national highways

M5 junctions 4a to 6 all lane running and M5 junctions 5, 6 and 7 improvements

One-year post-opening project evaluation

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Foreword

As Chief Customer and Strategy Officer, I want to know whether developments on our network are meeting their objectives and making a difference for our customers – the four million people that use the Strategic Road Network every day.

Evaluation is a key function in the safe running of the Strategic Road Network (SRN) and we carry out POPE1 evaluations at set points during a major enhancement scheme's lifetime to enable us to take stock and make any necessary interventions. POPEs provide an early indication if the scheme is on track to deliver the benefits over 60 years as set out in the business case appraisal.

This report evaluates the M5 junctions 4a to 6 all lane running (ALR) smart motorway scheme one year after its opening in 2019 following conversion from a conventional three lane motorway.

The report also evaluates improvements to Junction 5 and Junction 7 of the M5.

This report will be followed by a five years after report which will provide more robust data and analysis. The report includes an understanding of the safety and environmental impacts of a scheme, as well as how traffic has changed due to a scheme being in place.

There are three types of smart motorway, all lane running (ALR), dynamic hard shoulder (DHS) and controlled motorway. ALR and DHS motorways create more space on some of the most congested sections of the SRN by using hard shoulder as a running lane either permanently or only at busy times. They create extra capacity with less disruption to road users and fewer environmental impacts than physically widening the road, along with reduced carbon emissions associated with construction.

Although the performance of individual scheme is important at a local level, drawing together findings at a programme level helps us to understand patterns and trends across our network.

Safety remains our number one priority and the five-year POPEs published to date (representing approximately a quarter of those in operation) demonstrate that smart motorways are delivering safety benefits in line with or above those originally forecast, with most schemes evaluated having lower collision rates than would have been expected on the conventional motorways they replaced. Where it has been possible to assess changes to the severity of such collisions, the evidence shows those collisions have been less severe.

The published five-year POPEs show that smart motorways are broadly on track to realise their envisaged environmental objectives. With further planned mitigation these will be fully met.

The five-year ALR and DHS POPEs published to date for smart motorways also show that the schemes are delivering much needed capacity with schemes accommodating up to almost a quarter (22%) more traffic than before they were converted into smart motorways. The reports indicate that many of the motorway sections would have been unable to cater for today's traffic (at the busiest times) if they had not been converted into smart motorways.

According the to the reports, the schemes are currently on course to deliver benefits, but will not deliver all the originally expected benefits within the 60-year appraisal period. There has been lower traffic growth than was expected when these schemes were appraised, due to the 2008 financial crisis and lower population growth than originally forecast (this will impact all transport schemes, built around this time). This means fewer drivers are benefiting today from smart motorway schemes than original anticipated. Five-year POPEs also show that traffic on some smart motorway sections is not travelling as quickly as was forecast at the appraisal stage. Together these factors have resulted in the value for money for all schemes with five-year appraisals, over the 60-year appraisal period, currently being lower than anticipated at this stage when compared with the original appraisal. This is, however, a forecast and there is the opportunity to take further action to improve benefits.

We have therefore examined these results in detail and have identified specific actions to further improve the performance of schemes, including:

- Standardised operating procedures for DHS schemes
- Technology improvements
- Optimisation of the algorithms that set speed limits
- Investigating physical constraints off the network that impact performance

We will continue to monitor schemes in operation, enabling us to track their benefits and take further action if required to ensure these schemes deliver an improved experience for our customers.

Elliot Shaw

Chief Customer and Strategy Officer

September 2023

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1. Executive summary

The M5 motorway is a key strategic route in England, linking the West Midlands to the Southwest. The motorway provides a route to destinations such as Worcester, Droitwich Spa and Bromsgrove. The M5 junctions 4a-6 smart motorway project and M5 junctions 5, 6 and 7 were four separate projects in Worcestershire in the West Midlands.

This project added capacity by upgrading the M5 between junctions 4a and 6 to all lane running, converting the hard shoulder to a permanent running lane. Emergency areas were installed along the project extent and includes gantries which display variable mandatory speed limits. The project opened to traffic in May 2017; however, full benefits of the project may not have been realised until January 2020 owing to the refurbishment of the Oldbury Viaduct to the north of the project extent.

The completion of the project aimed to increase motorway capacity, reduce congestion, improve journey time reliability, and improve journey times on the M5 between J4a and J6 without having a detrimental impact on the surrounding road network. There was also an objective to ensure that queuing of traffic onto the motorway from junctions was minimised.

There has been a decrease in the number and rate of personal injury collisions. This is a positive early indication but will require revisiting at a later stage to draw any conclusions.

The smart motorway has been delivered and the information supplied to drivers has improved. Information available to date indicates that an improvement in reducing congestion, improving journey times and journey time reliability has been observed. There were marginal improvements to journey times in the morning northbound and evening southbound peaks, those journeys were also more reliable. Journey times reliability on the junctions were more mixed, but generally better than before.

The impact of the project on the various aspects of the environment was forecast to be neutral or slight adverse. Impacts on noise and air quality were assessed to be as expected.

The completion of the junction projects aimed to reduce congestion and improve safety performance. Early indications indicate that congestion has improved and there are positive early signs for safety at the improved junctions.

2. Introduction

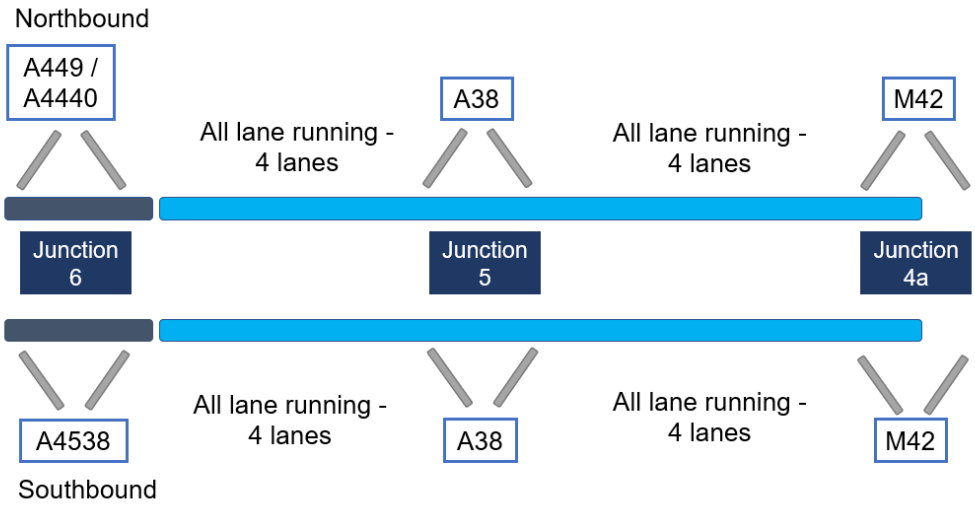
What is the project and what was it designed to achieve?

The M5 junctions 4a to 6 and M5 junction 5, 6 and 7 improvements are four projects combined into a one year after evaluation. The package has been combined owing to the close proximity of the projects and potential interacting effects on network performance.

M5 junctions 4a to 6 all lane running motorway

The M5 junctions 4a to 6 is an all lane running smart motorway. Drivers are notified of variable mandatory speed limits via motorway indicator signs above the main carriageway mounted on overhead gantries and verge mounted variable message signs. The hard shoulder was converted to a permanent running lane from M5 junctions 4a to 6 to provide more capacity (Figure 1). Emergency areas are included at regular intervals throughout.

Figure 1: Schematic of the M5 junctions 4a to 6 all lane running project layout



Construction commenced on the M5 junctions 4a to 6 all lane running project in March 2014. Initial work involved upgrading the central reservation, whilst the conversion of the hard shoulder and construction of additional infrastructure occurred from December 2015. The project opened for traffic in May 2017, traffic growth due to the project was delayed due to traffic management relating to the Oldbury Viaduct refurbishment project external to this evaluation.

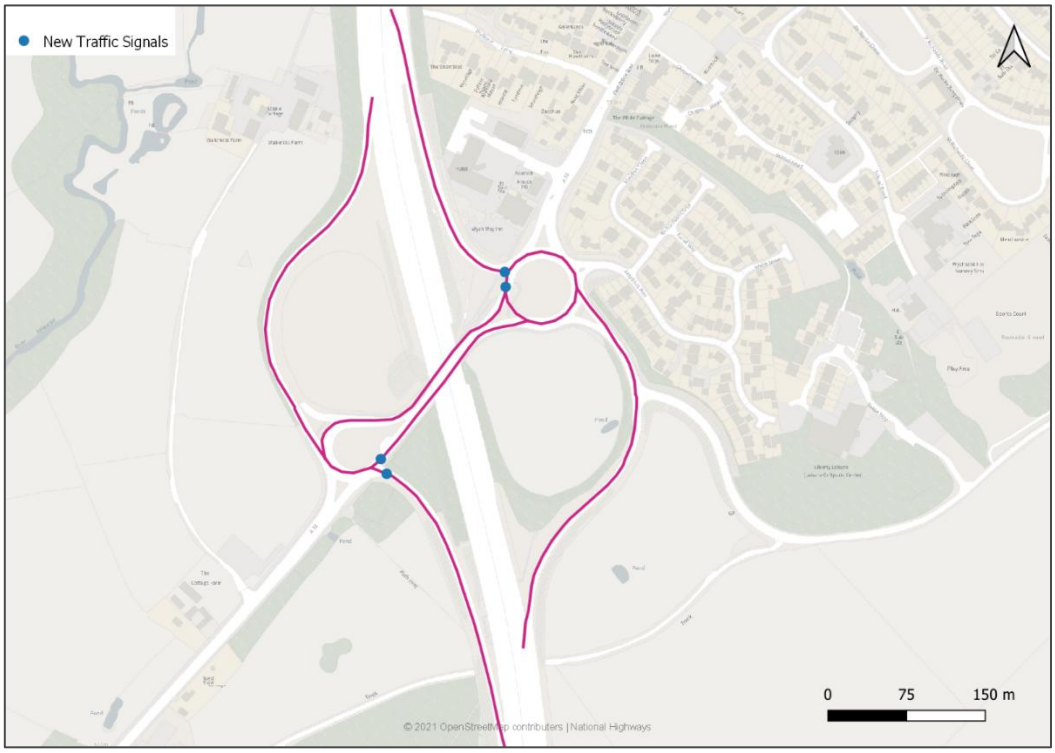
Prior to the installation of the project, the M5 junctions 4a to 6 was congested with traffic predicted to continue to increase. The route is used by long distance and local traffic to reach Birmingham, the West Midlands conurbation and Worcester. The all lane running smart motorway was designed to reduce congestion and provide journey time reliability improvements by increasing three lanes to four, mirroring other smart motorway all lane running projects.

M5 junctions 5, 6 and 7

The M5 junction 5 is a grade separated junction (highways are at different heights to keep traffic apart) consisting of two linked two-lane roundabouts either side of

the M5 main carriageway, intersecting with the A38. The project consists of new traffic signal controls on the southbound M5 exit slip road and respective circulatory on the roundabout, and on the M5 northbound exit slip road and respective circulatory on the roundabout (see Figure 2). This project started construction in September 2015 and was open to traffic in December 2015. Signal upgrades were installed primarily due to safety and congestion problems at the junction, with queueing on the southbound exit slip road from the M5, especially in the evening peak hour.

Figure 2: M5 junction 5 project layout

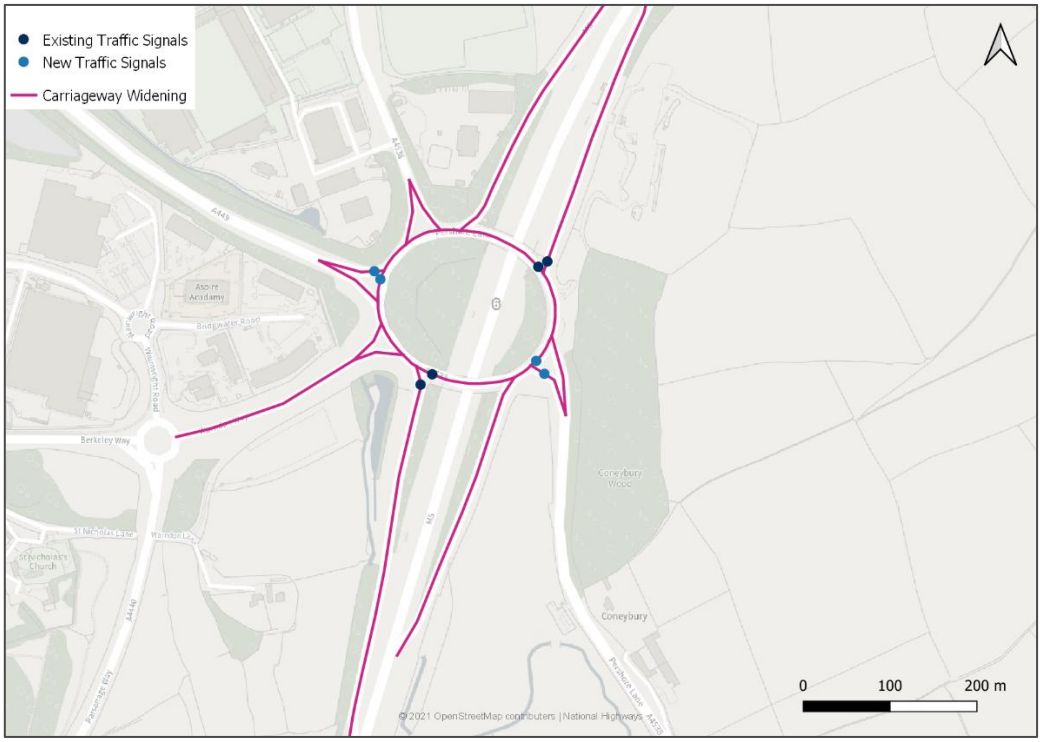


Source: National Highways and OpenStreetMap contributors

The M5 junction 6 is a six-arm roundabout, grade separated from the motorway (see Figure 3). The M5 junction 6 project consisted of the widening of all six approaches, namely the M5 slip roads, A449, A4440 Warndon Way, A4538 north and A4538 south. The roundabout circulatory was also widened from a minimum two lanes to a minimum three lanes. The project included the installation of signal controls on the A449 entry to the roundabout and respective circulatory, and A4538 south entry to roundabout and respective circulatory. This junction work started construction in March 2018 and was opened to traffic in November 2020. The project was identified due to the high collision rate at the junction, highlighted in the Area 9 Cluster Site Analysis.[1] The junction also had congestion problems, notably on the two M5 exit slip roads resulting in queuing at the approach to the roundabout in peak hours.

[1] Area 9 M5 Junction 5 Economy Study, June 2014 (Document reference: M91300473/001)

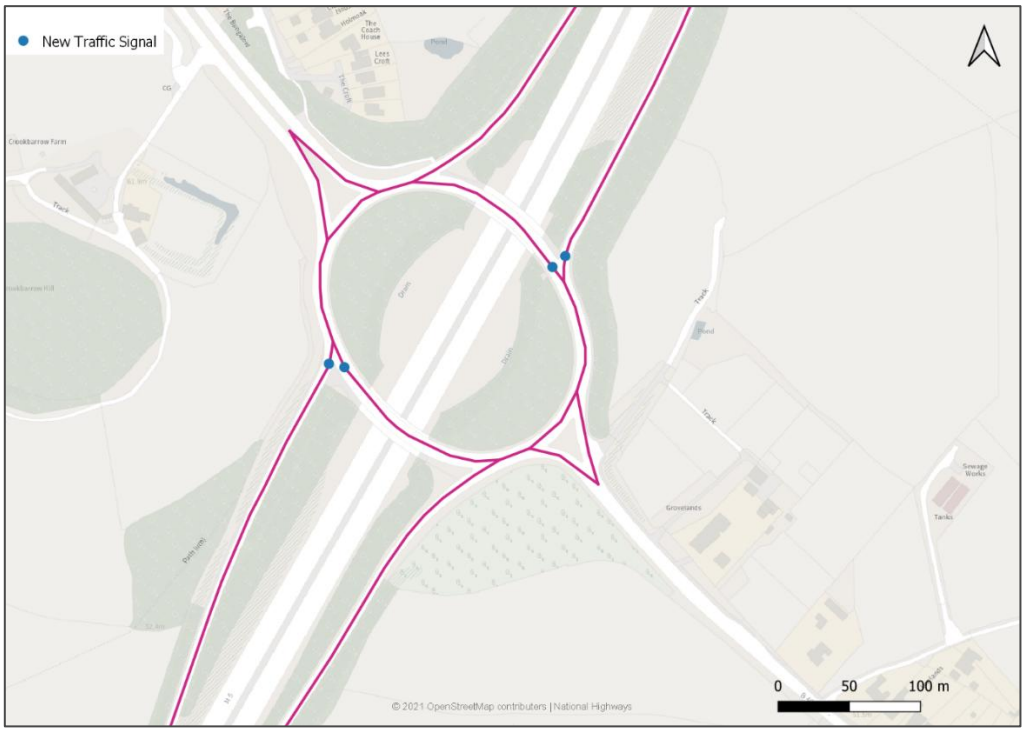
Figure 3: M5 junction 6 project layout



Source: National Highways and OpenStreetMap contributors

The M5 junction 7 is a four-arm grade separated roundabout intersecting with Whittington Road and B4084 Whittington Road (see Figure 4). The project included the installation of signals at both M5 exit slip road approaches to the circulatory and the respective circulatory. Construction commenced on the project in July 2015 and was opened to traffic in October 2015. The project was originally identified owing to safety concerns at the slip road junctions with the circulatory where several injury collisions were reported.

Figure 4: M5 junction 7 project layout



Source: National Highways and OpenStreetMap contributors

Project location

The M5 is a strategic route linking the South West of England to the Midlands, connecting the towns and cities of Birmingham, Worcester, Cheltenham, Gloucester, Bristol and Exeter. The M5 junctions 4a to 6 all lane running project and M5 junction 5, 6 and 7 projects are located in Worcestershire in the West Midlands. The location of the four project elements of this one year after evaluation and National Highways network extent are presented in Figure 5.

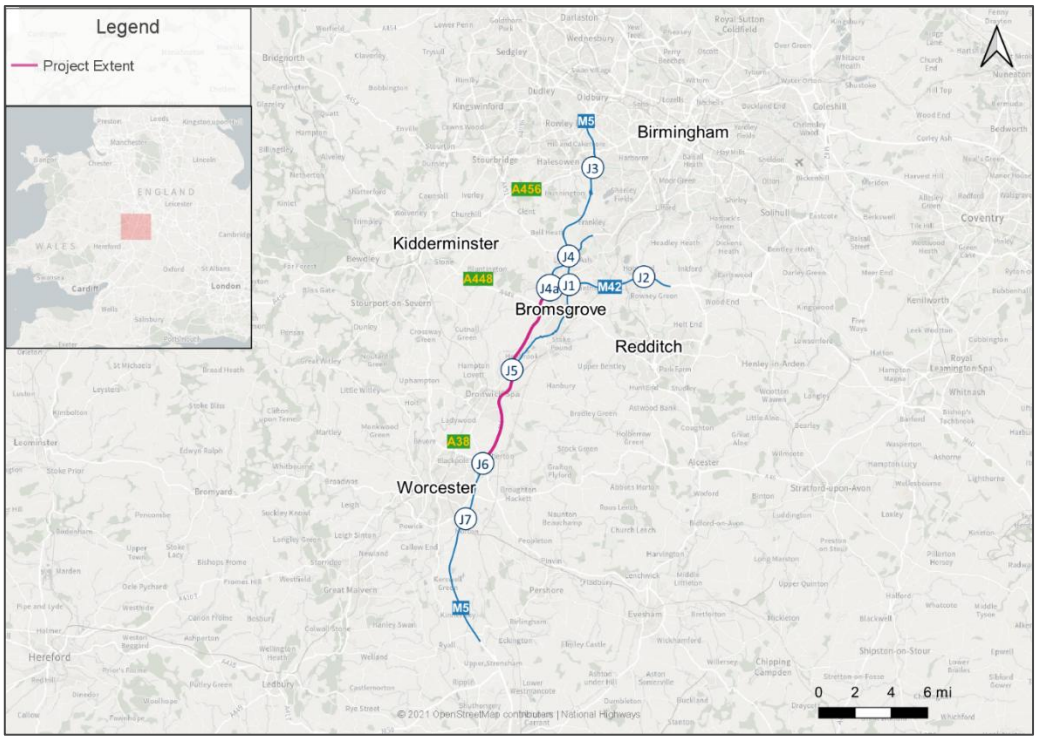
The M5 junctions 4a to 6 all lane running includes the M5 between junction 4a to the north-west of Bromsgrove (junction with the M42) and junction 6 to the northeast of Worcester (the interchange with the A449 at Worcester). This extent is 12 miles in length. The northern extent of the project is in close proximity to the M5, M6 and M42 motorways.

The M5 junction 5 project is located in proximity to Wychbold to the south-west of Bromsgrove and northeast of Droitwich Spa. Junction 5 provides access to the A38 which links Droitwich and Bromsgrove and is an alternative to the M5 for local traffic.

Junction 6 is located south of junction 5, to the north-east of Worcester. Junction 6 provides access to the A449 towards Kidderminster, A4440 to Worcester and A4538 providing a link to Gloucestershire and Warwickshire.

Junction 7 is situated to the south of junction 6, to the south-east of Worcester. Junction 7 links the B4084 Whittington Road towards Pershore to the south-east and Worcester via Whittington Road to the north-west.

Figure 5: M5 junctions 4a to 6 all lane running and M5 junctions 5, 6 and 7 project locations



Source: National Highways and OpenStreetMap contributors

How has the project been evaluated?

Post-opening project evaluations are carried out for major projects to validate the accuracy of expected project impacts which were agreed as part of the business

case for investment. They also seek to determine whether the expected project benefits are likely to be realised. They provide opportunities to learn and improve future project appraisals and business cases too. And are important for providing transparency and accountability for public expenditure, by assessing whether projects are on track to deliver value for money.

A post-opening project evaluation compares changes in key impact areas[2] by observing trends on a route before a project is constructed (baseline) and tracking these after it has opened to traffic. The outturn impacts are evaluated against the expected impacts (presented in the forecasts made during the appraisal) to review the project's performance. For more details of the evaluation methods used in this study please refer to the post-opening project evaluation (POPE) methodology manual on our website.[3]

The project has been evaluated comparing a pre-construction date of mid-September 2013 to mid-October 2013, and a one year after date of mid-September 2021 to mid-October 2021 (see Table 1). A mid-September to mid-October date range was selected to avoid the impact of school holidays on traffic volumes. A pre-construction date in 2013 was chosen as the all lane running project began construction in March 2014. A one year after date in 2021 was chosen owing to the opening date of the M5 junction 6 project of November 2020, and to avoid the impact of refurbishment to the Oldbury Viaduct which was finalised in January 2020. Therefore, evaluation dates of mid-September 2021 to mid-October 2021 are considered appropriate to allow for a one year after evaluation for all elements of the project.

