this scheme, along with three other areas of work). The pre-scheme and post-scheme period above avoids this period of traffic management.

4.8. Data was extracted for five routes, as shown in **Figure 4.1**. For each journey time route, data was collected only for vehicles making the corresponding movement at the junction.

Figure 4.1 – Journey Time Routes



Journey Time Comparison

4.9. The impact of the scheme during each of these seven time periods has been considered separately. **Table 4.2** presents the change in journey time between the pre-scheme and post-scheme periods for each movement. Negative values indicate a journey time saving and hence a benefit. **Table 4.2** shows journey time differences on every movement and every time period. The map references correspond to the routes shown in **Figure 4.1**.

Table 4.2 – Difference in Before and After Journey Times (seconds per vehicle)

Map Ref	Route	Wkday AM Pk	Wkday PM Pk 1	Wkday PM Pk 2	Wkday IP	7-Day O/Night	Sat Daytime	Sun Daytime
A	**M6 NB to M62 EB**	-139.6	-7.3	-15.2	-8.0	-0.2	-8.7	-1.3
B	**M6 NB Through**	-28.2	3.9	18.9	-0.5	0.4	-3.1	1.2
C	**M6 SB to M62 EB**	-76.8	-2.2	-7.9	-2.6	-0.3	-1.0	-4.7
D	**M6 SB Through**	-13.6	0.6	-2.6	-1.0	-0.3	0.0	-4.2
E	**M62 EB Through**	132.0	-4.9	-15.4	1.8	0.1	0.6	-0.3

Negative values indicate a journey time saving and hence a benefit. Savings > 20 secs are highlighted in Green. Positive values indicate an increase in journey time and hence a dis-benefit. Increases of > 20 seconds are highlighted in Red.

4.10. The largest changes in journey times since scheme opening are observed within the weekday AM peak period. During this period, journeys from the M6 northbound to M62 eastbound have reduced by 140 seconds per vehicle. The movement from the M6 southbound to the M62 eastbound has also improved with a saving of 77 seconds per vehicle.

4.11. There is also a saving evident for the M6 mainline flows as they approach the slip road diverges, even for vehicles not travelling onto the M62 eastbound. In the northbound direction, each vehicle now travels past the diverge 28 seconds faster with a 14 second saving for vehicles travelling along the M6 southbound carriageway past the slip road diverge point. This suggests that the changes to the slip road have had a positive impact on minimising the impacts experienced back on the M6 mainlines.

4.12. The data does however show that the changes to the merge layouts have had a detrimental effect on M62 eastbound traffic during the AM peak with each journey through past the merges now taking 132 seconds longer. This supports stakeholder feedback (detailed in Chapter 2) that there has been an increase in congestion on the M62 eastbound carriageway following the opening of the scheme.

4.13. Of the two weekday PM peak times evaluated, there is a greater impact evident for the later of the periods, between 17:00 and 18:00. During this hour, there is a journey time saving per vehicle of 15 seconds on both the movement from the M6 northbound to the M62 eastbound and the movements along the M62 through the junction (in contrast to the morning when the journey times on the M62 eastbound have increased and despite the fact that flows on the M62 are higher during the PM peak than in the AM peak).

4.14. There were also savings, albeit of a smaller scale, observed on the M6 southbound mainline through-flow and for vehicles travelling from the M6 southbound to join the M62 eastbound.

4.15. Unexpectedly, the data shows that during this PM peak hour (17:00 and 18:00), flows on the M6 mainline through the junction have increased by 19 seconds per vehicle. Given the measures introduced by the LNMS improved capacity on the slip road and made no amendments to the layout of the diverge, this increase in journey times is difficult to make sense of. It is possible that the impacts for this period are caused by something else which is unrelated to the LNMS. For example, shortly after the end point for analysis Route D is the merge point for traffic travelling from the M62 (both directions) to join the M6 northbound. It is possible that this period demonstrates delay as a result of this merge point which causes congestion which blocks back and directly impacts the analysis area used resulting in the journey time increases observed.

4.16. During the other five analysis periods, the changes in journey times are smaller and involve an increase or decrease of less than 10 seconds. This outcome is not considered to be unexpected, as the PAR made it clear that the scheme was primarily developed to improve the operation of the merges during the AM and PM peak periods.

4.17. Whilst **Table 4.2** presents the change in journey times, the actual before and after journey times observed in the Sat Nav data are presented in **Appendix A** and **Appendix B** respectively.

Journey Time Reliability

4.18. The Sat Nav data also allows any change in journey time reliability to be quantified, by using the inter-quartile range journey times and the 5th to 95th percentile journey times. By considering how these ranges have changed from the pre-scheme year to the post-scheme year the reliability of journey times can be assessed.

4.19. The Sat Nav data has been extracted as a series of vehicle movements which are impacted by the scheme. It is possible to assess the change in journey time reliability for each of these vehicle movements to make a robust assessment of how reliability has been affected.

4.20. The graphs presented in **Appendix C** show the journey time reliability for the same five vehicle movements as were used for the journey time analysis (indicated in **Figure 4.1)**.

4.21. In summary, the reliability graphs show:

- The largest changes in journey time reliability have been during the AM Peak (07:00 to 09:00). As shown in Chapter 3, this is when peak flows were observed when combining flows on the M6 northbound slip road, the M6 southbound slip road, and the M62 eastbound mainline. The largest improvement is for the movement from the M6 northbound to the M62 eastbound where the 95th percentile of journey times has reduced by almost 10 minutes (590 seconds) since scheme opening. The 75th percentile journey time is also reduced by over 2 minutes (140 seconds). The route from the M6 southbound to the M62 eastbound also shows a large benefit, with 95th percentile journey times having improved by almost 6 minutes (353 seconds) since scheme opening and the 75th percentile of journey time reduced by 77 seconds; There are also smaller improvements evident in terms of both 75th percentile and 95th percentile journey times for the M6 mainline movements along and past the diverge points in both directions;
- As with the journey times, where trips are now shown to be slower, reliability is also worse for journeys along the M62 eastbound passing the merge points during the AM peak. The 95th percentile journey time was over 7 minutes (427 seconds) longer for the year after the scheme opened. The 75th percentile of journey time also increased by 133 seconds indicating notably worse reliability;
- In the later of the PM peak analysis periods (17:00 to 18:00), there are observed improvements in the 95th percentile journey times for most movements, with the exception of the M6 northbound through trips where reliability is now worse. The 75th percentile journey times are less impacted and more consistent before and after the scheme. The largest improvement is for the M62 eastbound through movement where the 95th percentile journey time has decreased from 425 seconds to 333 seconds; a reduction of 92 seconds. The data also shows a 78 second improvement in 95th percentile journey time for the M6 northbound to M62 eastbound movement;
- For the M6 northbound movement in the later of the PM peak analysis periods, the 95th percentile journey time has increased by 65 seconds, with the 75th percentile journey time increased by 19 seconds. This adverse impact is also in line with the journey time data which showed a slower travel time for the movement during the hour. As discussed previously, this impact is difficult to understand based solely on the measures implemented by the LNMS and so may be as a result of another part of the strategic road network;
- The reliability impacts during the other PM peak analysis period (15:00 – 17:00) are observed to be largely negligible. For the M6 northbound to the M62 eastbound movement, a small saving of 12 seconds is shown for the 95th percentile journey times; and
- The changes in journey time reliability outside of the AM and PM peak periods are largely negligible.

Calculation of annual vehicle hour benefits

4.22. **Table 4.2** presented earlier in this chapter, demonstrates how journey times have changed for certain movements and time periods before and after the scheme's construction. It is assumed that these changes are a result of the scheme measures. Therefore, it is necessary to calculate the number of vehicle

hours saved in the opening year, in order to understand and quantify the overall impact for this evaluation.

4.23. The vehicle hour benefits which were forecast by the MAC and recorded in the PAR were detailed in the scheme's improvement options report. The forecasts were derived from a model which considered the impacts in the AM peak (considered as 07:00-09:00 in the model) and the PM peak (considered as 16:00-18:00 in the model) only. The PAR reported a forecast benefit of 185,959 vehicle hours in the opening year.

