highways england

M1 junctions 28 to 31 and junctions 32 to 35a all lane running and M1 junctions 31 to 32 controlled motorway

One-year post opening project evaluation

Foreword

Highways England's motorways are among the safest in the world[1].

In terms of fatality rates, smart motorways are the safest roads in the country. All road journeys involve risk, but the chance of death on smart motorways is less than on any other major road. It is less than on conventional motorways, and it is far less than on any SRN[2] A-road. But that does not mean that we do not need to do more.

As Executive Director, Strategy and Planning, I want to know that developments on our network are meeting their objectives and are putting the needs of drivers first. Post Opening Project Evaluation reports are a vital part of that assessment.

The three smart motorways on the M1 between junctions 28 and 35a were designed to reduce congestion, make journeys more reliable and improve driver information. The aim was to do this while keeping the road as safe and with minimal impacts on local roads.

The sections of the M1 between junctions 28 and 31, and junctions 32 and 35a are all lane running sections of motorway. The section between junction 31 and junction 32 is a controlled motorway scheme.

This report indicates how these three related schemes performed in their first year of operation. It indicates the all lane running sections are on track to meet their safety objectives, and that a marginal increase in the number of personal injury collisions[3] on the controlled motorway section is in line with what might have happened without the scheme. We know, however, that it is challenging to draw conclusions from first year safety statistics. This is due to the small amount of data available and the ability to make meaningful comparisons over a relatively short time scale. One-year studies provide only an indication of how each scheme is performing and longer-term evaluations are needed to determine whether scheme objectives are being fully met.

Collisions involving injuries are rare on the strategic road network and can be caused by many factors. Since the time period considered by this report, there have sadly been further fatalities on this stretch of motorway. We will use the lessons learned from these tragic events and include them in our longer-term assessment of the schemes.

Further findings from the one-year analysis of these schemes indicated journey times were generally becoming more reliable. Similarly, more data is required to draw firmer conclusions.

We will continue to assess the overall performance of these schemes as part of our programme of monitoring and evaluation. The impacts on the environment of these

[1] https://www.gov.uk/government/statistical-data-sets/ras52-international-comparisons
[2] Strategic Road Network – the roads Highways England manages
[3] from an annual average of 6 to 8

schemes and their economic performance will be evaluated fully at the five-years after their opening.

Alongside our monitoring, we are continuing to deliver further measures as set out in the Department for Transport's Smart motorway safety evidence stocktake and action plan[4], published in March 2020, and our Progress Report[5] published in April 2021, setting out our progress in delivering the actions.

These include:

- undertaking a separate review of safety on the M1 between junctions 30 and 35a, accelerating our work to install radar technology to detect stopped vehicles on all existing stretches of ALR motorway, including this stretch of the M1, by September 2022, six months earlier than planned
- upgrading special cameras on smart motorways, 10 months earlier than planned, so that they can be used to spot and prosecute motorists ignoring red X signs and illegally driving down closed lanes, putting themselves and others in danger
- installing around 1,000 additional approach signs on smart motorways, six months earlier than planned, alerting drivers to their nearest place to stop in an emergency.

Elliot Shaw

Executive Director, Strategy and Planning

July 2021

[4] https://www.gov.uk/government/publications/smart-motorway-evidence-stocktake-and-action-plan
[5] https://highwaysengland.co.uk/media/bb4lpkcp/smart-motorways-stocktake-first-year-progress-report-2021.pdf

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1. Executive summary

The M1 junctions 28 to 31 and M1 junctions 31 to 35a all lane running schemes, combined with a separate scheme between M1 junctions 31 and 32 from our 'Pinch Point' investment stream[6], mean that the whole section from junction 28 to junction 35a now has variable mandatory speed limits. Speed limits are changed to suit traffic conditions and displayed on electronic signs.

The smart motorways added capacity by adapting the hard shoulder to a running lane, providing four lanes permanently open for use, with provision of emergency areas. The section from junction 31 to junction 32 had already been widened in 2008 and has four lanes plus a hard shoulder. The schemes were constructed in phases with the whole section open in March 2017.

The M1 motorway is a strategic route in England, linking London with the Midlands and the North. The scheme sections are located in the districts of Derbyshire, Rotherham & Sheffield and form part of the primary strategic link between Nottingham and Sheffield. The route is important for freight with freight traffic making up a high proportion (22%) of total traffic flows.

Before construction of the schemes, congestion on this section of motorway was a problem and the extent and severity of congestion was expected to increase over time. There were also air quality concerns in the area and the scheme enabled a 60mph speed limit to be enforced between 7am to 9am and 3pm to 6pm to mitigate air quality issues.

The schemes were designed to reduce congestion, make journeys more reliable and improve driver information. The aim was to do this without making the road less safe and with minimal impacts on the local road network.

This report indicates how the schemes have been performing within the first year of them being in full operation. This initial assessment forms part of a longer-term evaluation which reviews performance over time, as the benefits mature. This initial study is not intended to provide conclusive evidence about the benefits but gives an early indication about whether the schemes are heading in the right direction. This helps us identify areas where we can focus effort to optimise the benefits of the scheme.

Evaluation findings

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 a number of years before we can be confident that a real change has occurred as result of the scheme. Initial indications are that the all lane running schemes are on track to meet their safety objective of being as safe as or safer than the road they replace. There has been a marginal increase in the number of personal injury collisions[7] in the vicinity of the pinch point scheme. However, this is no worse than might have

[6] The Pinch Point Programme was a collection of small-scale schemes (generally costing up to £10m) delivered on the strategic road network, specifically aimed to at stimulating growth in the local economy, relieving congestion and/or improving safety.
[7] from an annual average of 6 to 8

happened without the scheme. We need to monitor performance over a longer timeframe to draw firm conclusions.

While the findings from this study are not conclusive, we have been reviewing them carefully and will continue to monitor the safety of this scheme as part of our programme of monitoring and evaluation.

Journey time reliability improved in all time periods since implementation of the schemes. Average journey times had improved in some time periods, but not all. The steps we took to improve air quality, by implementing a speed limit, will have influenced this. At one year after opening, a 60mph speed limit was enforced between 7am to 9am and 3pm to 6pm. Overall, there was a slight time saving.