It is important to acknowledge the impact of the COVID-19 pandemic on traffic volumes, given that the one year after evaluation period was selected within 2021. September and October 2021 were chosen to avoid the impact of national lockdowns on traffic volumes. The chosen date range for the one year after evaluation was after the removal of most legal limits on social contact in England in July 2021 and before the introduction of 'Plan B' measures in England in December 2021, which asked people to work from home where possible.[4]

Table 1: Chosen-pre construction and one year after opening dates

Evaluation period	Dates used in appraisal
Pre-construction	16th September 2013 – 18th October 2013
One year after	13th September 2021 – 15th October 2021

All traffic level elements have been assessed using the above date ranges, with the exception of the section 4, 'how was the smart motorway operated', which assessed how the all lane running project operated in terms of variable mandatory speed limits and traffic volumes. For this section of the analysis, lane-based traffic volume and variable mandatory speed limit sign data was not available in October 2021. The date range used for this analysis was therefore 13th September 2021 to

[2] Key impact areas include safety, journey reliability and environmental impacts.
[3] https://nationalhighways.co.uk/media/exypgk11/pope-methodology-note-jan-2022.pdf
[4] Timeline of UK government coronavirus lockdowns and measures, https://www.instituteforgovernment.org.uk/sites/default/files/timeline-coronavirus-lockdown-december-2021.pdf

30th September 2021, which is a smaller date range of 18 days rather than 33 days for journey times, journey time reliability, traffic volumes, congestion and speed.

This report outlines the impact of the all lane running project and junction improvement projects separately due to differing individual objectives for each project element, as outlined in the next section.

3. Delivering against objectives

How has the project performed against objectives?

All our major projects have specific objectives which were defined early in the business case when project options were being identified. The project had four key objectives, primarily related to improving journey times, maintaining safety for road users, and supporting wider government transport policy. These benefits are appraised to be realised over 60 years; a one-year evaluation provides early indication if the project is on track to deliver the benefits.

Table 2 and Table 3 summarise the performance against each objective for the smart motorway and junction improvement projects, using evidence gathered for this study.

Table 2: Objectives and evaluation summary for the smart motorway

Objective	One-year evaluation outcome
The project will increase motorway capacity.	Achieved through the addition of a fourth lane and outturn increased traffic volumes for the majority of the route length.
The project will reduce congestion.	The project has had early signs of a positive impact on congestion based on a decrease in route stress.
The project will smooth traffic volumes.	Indications this has been achieved through more consistent speeds along the route length.
The project will provide more reliable journey times.	Early signs of improvements to journey time reliability across the project extent.
The project will increase and improve the quality of information for the driver.	The inclusion of variable messaging signs above the main carriageway mounted on overhead gantries and verge mounted variable message signs has provided variable mandatory speed limits and driver information where there was no information previously.
No worsening of safety performance	There has been a decrease in the number and rate of personal injury collisions. This will require revisit in a future evaluation to draw any conclusions.

Table 3: Objectives and evaluation summary for the junction improvements

Junction	Objective	One-year evaluation outcome
M5 junction 5	Address congestion problems (especially southbound exit slip road in the PM peak).	Early indications suggest that this has been achieved on the southbound exit slip road through improved journey time reliability. This has not been achieved at the northbound exit slip road as journey time reliability and average journey times have worsened.
	Address safety problems (especially southbound diverge in the PM peak).	No change in the number of personal injury collisions but collision rate has improved.
M5 junction 6	Address congestion problems (especially on diverges in both peaks).	Early signs of improvements to congestion through improved journey time reliability for journeys from the A449 and A4538. There has been a slight worsening in journey time reliability on both motorway exit slip roads, suggesting that congestion has worsened slightly.
	Address safety problems (especially on diverges in both peaks).	As a consequence of the works for this junction not completing until November 2020 we are unable to evaluate the safety performance at this stage. This will be evaluated at a later stage.
	Facilitate proposed development in the locality.	This has not been assessed specifically in the evaluation. This will be revisited in a later report.
M5 junction 7	Address safety issues (especially at intersections with circulatory).	Reduction in the number of personal injury collisions and a reduction in the collision rate.

4. Customer journeys

Summary

The evaluation seeks to gain an understanding of how traffic has changed since the opening of the all lane running and junction projects.

The initial findings at one year after indicated that the all lane running motorway has helped support an increase in the volume of traffic, whilst allowing for a reduction in congestion for road users. Forecasts underestimated the traffic volumes at one year after compared to the observed traffic volumes. Average journey times in the northbound direction in the morning peak and southbound direction in the evening peak are lower since the project opened. This suggests that the increased capacity provided by the project may have led to this improvement. Peak period journey time reliability has also improved, providing drivers with greater confidence of their journey time when using the route with addition of a fourth running lane. In addition, the use of variable mandatory speed limits has smoothed traffic volumes, providing more consistent speeds across the project extent.

There was a limited amount of forecast and observed pre-construction traffic count data available for the three junction projects, which meant the assessment of traffic volumes before and after project completion was somewhat limited, especially for the M5 junction 6. Observed traffic volumes were found to have increased at one year after when compared to before project construction at the M5 junction 5 slip roads and decreased on the M5 junction 7 southbound slip roads.

No forecast journey times were available for the junction projects to understand the predicted impact of the junction improvements versus the observed findings. Observed journey time reliability and average journey times improved for most time periods at the junctions, notably, the M5 junction 5 southbound exit slip road and journeys on the M5 junction 6 originating from the A449 and A4538, where new traffic signals have been installed. This outcome is particularly beneficial at the M5 junction 5 southbound exit slip road which was highlighted as being particularly congested prior to the project completion. There were some increases in average journey times, primarily on the M5 junction 5 northbound exit slip road at peak periods and the M5 junction 7 northbound exit slip road in the evening peak.

Overall, the combined projects have generally resulted in an improvement in journey time reliability at the peak periods. This has occurred despite increased traffic volumes along the majority of the all lane running project extent and M5 junction 5, and whilst there has been a decrease in traffic volumes at M5 junction 7.

How have traffic levels changed?

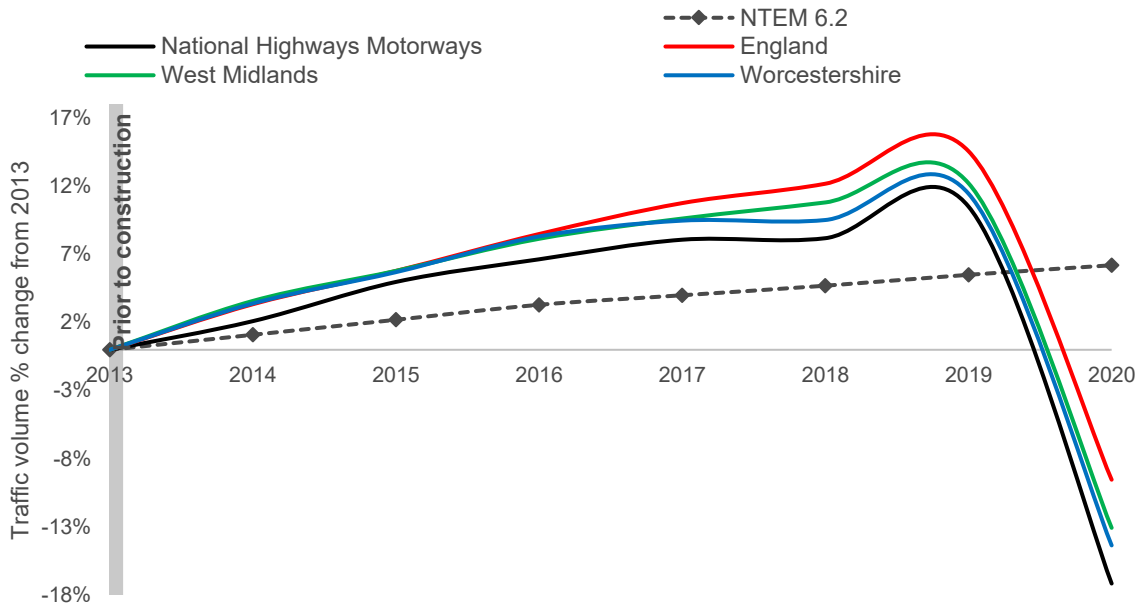
National and regional

To understand the impact the project had on traffic levels, it is important to consider changes in traffic volumes at a national and regional level. As demonstrated in Figure 6, there was a gradual increase in traffic volumes in 2014 to 2019 compared to 2013 for all national and regional road types considered. Growth was highest in 2019 both at a national and regional level, with increases

relative to 2013 in the range of 11-14%. The impact of the COVID-19 pandemic was evident for traffic volumes in 2020 with a 13-17% reduction in traffic volumes from 2013 levels, owing to governmental guidance and laws limiting people's interactions and movements.

National Trip End Model (NTEM) version 6.2 data is also illustrated, which was used in the forecasting for the M5 junctions 4a to 6 all lane running project. A gradual increase in traffic volumes after 2013 was forecasted by NTEM 6.2 based on 2008 population projections for the whole of Great Britain and did not predict the COVID-19 pandemic in 2020. Data for 2021, the one year after date, has not yet been released by the Department for Transport. This shows that until 2019, NTEM version 6.2 predicted growth was around 50% lower than outturn. Therefore, the forecasts may show lower traffic volumes than are observed.

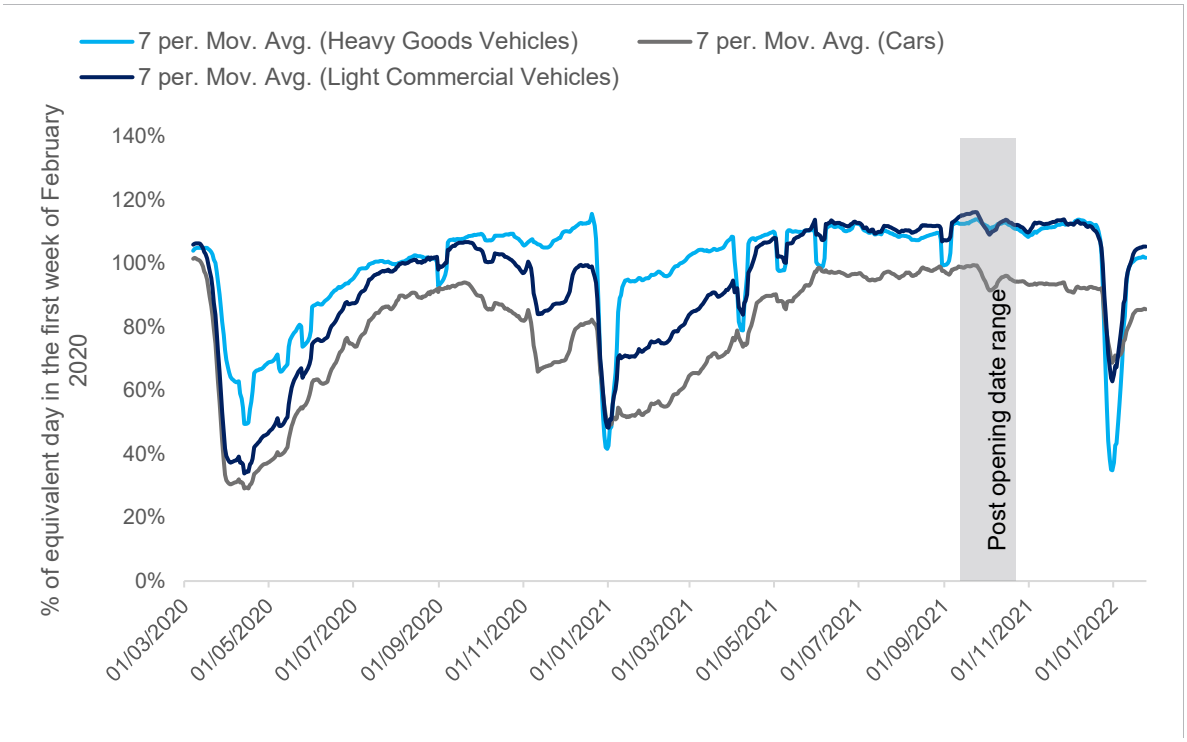
Figure 6: National and regional traffic volume changes since 2013



Source: Department for Transport road traffic statistics https://www.gov.uk/government/statistical-data-sets/road-traffic-statistics-tra#history

The impact of the COVID-19 pandemic on traffic levels in Great Britain is illustrated in Figure 7. The impact of lockdowns on traffic levels can be seen in March 2020 to July 2020 with traffic levels recovering to February 2020 levels in summer 2020 before falling again in January 2021 during the third national lockdown. The post opening dates of mid-September 2021 to mid-October 2021 chosen for this one year after evaluation illustrate traffic was largely up to pre pandemic levels. Car traffic volumes were at 95% of pre-pandemic levels whilst light commercial vehicles and heavy goods vehicles were above pre-pandemic levels. This provides greater confidence in the use of a 2021 one year after date and the resulting findings for this evaluation, as traffic volumes are not substantially impacted by the COVID-19 pandemic. Though this gives evidence that without the project the total volume of traffic is likely to have reduced by a small amount between 2019 and 2021.

Figure 7: Seven day moving average of traffic volume change by transport mode since February 2020 in Great Britain



Source: Department for Transport: transport use during the coronavirus (COVID-19) pandemic in Great Britain
https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic

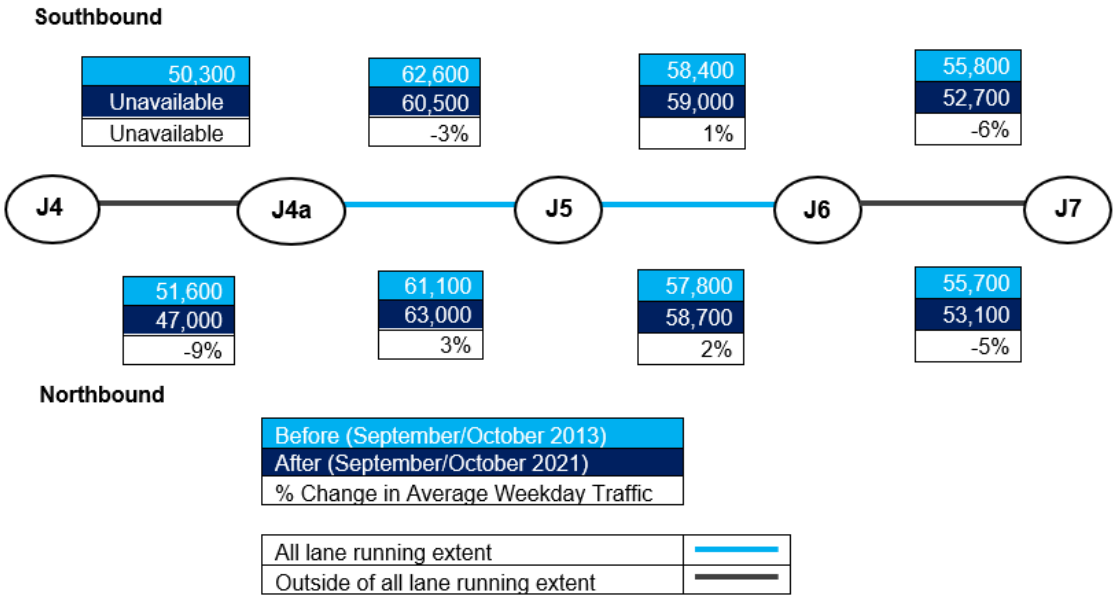
How did traffic volumes change?

M5 junctions 4a to 6 all lane running

The all lane running project aimed to improve journey times and journey time reliability through increased capacity on the M5 junctions 4a to 6 through the conversion of the hard shoulder to a permanent running lane. This section of the report examines the impact of the all lane running project on traffic volumes prior to construction and after the project was opened.

Changes in average weekday traffic along the all lane running motorway extent can be viewed in Figure 8. The northbound extent of the all lane running project experienced an increase in traffic volumes, as did the southbound junction 5 to junction 6 extent of the project. The increased capacity provided by the project allows for an increased number of vehicles to use the route in comparison to outside of the all lane running motorway. However, there was a 3% reduction in traffic volumes within the project extent between junction 4a to junction 5 southbound. This may be associated with local traffic from Bromsgrove joining the southbound motorway at junction 5 instead of using M42 junction 1, given the improvements made to this junction. However, traffic volumes for these local roads were not available to conclude this. This reduction in traffic volumes is similar to the reduction in traffic volumes outside of the all lane running extent between junction 4 and junction 4a and junction 6 and junction 7 in both directions. This reduction was in line with background trends for 2021, linked to the impact of the COVID-19 pandemic on traffic volumes.

Figure 8: Average weekday traffic volume between junctions and after M5 junctions 4a to 6 all lane running project completion



Source: National Highways WebTRIS, counts September/October 2013 and September/October 2021 rounded to the nearest hundred

M5 junctions 5, 6 and 7

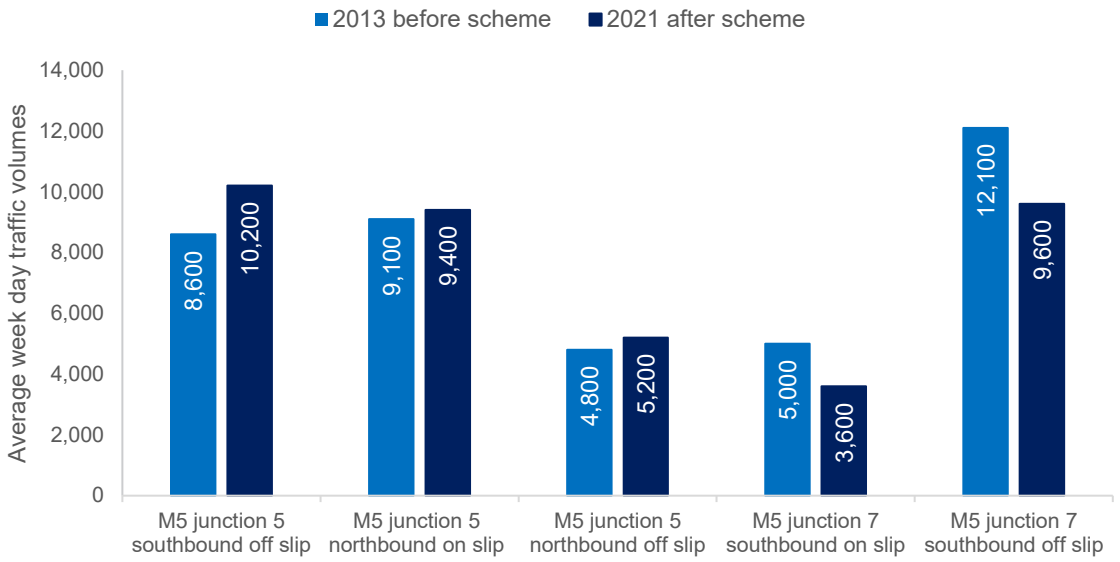
The M5 junctions 5, 6 and 7 improvements aimed to deliver safety and congestion improvements, especially the southbound exit slip road at M5 junction 5 and both motorway exit slip roads at the M5 junction 6. To understand the success of the projects on congestion, traffic volumes have been compared before and after project completion in Figure 9.

There is increased average weekday traffic at M5 junction 5 for both motorway exit slip roads, and the northbound entry slip road since the project opened. Data was not available to compare pre and post project opening for the southbound entry slip road. Greater traffic volumes may be using these slip roads owing to the greater capacity provided by the all lane running project. The increase in traffic volumes suggests that the installation of signals at the M5 junction 5 motorway exit slip roads has resulted in a reduction in congestion, allowing more vehicles to pass through the junction.

Data was not available for the M5 junction 6 slip roads for the pre and post construction dates, therefore this project cannot be assessed in terms of the impact of the improvements to traffic volumes.

There were decreased traffic volumes at the M5 junction 7 southbound entry and exit slip roads. This suggests there was a reduction in traffic volumes at this junction. Traffic volume data was not available for the M5 junction 7 northbound entry or exit slip roads. Southbound entry and exit slip road traffic may have reduced as a result of the more significant improvements at M5 junction 6 encouraging road users to use this junction to access Worcester via the A4440, however, data was not available to validate this.

Figure 9: Average weekday traffic volumes on the motorway slip roads before (September/October 2013) and after (September/October 2021) the junctions 5 and 7 project completions



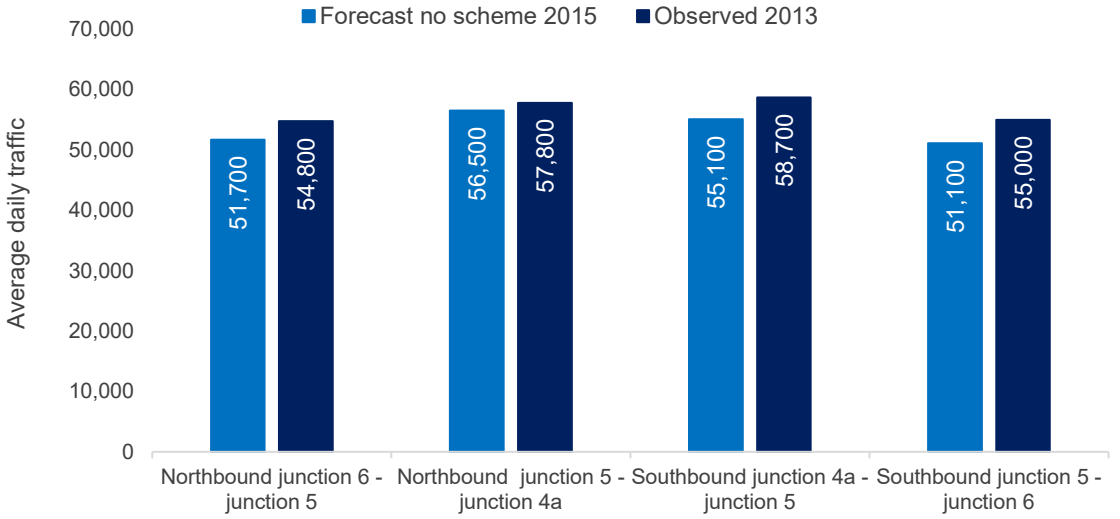
Source: National Highways WebTRIS, counts September/October 2013 and September/October 2021

Was traffic growth as expected within the business case?

M5 junctions 4a to 6 all lane running

Forecasts of traffic volumes in 2015 without the all lane running project were compared to observed pre-construction traffic volumes in 2013 (Figure 10). Forecast traffic volumes pre-construction underestimated the observed traffic volumes despite the forecast data having an additional two years of background trip growth. This means the forecasting likely underestimated the level of congestion on the network, the largest difference though is 7%.