4.24. Post-scheme traffic volumes have been identified using data for the period July 2012 to June 2013 from TRADS sites. The comparison of pre- and post-scheme flows in **Table 3.2** indicates that there has not been an increase in traffic of over 10%, and so there is no requirement to include a rule of half adjustment to the vehicle hour savings[1].

4.25. As outlined previously, the journey time assessment focuses on seven time periods and hence it is the vehicle movements during these periods which are relevant to the whole vehicle hour savings calculations.

4.26. Average weekly vehicle movement flows are presented in **Table 4.3**. These present the total vehicle movements in each time period across the average week.

Table 4.3 – Total Weekly Vehicle Flow by Period

Map Ref	Route	Wkday AM Pk	Wkday PM Pk 1	Wkday PM Pk 2	Wkday IP	7-Day O/Night	Sat Daytime	Sun Daytime
A	**M6 NB to M62 EB**	13,729	14,953	6,538	44,427	31,552	11,159	11,297
B	**M6 NB Through**	27,269	33,997	17,813	87,844	64,684	23,442	22,799
C	**M6 SB to M62 EB**	13,023	4,986	2,541	19,711	13,623	4,201	3,799
D	**M6 SB Through**	51,701	34,990	18,657	116,699	87,235	28,369	30,662
E	**M62 EB Through**	20,925	23,011	11,342	63,263	43,916	14,316	13,305
Total		**12,6647**	**111,937**	**56,891**	**331,944**	**241,010**	**81,487**	**81,862**

4.27. The vehicle movements outlined in **Table 4.3** are multiplied by the differences in journey times outlined in **Table 4.2** to identify the total weekly vehicle hour savings.

[1] The Rule of Half (RoH) is triggered when the flow increases by over 10%. On these occasions we can be confident that the flow difference is related to the scheme and not just traffic survey errors. Under the rule of half, the existing traffic experiences the full benefit, whereas the additional traffic volume only experiences half of the benefit.

4.28. Weekly vehicle hour savings are multiplied by 52 to calculate the annual vehicle hour savings. The annual resulting vehicle hour savings are summarised in **Table 4.4**.

Table 4.4 – Annual Vehicle Hour Savings

Route	Wkday AM Pk	Wkday PM Pk 1	Wkday PM Pk 2	Wkday IP	7-Day O/Night	Sat Daytime	Sun Daytime	Total
M6 NB to M62 EB	-27,687	-1,584	-1,438	-5,164	-85	-1,408	-209	**-37,575**
M6 NB Through	-11,117	1,914	4,869	-574	351	-1,050	387	**-5,220**
M6 SB to N62 EB	-14,455	-156	-290	-749	-60	-58	-256	**-16,023**
M6 SB Through	-10,159	293	-692	-1,612	-348	-17	-1861	**-14,397**
M62 EB Through	39,906	-1,614	-2,521	1,680	78	123	-48	**37,603**
Total	**-23,512**	**-1,147**	**-72**	**-6,419**	**-64**	**-2,411**	**-1,986**	**-35,611**

Negative values indicate a journey time saving and hence a benefit. These are highlighted in Green. Positive values indicate an increase in journey time and hence a dis-benefit. These are highlighted in Red.

4.29. **Table 4.4** demonstrates that:

- Overall the scheme has resulted in a reduction in journey times, producing 35,611 vehicle hours of journey time benefits in the opening year. This is lower than the 185,959 vehicle hour benefits which was forecast though the PAR;
- Across all routes, each time period analysed has had vehicle hour savings overall;
- Of the five journey time routes, all have shown journey time benefits per vehicle, with the exception of the M62 eastbound through route;
- The routes showing the greatest benefits are the M6 northbound to the M62 eastbound, and the M6 southbound to the M62 eastbound, with annual savings of 37,575 and 16,023 vehicle hours respectively;
- The largest change in journey times for each route is in the AM peak (07:00-09:00), where benefits are observed for most vehicle movements. The route onto the M62 eastbound from the M6 northbound has the largest net benefit with a 27,687 vehicle hour saving per annum. However, the changes have adversely impacted the M62 eastbound through movement with trips now slower on this route and a net increase of 39,906 vehicle hours per annum. Overall, the AM peak experiences a net improvement when also considering the positive impacts for M6 mainline traffic; and
- In the PM peak 2 period (17:00-18:00), the impacts of the scheme are positive. There are annual savings of 1,438 vehicle hours on the route to join the M62 eastbound from the M6 northbound, and 2,521 vehicle hour savings on the M62 eastbound through movement. However, there are substantial dis-benefits for the M6 northbound through movement with

4,869 additional vehicle hours per year. This offsets much of the benefits observed during this period resulting in a more neutral overall impact. As discussed previously in this report, the increase in journey time for this movement is not expected given the measures introduced and so these observed delays are more likely to have been caused by something independent to this LNMS scheme. However, the journey time increase on the M6 northbound is monetised and accounted for in the overall post-opening evaluation regardless.

4.30. **Table 4.5** presents a breakdown of the annual journey time savings, by the scale of the journey time impacts.

Table 4.5 – Annual Vehicle Hour Savings, by Size of Impact

Change in JT (Secs per Veh)	Journey Time Benefits	Journey Time Dis-Benefits	Total Journey Time Impact
0–10	-17,835	+4,826	**-13,009**
10–20	-14,118	+4,869	**-9,249**
20+	-53,259	+39,906	**-13,353**
Total	**-85,212**	**+49,601**	**-35,611**

4.31. **Table 4.5** demonstrates that of the total of 35,611 vehicle hours saved, the change in journey times are broadly spread evenly across the three different time bands. Of the 35,611 vehicle hours saved, 13,353 is attributable to changes in journey times above 20 seconds per vehicle. It is notable however that the benefits of 53,259 vehicle hours are largely offset by the journey time dis-benefits of 39,906 vehicle hours.

Summary

- The scheme has met its objective to reduce queuing on the M6 links to the M62 eastbound. The junction has reduced journey times through the junction by 35,611 vehicle hours in the opening year. However, the saving is substantially lower than the forecast of a saving of 185,959 vehicle hours;
- The largest journey time savings of the junction are from the M6 northbound mainline to the M62 eastbound, and the M6 southbound to the M62 eastbound. This is in line with the expected outcomes based on the scheme measures;
- The AM peak is the period where the most significant changes in journey times are observed. Whilst benefits are shown for most movements (including the two movements using the slip road to join the M62), the journey time to travel eastbound through the junction on the M62 eastbound mainline has increased by an average of 132 seconds per vehicle; and
- The impact of journey time reliability has been positive for the junction, with significant improvements particularly for the M6 northbound mainline to the M62 eastbound, and the M6 southbound to the M62 mainline in the AM peak. However, when travelling through the junction on the M62 eastbound in the AM peak, there has been an increase in variability.

5. Safety Impacts

Introduction

5.1. A critical component of any highway scheme is safety. This scheme aimed to reduce the number of accidents occurring at the junction. This chapter examines the safety impacts associated with the scheme, and compares the pre- and post-scheme opening accident rates to determine whether the scheme has resulted in a post opening safety benefit or dis-benefit.

Data Source

5.2. The PAR used accidents[2] from the five year period 1st January 2005 to 31st December 2009 as evidence for the pre-scheme conditions at the scheme site. The PAR stated that there had been 39 accidents during this period and that the scheme aimed to save 1.6 accidents in the opening year.

5.3. The PAR covers the evidence used to support the decision to proceed with the scheme, effectively outlining the business case. However, once a PAR has been completed and agreed, there can be a time delay before the start of scheme construction.

5.4. The delay between collecting evidence for a scheme and starting construction means the accident data used to evidence the situation before the scheme is often dated. As such, to understand just the impact of the scheme, a five year pre-construction accident analysis represents a better comparison to the outturn accident rate, and hence representation of scheme impacts.