The impacts on the environment will be evaluated fully at the five-years after opening stage, when a site visit will be undertaken. A separate programme of air quality monitoring is underway to evaluate the operational impacts and the continuing need for mitigation. The results of this work will inform the five-year evaluation.

The economic performance of these schemes will be considered after the longer-term assessment of the schemes impacts has been completed.

2. Introduction

2.1. What is the scheme?

This report relates to three improvements, namely:

- M1 junctions 28 to 31 all lane running (ALR) scheme
- M1 junctions 31 to 32 controlled motorway pinch point scheme
- M1 junctions 32 to 35a all lane running (ALR) scheme

The smart motorway schemes are about 18 and 13 miles long respectively, with the pinch point scheme covering just over a mile in between.

The pinch point scheme opened in 2014 and installed controlled motorway[8] technology in between the two proposed smart motorway schemes, with the aim of providing a consistent journey experience for users. This section had already been widened and retains a hard shoulder, opening in February 2008. The controlled motorway was expected to save 2.4 Personal Injury Collisions (PIC) a year and improve journey time reliability.

The smart motorways added capacity by adapting the hard shoulder to a running lane, providing four lanes permanently open for use by road users, with provision of emergency areas. The schemes were constructed in phases with the whole section open in March 2017. The whole section, junctions 28 to 35a, now has variable mandatory speed limits.

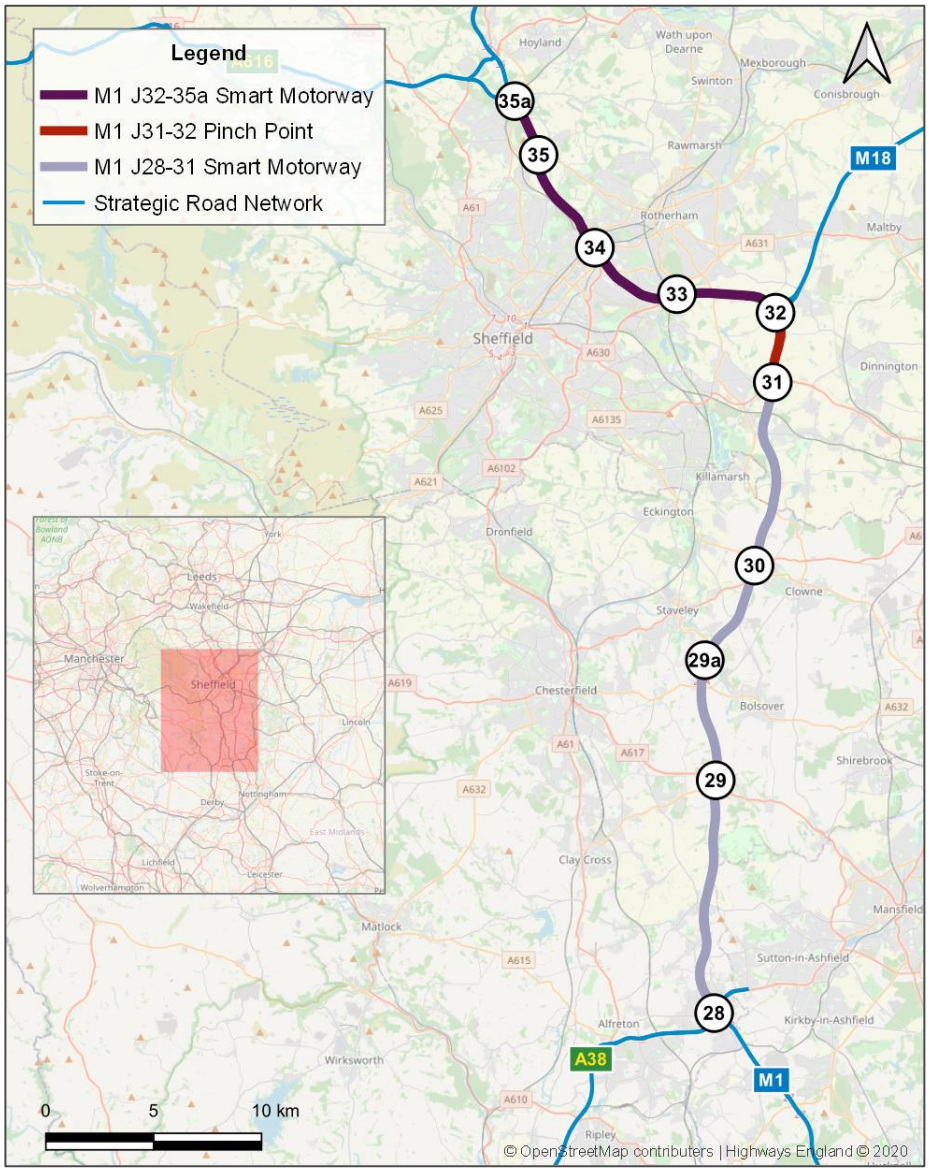
Upon opening of the full scheme extent, a 60mph speed limit was enforced between 7am to 9am and 3pm to 6pm to mitigate against air quality problems.

2.2. Scheme Locations

The M1 motorway is a strategic route in England, linking London with the Midlands and the North. The scheme sections are located in the districts of Derbyshire, Rotherham & Sheffield and form part of the primary strategic link between Nottingham and Sheffield. The route is important for freight with freight traffic making up a high proportion (22%) of total traffic flows.

[8] A controlled motorway has electronic message signs which display the speed limit. These speed limits are mandatory and vary according to traffic conditions. It retains a hard shoulder.

Figure 1 : Location of schemes



Source: Highways England and OpenStreetMap contributors

2.3. What were the schemes designed to achieve?

Before construction of the schemes, congestion on this section of motorway was a problem and the extent and severity of congestion was expected to increase over the coming 20 years. The schemes were designed to reduce congestion, make journeys more reliable and improve driver information. The aim was to do this without making the road less safe and with minimal impacts on the local road network.