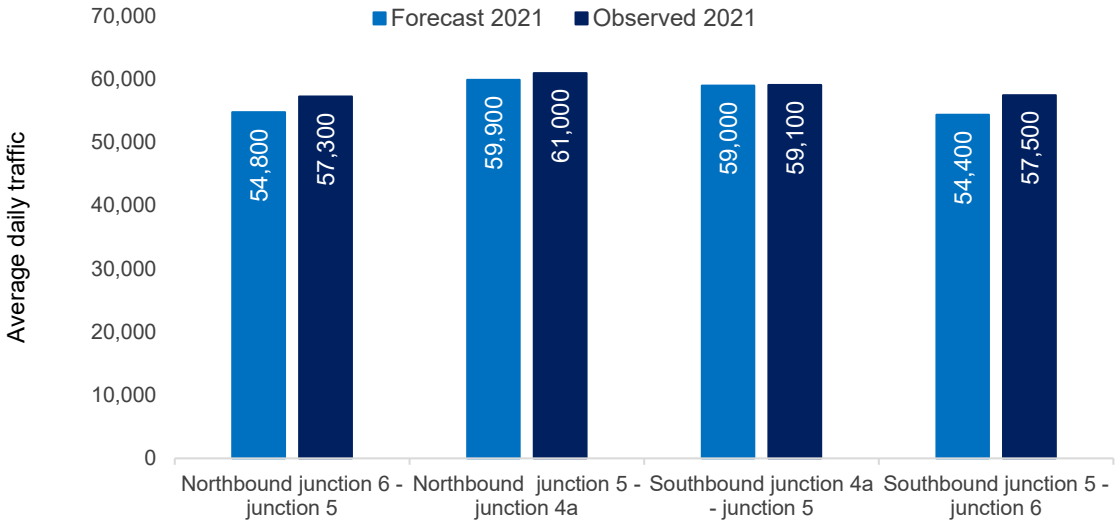
Figure 10: Forecast (2015) and observed (2013) traffic volumes without the all lane running project



Source: Forecasts from Traffic and Economic Appraisal Report observed data from National Highways WebTRIS. Note: Forecasts of do minimum (2015) - with the all lane running project and observed before all lane running volumes (2013). 2015 used as forecasted as post opening date

Figure 11 presents interpolated forecast and observed data in 2021 with the project. This shows a very similar trend to the pre-construction data, in that the forecast data is 5-10% lower than the observed traffic flows. Therefore, the forecasts correctly predicted a small increase in traffic flows as a result of the project, despite not getting the absolute flow levels correct. The only exception to this rule is M5 junctions 4a to 5 southbound, where the forecast and observed values are almost identical. This results from the lack of observed growth in traffic we previously noted in this location.

Figure 11: Forecast and observed traffic volume with the all lane running project (2021)



Source: Forecasts from Traffic and Economic Appraisal Report observed data from National Highways WebTRIS. 2021 forecast traffic volumes interpolated from 2015 and 2030 forecasted traffic volumes.

M5 junction 5, 6 and 7

Forecast traffic volume data was not available for the M5 junction 5 and junction 7. Forecast turning count data was provided for M5 junction 6, however, it was not possible to compare with observed data as traffic volume data post project opening had not been collected. Turning count data is to be completed at five-year after to understand forecast versus observed traffic volumes for the projects.

Relieving congestion and making journeys more reliable

All lane running is used on the busiest routes, to ease congestion and make journey times more predictable. These routes are often where we anticipate congestion will increase and the all lane running project seeks to limit this. Analysis of journey times and speeds indicate the impact of the all lane running project on congestion. The extent to which journey times vary from the expected average journey time indicates how reliable a journey is.

This section evaluates how the project impacted journey times and the reliability of journeys. SatNav data has been used to understand how the project has impacted on journey times, journey time reliability and speed. Lane specific traffic volume and variable speed limit data has additionally been used to understand the operation of the all lane running motorway, to indicate when variable speed limits were in place along the length of the project.

Did the project deliver journey time savings?

Journey times were assessed for the weekday morning peak, daytime and evening peak. The hours included in each time period are outlined in Table 4. These journeys times were determined using average weekday daily traffic volumes from observed traffic volumes over the study period, to produce a daily profile of traffic volumes to select the peak weekday hours for all four projects. These plots are presented in Appendix A.

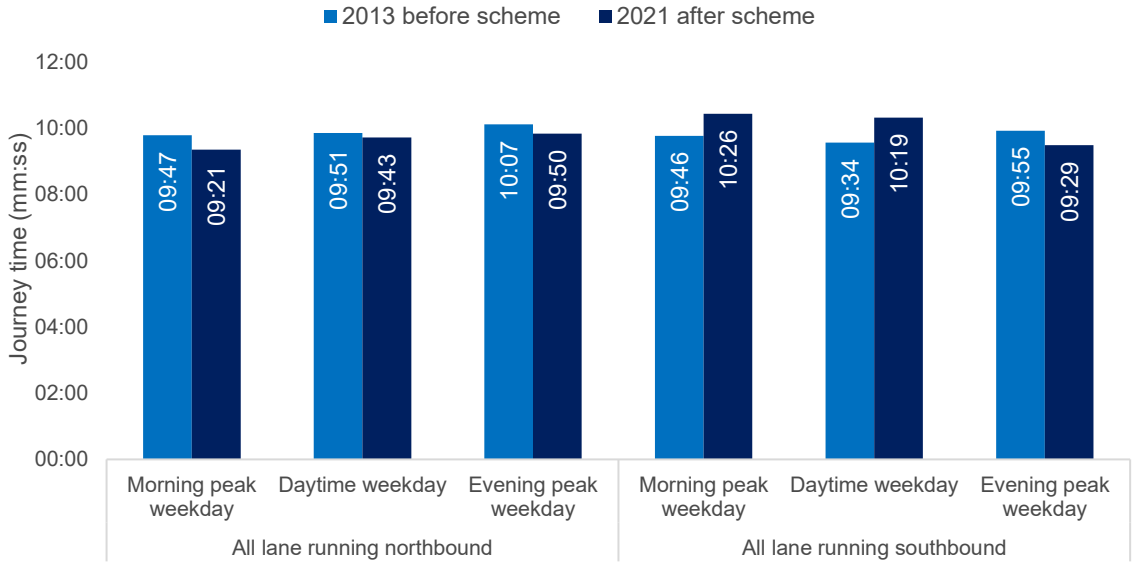
Table 4: Peak weekday period hours used in the journey time analysis

Time period	Time period used in evaluation
Morning peak	07:00-09:00
Daytime	09:00-16:00
Evening peak	16:00-18:00

M5 junctions 4a to 6 all lane running

The all lane running project aims to provide more reliable journey times and smooth traffic volumes. Changes in journey times on the M5 junctions 4a to 6 were assessed to understand how successful the project was against these key objectives. The results for weekday traffic are shown in Figure 12.

Figure 12: Observed average weekday journey times by peak period one year after (2021) versus pre-construction (2013)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Average journey times have decreased one year after opening compared to pre-construction for most time periods across the all lane running motorway. In particular there is a 26 second decrease in journey times in the morning peak on the northbound carriageway and the evening peak on the southbound carriageway. The northbound carriageway has improvements for all time periods, whilst the southbound carriageway has increased weekday journey times in the morning peak and daytime. Journey times have increased by 40 seconds in the morning peak and 45 seconds during the daytime.

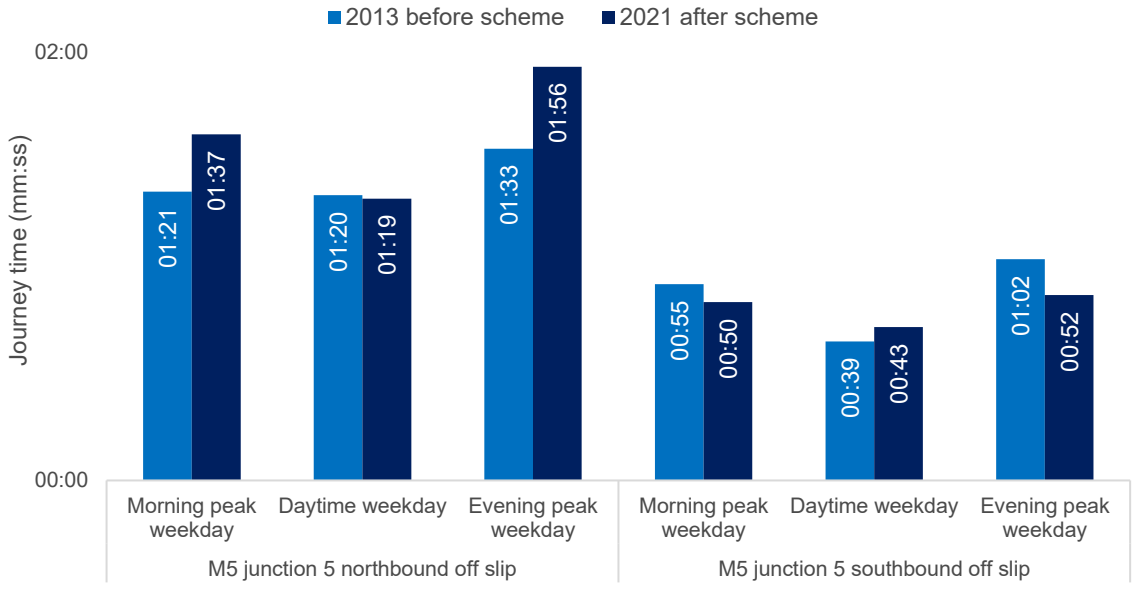
In the northbound direction this suggests that the additional running lane and associated additional capacity has improved journey times. This is also true southbound in the evening peak.

M5 junction 5, 6 and 7

Figure 13 shows average journey times for the M5 junction 5 motorway exit slip roads where new signals have been installed. There were increased journey times in the morning and evening peak periods for the northbound exit slip road but decreases for the southbound exit slip road. Changes in journey times were minimal in the daytime for both northbound and southbound motorway exit slip roads.

The change in journey times suggests that the traffic signal controls are increasing journey times on the northbound M5 exit slip roads, especially in the peak periods where there is likely to be a greater level of traffic. The decrease in journey times on the southbound M5 exit slip road suggests that the traffic signals have reduced congestion on this exit slip road. This result is particularly important for the southbound exit slip road in the morning peak, which was noted as being particularly congested prior to the project.

Figure 13: Observed average weekday journey times on the M5 junction 5 motorway slip roads by peak period one year after (2021) versus pre-construction (2013)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

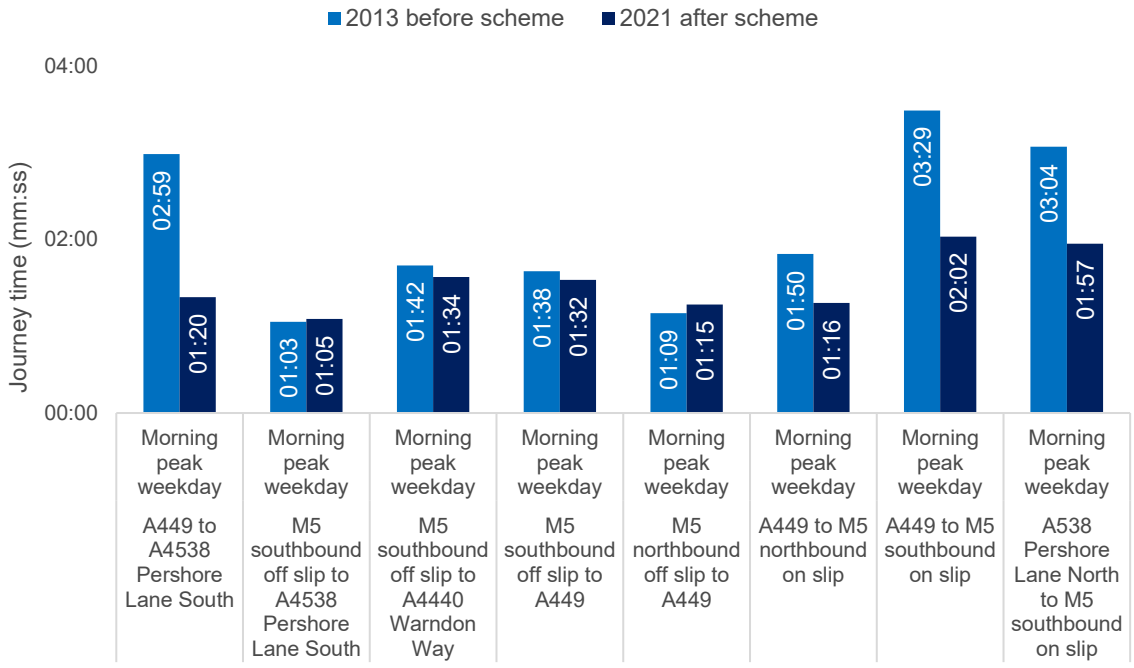
The M5 junction 6 average weekday journey times in the morning peak, daytime and evening peak are presented in Figure 14, Figure 15 and Figure 16 respectively. Eight key movements with the highest traffic volume pre-construction have been analysed.

In the morning and evening peaks there has been a reduction in journey times for the majority of journeys through the junction, especially journeys originated from the A449 and the A4538. Improvements in journey times were smaller for journeys originating from the M5 exit slip roads. In the daytime changes in journey times were minimal, suggesting the junction did not have notable delays outside of the peak periods.

Overall, this suggests that the large-scale changes to the junction, including carriageway widening and installation of signals at the A449 and A4538 Pershore

Lane South approaches, have resulted in improved journey times due to greater capacity and efficiency of the junction.

Figure 14: Observed average weekday journey times on the M5 junction 6 movements in the weekday morning peak one year after (2021) versus pre-construction (2013)

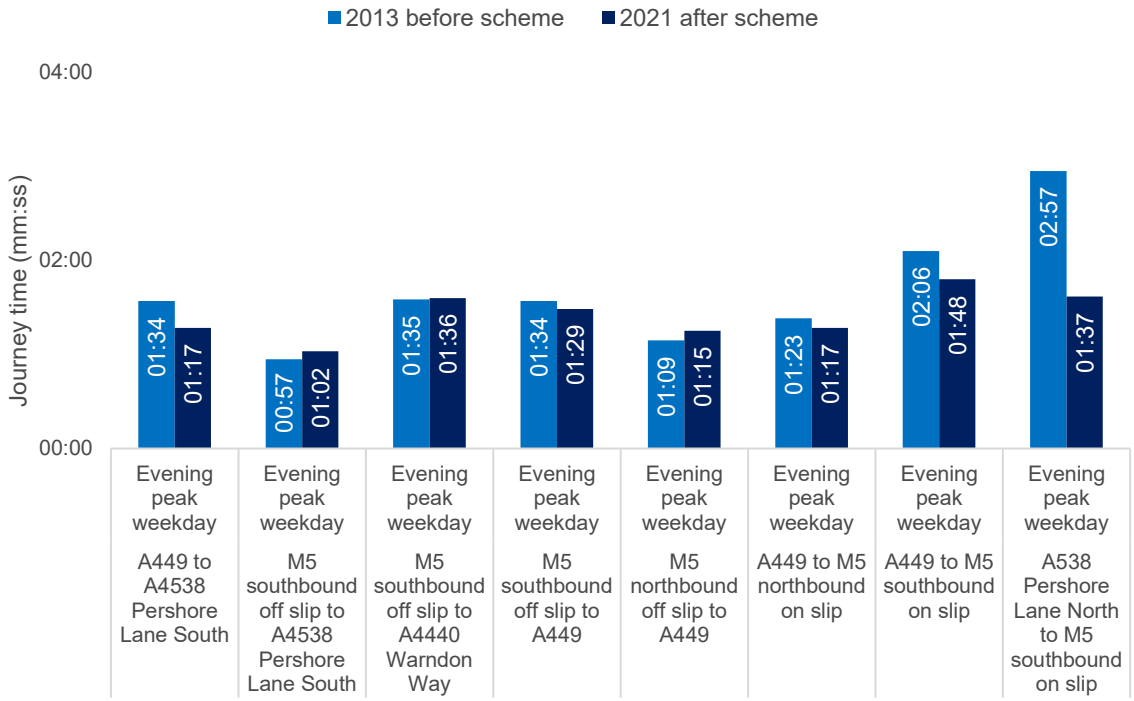


Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 15: Observed average weekday journey times on the M5 junction 6 movements in the weekday daytime one year after (2021) versus pre-construction (2013)

Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

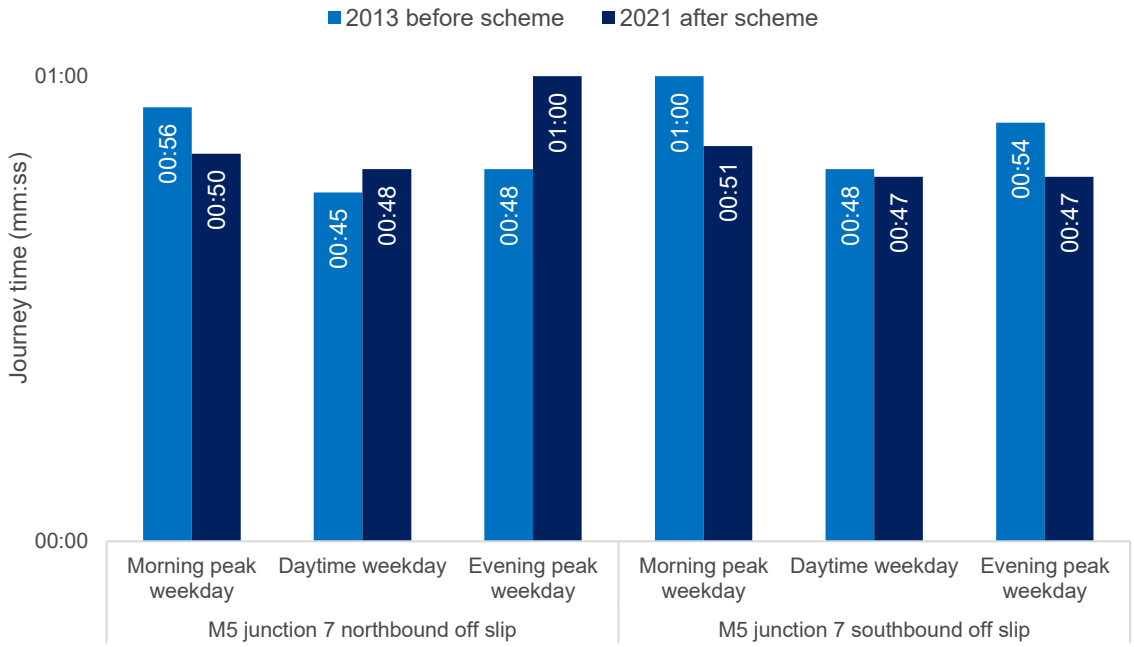
Figure 16: Observed average weekday journey times on the M5 junction 6 movements in the weekday evening peak one year after (2021) versus pre-construction (2013)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

At the M5 junction 7 journey times changes, shown in Figure 17, were minimal. There was a slight increase in journey times during the daytime and evening peak for the M5 northbound exit slip road. On the M5 northbound exit slip road in the morning peak and the M5 southbound exit slip road for all time periods, there was a slight decrease in journey times. As the project's objective was associated with safety and not congestion, it is reassuring that this has not had the consequence of increasing journey times.

Figure 17: Observed average weekday journey times on the M5 junction 7 motorway slip roads by peak period one year after (2021) versus pre-construction (2013)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Were journey time savings in line with forecast?

It was not possible to compare journey time forecasts for the all lane running project due to a lack of available journey time forecast data. A qualitative insight can be made for the all lane running project, which has set objectives to smooth traffic volumes, suggesting that the project would decrease journey times. This is in line with the average journey time results for the northbound direction for all time periods and southbound in the evening peak. However, journey time increased southbound in the morning peak and daytime, suggesting that journey time savings were not as predicted in this direction and time period.

The three junction projects did have forecast journey times. The M5 junction 7 forecast journey times are not included as these were based on a proposed project design which did not include the installation of traffic signals on the M5 motorway off slips[5].

Presented in Table 5: M5 junction 5 forecast journey times with and without the project and Table 6: M5 junction 6 forecast journey times with the project and difference between the forecast journey times and the base or pre-construction modelled journey times are the forecast journey times for the M5 junction 5 and M5 junction 6. On the M5 junction 5 northbound motorway exit slip road after project completion, journey times were forecast to increase across all morning and evening time periods between 6 to 23 seconds per vehicle. On the M5 junction 5 southbound motorway exit slip road, journey times were forecast to decrease in the evening and 08:00-09:00. The forecasts are similar to the findings at one year after project completion, which also showed an increase in journey times on the northbound motorway exit slip road and a decrease in journey times on the southbound motorway exit sip roads (Figure 13).

[5] M5 Junction 7 Operational Review Economy Study, February 2014

The M5 junction 6 forecast journey times were expected to increase with the proposed project, relative to the base model, for the M5 junction 6 motorway exit slip roads and decrease on the A4538 Pershore Lane, A449 and A4440 Warndon Way approaches. This was in line with findings at one year after project completion in the morning and evening peak (Figure 14, Figure 16).

Table 5: M5 junction 5 forecast journey times with and without the project

Approach	07:00-08:00	08:00-09:00	09:00-10:00	16:00-17:00	17:00-18:00	18:00-19:00
With project forecast journey time (seconds per vehicle)						
M5 northbound diverge slip	109.3	120.3	93.4	121.2	145.9	105.4
M5 southbound diverge slip	94.4	103.7	82.8	110.5	139.8	99.5
Without project forecast journey time (seconds per vehicle)						
M5 northbound diverge slip	98.1	106.1	86.3	109.6	123.2	99.5
M5 southbound diverge slip	85.4	109.7	74.9	112.7	202.5	106
Difference between with and without project forecast journey time (seconds per vehicle)						
M5 northbound diverge slip	11.2	14.2	7.1	11.7	22.7	5.9
M5 southbound diverge slip	8.9	-6.0	7.9	-2.1	-62.6	-6.5

Source: Area 9 M5 Junction 5 Economy Study, June 2014

Table 6: M5 junction 6 forecast journey times with the project and difference between the forecast journey times and the base or pre-construction modelled journey times

Approach	07:00-09:00 (seconds per vehicle)	Difference (Proposed – Base) (seconds per vehicle)	16:00-18:00 (seconds per vehicle)	Difference (Proposed – Base) (seconds per vehicle)
M5 SB off slip	33	3	30	2
A4538 Pershore Lane (S)	82	-55	89	-31
M5 NB off slip	29	3	29	2
A4440 Warndon Way	41	-18	35	-36
A449	47	-146	45	-21
A4538 Pershore Lane (N)	34	-22	34	-24

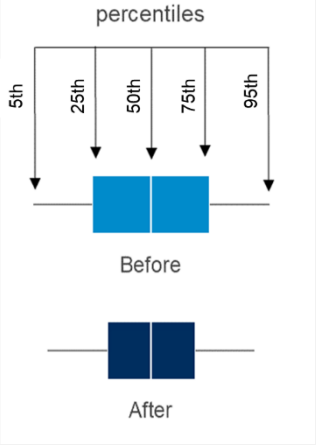
Source: Area 9 M5 Junction 6 Economy Study, February 2014

Did the project make journeys more reliable?