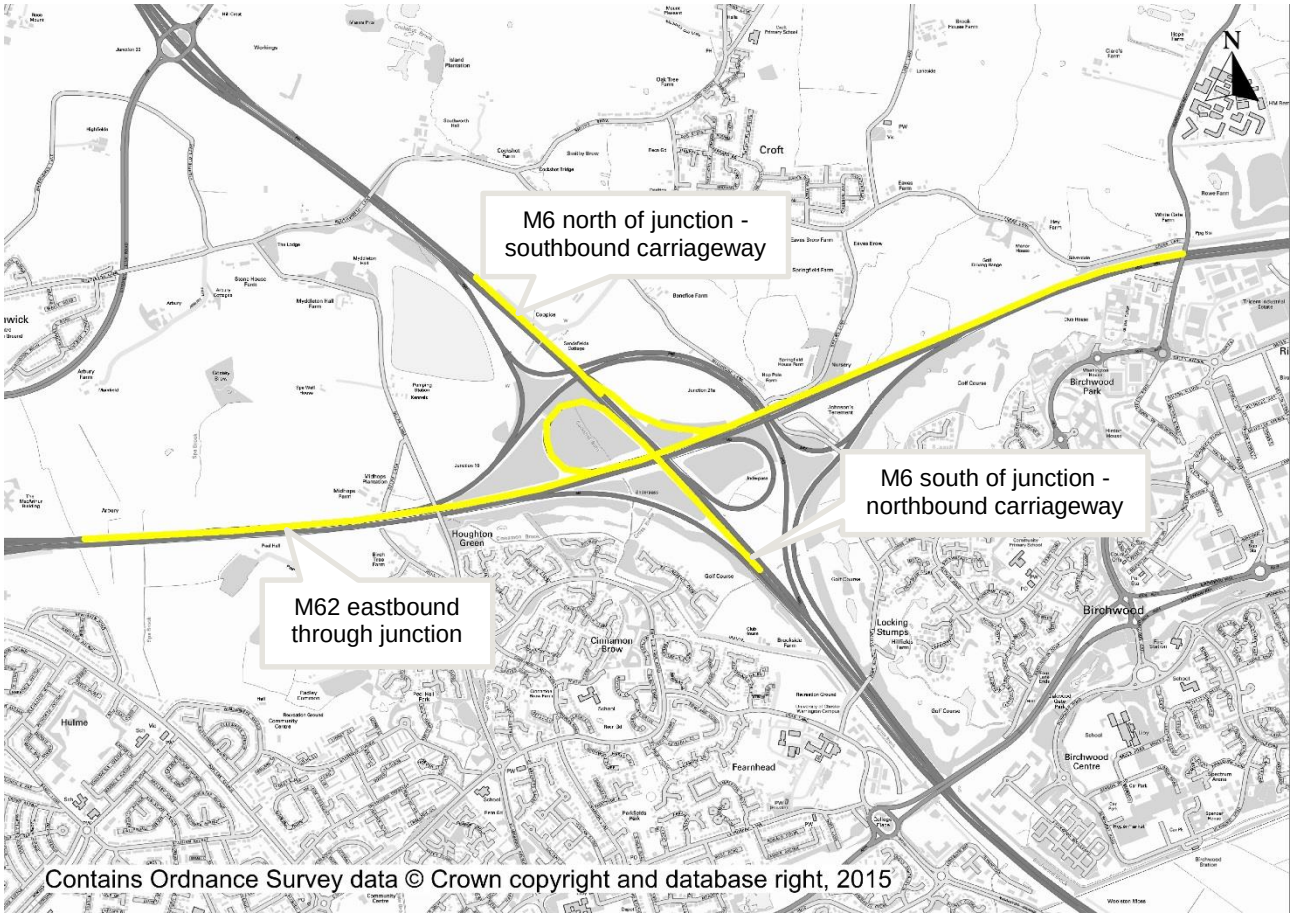
5.5. For this scheme, the PAR used accident data up until December 2009. However, scheme construction did not begin until September 2011. Therefore, there are 20 months between the evidence and the scheme, during which time the accident rate could have changed.

5.6. As such, to understand just the impact of the scheme, accident data has been analysed for the same location for a period of five years directly before construction began (September 2006 to August 2011). While the construction period for this scheme was not confirmed by the ASC, the post-opening evaluation team are aware that traffic management was in place through M62 junctions 9 to 11 from September 2011 to June 2012, to facilitate works on schemes which included the M6 to M62 eastbound merges LNMS. The period of construction is therefore considered to be from the known start date of the traffic management (September 2011) through to the known scheme opening date (February 2012).

[2] All references to accidents in this report refer to Personal Injury Collisions (PICs).
The accident data referred to in this report has not necessarily been derived from the national validated accident statistics produced by Department for Transport (DfT). As such, the data may subsequently be found to be incomplete or contain inaccuracies. The requirement for up-to date information and site specific data was a consideration in the decision to use non-validated data and, as it is sourced from Local Processing Units through the Managing Agent Contractors or Asset Support Contractors, it is sufficiently robust for use in this context.

5.7. The area of accident analysis undertaken is shown in **Figure 5.1**.

Figure 5.1 – Accident Analysis Area



5.8. The results are presented in **Table 5.1** which shows that 75 accidents occurred during this pre-scheme opening period (average of 15 per year), of which 65 were at a slight severity level, 10 were serious, and none were fatal.

Table 5.1 – 5 Year Pre-Scheme Accident Rates

Accidents	Dates	Slight	Serious	Fatal	Rate	Severity Index
5yr Pre-Construction	Sept 06 – Aug 11	65	10	0	15.00	13.3%

Construction

5.9. It is important to consider the effect of construction on accidents. While this is not typically monetised in LNMS evaluations, it is informative to consider whether the construction process introduces accidents to the road network.

5.10. For the M6 to M62 eastbound merges scheme, the construction period is understood to be between September 2011 and February 2012. During this period, there were nine accidents recorded in the area affected by the scheme, of which eight were of a slight severity level, and one was serious.

5.11. It can be seen from the accident descriptions that of the nine accidents, at least five occurred in heavy and slow moving traffic. As congestion was also an issue pre-scheme in the scheme area, it is difficult to say if these were due to scheme construction. One accident occurred, as two vehicles collided as one slowed down to enter a coned area of the road works on the M62 eastbound approach. Based on accident descriptions, this is the only accident which can be directly linked to construction activities.

Post-Scheme

5.12. To understand the safety performance of the road network after the scheme implementation, data has been collected for the period since the scheme opened. The scheme opened in February 2012, and data has been collected from this date to as recent a date as possible. For this scheme, data was available until the end of May 2015, meaning that there are 39 months (from March 2012) of data to interrogate post-opening for this scheme.

5.13. As discussed previously in this report, it is understood that there was traffic management in place on the M62 between junctions 9 and 11 to facilitate a number of improvements works including this LNMS. As the ASC has informed that this scheme opened in February 2012, it is considered that any traffic management in the accident analysis would therefore have been removed from this date and so it is robust to begin the analysis from this time. It is noted however that traffic management may have remained in place elsewhere on the M62 near to the LNMS site for a few months into the start of the post-opening period.

5.14. The accident data provided is outlined in **Table 5.2**.

Table 5.2 – Post-Scheme Accident Summary

Accidents	Dates	Slight	Serious	Fatal	Rate	Severity Ratio
Post-Scheme	Mar 12 – May 15	27	7	1	10.77	22.9%

5.15. The table demonstrates that there have been 35 personal injury accidents since the scheme opened, of which 27 were slight, 7 were serious, and 1 was fatal. The post-scheme accident rate is 10.77 accidents per annum; a significant reduction on the five year pre-scheme accident rate.

5.16. Analysis of accident descriptions shows that the fatal accident to occur was related to a pedestrian being on the live highway and so cannot be attributed to the highway layout or the scheme measures.

Accident Rate Change

5.17. The key changes in accidents that can result from a scheme are:

- Change in the frequency of accidents; and
- Change in the severity of accidents.

5.18. By understanding the impact the scheme has had on these metrics, it is possible to draw conclusions on the safety aspects of the M6 to M62 eastbound merges scheme.

5.19. Table 5.3 shows the accident rate and severity index for the pre-construction and post-scheme periods.

Table 5.3 – Impact of Scheme on Accident Rates

5yr Pre-Construction Period		Post-Scheme Period		Accident Saving
Accident Rate	Severity Index	Accident Rate	Severity Index	
15.00	13.3%	10.77	22.9%	4.23

5.20. The table shows that the accident rate has reduced by 4.23 accidents per year since the scheme opened. This is substantially greater than the forecast saving of 1.60 accidents per annum which was stated in the PAR.