There are also air quality concerns in the area and the scheme enabled a 60mph speed limit which was enforced on weekdays between 7 am to 9 am and 3 pm to 6pm to mitigate air quality issues.

2.4. How have the schemes been evaluated?

A post-opening project evaluation (POPE) compares changes in key impact areas[9] by observing trends on the route before the scheme was constructed (baseline) and tracking these after the opening of the scheme to traffic. The outturn impacts of the scheme are evaluated against the expected impacts of the scheme (presented in the forecasts made during the project planning process) to review the scheme's performance.

Evaluation is important for transparency and accountability of public expenditure by assessing whether schemes are on track to deliver the anticipated benefits and value for money. We undertake POPE studies for all our major investment schemes. In this case we are also including the M1 J31 to 32 pinch point scheme as it is located between the two ALR schemes and the impacts are inter-related.

This report is based on data after approximately one year of operation. It is anticipated that this will be followed by a five year after evaluation when it will be possible to comment with more certainty on impacts such as safety performance and where the impact on environmental topics such as landscape and biodiversity will be included.

[9] Key impact areas including, safety, journey reliability and environmental impacts

3. Delivering against objectives

3.1. How has the scheme performed against objectives?

All Highways England major schemes have specific objectives which are defined early in the appraisal when scheme options were being identified. Table 1 summarises these for the all lane running and pinch point schemes. Detail supporting whether the schemes are on track to meet the objectives is contained in the following sections.

Table 1: Scheme objectives

Objective	One-year evaluation
All Lane Running schemes	
Reduce congestion	Both schemes have had a positive impact on congestion, but only to a very slight degree for the M1 junctions 32 to 35a scheme.
Improve journey time reliability (particularly delay to worst 10% journeys)	Journeys are more reliable, providing road users more confidence in their journey time.
Minimise detrimental traffic effects on the surrounding network	Insufficient evidence to conclude
Improve driver information	Not assessed in this evaluation, however signs and signals have been installed which will have improved driver information.
No worsening of accident rate	On track to be realised.
Controlled Motorway scheme	
To provide road users with a consistent journey along the route and visually replicate the appearance of a controlled motorway on the section.	This has been achieved, with variable mandatory speed limits over the whole section junctions 28 to 35a.

4. Traffic Evaluation

4.1. Traffic Summary

Traffic evaluation was undertaken to understand traffic changes since the opening of the scheme and to establish to what degree the changes were attributable to the scheme, or whether they occurred as part of a wider regional or national change. The evaluation compared data from prior to the start of construction (2013) and one year after opening (2018).

There was no material change in overall traffic levels, but flows reduced in the time periods where the speed limit has been reduced. Forecasting of the flows for junctions 32 to 35a did not anticipate this reduction associated with the speed limit change. Forecasting for junctions 28 to 32 was more accurate but reflected the expectation that the speed limit reduction would be imposed 7am to 7pm, not just limited to the peak periods.

The schemes reduced journey times for some road users and performed better than expected for those travelling southbound in the morning peak period. Road users travelling northbound in the morning peak period are experiencing slower journeys. This was not anticipated within the business case. Overall, there have been slight improvements in journey times over the whole section.

Journey times are more reliable since the introduction of the schemes, meaning road users can be more confident in the time their journey will take.

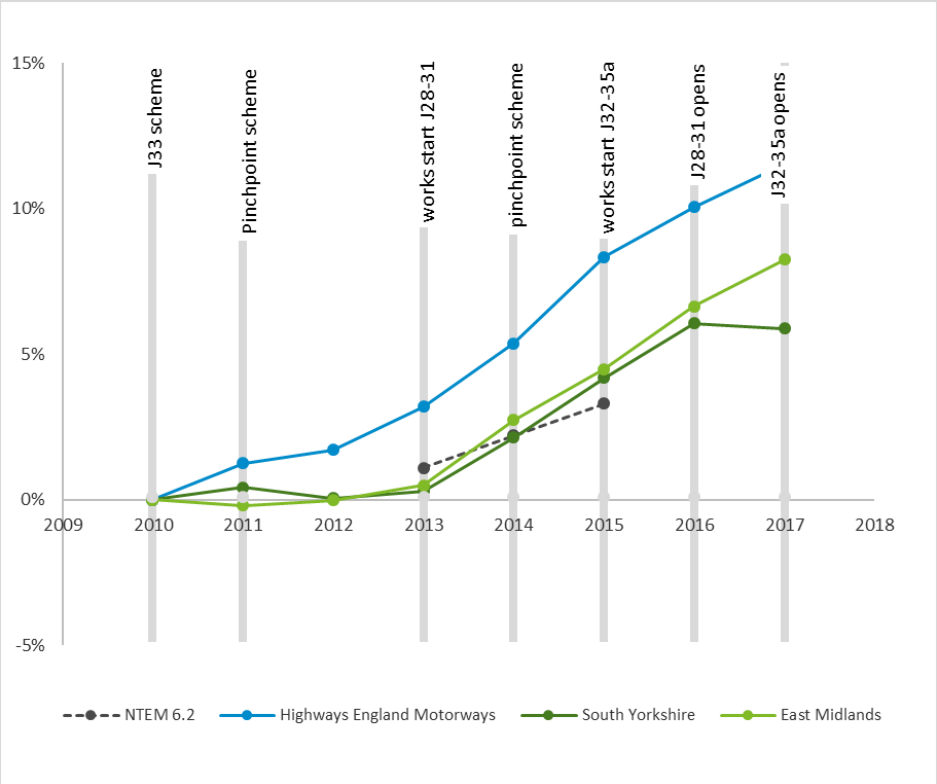
4.2. How have traffic levels changed?

4.2.1. National, Regional and Local Trends

To assess the impact of the scheme on traffic, it is helpful to understand the changes within the context of changes in national, regional and local traffic[10] as presented in Figure 2.