Congestion can make journey times unreliable. If the time taken to travel the same journey each day varies, journey times are unreliable, and the road user is less confident in planning how long their journey will take them. If journey times do not vary, the road user can be more confident in the time their journey will take and

allowing a smaller window of time to make that journey. A breakdown of the box plots shown in this section of analysis can be viewed in Figure 18.

Figure 18: What does a box plot show?



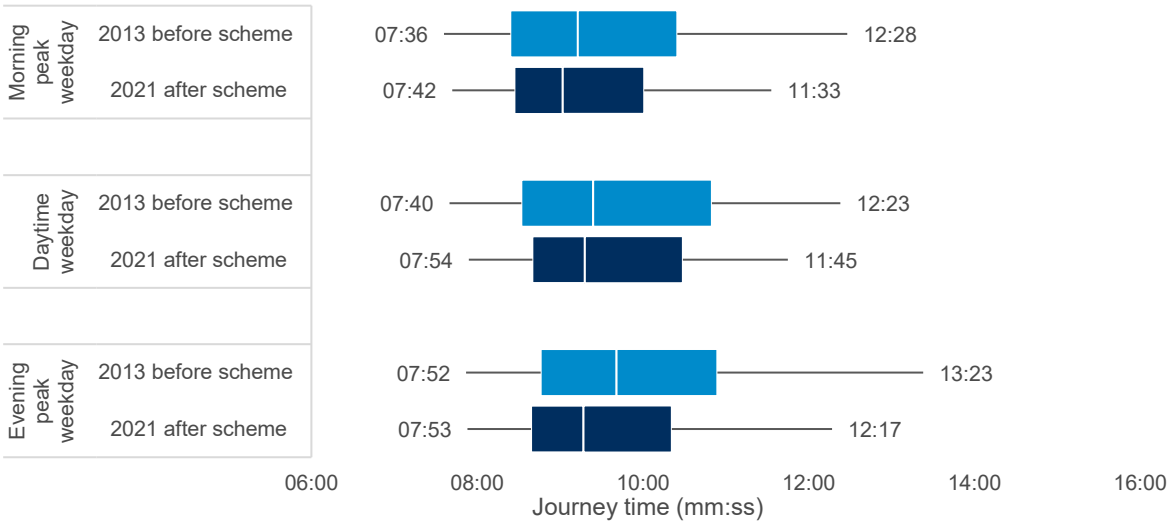
The lowest point is the 5th percentile, this means 5% of journeys take less than this amount of time to complete. The highest point is the 95th percentile, this means 95% of journeys take less time than this to complete. This shows the difference between the longest and the shortest journey times observed.

The length of the box shows how the journey times vary between the 25th and 75th percentile (the journey time 25% and 75% of journeys are faster than). The narrower the box the less variable, and hence more reliable, the journey.

M5 junctions 4a to 6 all lane running

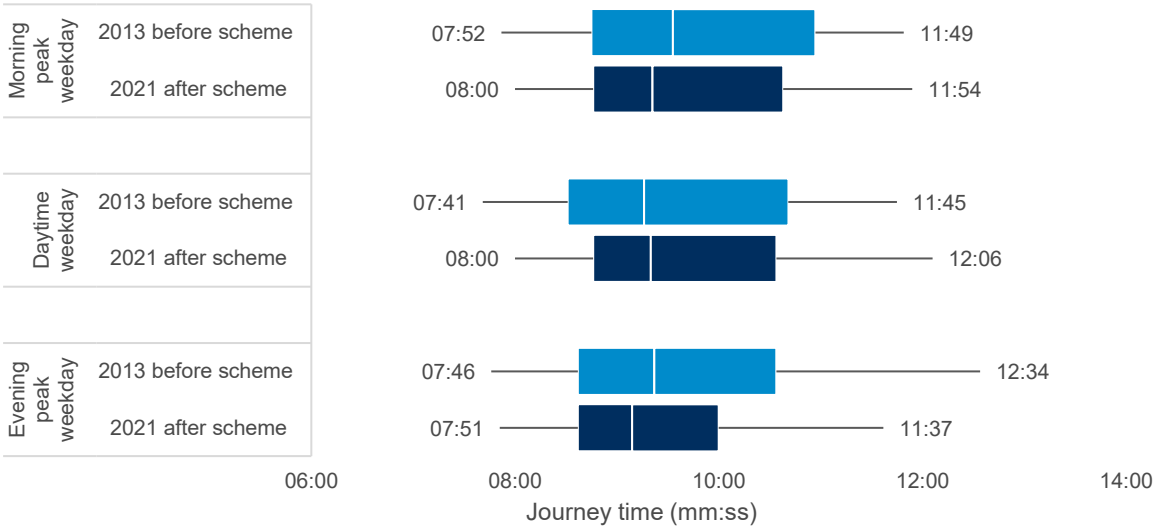
A key objective for the M5 junctions 4a to 6 all lane running project was to provide more reliable journey times, improving driver confidence in using the route. Journey time reliability before and after project completion in the northbound and southbound direction can be viewed in Figure 19 and Figure 20.

Figure 19: Weekday journey time reliability (northbound all lane running)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 20: Weekday journey time reliability (southbound all lane running)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Are the longest journeys more reliable?

The longest journey can be viewed as the 95th percentile which is the line extending to the right of the boxes in Figure 19 and Figure 20. The 95th percentile refers to the 5th highest journey time for every 100 journeys completed.

In the northbound direction the longest journeys decreased across all time periods by between 38 and 66 seconds. In the southbound direction, the longest journeys remained broadly the same in the morning peak and increased marginally during the daytime by 21 seconds. The longest journeys decreased in the evening peak by 57 seconds. This suggests that the objective to provide more reliable journey times has been achieved for the longest journeys in the northbound direction for all time periods and southbound only in the evening peak.

Have the quickest journeys been impacted?

The quickest journeys are considered using the 5th percentiles, the line extending to the left of the box plots. The shortest journeys have increased in journey time in both the northbound and southbound direction for all time periods, but the absolute level of change is small. This may be due to increased traffic volumes along the all lane running extent in the northbound direction and between junction 5 and junction 6 in the southbound direction.

Are average journeys more reliable?

Average journey times are outlined within the blue boxes in Figure 19 and Figure 20. If these boxes are shorter, there is an improved average journey reliability and a greater confidence in journey times for drivers.

In both the northbound and southbound direction, in all time periods, there has been improved journey time reliability. This was particularly evident in the northbound direction and the evening peak in the southbound direction. This mirrored the result from the overall journey time savings that the project has been successful in journey time terms aside from the southbound direction in the morning peak and daytime. The use of variable mandatory speed limits would also help reduce variability of average journey times resulting in a greater average journey time reliability.

The all lane running project has therefore achieved a key objective to provide more reliable journey times between M5 junction 4a to junction 6

Congestion

Congestion can have an impact on journey times by increasing the unreliability of journey times. To supplement the improvements in journey times on the all lane running extent at the majority of time periods, a route stress metric[6] has been calculated for pre-construction and after project completion. As shown in Table 7, there was a reduction in route stress and congestion since project completion, demonstrating that journey time reliability has likely improved and that the all lane running project has provided extra capacity due to the addition of a fourth lane.

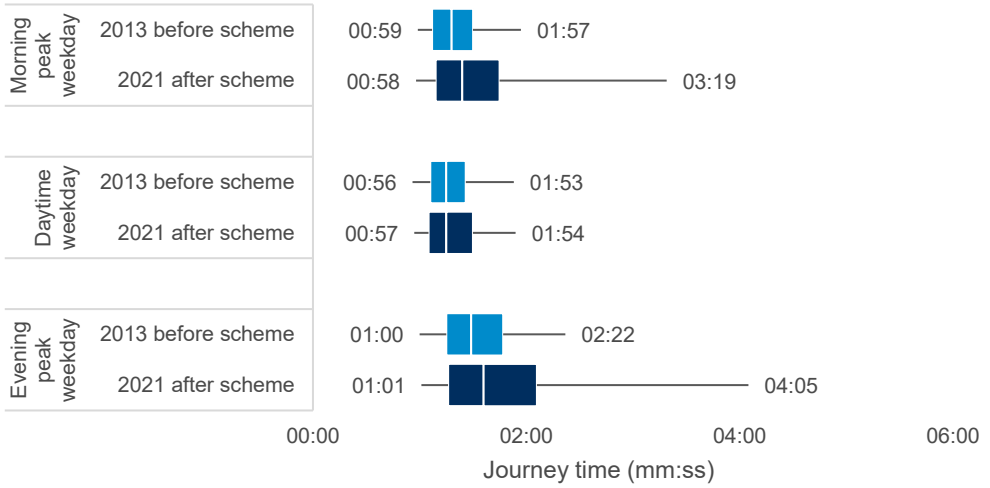
Table 7: Route Stress Metric[7]

Evaluation period	Route Stress
Before (2013)	0.85
One year after (2021)	0.75

M5 junction 5, 6 and 7

For the junction projects, journey time reliability has been assessed for the motorway exit slip roads at junctions 5 and 7 and the eight key journeys for junction 6 based on the greatest observed traffic volumes before project completion. Journey time reliability before and after project completion for all time periods for the M5 junction 5 motorway exit slip roads can be viewed in Figure 21 and Figure 22. The M5 junction 6 journey time reliability is shown for four of the eight key journeys in Figure 23 to Figure 26 and the additional four journeys for this junction are presented in Appendix B. The M5 junction 7 motorway exit slip roads journey time reliability is outlined in Figure 27 and Figure 28.

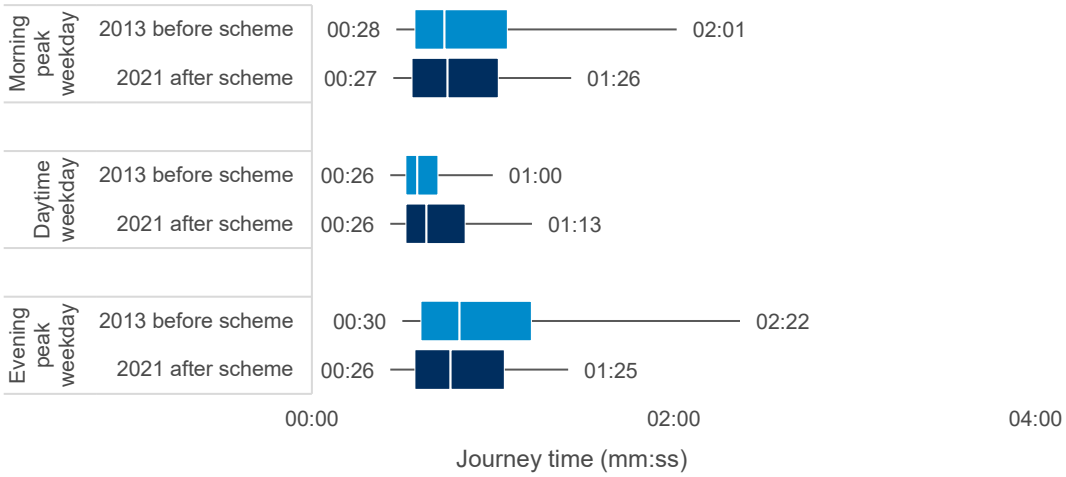
Figure 21: Weekday journey time reliability (M5 junction 5 northbound off slip)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

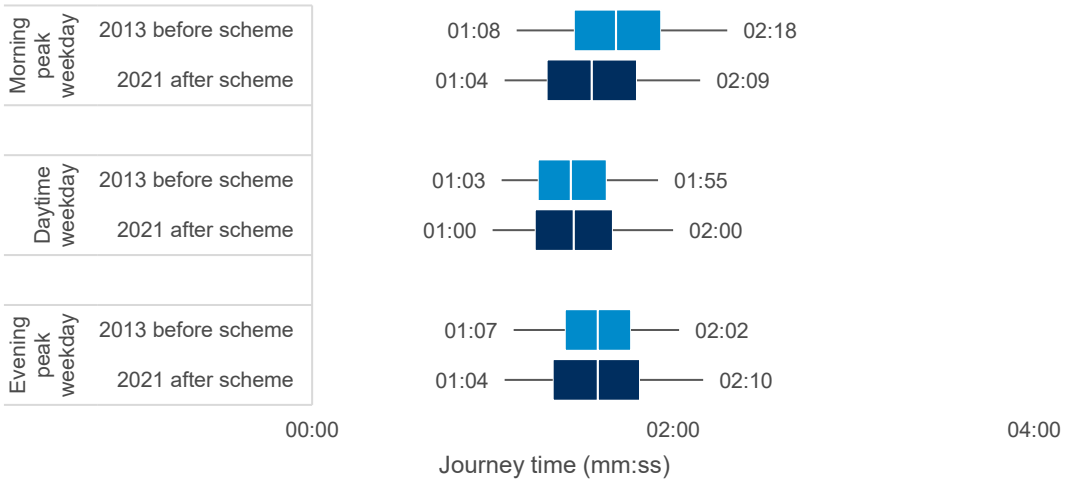
[6] 'Route Stress' is a standard metric for journey time reliability, which considers the ratio of the amount of traffic using a road to the theoretical capacity as measured by 'congestion reference flow'. A decrease in 'route stress' is an indication of improved journey time reliability.
[7] Route stress metric has a range of 0.75 (uncongested and reliable journey times) to 1.25 (congested and unreliable journey times). HGV flows were not available for observed, therefore forecasted interpolated Heavy Goods Vehicles % were used for the given evaluation years.

Figure 22: Weekday journey time reliability (M5 junction 5 southbound off slip)



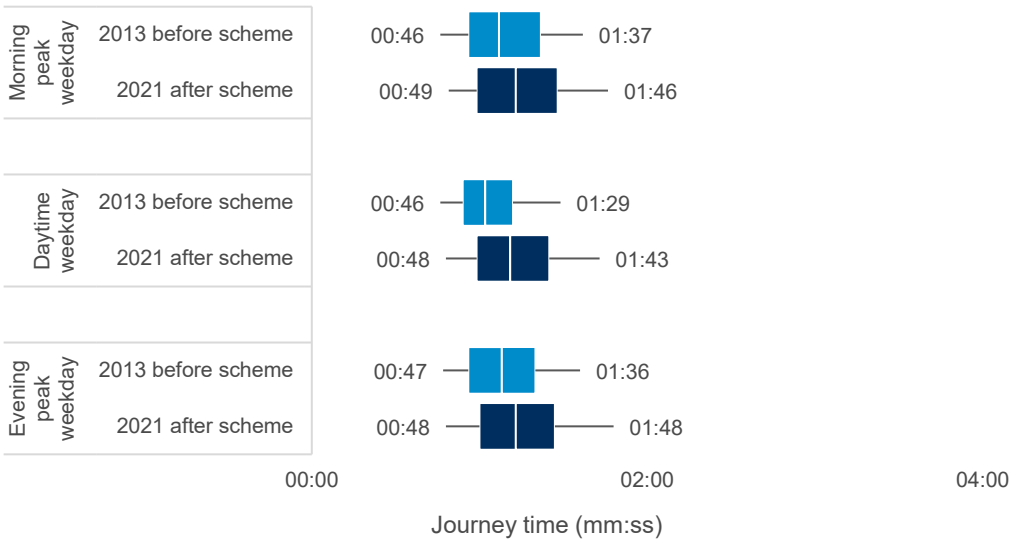
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 23: Weekday journey time reliability (M5 junction 6 southbound off slip to A4440 Warndon Way)



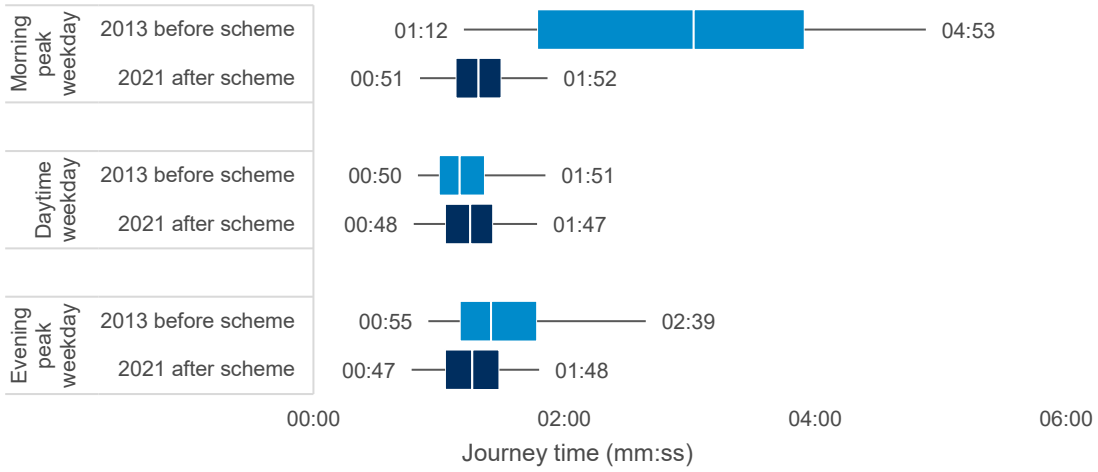
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 24: Weekday journey time reliability (M5 junction 6 northbound off slip to A449)



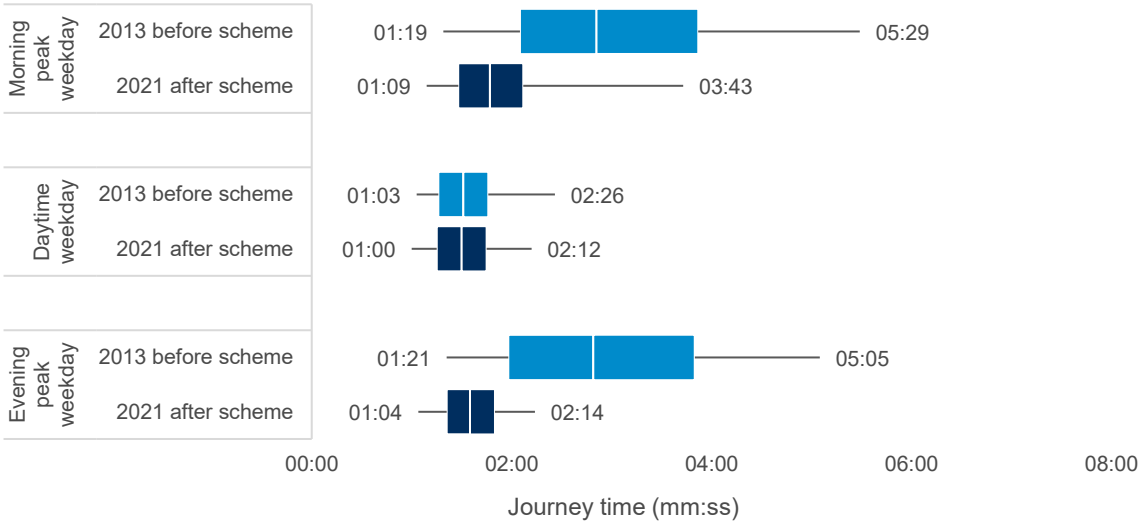
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 25: Weekday journey time reliability (A449 to A4538 Pershore Lane south)



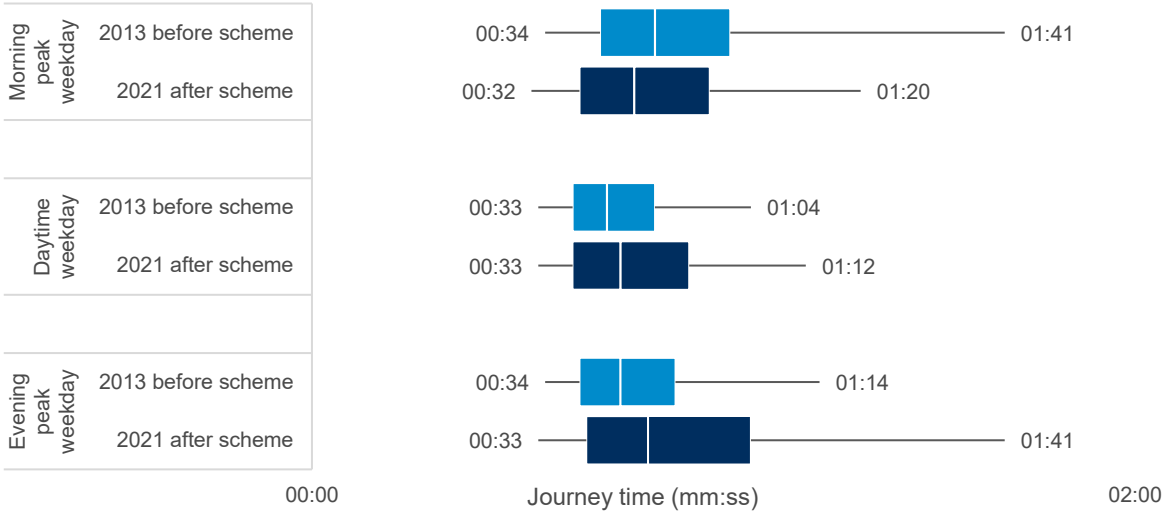
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 26: Weekday journey time reliability (A4538 Pershore Lane North to M5 junction 6 southbound on slip)



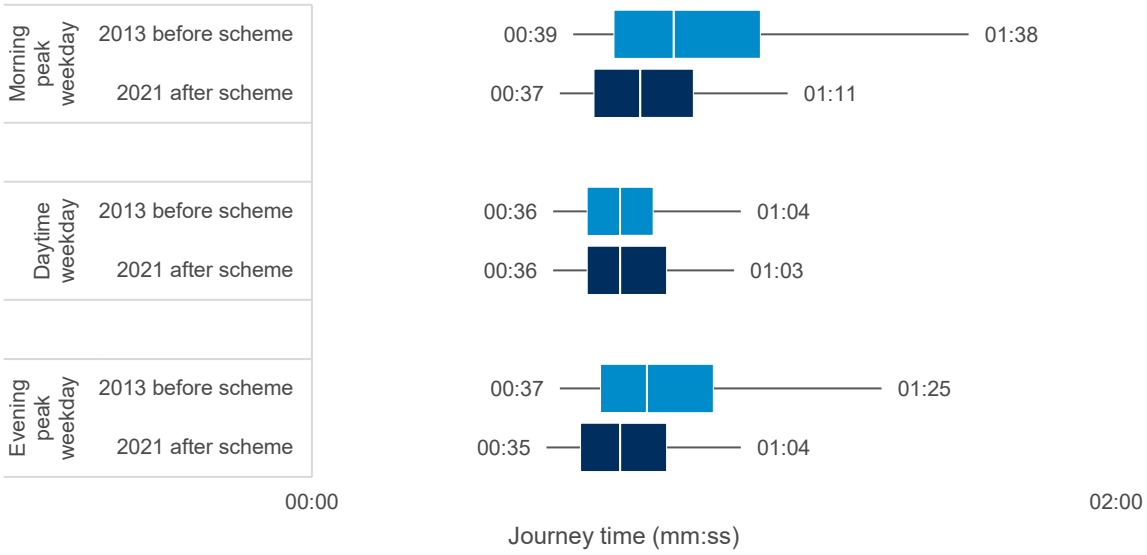
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 27: Weekday journey time reliability (M5 junction 7 northbound off slip)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 28: Weekday journey time reliability (M5 junction 7 southbound off slip)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Are the longest journeys more reliable?