5.21. The post-scheme severity index of 22.9% is higher than the pre-scheme severity index of 13.3%. This is largely a reflection of the slight accidents reducing at a higher rate than the serious and fatal accidents. The annual rate of accidents of a serious severity has remained constant, but there was one fatal accident post-scheme while there was none in the pre-scheme period. However, analysis of the accident descriptions show that this accident was not related to the scheme.

Accident Causation

5.22. STATS19 accident data provides a comprehensive record of the accidents that have occurred. This allows us to go beyond the frequency and severity of accidents and consider the reasons why accidents have been occurring. It is possible to consider the scheme's impact on both the vehicle movements which lead to accidents, and the contributory factors recorded during accidents.

5.23. **Table 5.4** and **Table 5.5** demonstrate the before and after frequency of vehicle movements and contributory factors respectively. In the outturn column of these tables, savings above 0.2 accidents per annum are highlighted in green, increases above 0.2 accidents per annum are highlighted in red, while changes of 0.2 accidents per annum or less are highlighted in amber.

Table 5.4 – Impact on Vehicle Movements leading to Accidents per Annum

Movement	5 Year Pre Construction	Outturn
Turning Left	1.2	1.8
Turning Right	0.8	1.5
Overtaking	0.0	0.3
Going Ahead	15.8	13.2
Slowing, Stopped, Waiting or Moving Off	13.4	8.0

Table 5.5 – Impact on Contributory Factors to Accidents per Annum

Movement	5 Year Pre Construction	Outturn
Road Environment Contributed	0.4	0.0
Vehicle Defects	0.4	0.0
Injudicious Action	6.2	4.0
Driver/rider error or reaction	17.6	11.4
Impairment or distraction	1.4	1.8
Behaviour or inexperience	2.8	1.5
Vision affected	1.6	1.5
Pedestrian only	0.0	0.9
Special	0.2	0.0

5.24. As the scheme has resulted in a reduction in accidents, there is also a reduction in particular vehicle movements and contributory factors. In terms of vehicle movements, the largest percentage reduction has been in accidents involving vehicles slowing down, stopping, waiting or moving off. Since the completion of the scheme there have been 5.4 fewer accidents each year involving these vehicle movements. This outcome would be expected given the increased capacity on the links between the M6 and the M62 eastbound, and is also supported by the reduction in journey time shown in Chapter 4 of this report.

5.25. In terms of contributory factors, there has been a particular reduction in accidents relating to injudicious action and driver or rider error with 8.4 fewer accidents occurring each year.

5.26. Pre-scheme, there were specific safety concerns identified with vehicle weaving between junctions 10 and 11 on the M62, and flow breakdown to junction 9. The pre-scheme accident data reflects this with 9.4 accidents per annum on the M62 eastbound sections of the analysis area (shown in **Figure 5.1)**. Analysis of the accident descriptions also shows that accidents occurred largely in congested conditions. Post-scheme, the accident rate is reduced to 7.3 per annum across the same area of the M62 eastbound.

5.27. There has also been a reduction of accidents on the M6 northbound to M62 eastbound slip road and its merge onto the mainline; with 2.0 accidents per annum observed in the pre-scheme period, compared to 1.0 accident per annum during the post-scheme months.

5.28. On the M6 southbound slip road to the M62 eastbound mainline, there were no accidents during the pre-scheme period with only one accident to occur since the scheme opened. However, on the merge, with the M62 eastbound mainline, there were 0.8 accidents per annum in the pre-scheme period, which increased to 1.8 accidents per annum post-scheme.

5.29. The improvement options report (August 2011), produced by the MAC to assist the development of the scheme, also noted traffic queues on lanes 1 and 2 of the M6 northbound resulting from traffic on the M62 eastbound diverge slip road.

This was noted as a key safety issue with fast moving vehicles approaching the rear of slow moving traffic, and vehicles trying to bypass stationary vehicles by changing lanes at the head of the traffic leading to side-swipe accidents. The accident data supports that this was an issue with 3.80 accidents per annum observed on the M6 northbound within 800 metres of the diverge point to the M62 eastbound. Across the same area since the scheme opened there have been only 1.00 accidents per annum. The accident descriptions show the incidents on the M6 northbound area were predominately in conditions of high traffic both pre-scheme and post-scheme.

Summary

- The scheme has succeeded in its safety objective, with a reduction of 4.23 accidents per annum, when compared to the five years prior to the scheme being constructed. This is substantially higher than the saving of 1.60 accidents per annum which was forecast through the PAR;
- There have been 35 accidents between July 2011 and May 2015 after scheme opening;
- The accident severity index (proportion of KSI) has increased from 13.3% to 22.9%. This has largely been a result of the number of slight accidents reducing at a higher rate than the number of serious and fatal accidents. The frequency of serious accidents has remained constant between pre-scheme and post-scheme, and there has been one fatal accident since the scheme opened (although this was unrelated to the scheme), compared to none in the period before construction began;
- In terms of contributory reasons, there has been a large percentage reduction in the number of accidents per annum relating to vehicles slowing, stopping, waiting or moving off;
- There has been a reduction in the frequency of accidents on the M62 eastbound through the junction; accidents reduced from 9.6 accidents per annum pre-scheme to 7.3 per annum post-scheme; and
- There has been a reduction in the number of accidents occurring on the M6 northbound mainline approach to the slip road linking it to the M62 eastbound. The accident rate has fallen from 3.80 accidents per annum pre-scheme to 1.00 accidents per annum since the scheme opened.

6. Economy

Introduction

6.1. This chapter of the report takes the journey time and safety impacts reported in chapters 4 and 5, and considers the monetary value of these impacts. These monetised benefits are then compared to the cost of scheme construction to inform two measures of value for money:

- **First Year Rate of Return (FYRR):** This is a measure of the scheme's first year benefits as a proportion of the scheme cost. It is given as a percentage and informs the percentage of the scheme costs recouped in the opening year. The FYRR given is evidence based and a primary finding of this report; and
- **Benefit Cost Ratio (BCR):** This is a measure of all the benefits that the scheme is likely to accrue over its workable life divided by the scheme cost over its life. This can only be a prediction, as this is a one year after opening report and it is not known how the scheme will perform in the future. However, this forecast is revised from that provided in the PAR based on the first year evidence.

6.2. All monetised figures in this section are quoted in 2002 prices, discounted to opening year, unless otherwise specified.

PAR and Outturn Comparison

6.3. The benefits calculated and discussed in this report can be monetised using standard value of time and accident values from WebTAG. A positive impact is considered to provide a monetary saving. Once monetised in this way, the economy and safety impacts of the scheme are offset against the scheme costs to inform the overall Value for Money of the scheme package in both an opening year, and over a longer scheme life period of 60 years.

6.4. **Table 6.1** summarises this comparison, presenting the PAR and Outturn costs and benefits of the scheme. It also includes opening year and scheme life figures for both costs and benefits of the scheme.

Table 6.1 – PAR and Outturn Economy Comparison

		PAR	Outturn
Opening Year (2012)	Total Cost	£1,504,812	£1,545,084
	Opening Year Accident Saving (number)	1.60	4.23
	Opening Year Accident Saving (£)	£121,733	£321,890
	Opening Year Journey Time Benefits (£)	£2,276,256	£435,882
	FYRR	159%	49%
Scheme Life (60 years)	Costs	£1.505M	£1.545M
	Safety Benefits	£4.888M	£12.924M
	Journey Time Benefits	£86.648M	£16.592M
	BCR	60.8	19.1

Summary

6.5. It was anticipated that the scheme would deliver a large journey time saving, as well as preventing some of the accidents which were occurring along the scheme extent. Overall, the benefits were forecast to be 95% economy and 5% safety.

6.6. The scheme has had a beneficial impact for both economy and safety. However, the scheme is shown to not be as successful as was anticipated. The outturn benefits were 56% economy and 44% safety.

6.7. The Sat Nav data has provided evidence that there is a net journey time benefit for traffic moving through the scheme area following scheme opening. However, there is also evidence that certain drivers have been adversely impacted. For example, it is now slower to travel eastbound on the M62 through the junction during the AM period. Once all impacts have been annualised, there is a net journey time benefit of £16.592m per annum. This is however only 19% of the journey time savings which were forecast in the PAR.