[10] Department for Transport Motor vehicle traffic (vehicle kilometres) by local authority in Great Britain. Table TRA8904

Figure 2: National, Regional and Local Traffic Growth



Source: Department for Transport road traffic statistics 2018

The time period of most interest is since 2013, when the smart motorway construction began. Figure 2 shows that over this time period motorway traffic has increased by 8%. Regional traffic growth was generally similar, on average about 7%. The NTEM[11] 6.2 line shows the growth that was anticipated by the traffic modelling that informed the appraisal. The following analysis needs to be considered within this context.

4.2.2. How did traffic volumes change?

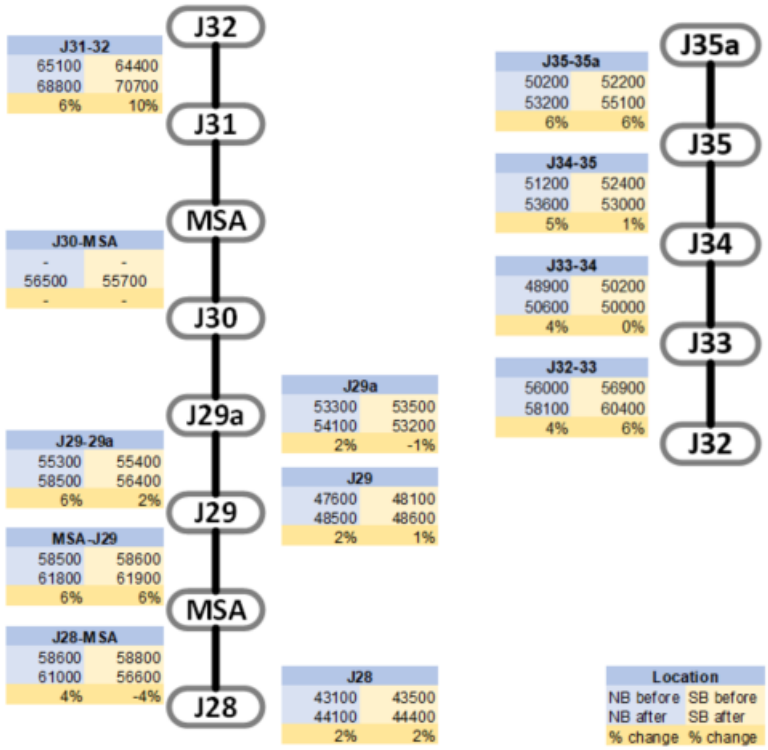
To assess the impact of the scheme improvements on the volume of traffic on the scheme extent and within the local area, changes in traffic volumes between pre-construction and post-opening are considered.

Both all lane running schemes have an objective to: *minimise detrimental effects on the surrounding road network*. However, due to both schemes having limited locations with forecasts and also before and after traffic data, there is insufficient evidence to conclude whether or not there has been an impact on the surrounding network.

The change in flow on the scheme extent is presented in Figure 3, below. It is difficult to attribute any changes to the schemes as they are generally in line with or below background growth.

[11] NTEM – national trip end model. This is used in appraisal to estimate future traffic growth trends

Figure 3: Comparison of pre-construction and post-opening average daily traffic volumes



Source: webTRIS (2012/13, 2017/18) Note: MSA = motorway service area, figures presented to nearest 100

4.2.3. Was traffic growth as expected?

As part of the appraisals of the all lane running schemes, detailed forecasts were made of the impact of each scheme on traffic flows. The time periods considered are set out in Table 2.

Table 2: Time periods used in appraisal

	J28-31	J32-35a
AM	7-9am	7-9am
IP (Interpeak)	9am-3pm & 6-7pm	9am-4pm & 6-7pm
PM	3-6pm	4-6pm

Source: Traffic forecasting reports for each scheme

4.2.3.1. Junctions 28 to 32

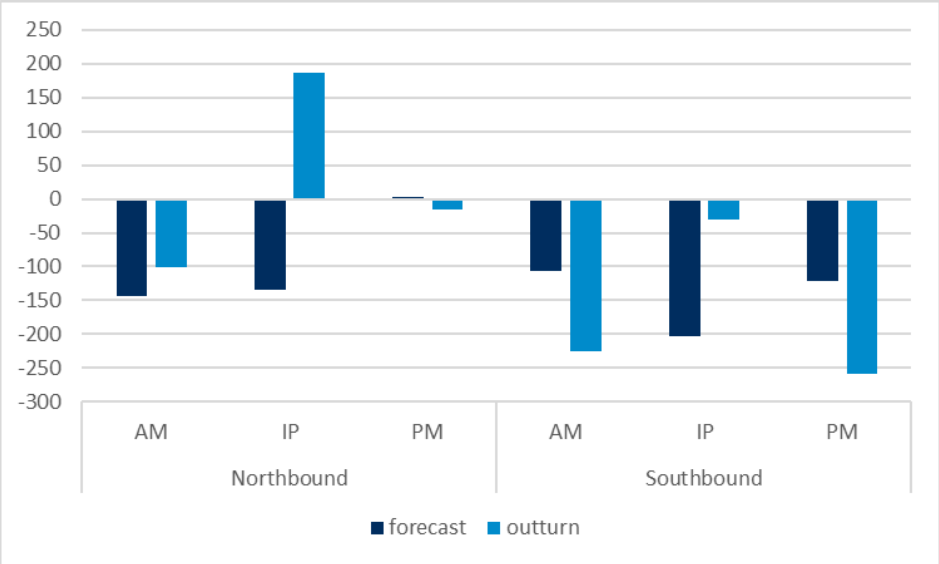
The junctions 28 to 31 scheme, anticipated that the number of road users would reduce as consequence of 60mph speed limit being applied[12]. It was assumed in the appraisal that the speed limit would be applied all day, hence the forecast reduction

[12] As the junctions 31 to 32 scheme did not forecast any changes in traffic volumes, the changes seen in this section are attributed to the junctions 28 to 31 scheme and compared to that scheme's appraisal forecasts. The forecasts for the junctions 28 to 31 scheme took into consideration the impact of the junctions 32 to 35a all lane running scheme.

in volumes in the interpeak. However, it was only necessary to apply the speed limit between 7am to 9am and 3pm to 6pm.