The M5 junction 5 northbound exit slip road has an increased longest journey times by 1 minute 22 seconds in the morning peak and 1 minute 43 seconds in the evening peak (Figure 21). Whereas for the southbound motorway exit slip road, the longest journey times have decreased in the morning peak by 35 seconds and in the evening peak by 57 seconds (Figure 22). The introduction of traffic signals at the end of the motorway exit slip roads have improved journey times in the southbound approach but not the northbound approach. This may be linked to greater traffic volume on the southbound exit slip road relative to the northbound off slip (Figure 9).

At M5 junction 6, the longest journey times have decreased for five out of the eight movements for journeys originating from the A449 or A4538. The greatest improvement in the longest journey times was in the morning peak for the A449 to A4538 Pershore Lane movement, with a decrease of three minutes (Figure 25). An increase in the longest journey times was found for journeys originating from the M5 junction 6 motorway exit slip roads (Figure 23, Figure 24), however the journey time increases remained under 20 seconds. A greater number of vehicles may be exiting the M5 at junction 6, resulting in longer journey times compared to more local movements which are now benefitted by additional signals at the junction.

The M5 junction 7 has decreased longest journey times for journeys originating from the M5 junction 7 northbound exit slip road in the morning peak (Figure 27) and all time periods in the southbound exit slip road (Figure 28). The greatest improvement was recorded in the morning peak on the southbound motorway exit slip road, with a reduction in the longest journey time of 27 seconds. On the northbound motorway exit slip road there was an increase in the longest journey times by 27 seconds in the morning peak. The southbound motorway exit slip road at junction 7 had a reduction in traffic volumes after project opening which may explain the improvements in longest journey time. Traffic volume data for the northbound off slip was not available.

Have the quickest journeys been impacted?

At the M5 junction 5 motorway exit slip road, the quickest journey times have increased slightly by up to 19 seconds. It is likely that these lowest journey times are for relatively uncongested periods when the traffic lights were green on approach and vehicles did not need to slow significantly, whilst pre-construction they would have had to slow in anticipation of giving way.

On the M5 junction 6, the quickest journeys have remained broadly the same. There have been some improvements to the quickest journey time for journeys originating from the A449 and A4538, especially the A449 to the A4538 south in the morning peak by 21 seconds (see Figure 25). This once again likely reflects the removal of the give way and need for all vehicles to slow in advance of this.

The quickest journeys on the M5 junction 7 have remained broadly the same. This suggests the signalisation results in minimal delay when there are low traffic volumes.

Are average journeys more reliable?

Average journey times have become less reliable for the M5 junction 5 northbound exit slip road for all time periods (Figure 21). Whereas there has been a slight increase in average journey time reliability on the M5 junction 5 southbound exit slip road in the morning and evening peaks. As noted for the longest journey times the new traffic signals may optimise the traffic controls for the southbound exit slip road, where there are greater traffic volumes, which would increase average journey reliability.

The M5 junction 6 average journey time reliability has improved substantially for journeys which start at the A449 and A4538, notably in the morning and evening peak for the A4538 Pershore Lane North to M5 southbound entry slip road (Figure 25 and Figure 26). Average journey times for journeys originating from the M5 northbound and southbound exit slip roads have either remained the same or increased slightly. This is most likely due to heavier traffic volumes from the busier M5 and signalisations at the end of both slip roads both before and after project completion keeping average journey times similar. New signals have been installed as part of the project at the A4538 south and A449 which may be improving journey reliability on these approaches.

Average journey time reliability on the M5 junction 7 motorway northbound exit slip road remains largely the same or slightly increases yet improves slightly for the southbound motorway exit slip road. Reduced traffic volumes on the southbound motorway exit slip road may be facilitating this reduction in journey times. The installation of signals at both motorway exit slip roads appears to be keeping average journey times largely similar to before the project, maintaining a consistent journey time rather than causing vast improvements.

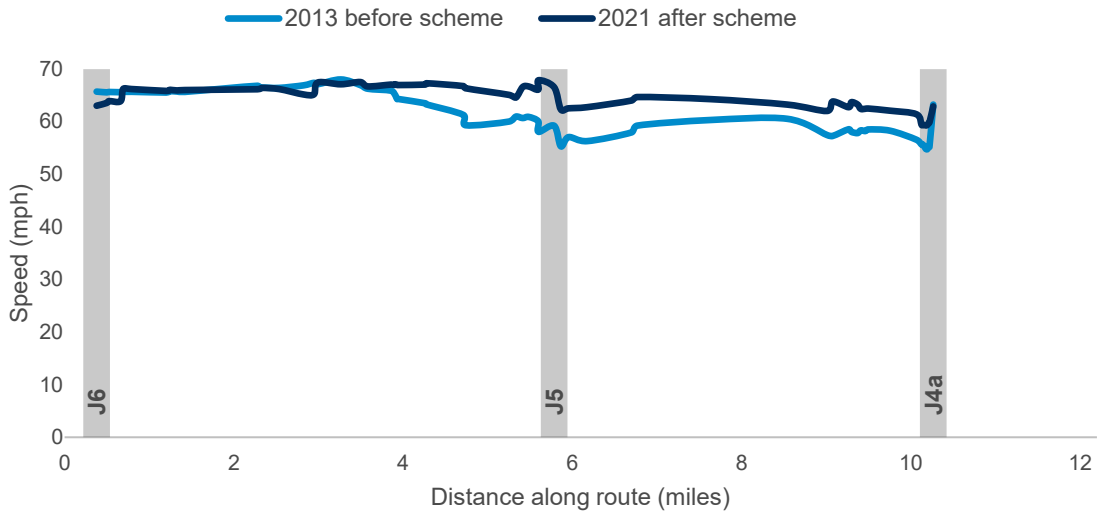
How did the project impact speed?

M5 junctions 4a to 6 all lane running

Speed analysis has been completed to outline the impact of the project on congestion. Changes in speed can indicate congestion on a road, however, often all lane running projects aim to make journeys smoother to allow for a consistent speed across the length of the route through the use of variable mandatory speed limits. A key objective of the all lane running project are to smooth traffic volumes and reduce congestion on the route.

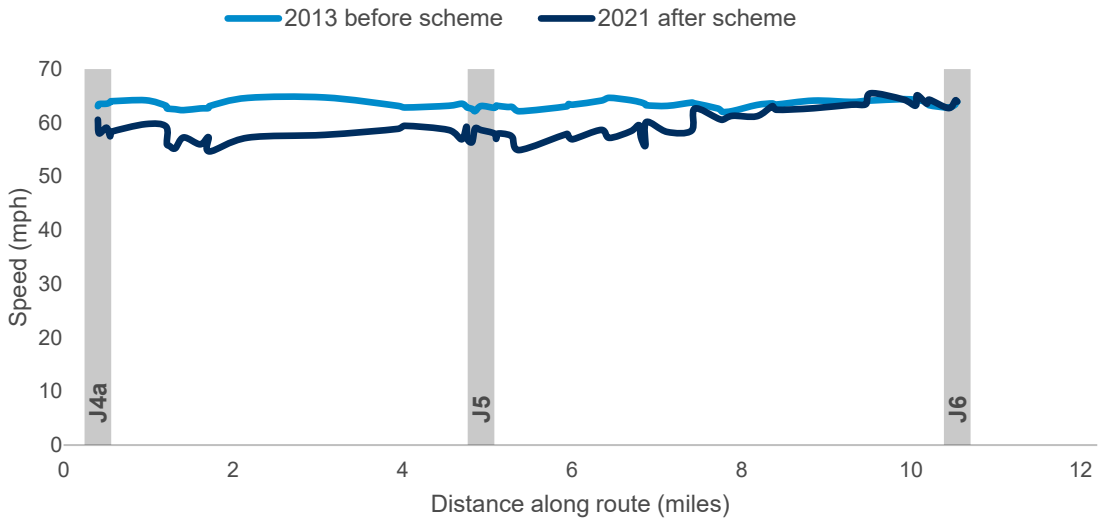
In the northbound direction in the morning peak, there were more consistent speeds across the extent of the all lane running project, increasing the speed and reliability when compared to before project completion, notably between junction 5 and junction 4a (see Figure 29). The increased speeds at one year after suggests that the addition of a fourth lane has increased speeds from when there were three lanes. In the southbound direction, there has been a decrease in speed compared to before project completion (see Figure 30). Speeds were more consistent before the project was in place, however, there is still a fairly consistent speed ranging from approximately 55mph to 65mph.

Figure 29: Average speed comparison (all lane running northbound morning peak)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

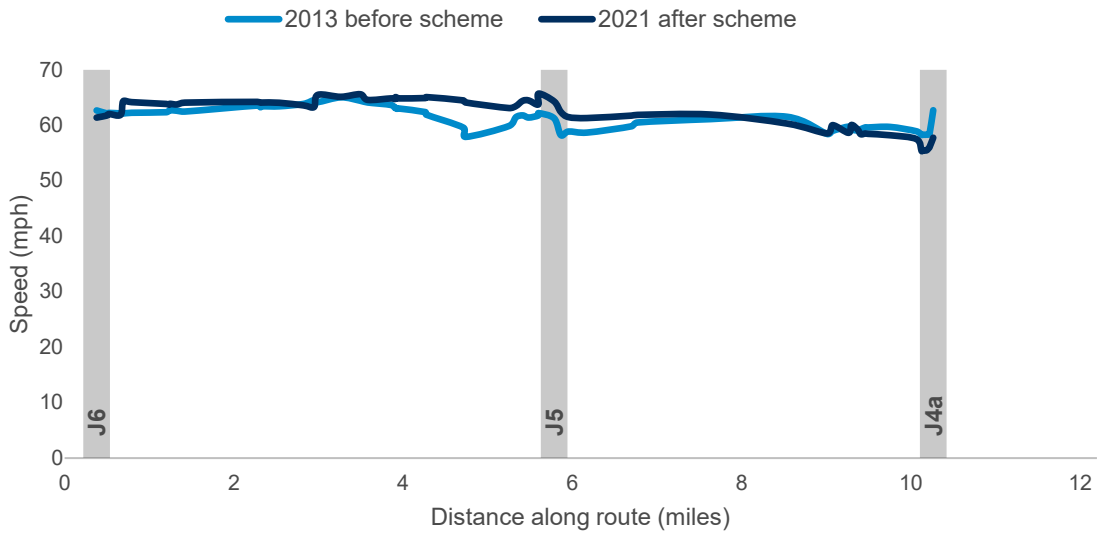
Figure 30: Average speed comparison (all lane running southbound morning peak)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

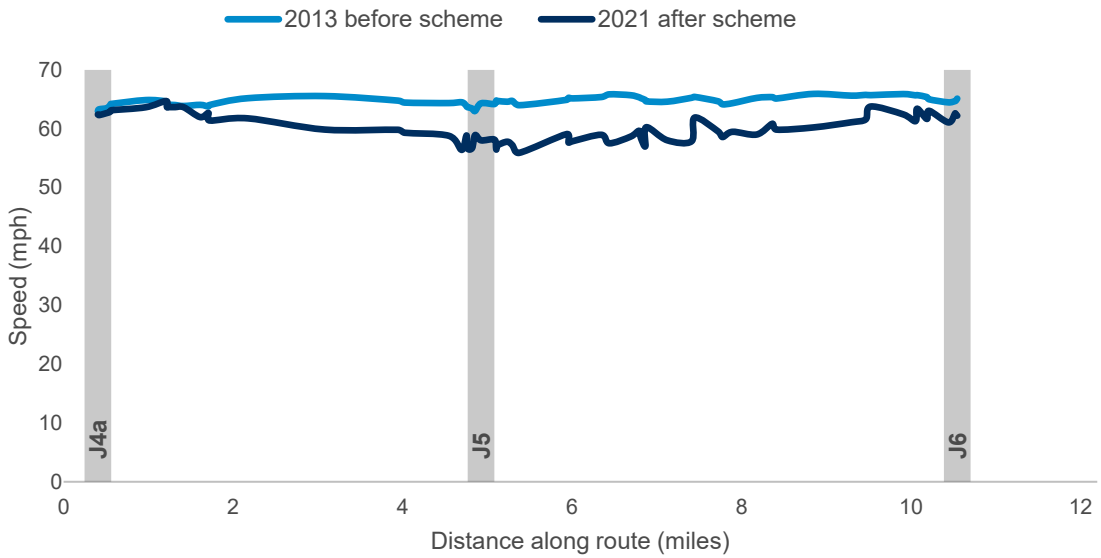
During the daytime, there has been a slight improvement in speeds in the northbound direction (Figure 31). In the southbound direction, speeds are slower than before project, however, remain broadly consistent (Figure 32).

Figure 31: Average speed comparison (all lane running northbound daytime)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

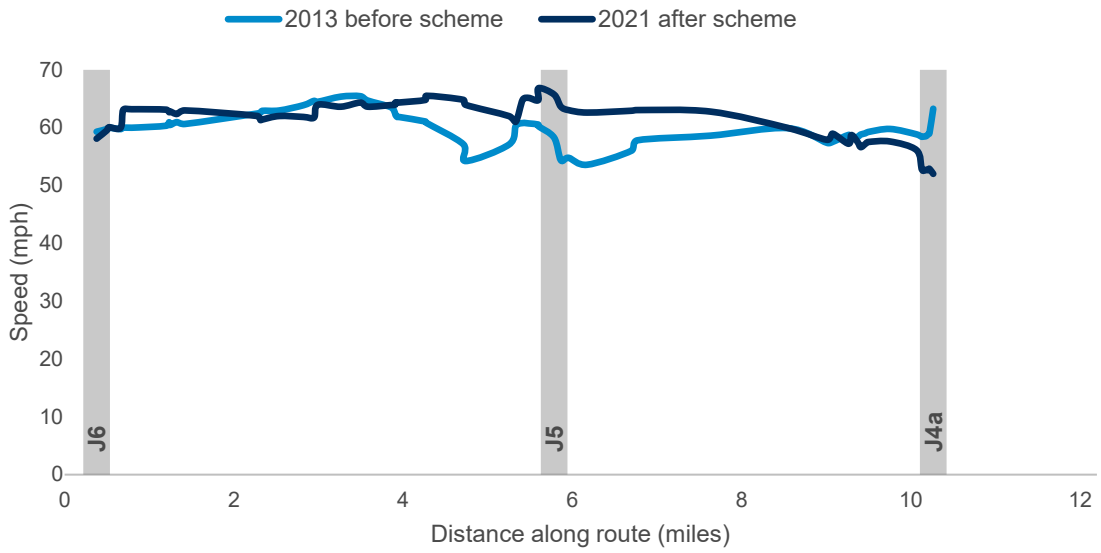
Figure 32: Average speed comparison (all lane running southbound daytime)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

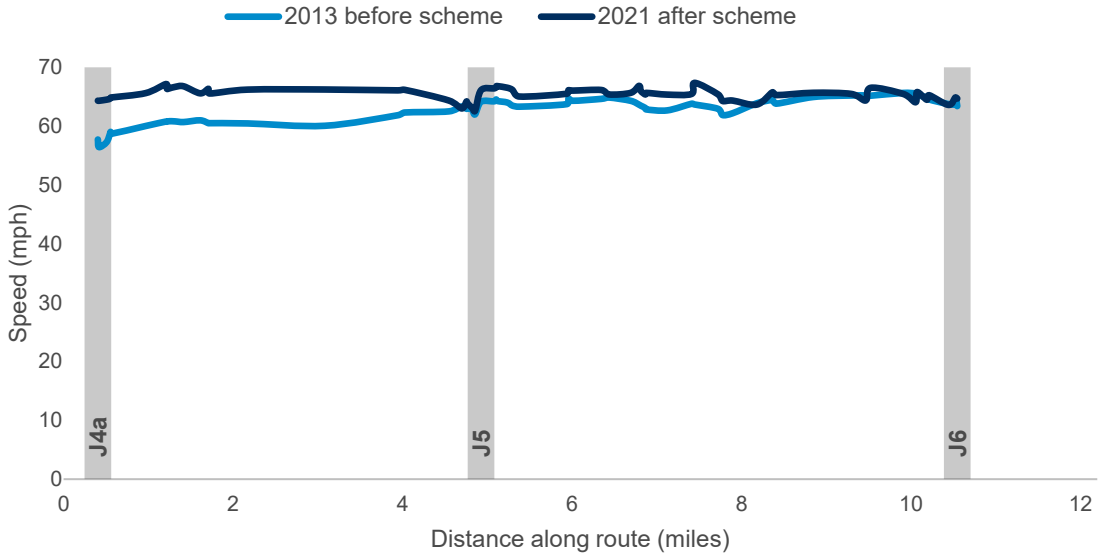
In the evening peak, the smart motorway has smoothed traffic by allowing higher speeds in both the northbound and southbound directions (Figure 33 and Figure 34). This improvement in consistency may be due to the additional fourth lane which would alleviate congestion.

Figure 33: Average speed comparison (all lane running northbound evening peak)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 34: Average speed comparison (all lane running southbound evening peak)



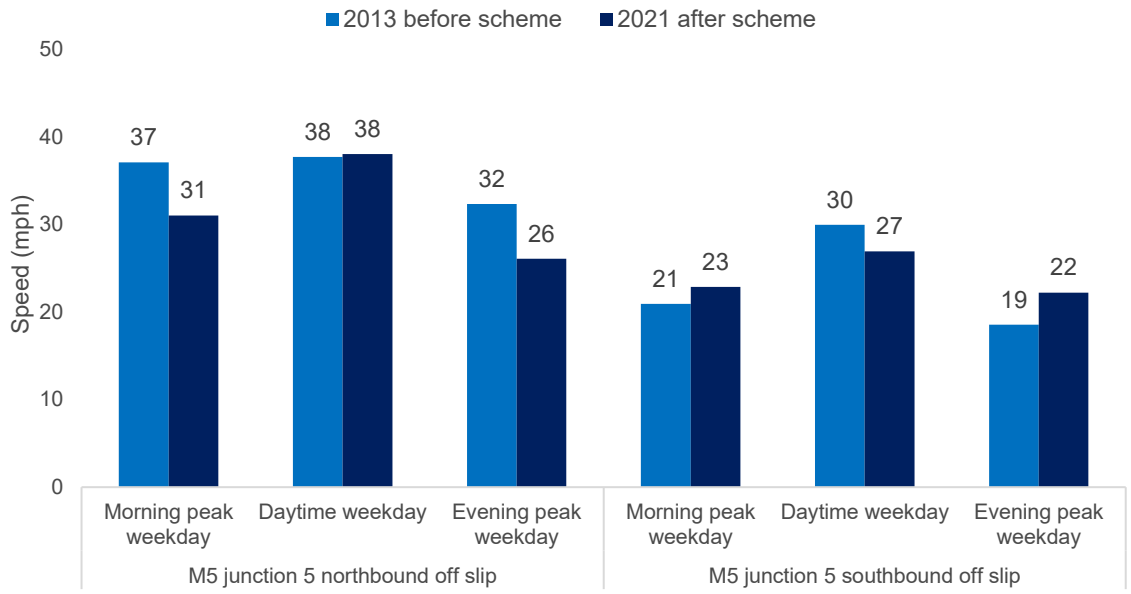
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

M5 junction 5, 6 and 7

Average speed comparisons have been assessed for the junction projects to view potential changes in speeds related to congestion and journey times. Speeds can act as an indicator for the performance of the junction projects; however, newly installed signals may slow speeds.

On the M5 junction 5 motorway slip roads average speeds have decreased in the morning and evening peaks on the northbound motorway exit slip road and increased slightly on the southbound motorway exit slip road (Figure 35). There are slower speeds on the southbound motorway exit slip road than the northbound motorway exit slip road. This is in line with there being higher traffic volumes on the southbound exit slip road. The newly installed signals have either slowed or kept speeds consistent.