6.8. The scheme has also saved considerably more accidents than were forecast. Whilst it was anticipated that 1.60 accidents would be saved per annum, the actual saving has been 4.23accidents per annum. As a result, the economic safety benefits are substantially higher than forecast, at £12.924m across the 60 year scheme life, as opposed to £4.888m.

6.9. The outturn scheme cost was also recorded as being very similar to the cost forecast in the PAR.

6.10. Although the higher than expected accidents savings does offset some of the shortfall in journey time benefits, the outturn FYRR and BCR are lower than anticipated in the PAR. However, a 60 year BCR of 19.1 is still significant and indicative of a successful scheme which represents very good value for money.

7. Other Impacts

7.1. This chapter of the report presents information relating to the WebTAG objectives which are not related to journey times, reliability or safety, as set out in the PAR's AST (as these have already been discussed in previous chapters).

7.2. This information will be compared to the forecasts made in the AST (provided in Appendix E). These comparisons are used to score the scheme against WebTAG objectives based on the first years' observed findings and are recorded in the Evaluation Summary Table (EST). The EST can be found in Appendix F.

7.3. Those impacts which are not detailed below have all been assessed as 'not applicable'.

Journey Quality

7.4. Journey quality is related to traveller care, views and stress. The scheme's PAR did not consider that the scheme would have any impact on journey quality.

7.5. While there has been an increase in journey times on the M62 eastbound since scheme opening, particularly during the AM peak period, there have been substantial journey time savings overall across the routes impacted by the scheme. This is detailed through Chapter 4. Taking account of all routes, it is considered that the increased capacity on the M6 links to the M62 eastbound has overall reduced levels of driver frustration by improving the ability of drivers to make good progress in their journeys. This represents a score of +1 for journey quality.

7.6. The overall reduction of queuing on the junction has acted to reduce the presence of other vehicles when travelling through the scheme, leading to a reduction in the fear of potential accidents. This represents a further score of +1 for journey quality.

7.7. The combination of these scores has resulted in an overall score of **moderate beneficial**.

Landscape

7.8. The scheme's PAR did not consider that the scheme would have any impact on landscape.

7.9. The scheme includes measures including the upgrade of signs and the replacement of road lighting in a rural area. However, the scheme is not within or adjacent to a national park or area of natural beauty, and the scheme is wholly within the carriageway. It is not considered that the scheme has an adverse impact on the landscape, and maintains the landscape which existed before scheme opening.

7.10. Therefore, it is considered that the scheme has a **neutral** impact on landscape.

Physical Activity

7.11. The scheme's PAR did not consider that the scheme would have any impact on physical activity.

7.12. The measures as part of the scheme do not impact the number of people who would walk or cycle, therefore it is considered that the scheme has had a **neutral** impact on physical activity in the area.

Severance

7.13. The scheme's PAR did not consider that the scheme would have any impact on severance.

7.14. The scheme's measures do not cause any change in the routes used by pedestrians, equestrians or cyclists, and it is therefore considered that the scheme has a **neutral** impact on severance.

Noise

7.15. There are properties within 300 metres of the scheme, but the traffic analysis in Chapter 3 shows that there has not been a significant change in traffic volumes travelling through the junction since the scheme opened. Although there are other factors to be considered in a full noise assessment, this data provides an indication that noise levels have not changed significantly. Therefore, the EST includes a **neutral** impact for noise.

Air Quality

7.16. There are no properties within 50 metres of the scheme, and therefore it is considered that the scheme has had a neutral impact on this sub-objective.

Greenhouse Gases

7.17. It is not considered that the scheme has had an impact on the total distance travelled by traffic, and therefore the scheme has been given a score of **neutral** in the EST.

Heritage of Historic Resources

7.18. As the scheme's measures are wholly within the highway boundary, and they have not had any impact on archaeological or noteworthy built heritage sites, it is considered that the M6 to M62 eastbound merges scheme has a **neutral** impact on heritage of historic resources.

Biodiversity

7.19. The scheme does not impact biodiversity, and therefore the EST includes a **neutral** score for this objective.

Water Environment

7.20. It is considered that the scheme performed in line with expectations, and that it has therefore had a **neutral** impact on highway drainage and discharge.

Security

7.21. It is considered that the scheme performed in line with expectations, and that it has therefore had a **neutral** impact on security.

Affordability

7.22. The PAR did not assess the scheme's impact on affordability. As it is considered that the scheme has not had an impact on vehicle operating costs, the scheme has been given a score of **neutral** for affordability in the EST.

8. Conclusions and Recommendations

8.1. This report presents the POPE of the M6 to M62 Eastbound Merges Improvements LNMS, implemented by the Area 10 MAC in early 2012. The scheme evaluation has considered all elements of the WebTAG criteria. The evaluation team have worked closely with the ASC to ensure the best data possible was used and the scheme thoroughly understood.

8.2. The purpose of this chapter is to:

- Summarise the key impacts of the scheme and how these compare to forecasts; and
- Consider the lessons learnt and make recommendations to improve future LNMS.

8.3. The M6 to M62 eastbound merges LNMS opened in February 2012. The scheme involved the removal of hatching on the M6 northbound and M6 southbound links to the M62 eastbound mainline, to provide two lanes for the entire length of the slip road, and therefore increase capacity. In addition, the merge layouts were improved as part of the scheme, with the utilisation of a ghost island layout. Along with these improvements, there was the upgrade of existing signing, street lighting and vehicle restraint systems, as well as works to the existing highway drainage.

8.4. The journey time analysis identified that the scheme was successful in reducing journey times for the junctions, particularly for the movements from the M6 northbound and southbound to the M62 eastbound. It should be noted, however, there was a notable increase in journey times on the M62 eastbound through the junction in the AM peak.

8.5. Although presented as an economy scheme, there was also anticipated to be an accident reduction due to the scheme. In actuality, the evidence shows that the accident savings that have been achieved are notably greater than was forecast, which has resulted in a higher than anticipated economic benefit for safety.

8.6. Combining the journey time and accident benefits, the scheme performs positively with an outturn FYRR of 49% and a BCR of 19.1. Although these results are lower than was forecast in the PAR, they still indicate that the M6 to M62 eastbound merges LNMS has been a successful scheme.

Scheme Specific Objectives

8.7. Drawing on information presented in this report, a summary of the scheme's success against the scheme specific objectives, listed in the introduction to this report, is provided in **Table 8.1**.

Table 8.1 – Scheme Specific Objectives

Objective	Evaluation Summary	
Economy: Reducing congestion and improving reliability	The scheme has resulted in a reduction in journey times, with a reduction of 35,611 vehicle hours in the opening year, with positive impacts overall on reliability. However, it should be noted that there has been an increase in journey times on the M62 eastbound though the junction during the AM Peak of 132 seconds per vehicle.	✓
Safety: Reducing accidents	The scheme has had a significant impact in reducing accidents, with the annual accident rate falling from 15.00 in the five year pre-construction period to 10.77 after the introduction of the scheme.	✓

Lessons Learned

8.8. During the course of this evaluation, the ways in which the LNMS appraisal process could be adapted to improve the accuracy of pre-scheme forecasting has been considered. The evaluation has reinforced the potential for the annual accident rate to change during the period between the PAR is completed, and construction starts. As an economy scheme, it is considered that this is less significant than for a safety scheme.

8.9. For the purpose of evaluation, it would be beneficial for the description of the accident area in the PAR to be as clear as possible, with the avoidance of any ambiguity. The inclusion of these details would be beneficial in order to assess the suitability of the forecast, and where appropriate, a like-for-like area can be analysed during evaluation.