In Figure 4 the anticipated trend materialised in the other time periods. Note that the volumes of change are very small compared total flow.

Figure 4: Change in flow J28-32



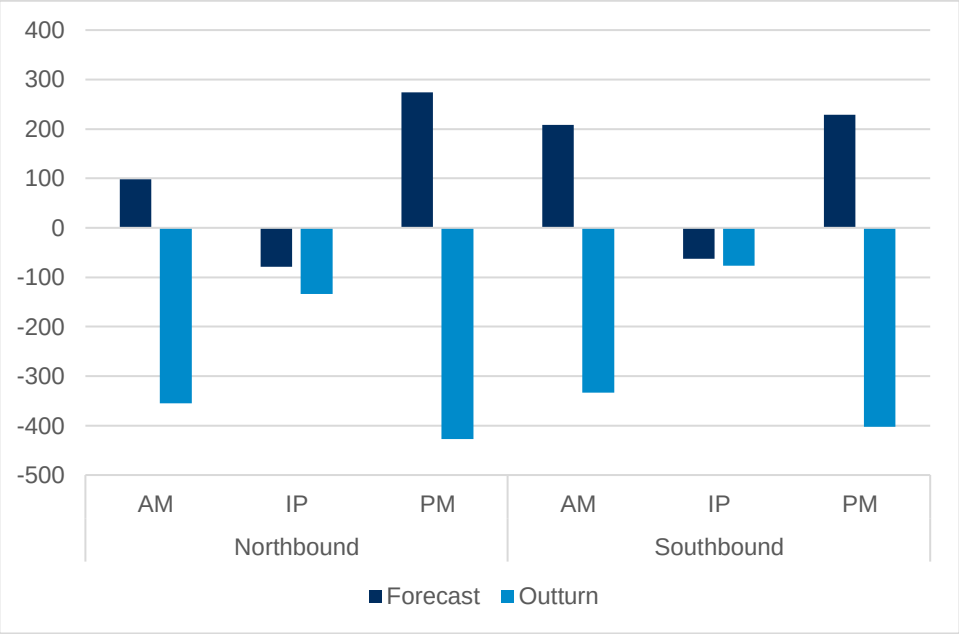
Source: Traffic forecasting report (2015 DS[13] forecasts) and webTRIS (2013 & 2018)

4.2.3.2. Junctions 32 to 35a

The speed limit also had a similar impact on the flow of traffic between junctions 32 and 35a. The business case for this scheme did not anticipate this impact and there was an expectation that the volume of road users would increase by five percent. This can be seen in Figure 5. Although we note an inconsistency in forecasting approach between the schemes, only 4 locations have a forecasting error greater than 15%.

[13] DS – 'Do Something'. The forecast of how the road network would perform if the scheme is constructed

Figure 5: Change in flows J32-35a



Source: Traffic forecasting report (2015 DS forecasts) and webTRIS (2013 & 2018)

4.3. Relieving congestion and making journeys more reliable

Smart motorways are applied to the busiest routes, to ease congestion and ensure journey times are more predictable. These routes are often where we anticipate congestion will increase and the smart motorway seeks to limit this. Analysis of journey times[14] and speeds indicate the impact of the smart motorway 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 scheme impacted journey times and the reliability of journeys.

4.3.1. Did the schemes deliver journey time savings?

The traffic modelling informing the appraisal assumed the 60mph speed limit to be in place 7am until 7pm. However, in reality, it was only necessary to apply it in the peaks. Therefore, the anticipated journey time disbenefits have not occurred during the interpeak period.

4.3.1.1. Junctions 28 to 32

As can be seen in Figure 6, journey time savings were anticipated between junctions 28 and junctions 32[15] in most time periods. The scheme reduced journey times for some road users and performed better than expected for those travelling southbound

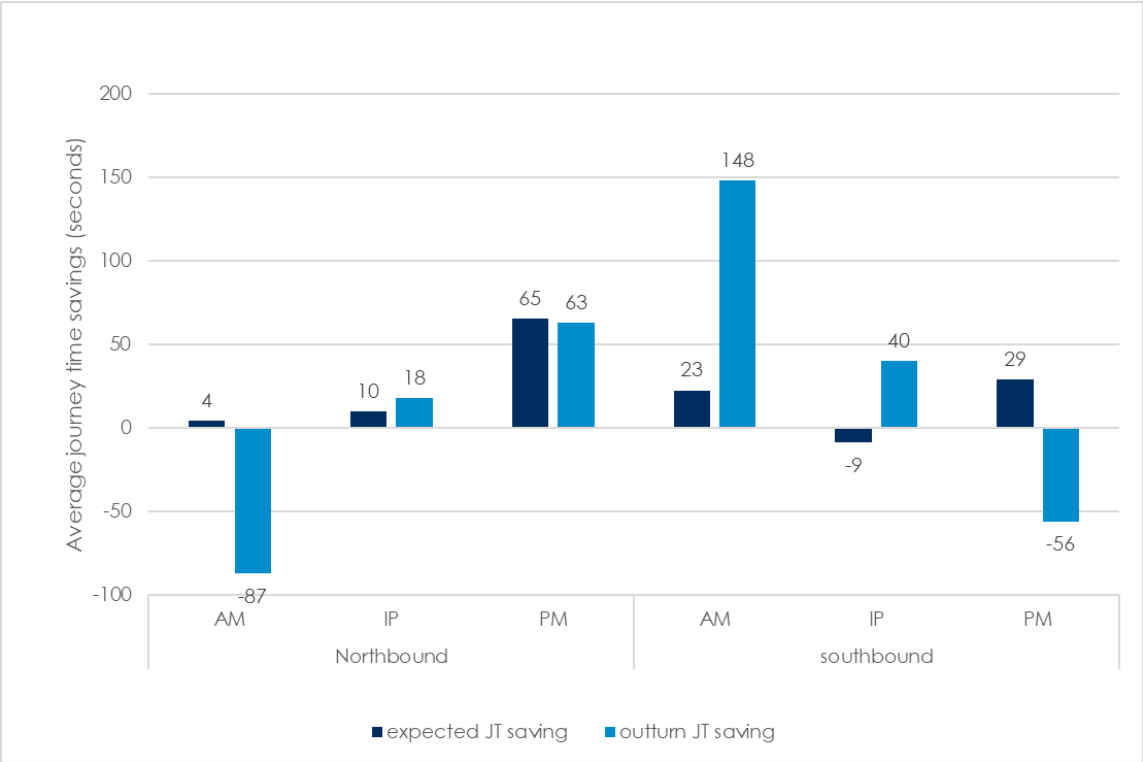
[14] Evaluated using TomTom satellite navigation data, June 2012- May 2013 before period, June 2017-May 2018 after period.