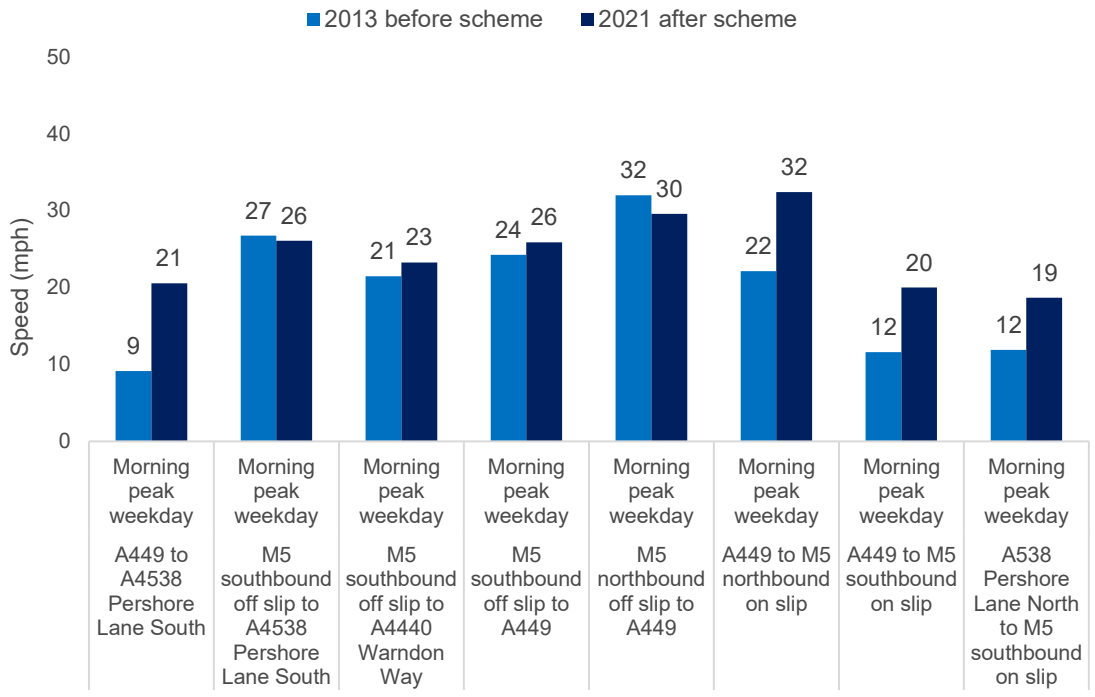
Figure 35: Average weekday speed comparison M5 junction 5 motorway slip roads



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

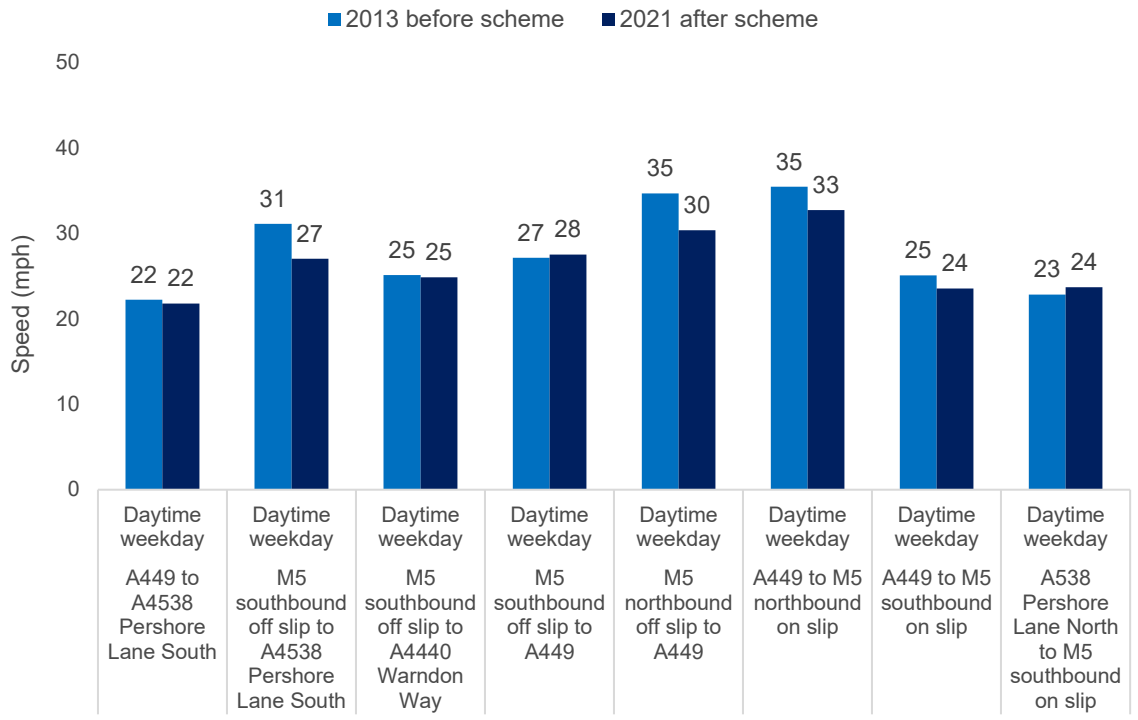
At the M5 junction 6, the speed analysis has broadly mirrored the journey time analysis with increased speeds after project completion for journeys originating from the A449 and A4538, in line with decreased journey times (Figure 36 to Figure 38). Speeds of journeys originating from the M5 motorway exit slip roads remained fairly consistent compared to before project completion. This demonstrates the presence of signals at the motorway exit slip roads both before and after project completion, keeping speeds consistent.

Figure 36: Average weekday speed comparison M5 junction 6 key movements in the weekday morning peak



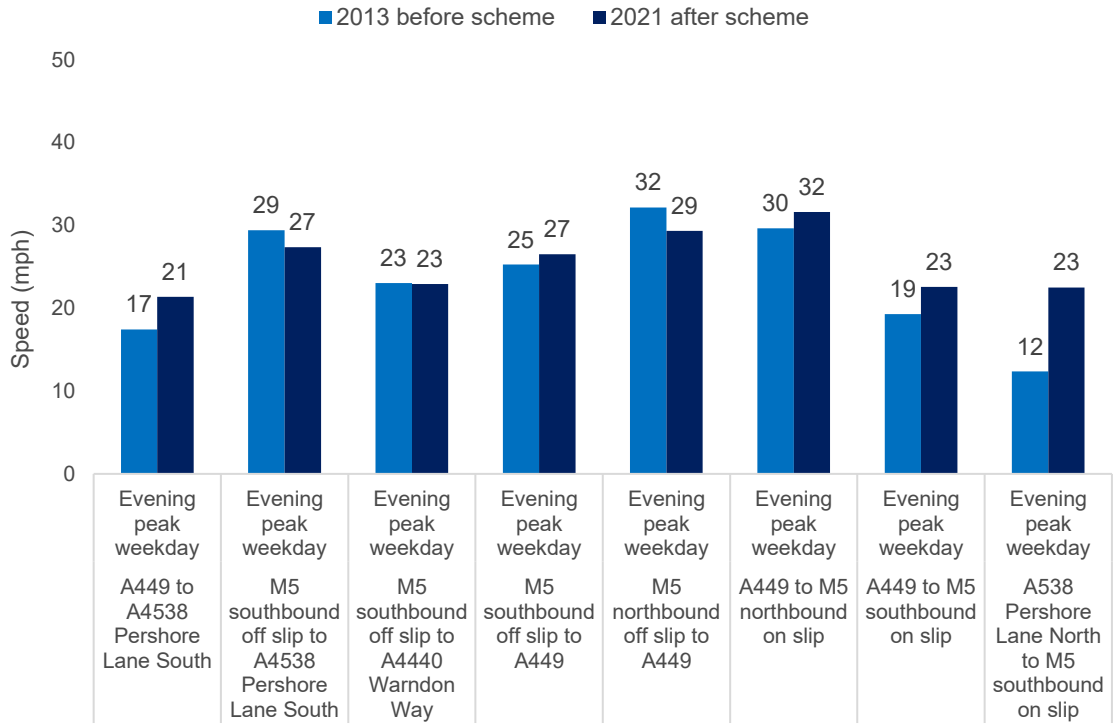
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 37: Average weekday speed comparison M5 junction 6 key movements in the daytime



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

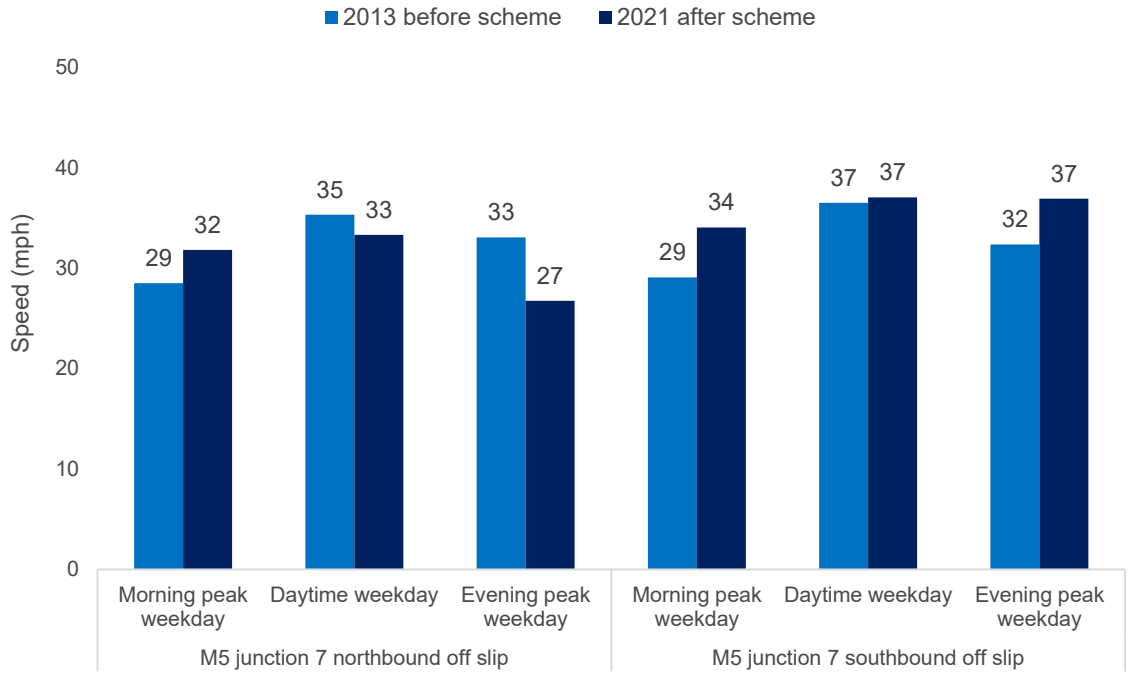
Figure 38: Average weekday speed comparison M5 junction 6 key movements in the weekday evening peak



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

The M5 junction 7 motorway exit slip roads speeds have increased slightly on the northbound exit slip road in the morning peak and the southbound exit slip road in the morning and evening peaks (Figure 39). This increase in speed on the southbound exit slip road may relate to the decrease in traffic volumes after project completion. The increase on the northbound exit slip road in the morning peak and decrease during the daytime and evening peak suggests the signals controls are varying the signal timings based on congestion, influencing speeds depending on how busy the exit slip road is at each time period.

Figure 39: Average weekday speed comparison M5 junction 7 motorway slip roads



Source: Satellite navigation September/October 2013 and September/October 2021

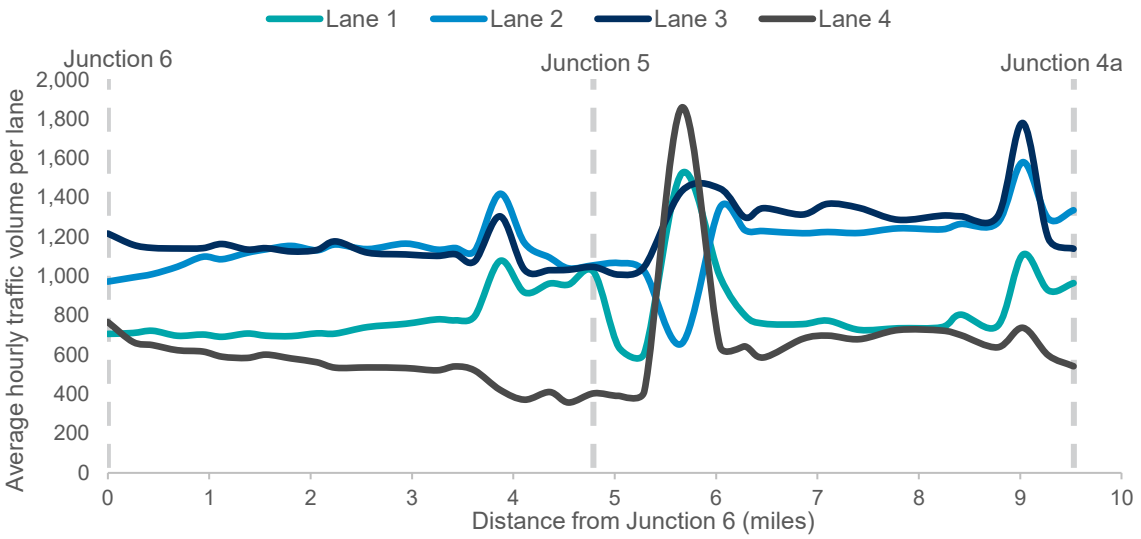
How was the smart motorway operated?

Lane utilisation of the smart motorway

The smart motorway is composed of four lanes along the entire project extent, including through M5 junction 5. Weekday hourly traffic volumes have been assessed from lane-based traffic volume data, to understand the use of the four lanes at different time periods. As noted previously, lane-based traffic volume data was only available from mid-September 2021 to the end of September 2021, and no data was available for October 2021.

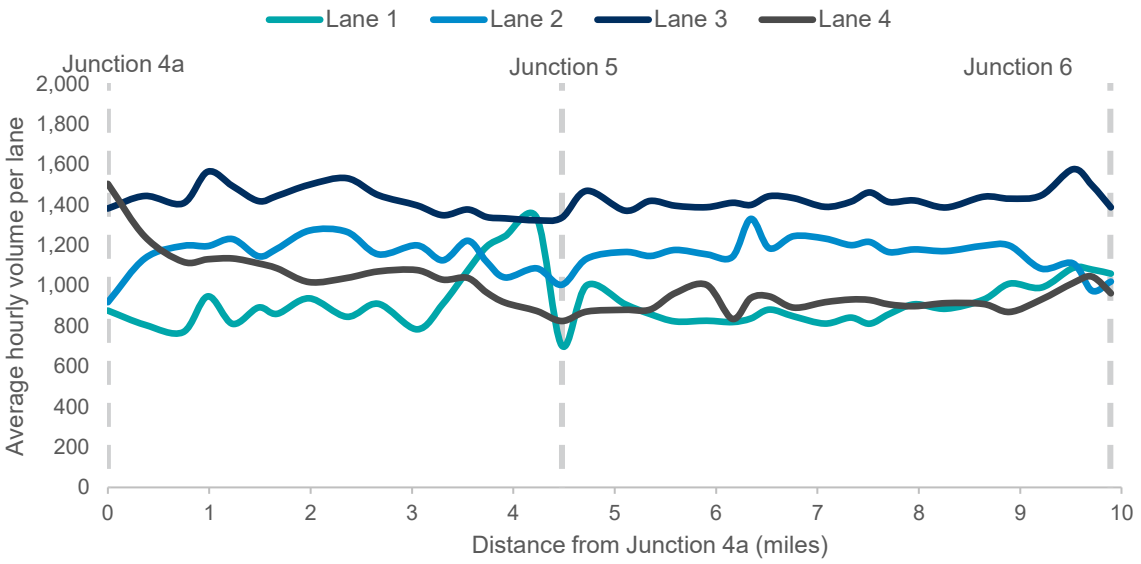
In the morning peak, there was a steady volume of vehicles per lane between junction 6 to junction 5 in the northbound direction (Figure 40) and from junction 4a to 6 in the southbound direction (Figure 41). Overall, the southbound direction has steadier volume of vehicles and a greater number of vehicles than the northbound direction. Traffic volumes were greatest in the middle two lanes, lane 2 and lane 3, as is typical due to lane 1 being used by heavy good vehicles, whilst lane 4 is intended for overtaking only. There seems to be a greater amount of lane changing in the northbound direction, notably on lane 4 which increases substantially after junction 5 and then falls at around 6 miles from junction 6.

Figure 40: Northbound weekday hourly traffic volume in the morning weekday peak



Source: Lane-based traffic volumes (MIDAS) mid-September 2021 to September 2021

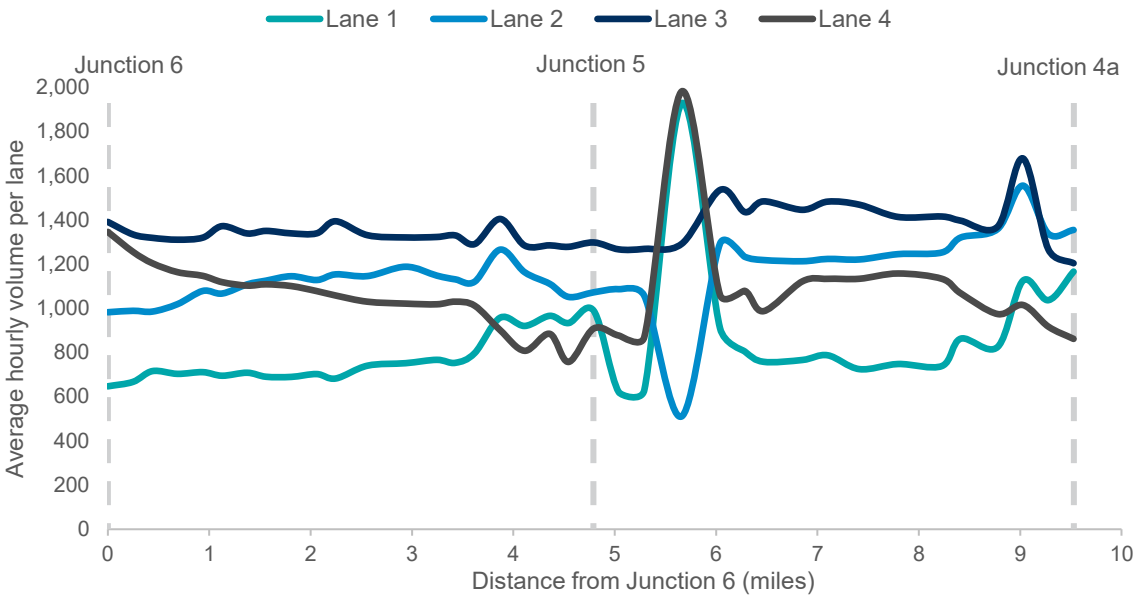
Figure 41: Southbound weekday hourly traffic volume in the morning weekday peak



Source: Lane-based traffic volumes (MIDAS) mid-September 2021 to September 2021

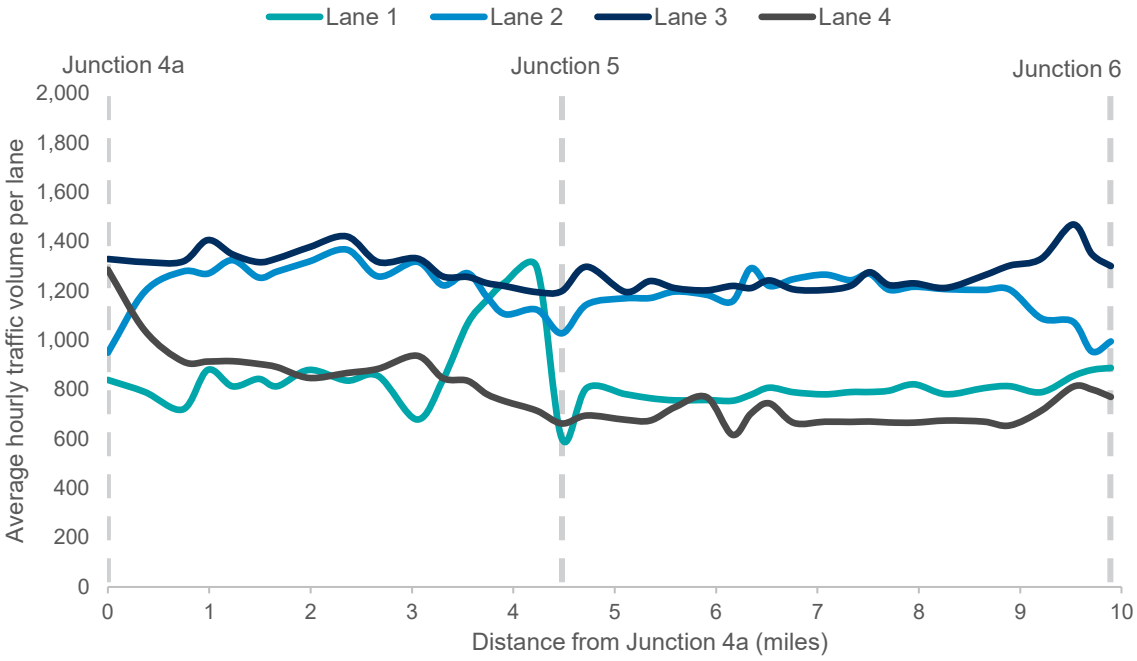
The evening peak follows a similar pattern to the morning peak. In the northbound direction, there is greater variability of hourly traffic volumes especially after junction 5 and in the southbound direction traffic volumes remain fairly consistent across the all lane running extent (Figure 42 and Figure 43). However, the evening peak differs to the morning peak in that there are less vehicles travelling on the route in the southbound direction.

Figure 42: Northbound weekday hourly traffic volume in the evening weekday peak



Source: Lane-based traffic volumes (MIDAS) mid-September 2021 to September 2021

Figure 43: Southbound weekday hourly traffic volume in the evening weekday peak



Source: Lane-based traffic volumes (MIDAS) mid-September 2021 to September 2021

How often are speed limits set?

Variable mandatory speed limits are set as part of the all lane running projects in order to smooth traffic volumes, preventing congestion and improving journey time reliability. Variable speed limit data has been used to understand how often variable mandatory speed limits were set on the M5 junctions 4a to 6. As noted previously, variable mandatory speed limit data was only available from mid-September 2021 to the end of September 2021, and no data was available for October 2021.

Across all time periods and directions there is minimal use of variable mandatory speed limits (Table 8). In the northbound direction variable mandatory speed limits were set no more than 5% of the time period. In the southbound direction variable mandatory speed limits were set to no more than 3% of the time period.

The majority of variable mandatory speed limits were set due to incidents on the route rather than congestion. As traffic flows have increased by a maximum of 3% along the all lane running extent (see Figure 8), the activation of variable mandatory speed limit signage was minimal as congestion was minimal, especially with the addition of a fourth running lane.

Table 8: Activation of all lane running variable mandatory speed limit in morning, daytime and evening weekday peak periods (% of time period)

Location	Morning peak		Daytime		Evening peak	
	60mph or below speed limit	50mph or below speed limit	60mph or below speed limit	50mph or below speed limit	60mph or below speed limit	50mph or below speed limit
Northbound						
M5 northbound junctions 6 to 5	3%	3%	4%	2%	5%	5%
M5 northbound through junction 5	0%	0%	2%	0%	2%	1%
M5 northbound junction 5 to 4a	2%	2%	4%	2%	5%	4%
Southbound						
M5 southbound junctions 4a to 5	3%	1%	3%	2%	2%	2%
M5 southbound through junction 5	1%	0%	1%	1%	2%	0%
M5 southbound junction 5 to 6	0%	0%	1%	1%	2%	0%

Source: Variable speed limit data (HALOGEN) mid-September 2021 to September 2021

5. Safety evaluation

M5 J4a-6 Summary

The safety objective for this all lane running project was to achieve no worsening of safety performance. The number and rate per million vehicle miles of personal injury collisions were analysed to track a change over time. In the first year of the all lane running motorway being operational, there has been a reduction in the rate and number of personal injury collisions compared with the annual average for the five years before the project was built.

During the first 12 months of the all lane running motorway being open there were 10 personal injury collisions compared with an average of 25 per year before the project was constructed. If the road had not been converted to all lane running, we estimate that the number of personal injury collisions would have changed to between 7 and 29.

The annual average rate of personal injury collisions per hundred million vehicle miles had also improved over time. The average collision rate had decreased to 3 personal injury collisions per hundred million vehicle miles. Before the project, the collision rate was 6.4 personal injury collisions per hundred million vehicle miles. If the project had not been implemented, we estimate the collision rate would increase to 7.2 personal injury collisions per hundred million vehicle miles.