Appendices

Appendix A. Pre-Scheme Journey Times

Route	Wkday AM Pk	Wkday PM Pk 1	Wkday PM Pk 2	Wkday IP	7-Day O/Night	Sat Daytime	Sun Daytime	Simple Average
M6 NB to M62 EB	565.0	298.3	363.5	286.0	262.8	267.4	258.8	**328.8**
M6 NB Through	230.4	108.2	117.6	106.6	96.9	94.8	98.6	**121.9**
M6 SB to M62 EB	468.0	167.8	217.5	160.5	151.4	145.4	144.6	**207.9**
M6 SB Through	93.3	71.0	73.7	66.8	59.3	57.4	61.7	**69.0**
M62 EB Through	176.7	161.0	198.4	149.2	141.6	142.0	137.7	**158.1**
Total	**1533.3**	**806.3**	**970.6**	**769.1**	**712.0**	**706.9**	**701.4**	

Journey times are given in seconds

Note: The average value is a simple average, and is not weighted by volume of traffic

Appendix B. Post-Scheme Journey Times

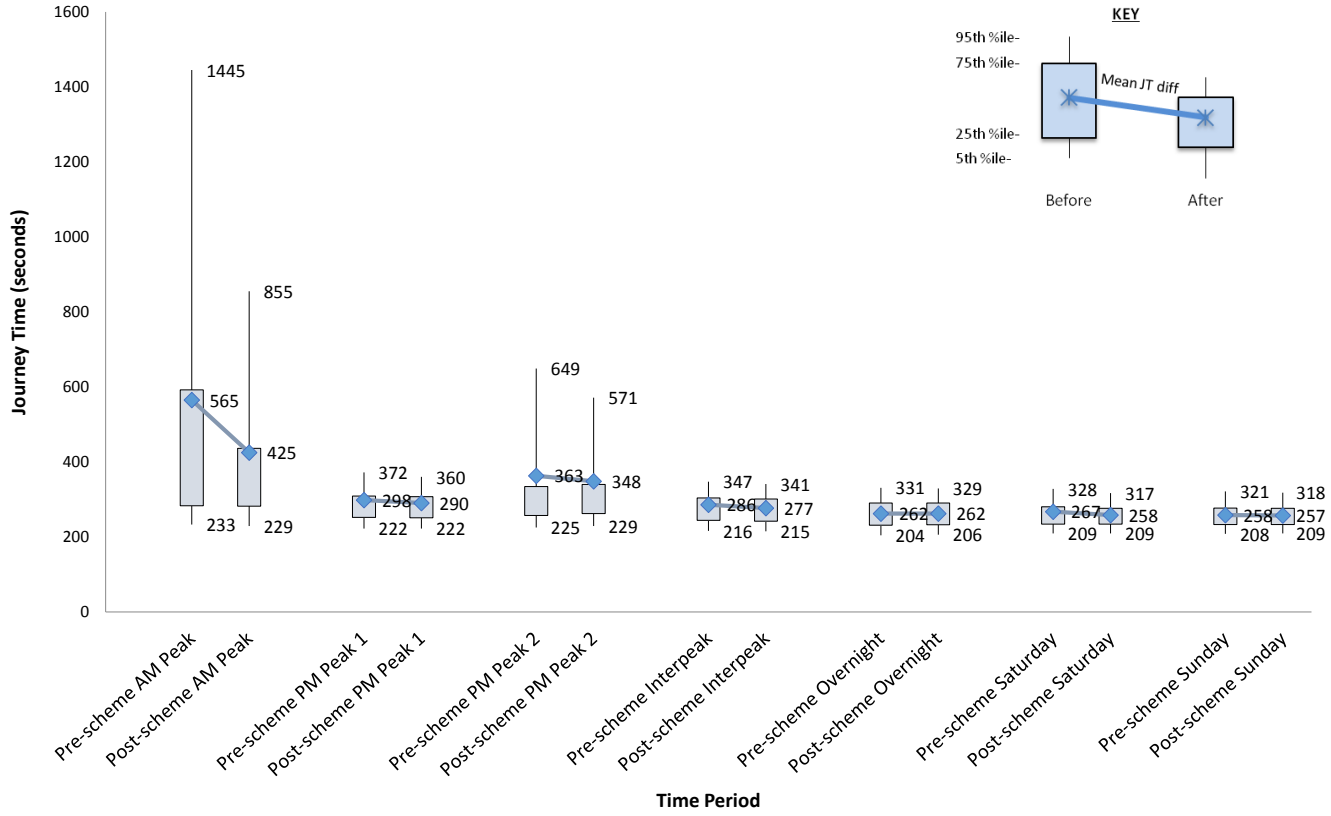
From	Wkday AM Pk	Wkday PM Pk 1	Wkday PM Pk 2	Wkday IP	7-Day O/Night	Sat Daytime	Sun Daytime	Simple Average
M6 NB to M62 EB	425.4	291.0	348.3	278.0	262.6	258.7	257.5	**303.1**
M6 NB Through	153.6	106.0	109.7	103.9	96.6	93.8	93.9	**108.2**
M6 SB to M62 EB	600.0	162.9	202.1	162.4	151.6	145.9	144.4	**224.2**
M6 SB Through	79.6	71.5	71.1	65.8	59.0	57.4	57.5	**66.0**
M62 EB Through	148.5	164.9	217.3	148.8	142.0	138.9	138.9	**157.0**
Total	**1407.1**	**796.4**	**948.5**	**758.8**	**711.8**	**694.7**	**692.1**	

Journey times are given in seconds

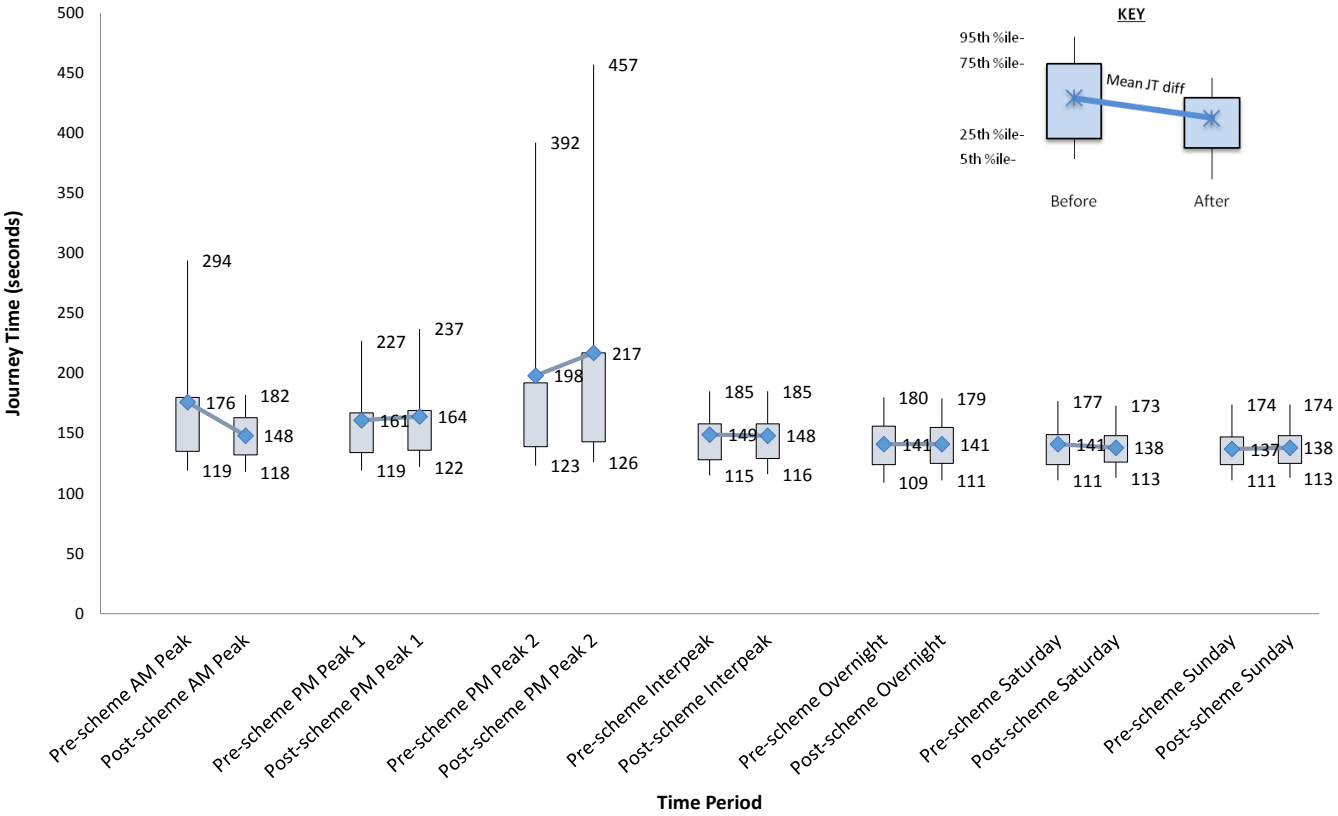
Note: The average value is a simple average, and is not weighted by volume of traffic