[15] The J31-32 Controlled Motorway infill scheme did not forecast any journey time benefits in the Project Appraisal Report (PAR). This is in line with appraisal guidance which stated that for this type of scheme (where no additional capacity was provided, just control/smoothing of traffic) no journey time benefits should be claimed. This means that all journey time benefits in the section junctions 28 to 32 can justifiably be allocated to the junctions 28 to 31 scheme, which did forecast impacts over this whole section.

in the morning peak period with journeys being around two and a half minutes faster. Road users who are travelling northbound in the morning or southbound in the afternoon peak periods are experiencing slower journeys (by up to a minute and a half longer). This was not anticipated within the business case.

In some time periods the forecasts were inaccurate. The largest discrepancy is in the order of 2 minutes[16]. The inaccuracy appears to stem from the forecast of how the road network would perform without scheme (the do-minimum[17] scenario). Journey times before the scheme were not as bad as expected in the do-minimum forecast. This is often the more difficult scenario to forecast accurately because it requires modelling how a congested network performs.

Figure 6: Accuracy of journey time forecasting J28-32



Source: Traffic forecasting report and TomTom satnav data

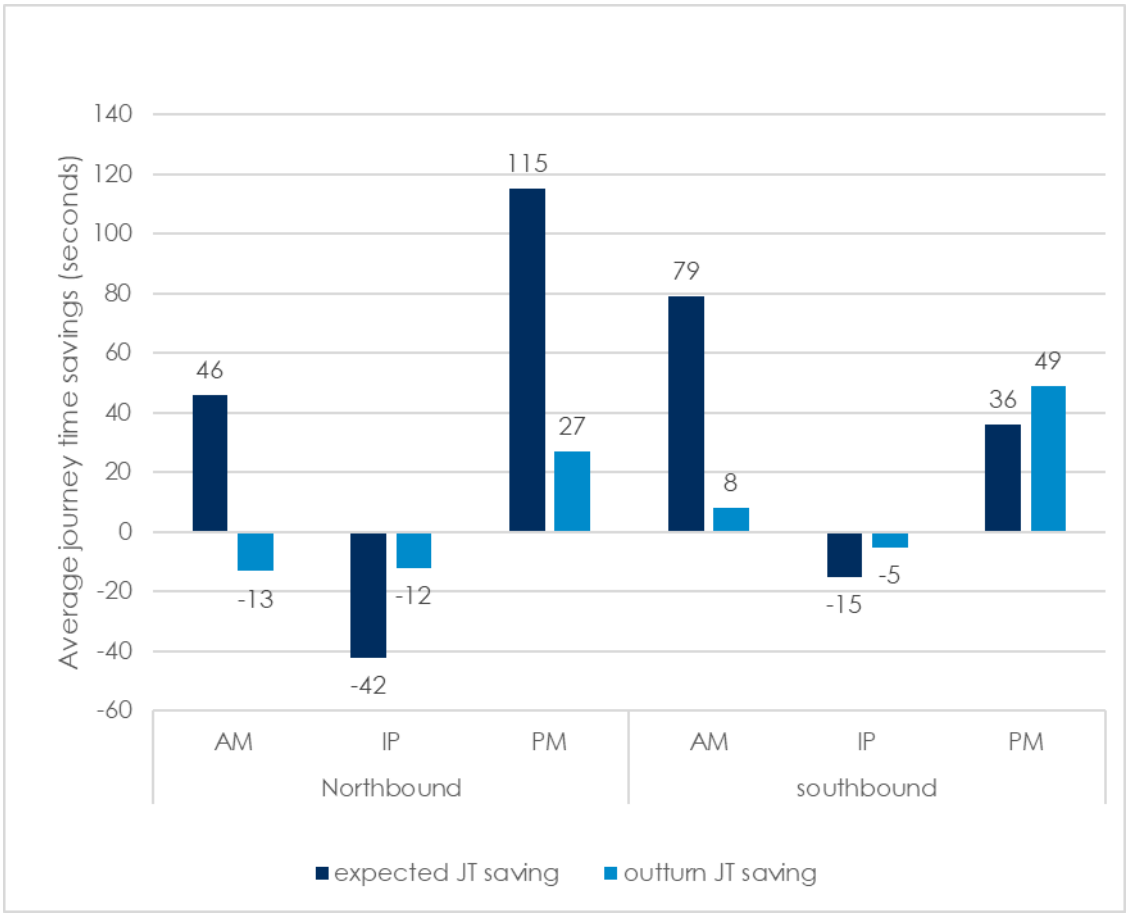
[16] Over a distance of 20 ½ miles

[17] DM – Do Minimum, the forecast of how the network would perform if the scheme wasn't constructed.

Junctions 32 to 35a

As illustrated in Figure 7, the outturn journey times largely follow the same pattern as the forecast (with the exception of northbound in AM), but the observed change is smaller than anticipated.

Figure 7: Accuracy of journey time forecasting J32-35a



Source: Traffic forecasting report and TomTom satnav data

Although the outturn values are different to forecast, the values are small. The biggest discrepancy is under a minute and a half (on journey times of over 10 minutes). The model correctly forecast the direction of the change in most time periods - the exception being the northbound in the morning peak.

4.3.2. Overall impact on journeys

With journey times improving in some time periods and not in others, the best way to conclude if customer journeys have improved, and the scheme has met its objective to: *reduce congestion,* is to undertake a vehicle hour calculation. This considers the volume of traffic and the journey times before and after to consider whether the after situation is an improvement on the conditions before.