In the context of other findings in this report these are positive early signs. Collisions are reducing at a time where congestion is being released and traffic is moving quicker in some time periods. Traffic levels are set to increase in later years, however, and so results at the follow up evaluation will be essential to check if this trend continues.[8]

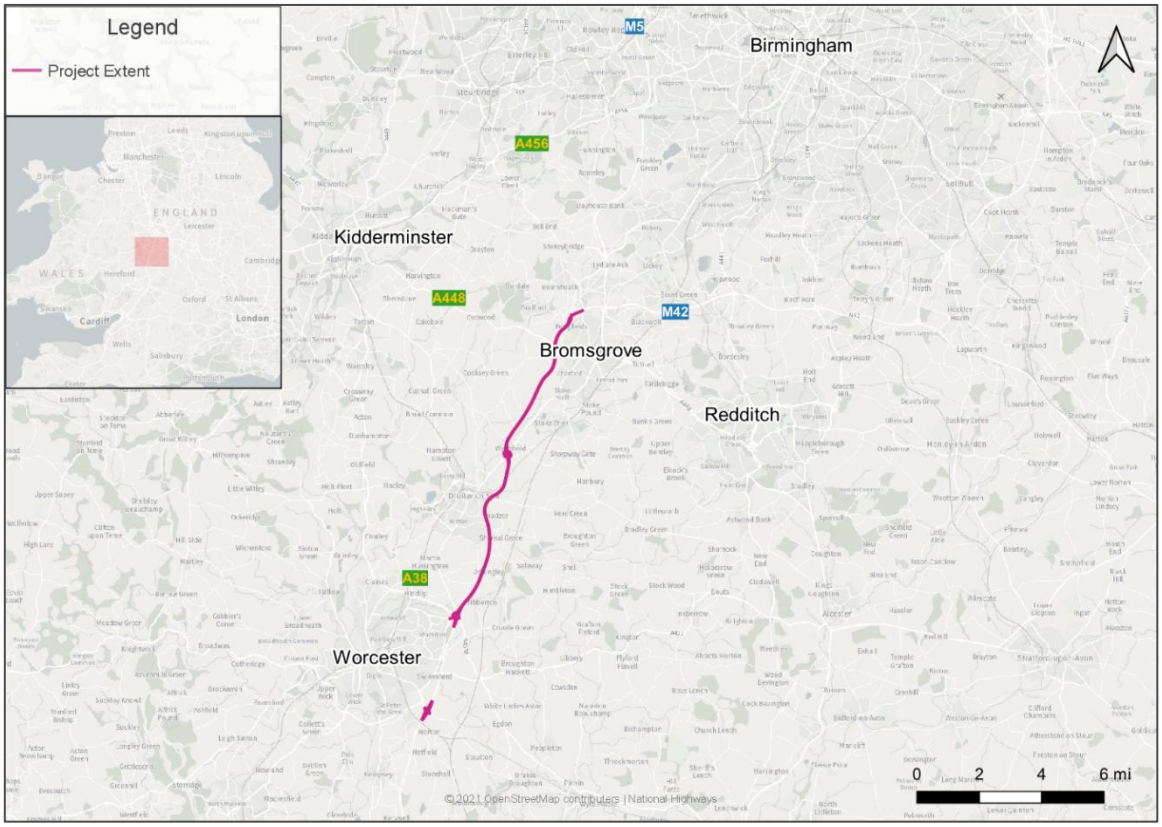
The early indications are that the safety objective, is on track to be achieved. The analysis will need to be revisited in later years before we are sure that the change is significant. It will require a longer timeframe to determine if these initial positive findings are a real trend or natural fluctuation.

Safety study area

The safety study area is shown in Figure 44. This area is assessed in the appraisal supporting the business case for the project. It checks any potential wider implications for the intervention. This information is then used with other predictions around the potential impact of the project such as by how much traffic may grow. We have therefore replicated the appraisal study area to understand the emerging safety trends.

[8] The impact the project has had on casualties using the FWI measure is not considered in this report. This will be reported on during further evaluations of the project.

Figure 44: Safety study area



Source: National Highways and OpenStreetMap contributors

What are the emerging safety trends within the first 12 months of the project?

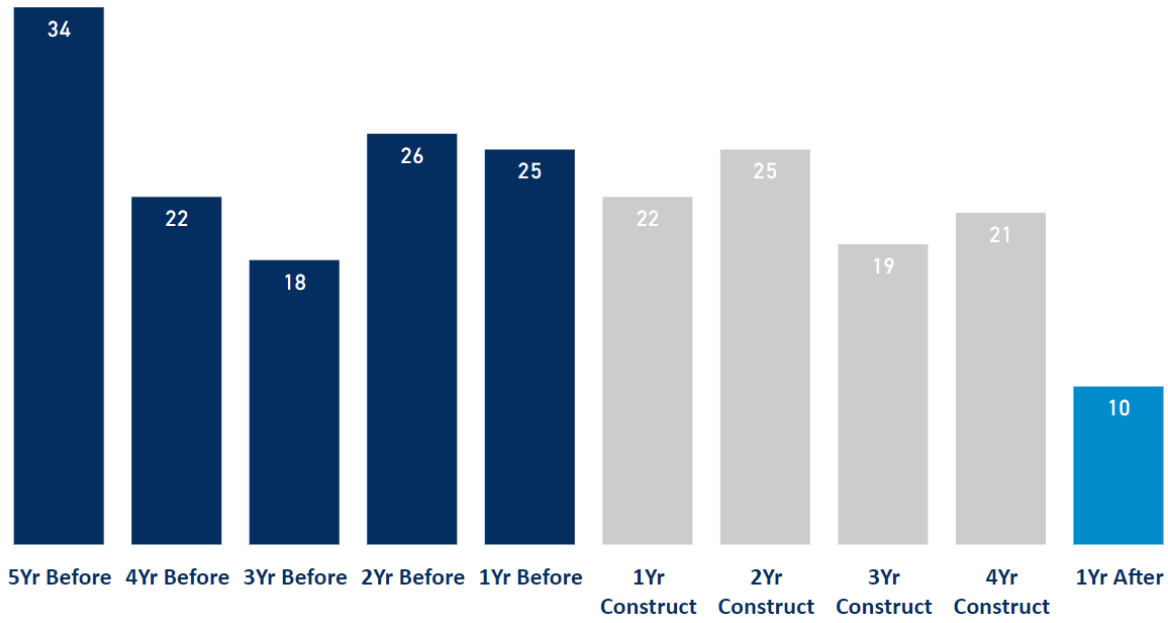
Safety data for this evaluation was obtained from Department for Transport Road Safety Data. This records incidents on public roads that are reported to the police. This evaluation considers only collisions that resulted in personal injury.

The safety analysis has been undertaken to assess changes over time looking at the trends in the five years before the project was constructed to provide an annual average. We have then assessed the trends from the first 12 months after the smart motorway was operational and open for road users. This provides an early indication of safety trends, but this will be monitored over a longer timeframe before conclusions can be drawn about the safety impact of the project across the following time periods:

- Pre-construction: 30 November 2010 – 29 November 2015
- Construction: 30 November 2015 – 31 December 2019
- Post-opening: 1 January 2020 – 31 December 2020

The early indications are that the number of personal injury collisions for the first year of the smart motorway are lower than the period before construction began. The annual number of personal injury collisions can be seen in Figure 45 and we can see this has reduced from an annual average of 25 to 10 personal injury collisions during the first 12 months of the smart motorway being open for road users. Safety trends can vary each year and we will monitor this trend over a longer timeframe before drawing conclusions about the safety impact of the smart motorway.

Figure 45: Annual personal injury collisions



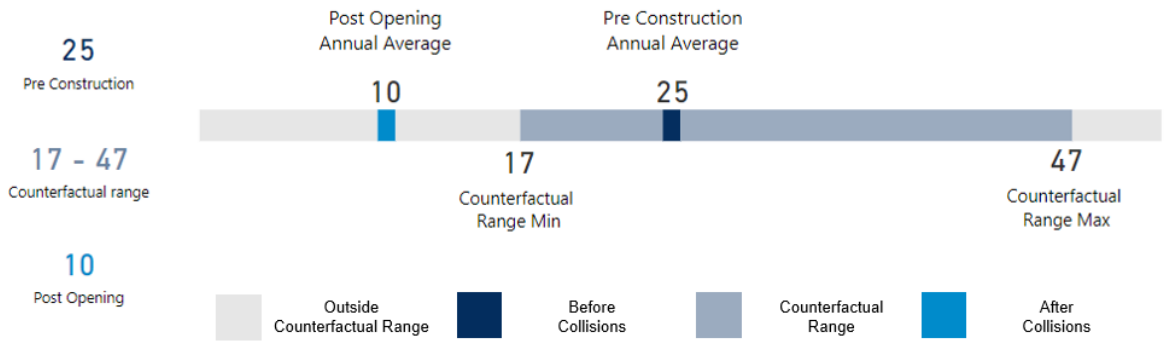
Source: STATS19 30th November 2010 – 31st December 2020

As part of the safety evaluation, we look to assess what changes in personal injury collisions might have occurred due to factors external to the project over this timeframe. To do this we estimate the trend in personal injury collisions which might have occurred if the road had remained a conventional motorway (this is referred to as a counterfactual). This is based on changes in regional safety trends for conventional motorways with a high volume of roads users. This helps us to estimate how the pre-construction safety levels would have changed over the evaluation period if the road had remained a conventional motorway.

Previously the counterfactual for all smart motorways was based on the national trends averaged across all types of motorways, the new method provides information for average conventional motorways and those with higher-than-average traffic levels (which are more comparative to the motorways which were converted to smart motorways). It also allows for differentiation between different types of smart motorways.

Based on this assessment we estimate that if the road had not been converted to all lane running the trend in the number of personal injury collisions would have changed over time period to between 17 and 7 (Figure 46) so with the observed number of collisions appearing below the range, it indicates that the all lane running motorway is on its way to achieving the objective to maintain, and where possible, improve safety standards. Another study will be conducted after the all lane running motorway has been open for a longer timeframe, allowing a more representative time-period, to determine if the safety objective has been achieved.

Figure 46: Annual average number of personal injury collisions on the smart motorway



Source: STATS19 30th November 2010 – 31st December 2020

How has traffic flow impacted on collision rates?

Smart motorways are implemented on some of England's busiest routes. It is, therefore, important to contextualise any incidents in the volume of traffic seen on this stretch. To do so a collision rate is calculated: the number of collisions per hundred million vehicle miles (hmvm).

The average collision rate has decreased to three per hundred million vehicle miles – this equates to travelling almost 35.1 million vehicle miles before seeing an incident. Before the project this figure stood as six per hundred million vehicle miles a decrease of 3 personal injury collisions per hundred million vehicle miles.

A counterfactual test was undertaken. It found that the collision rate would likely have been four collisions per hundred million vehicle miles in the counterfactual period; in line that of the first year after opening the smart motorway.

Similar to collisions, therefore, collision rates are below what we would have expected without the project. This is a positive initial indication: even though traffic levels have increased slightly, collisions have reduced. As these are the first year's results, however, we are not yet confident yet that these initial indications are enough to form a trend. An evaluation will be conducted at five years after opening to establish if early positive findings have continued.

Looking at the rate in terms of distance, before the smart motorway was constructed (based on the five-year pre-construction period), road users travelled an average of 16.3 million miles each year before a personal injury collision occurred. Road users have travelled an additional 18.8 million miles without a personal injury collision occurring.

What are the emerging trends on the severity of collisions?

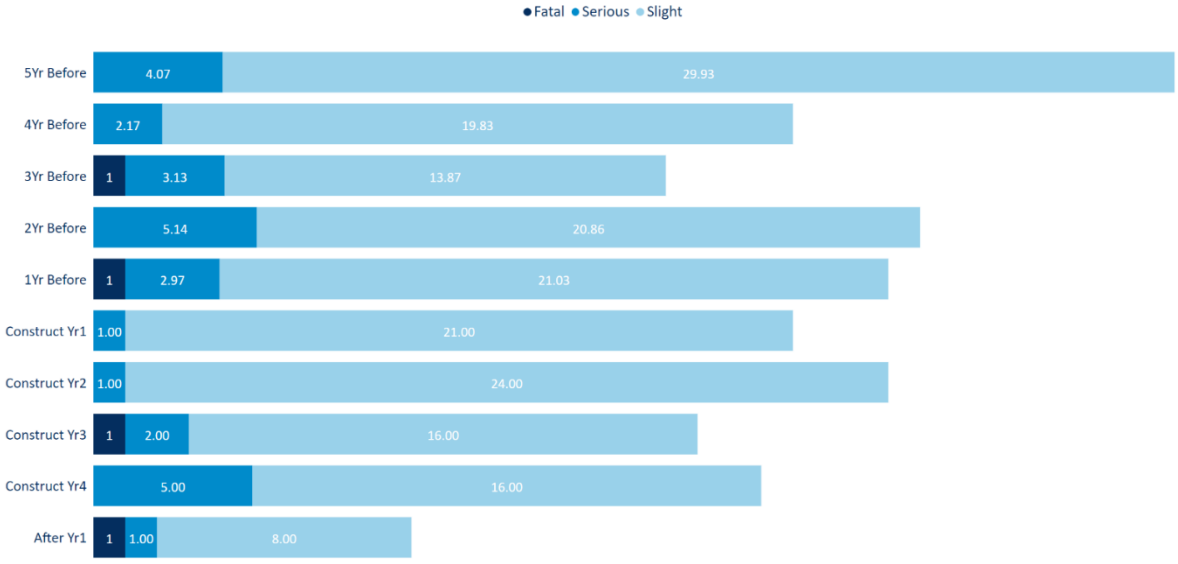
Collisions which result in injury are recorded by severity as either fatal, serious, or slight. The way the police record the severity of road safety collisions changed within the timeframes of the evaluation, following the introduction of a standardised reporting tool – Collision Recording and SHaring. This is an injury-based reporting system, and as such severity is categorised automatically by the most severe injury. This has led to some disparity when comparing trends with the previous

reporting method, where severity was categorised by the attending police officer.[9] As a consequence, the Department for Transport have developed a severity adjustment methodology[10] to enable robust comparisons to be made. See Annex C.2 for more information.

For this evaluation, one reporting mechanism was largely used prior to the smart motorway conversion and another afterwards. The pre-conversion collision severity has been adjusted, using the Department for Transport's severity adjustment factors, to enable comparability with the post-conversion safety trends.[11]

During the first 12 months of operation we have observed a total of one collision resulting in fatalities (compared to two before). There was one collision resulting in serious injuries per year (compared to an average of three before). There were eight collisions resulting in slight injuries per year (compared to an average of 21 before). The early results are promising an evaluation will be conducted at five years after opening to establish if early positive findings have continued. Figure 48 shows the severity of personal injury collisions.

Figure 47: Collisions by Severity on Project Extent



Source: STATS19 30th November 2010 – 31st December 2020

Has the project's safety objective been met?

The safety objective was to achieve no worsening of safety performance. Early findings suggest a positive result in this direction, but further analysis is required over the next few years to confirm whether this trend will continue.

M5 Junction 5 Summary

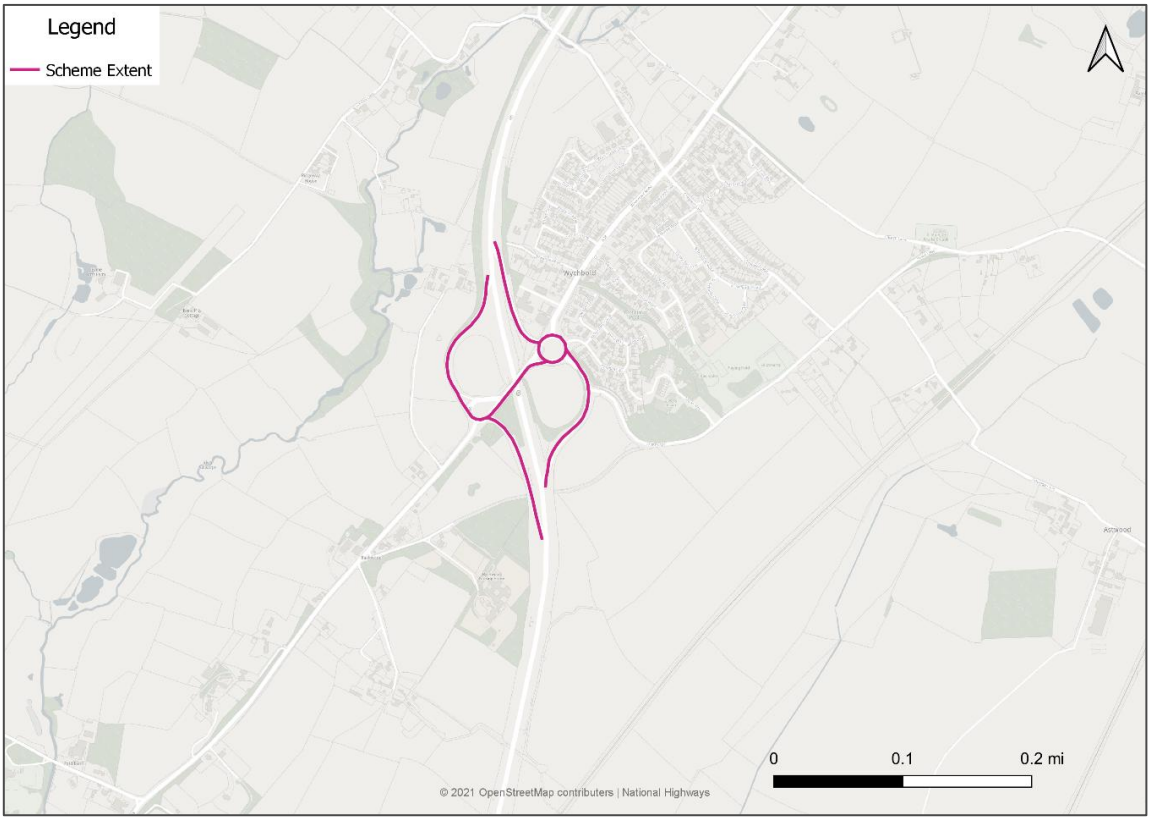
The safety objective for this junction was to address safety issues. The safety study area is shown in Figure 48.

9 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820588/severity-reporting-methodology-final-report.odt

10 https://www.gov.uk/government/publications/guide-to-severity-adjustments-for-reported-road-casualty-statistics/guide-to-severity-adjustments-for-reported-road-casualties-great-britain#guidance-on-severity-adjustment-use

11 Collision Severities within this report use the 2020 adjustment factor.

Figure 48: M5 J5 safety study area



Source: National Highways and OpenStreetMap contributors

The safety analysis has been undertaken to assess changes over time looking at the following time periods:

- Pre-construction: 30 November 2010 – 29 November 2015;
- Construction: 30 November 2015 – 31 December 2019;
- Post-opening: 1 January 2020 – 31 December 2020

There was an annual average of three personal injury collisions observed before the junction improvement and an annual average of three personal injury collisions after the junction improvements became operational.

The average collision rate has decreased to 52 per hundred million vehicle miles. Before the project this figure stood as 74 per hundred million vehicle miles a decrease of 22 personal injury collisions per hundred million vehicle miles.

M5 Junction 7 Summary

The safety objective for this junction was to address safety issues. The safety study area is shown in Figure 49.

Figure 49: M5 J7 safety study area

Source: National Highways and OpenStreetMap contributors

The safety analysis has been undertaken to assess changes over time looking at the following time periods:

- Pre-construction: 30 November 2010 – 29 November 2015;
- Construction: 30 November 2015 – 31 December 2019;
- Post-opening: 1 January 2020 – 31 December 2020

There was an annual average of six personal injury collisions observed before the junction improvement and an annual average of two personal injury collisions after the junction improvements became operational.

The average collision rate has decreased to 38 per hundred million vehicle miles. Before the project this figure stood as 115 personal injury collisions per hundred million vehicle miles a decrease of 77 personal injury collisions per hundred million vehicle miles.

6. Environmental evaluation

Summary

The evaluation of environmental impacts used information on the predicted impacts gathered from the environmental appraisal within the Business Case and the Environmental Assessment Report. At one-year after our evaluations of smart motorway projects focus on the traffic related topics of noise, air quality and greenhouse gases. Wider environmental impacts[12] are considered at five-years after when impacts and mitigation will have had more time to mature. The wider environmental impacts of the project including those associated with the junction improvements will be considered at five-years after.

Our evaluation identified that observed traffic flows were higher than forecast but not high enough to change the predicted outcome of the noise and air quality assessments. Noise mitigation had been implemented and so impacts were broadly as expected. Greenhouse gas emissions along the project extent were likely to be higher than predicted in the opening year due to the higher than forecast traffic flows. However, we were unable to quantify the change or consider the impact of changes in speeds and number of Heavy-Duty Vehicles (HDV) because the necessary speed and HDV data was unavailable.

Traffic Forecast Evaluation

Three of the environmental sub-objectives (noise, local air quality, and greenhouse gases) are directly related to traffic volumes. No new noise or air quality surveys are undertaken for POPE and an assumption is made that the level of traffic and the level of traffic noise and local air quality are related.

In order for a comparison to be made with the observed year, forecast traffic volumes from 2015 and 2030 were used to derive a linear growth factor for each link. This growth factor was applied to the forecast data for use in Table 9 to provide the forecast traffic volumes for 2021. Observed traffic data is based on Average Daily Traffic figures to match with the forecast. No forecast speed or observed HDV data was available for the project nor any forecast data for the junction improvements. This limited the scope of our evaluation.

Table 9: With the project (2021) traffic volumes: observed vs forecast

Site	Forecast *	Observed	Difference	% Difference
M5 Northbound junctions 6 to 5	54,800	57,300	+2,500	4%
M5 Southbound junctions 5 to 6	54,400	57,500	+ 3,100	5%
M5 Northbound junctions 5 to 4a	59,900	61,000	+ 1,100	2%
M5 Southbound junctions 4a to 5	59,000	59,100	+ 100	0%

*Data interpolated between 2015 and 2030 DM and DS to gain a 2021 forecasted figure to compare with observed 2021 data. Data is rounded to the nearest hundred.

Source: Forecasts from Traffic and Economic Appraisal Report, observed data from National Highways WebTRIS

[12] These wider impacts include those on landscape, biodiversity and cultural heritage.

Noise

An environmental assessment was undertaken to understand the likely impacts and predicted effects of the project. The assessment predicted that converting the hard shoulder into a running lane would move traffic and traffic noise closer to nearby properties. Combined with changes to traffic flows and speeds, the project would cause adverse noise impacts. However, to help mitigate these impacts a low noise surface would be lain along the project extent. The assessment predicted that with a low noise surface in place, the project would not cause any adverse impacts in the opening year and nearby properties would experience reductions in noise. In the longer term[13] these noise benefits would be reduced by increases in traffic and changes in speeds. Most properties would still experience noise benefits but there would also be some that experience noise increases. Overall, however the noise impacts were not predicted to be significant.