Appendix C. Journey Time Reliability Comparison Graphs

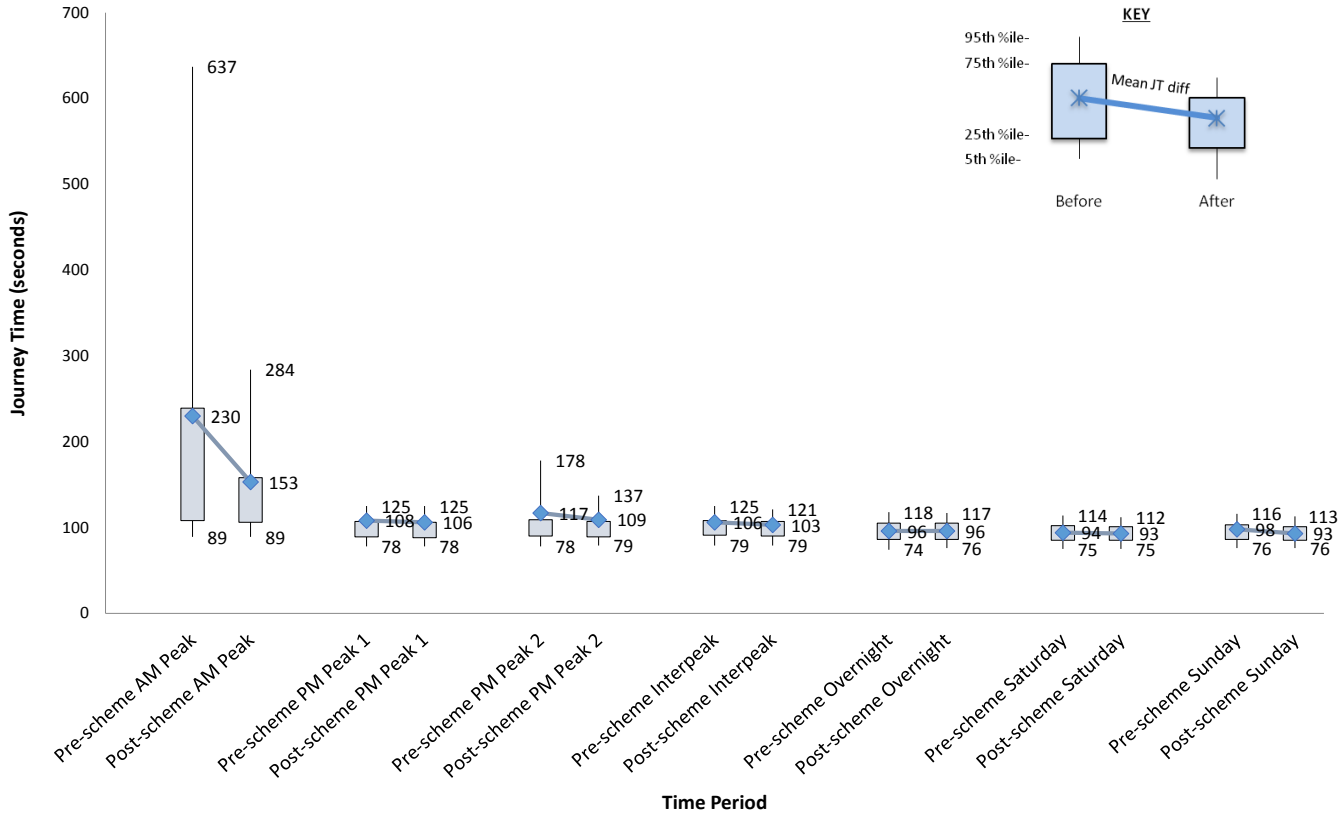
Route A. M6 Northbound to M62 Eastbound via Slip Road