For both the all lane running schemes the appraisal considered a 12-hour period in the appraisal, so that same period is considered in Table 3 below:

Table 3: Vehicle hour savings

Vehicle hour saving in opening year	
M1 J28-31	217,000
M1 J32-35a	23,000

Note: figures presented to nearest 1000

Both schemes had a positive impact on congestion, but only to a very slight degree for the M1 junctions 32 to 35a scheme.

4.3.3. Did the schemes make journeys more reliable?

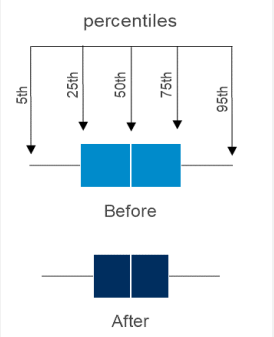
An objective of smart motorways is to improve the reliability of journeys, making them more predictable for road users. If the time taken to travel the same journey each day varies, the road user is less confident in planning how long their journey will take them. If journey times do not vary, the road user can be more confident in the time their journey will take and allow a smaller window of time to make that journey.

To understand how the schemes impacted journey reliability, we examined how much journey times varied from the average journey time. Identifying percentile ranges[18] of journey times above or below the median journey time provided an indication of the variability of journey times.

All three schemes expected to improve reliability, but we are only able to breakdown the data into two sections: junctions 28 to 32 and junctions 32 to 35a.

Figure 9 and Figure 10 show that northbound, journey time reliability improved in all time periods, even when the average journey time did not.

Figure 8: What does a Box Plot Show?

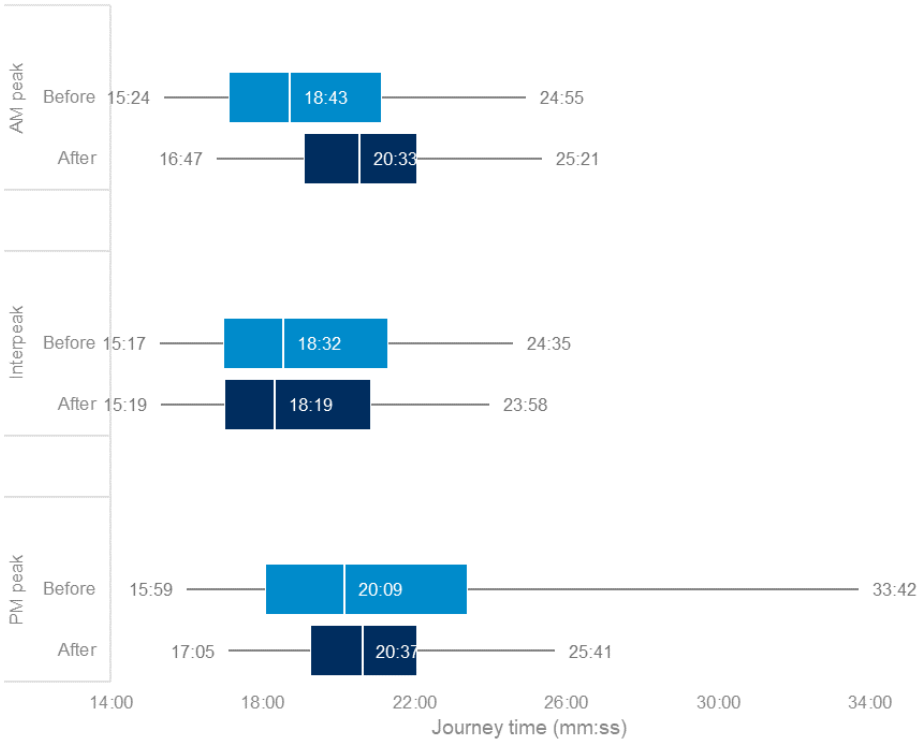


The lowest point is the 5th percentile, this means 5% of journeys take less than this to complete. The highest point is the 95th percentile, this means 95% of journeys take less time than this to complete. This shows the difference between the longest and the shortest journey times observed.

The length of the block shows how the journey times vary between the 25th and 75th percentile (25% and 75% of journeys). The shorter the block the less variable and hence more reliable a journey would be.

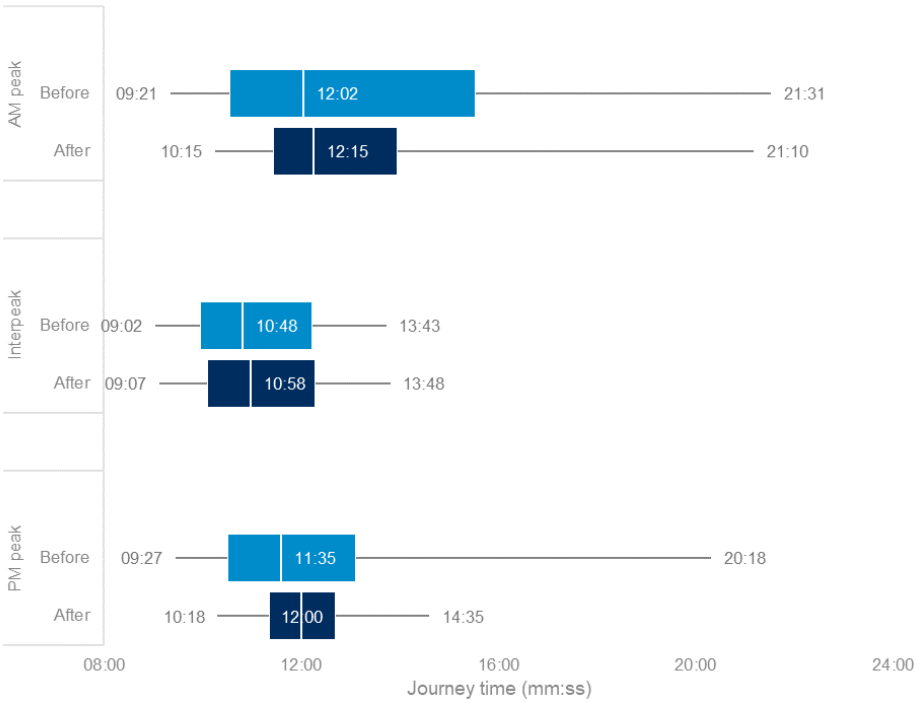
[18] A percentile indicates the value below which a given percentage of observations falls. For example, the 20th percentile is the value **below** which 20% of the observations may be found. Equivalently, 80% of the observations are found **above** the 20th percentile.