Our evaluation considered both the available asset data and traffic data for the project. The asset data confirmed that a low noise surface was lain along the project and where noise barriers were removed during the construction of the project they were replaced.

POPE methodology assumes that if traffic conditions vary by the following amounts when compared with what was originally forecast in a particular year, then it would be assumed that the local noise impact is likely to be either 'worse than' or 'better than' expected:

- Traffic volumes (number of vehicles >1,000 per day) are 25% more or 20% less, or
- Average speed is different by at least 10kph, or
- Percentage of Heavy-Duty Vehicles (HDVs) differs by at least 10%.

Based on the traffic volumes reported in section Table 9, our analysis showed that although traffic flows were higher than forecast, they were not high enough to change the likely noise impacts experienced. Overall, as the predicted noise mitigation was in place the impact of the project on the local noise environment was considered to be as expected.

Table 10: Evaluation summary - noise

	Noise Summary	Score
Appraisal Summary Table	900 dwellings experienced a noise level increase of 0.1 to 2.9 dBA. 5,000+ dwellings experienced a noise level decrease of 0.1 to 2.9 dBA. 12 dwellings experienced a noise level decrease of 2.9 to 5dBA.	Net change in Population Annoyed -310.
Evaluation	A low noise surface was lain, and existing noise barriers replaced. A comparison of forecast and observed traffic flows indicated that impacts were as expected.	As expected

[13] In the environmental assessment this was the design year – 15 years after opening.

Air quality

An environmental assessment was undertaken to understand the likely impacts and predicted effects of the project. The assessment predicted that converting the hard shoulder into a running lane would move traffic closer to nearby properties. The project was predicted to cause an overall worsening in air quality[14] in the modelled 2015 opening year due to a combination of small increases in traffic flows and speeds. The environmental assessment considered that deterioration in air quality would be small, and concentrations of nitrogen dioxide would reduce to pre-project levels within approximately two years. Overall, the impacts were predicted to be not significant.

Our evaluation focussed on comparing the interpolated 2021 forecast and observed traffic data for the project to understand the impact of the differences observed. We also considered the latest air quality monitoring and analysis published by the local authorities through which the project passes.[15]

POPE methodology assumes that local air quality will be as expected unless traffic conditions vary by the following amounts when compared with what was originally forecast in a particular year. Where it varies, it would be assumed that the local air quality impact is likely to be either 'worse than' or 'better than' expected:

- Annual average daily traffic volumes differ by more than 1,000 vehicles, or
- Average speeds differ by at least 6 mph, or
- Annual average daily number of HDVs differ by more than 200 vehicles.

Based on this methodology, traffic volumes recorded in Table 9 indicated that when two-way flows were considered, the air quality emissions were likely to be worse than expected along the project extent.

To understand the potential impact of this we looked at the environmental assessment in more detail. The air quality assessment predicted a number of small changes above the Air Quality Strategy[16] objectives on the M5 south of junction six at Droitwich. Our traffic analysis in section 4 indicated that the predicted traffic flows used in the environmental assessment were around five to 10% lower than what was observed. However, although the observed flows were underestimated, the forecasts did correctly predict that the increases in flows due to the project would only be small. The impact of this would be that the absolute concentrations modelled would be slightly higher than predicted in the environmental assessment but the change as a result of the project would still be small. Assuming as a worse case the concentrations of nitrogen dioxide due to the project was uplifted by a factor of 10%, there was the potential for two additional receptors[17] to exceed the Air Quality Strategy objectives. This would mean that there would be six receptors

[14] Changes in concentrations in nitrogen dioxide, the principal air quality pollutant associated with road traffic, were modelled at representative properties and locations within the study area. Particulate matter (PM_{10}) was also modelled but changes were imperceptible.
[15] The latest Air quality annual status reports published by Bromsgrove District Council (2022), Worcester City Council (2021) and Wychavon District Council (2021). https://www.worcsregservices.gov.uk/all-services/pollution/air-quality/local-air-quality-reporting/
[16] Further details on the UK Air Quality Strategy can be found here https://uk-air.defra.gov.uk/air-pollution/uk-eu-limits
[17] Receptors are properties and other locations which are sensitive to air quality changes and so the impacts on them are considered by the environmental assessment.

instead of four used in the judgement to determine whether the project was significant. This would not therefore change the conclusion of the assessment.

To add some further context, we reviewed the analysis presented in the local authority air quality annual status reports. Both Bromsgrove and Wychavon district councils reported a general downward trend in nitrogen dioxide concentrations across their areas over the period between 2016 and 2020 which covers the opening years of the project.

Therefore, although higher than forecast traffic flows suggests air quality impacts were worse than expected, our analysis indicated that there was a low risk that the observed traffic flows would change the outcome of the environmental assessment. The impacts were likely to remain not significant as expected.

Table 11: Evaluation summary – air quality

	Air Quality Summary	Score
Appraisal Summary Table	Overall deterioration of air quality for NOx and PM_{10} (758). No effect on air quality in AQMAs.	**PM_{10}**: No. of properties with; Improvement: 0 No change: 0 and Deterioration:758 **NO_2:** No. of properties with; Improvement: 0 No change: 0 and Deterioration:758
Evaluation	Based on a comparison of traffic volumes, the impacts of the project on local air quality were worse than expected. However, the change was still small and there was a low risk that it would change the outcome of the assessment.	Not significant as expected

Greenhouse gases

The appraisal predicted that the project would cause an increase in carbon emissions dues to changes in traffic volumes following the implementation of the project. Over 60 years this increase was predicted to be 0.41$MtCO_2e$.[18] Greenhouse gases were only appraised for the M5 junctions 4a to 6 all lane running component of the project. The M5 junctions 5 and 7 improvement projects have not been evaluated owing to the lack of forecast data available to provide an appropriate comparison.

It was not possible to effectively evaluate greenhouse gas emissions of the project because to replicate the extent of the original appraisal we would require forecast

[18] $MtCO_2e$ – This is a unit of measurement used to standardise the global warming potential of all greenhouse gases to that of carbon dioxide.

and observed traffic data for all the road links used in the appraisal study area. This data was not available and so we focussed just on the project extent.[19]

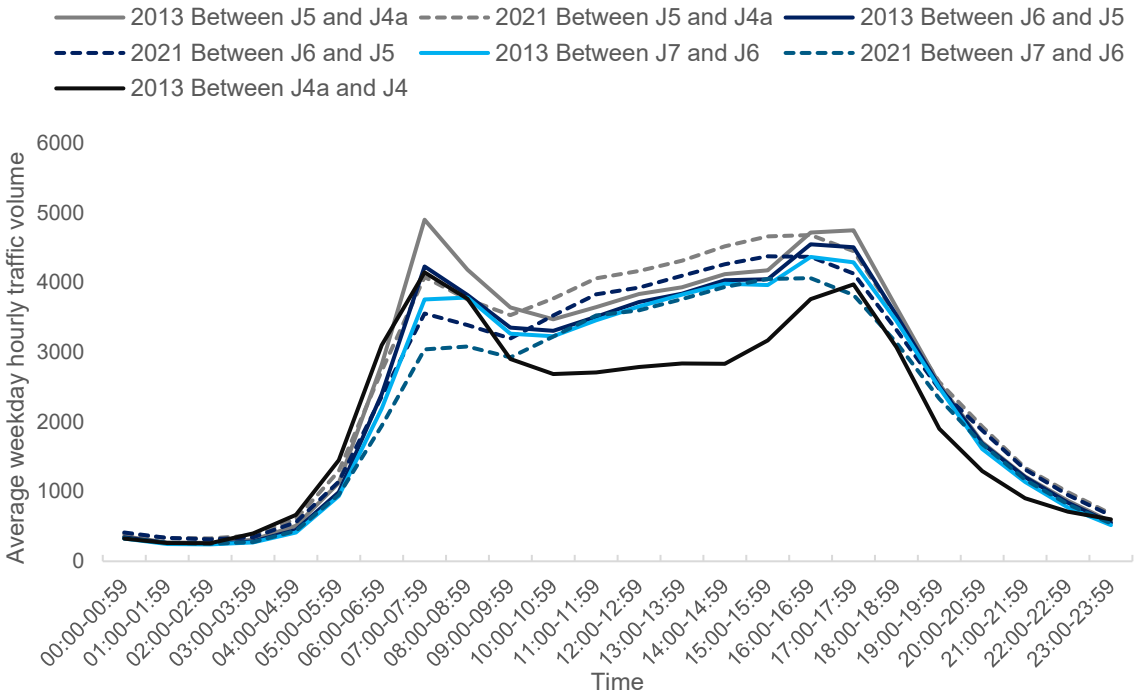
Observed traffic volumes were higher than forecast along the project extent. This suggested that greenhouse gas emissions were likely to be higher than forecast along this section of the project. However, we did not have sufficient speed and HGV data to be able to quantify or measure the effect of these changes or what impact this might have had on our conclusion.

[19] We don't normally have observed data for the whole appraisal area, so we would usually recalculate a forecast and a new observed emission along a section of the project where we do have data, Usually, just the project extent. We would then comment on its accuracy. For this project we didn't have the necessary speed and HGV data to enable us to do this.

Appendix A Diurnal traffic volume profiles

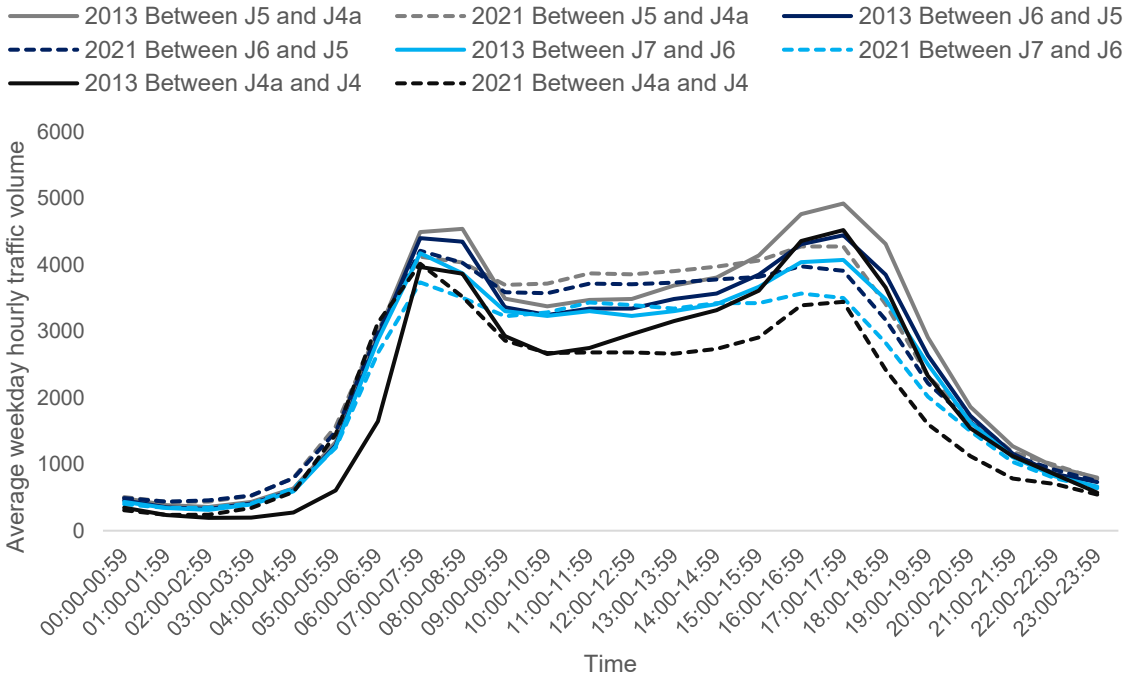
Presented below are plots of average weekday traffic volumes over the course of 24 hours for the study period. These plots were used to define the time periods for the morning peak, daytime and evening peak.

Figure 50: Average weekday hourly traffic volume profile (M5 junctions 4a to 6 northbound)



Source: National Highways WebTRIS, counts September/October 2013 and September/October 2021

Figure 50: Average weekday hourly traffic volume profile (M5 junctions 4a to 6 southbound)

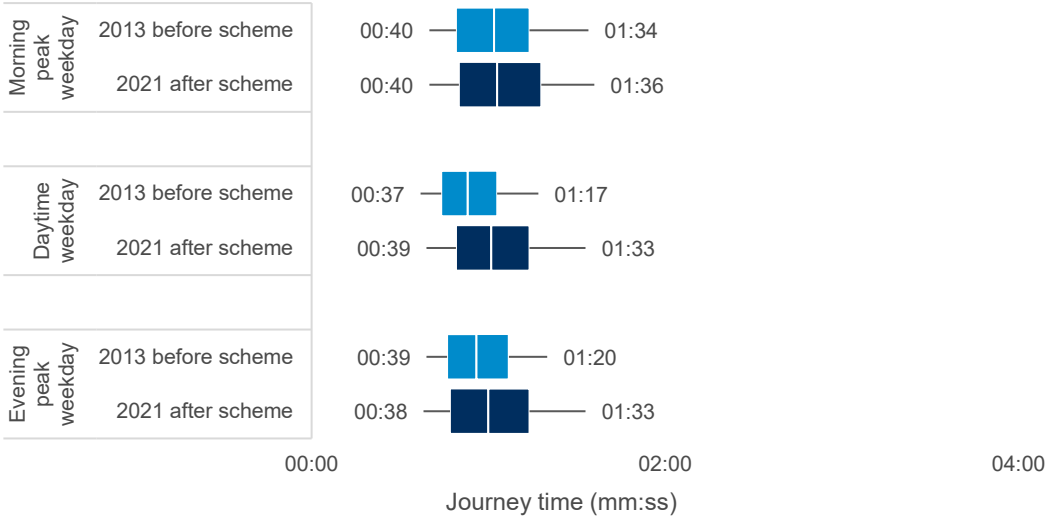


Source: National Highways WebTRIS, counts September/October 2013 and September/October 2021

Appendix B Journey time reliability plots for the M5 junction 6 project

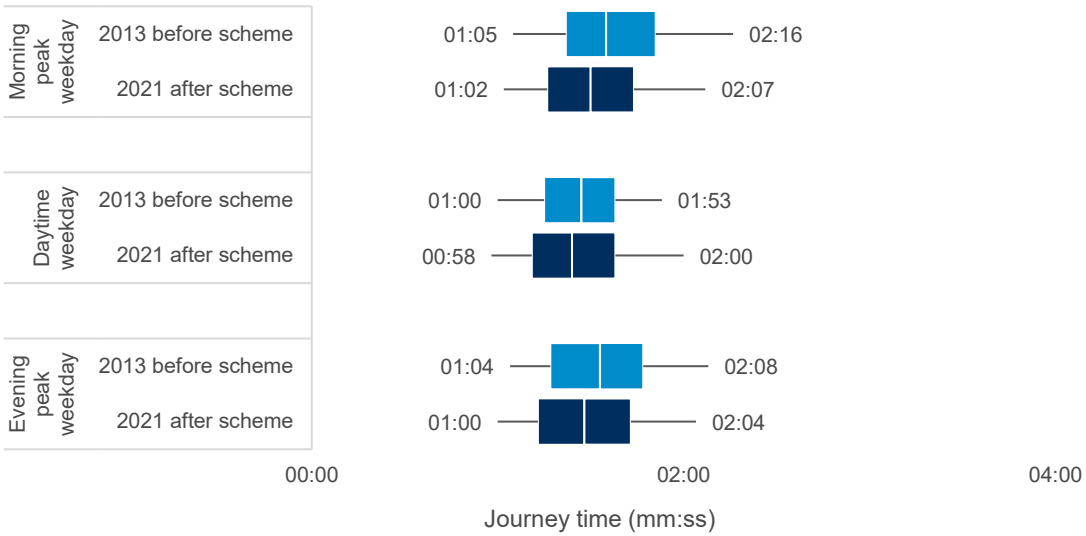
Presented below are plots of journey time reliability for the M5 junction 6 journeys which are not outlined in section 4.

Figure 51: Journey time reliability (M5 junction 6 southbound off slip to A4538 Pershore Lane South)



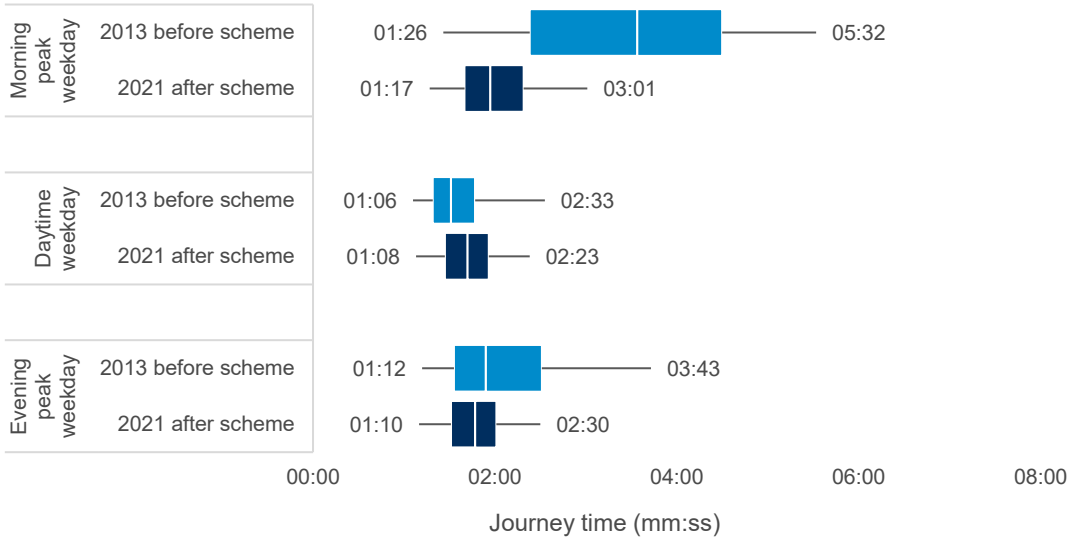
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 52: Journey time reliability (M5 junction 6 southbound off slip to A449)



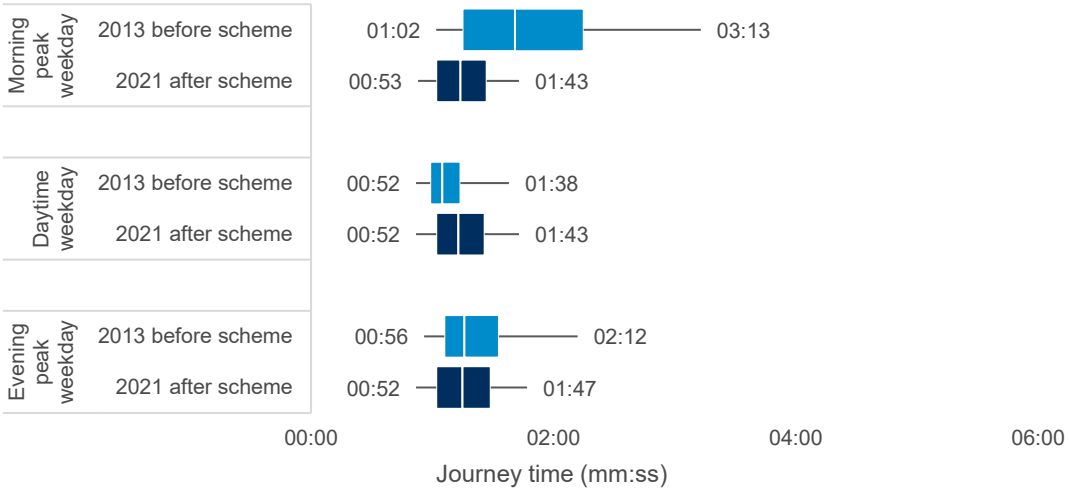
Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 53: Journey time reliability (A449 to M5 junction 6 southbound on slip)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Figure 54: Journey time reliability (A449 to M5 junction 6 northbound on slip)



Source: Satellite navigation (TomTom) September/October 2013 and September/October 2021

Appendix C

C.1 Safety counterfactual methodology

Personal injury collisions on the strategic road network are rare and can be caused by many factors. Due to their unpredictable nature, we monitor trends over many years before we can be confident that a real change has occurred as result of the project.

To establish whether any change in collision numbers is due to the project or part of wider regional trends we estimate what would have likely occurred to the safety trends if the project was not constructed. Prior to 2020, post opening project evaluations answered this question by applying the national average trends in personal injury collisions to the baseline observed before the project was constructed

During 2020 the methodology has been reviewed and updated to generate a more appropriate range. The revised method enables us to align the counterfactual with regional rather than national trends in traffic volumes and personal injury collisions.

It also allows for a more granular differentiation of road type. Previously the counterfactual for smart motorways was based on the national trends averaged across all types of motorways, the new method provides information for average conventional motorways and those with higher-than-average traffic levels (which are more comparative to the motorways which were converted to smart motorways). It also allows for differentiation between different types of smart motorways.

We now also report a counterfactual range, rather than an individual figure. This is the likely number of collisions that would occur, at the same post evaluation point, if the smart motorway was not built. The range is based on a 95% confidence interval.

C.2 Incident reporting methodology

Since 2012, many police forces have changed the way they collect STATS19 data (for more information see here). These changes mean casualty severity is now categorised automatically based on the most severe injury, rather than the judgement of an attending police officer.

Police forces using the new systems, called injury-based severity reporting systems, (also known as CRaSH and COPA) report more seriously injured casualties than those which do not. These changes make it particularly difficult to monitor trends in the number of killed and seriously injured casualties over time, or between different police forces. In response to these challenges, DfT and the Office for National Statistics (ONS) have developed an approach to adjust the data collected from those police forces not currently using injury-based reporting systems.

These adjustments are estimates for how casualty severity may have been recorded had the new injury-based reporting system been used. These adjusted estimates apply retrospectively from 2004 and adjust historical data to show casualty severity ‘as if’ this was recorded under the new injury-based system. Until all police forces have started using the new systems, these historical adjustments

will continue to be updated every year. Using these adjusted totals allows for more consistent and comparable reporting when tracking casualty severity over time, across a region, or nationally. While there is no impact on total casualties or collisions, and no impact on total fatalities, these adjustments do impact serious and slight casualties and collisions.

C.3 Unadjusted Collision Severities

The project extent of the M5 J4a-6 is covered by West Mercia Police who transferred from Stats19 to CRASH system for reporting personal injury collisions in December 2015.

Figure 56 shows the unadjusted collision severities on the project extent:

Figure 55: Unadjusted Collision Severities

Observation Year	Fatal	Serious	Slight
5Yr Before		2	32
4Yr Before		1	21
3Yr Before	1	2	15
2Yr Before		4	22
1Yr Before	1	2	22
1Yr Construct		1	21
2Yr Construct		1	24
3Yr Construct	1	2	16
4Yr Construct		5	16
1Yr After	1	1	8

Source: STATS19 30th November 2010 – 31st December 2020

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