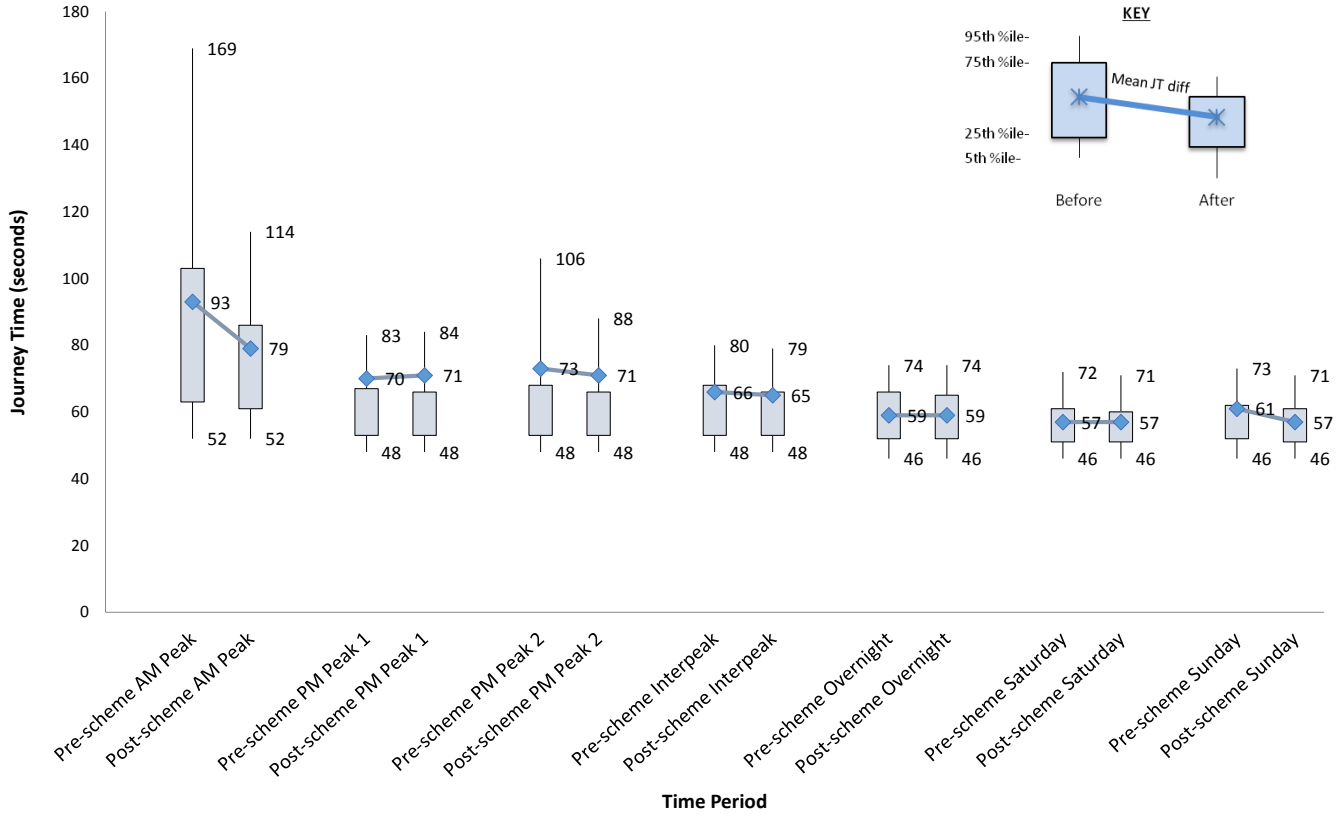
Route B. M6 Northbound Through Movement



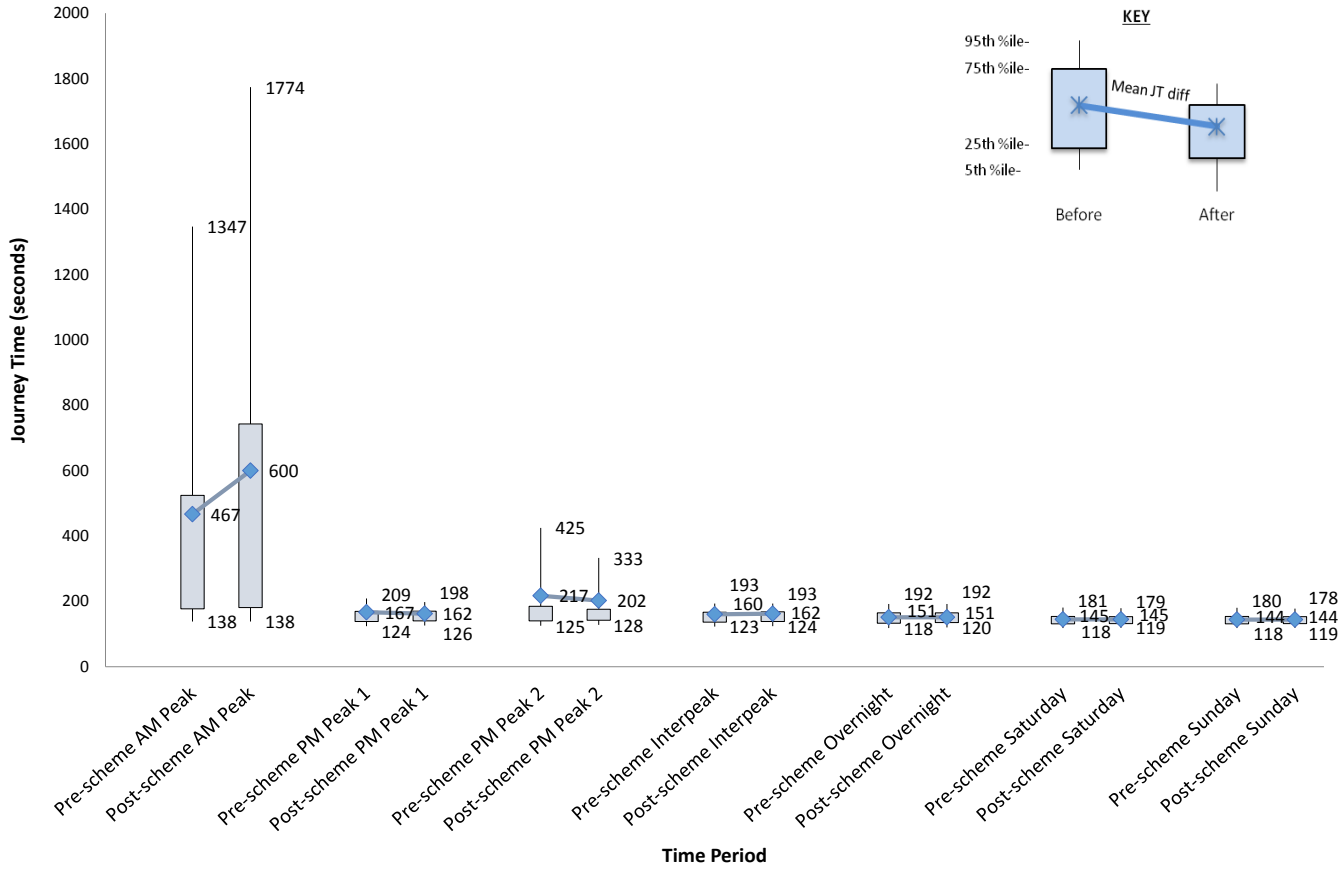
Route C. M6 Southbound to M62 Eastbound via Slip Road



Route D. M6 Southbound Through Movement



Route E. M62 Eastbound Through Movement



Appendix D. Appraisal Summary Table (AST)

	Sub-Objective	Key Points	Metrics	Assessment
ECONOMY	TEE (Business and Commuting Users)	Peak Hour flows are taken from Table 4.2 and Table 4.3 from JMP modelling	Total hours saved (Business and Commuting Users) = unknown	Travel Time & VOC PVB = £36.334M (Net of developer contributions)
	Reliability (Business and Commuting Users)	DDV - There is no change in the capacity of oversaturated traffic lanes IRV - The benefits are the result of a reduction in accidents	Not Applicable	DDV - Neutral IRV - Moderate Beneficial
	Regeneration	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Journey Quality	Scheme will not affect Journey ambience.	Not Applicable	Neutral
	Wider Impacts	<impact not applicable>	<impact not applicable>	<impact not applicable>
ENVIRONMENT	Noise	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Air Quality	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Greenhouse gases	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Landscape	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Townscape	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Heritage of Historic Resources	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Biodiversity	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Water Environment	<impact not applicable>	<impact not applicable>	<impact not applicable>
SOCIETY	TEE (Other users)	Peak Hour flows are taken from Table 4.2 and Table 4.3 from JMP modelling	Total hours saved (Other Users) = unknown	Travel Time & VOC PVB = £25.093M
	Reliability (Other Users)	DDV - There is no change in the capacity of oversaturated traffic lanes IRV - The benefits are the result of a reduction in accidents	Not Applicable	DDV - Neutral IRV - Moderate Beneficial
	Physical Activity	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Accidents	None	97 accidents saved.	Accidents PVB = £4.888M
	Security	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Access to Services	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Affordability	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Severance	<impact not applicable>	<impact not applicable>	<impact not applicable>
	Option Values	<impact not applicable>	<impact not applicable>	<impact not applicable>
PUBLIC ACCOUNTS	Transport Budget	None	Investment Cost PVC = £1.079M Operating Cost PVC = £0.025M	Total Cost PVC = £1.505M
	Wider Public Finances	None	Tax Benefit PVB = £0.000M	Tax Benefit PVB = £0.000M

Appendix E. Evaluation Summary Table (EST)

	Sub-Objective	Key Points	Metrics	Assessment
ECONOMY	TEE (Business and Commuting Users)	N/A	Total Vehicle Hours Saved (Business and Commuting Users) = Unknown	Net journey time reductions across the scheme life = £9.814M
	Reliability (Business and Commuting Users)	Improvement as per earlier analysis of journey time information	-	Moderate beneficial
	Regeneration	Not applicable as set out in the PAR 6 TAME ACO Guidance Note	-	Not applicable
	Journey Quality	Score of +2 due to the reduction in driver frustration, and due to the reduced fear of accidents	Score of +2	Moderate beneficial
	Wider Impacts	Not applicable as set out in the PAR 6 TAME ACO Guidance Note	-	Not applicable
ENVIRONMENT	Noise	While there are properties within 300m of the scheme, the lack of change in traffic volumes suggests that changes in noise are not significant	-	Neutral
	Air Quality	There are no properties within 50m of the scheme	-	Neutral
	Greenhouse gases	No change in the distance travelled by traffic due to this scheme	-	Neutral
	Landscape	It is not considered that the scheme has had an adverse impact of landscape	-	Neutral
	Townscape	Not applicable as the scheme is situated in a rural area	-	Not applicable
	Heritage of Historic Resources	Scheme does not impact on any archeological or heritage site	-	Neutral
	Biodiversity	Scheme does not impact on biodiversity	-	Neutral
	Water Environment	Scheme does not impact on water environment	-	Neutral
SOCIETY	TEE (Other users)	N/A	Total hours saved (Other Users) = Unknown	Net journey time reductions across the scheme life = £6.778M
	Reliability (Other Users)	Improvement as per earlier analysis of journey time information	-	Moderate beneficial
	Physical Activity	Scheme does not impact on physcial activity	-	Neutral
	Accidents	The benefits are the result of a reduction in accidents	255 accidents saved during 60 year scheme life.	Accidents PVB = £12.924M
	Security	Scheme does not impact on security	-	Neutral
	Access to Services	Not applicable, as set out in the Standard Impact Assessment page	-	Not applicable
	Affordability	Scheme does not impact on affordability	-	Neutral
	Severance	Scheme does not impact severance	-	Slight beneficial
	Option Values	Not applicable, as set out in the Standard Impact Assessment page	-	Not applicable
PUBLIC ACCOUNTS	Transport Budget	PVC calculated within evaluation	Outturn Investment Cost = £1.545M Operating Cost = £0.00M	Outturn PVC = £1.545M
	Wider Public Finances	PVB for wider finances not calculated within evaluation	-	Not assessed

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Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ
Highways England Company Limited registered in England and Wales number 09346363