Figure 9: Journey time reliability - northbound J28-32



Source: TomTom satnav data

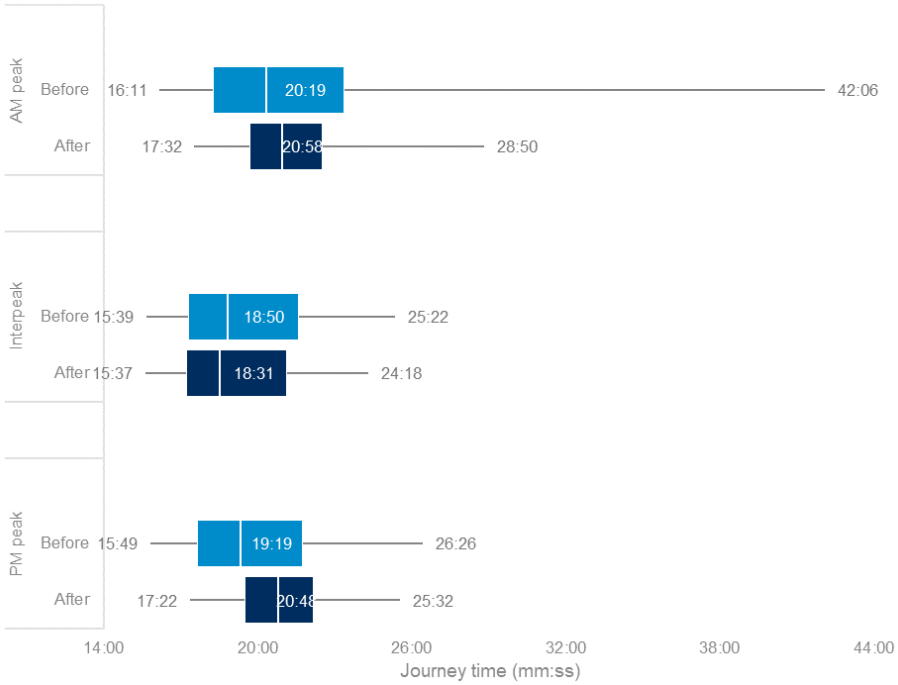
Figure 10:Journey time reliability - northbound J32-35a



Source: TomTom satnav data

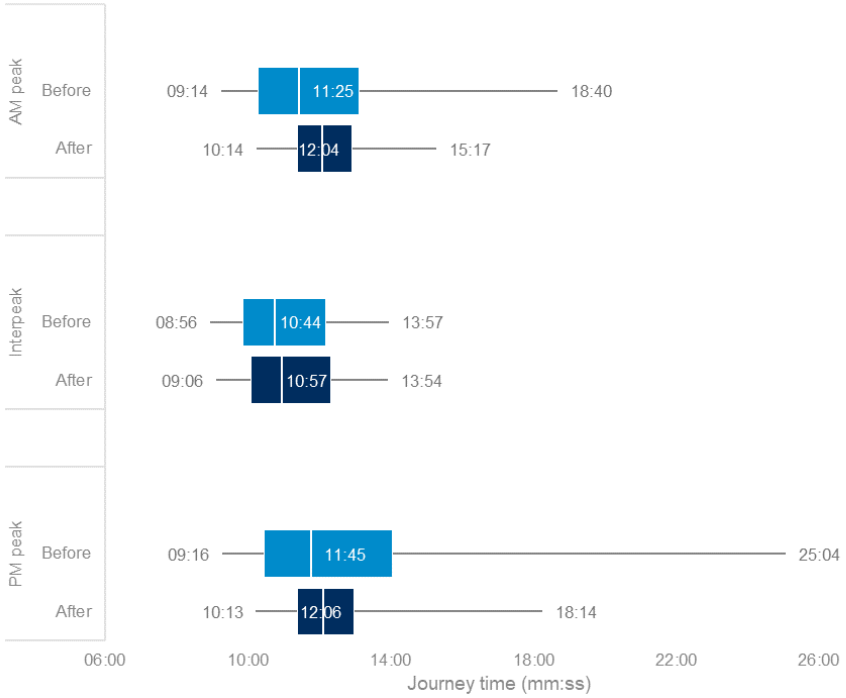
Figure 11 and Figure 12 show that journey time reliability also improved in all time periods, in the southbound direction, even when the average journey time did not.

Figure 11:Journey time reliability - southbound J28-32



Source: TomTom satnav data

Figure 12: Journey time reliability - southbound J32-35a



Source: TomTom satnav data

Both the all lane running schemes had an objective to: *'improve journey time reliability (particularly delay to worst 10% journeys)'*. In addition to the analysis above, the journey time at the 90th percentiles generally decreased after the opening of the schemes, so it is reasonable to conclude that the schemes have been successful at improving the worst 10% of journeys.

5. Improving road user safety

5.1. Safety Summary

The safety objective for this smart motorway was to be as safe as, or safer than, the road it replaces. The number and rate per million vehicle kilometres of personal injury collisions were analysed to track changes over time. Initial indications are that there was a reduction in the rate and number of personal injury collisions compared with the annual average for the five years before the schemes were built.

During the first 24 months of the M1 J28 to 31 smart motorway being open there was an annual average of 27 personal injury collisions compared with an average of 98 per year before the scheme was constructed. If the road had not been converted to a smart motorway, we estimate that the annual average number of personal injury collisions would have changed to between 64 and 100.

During the first 12 months of the M1 J32 to 35a smart motorway being open there was an annual average of 16 personal injury collisions compared with an average of 52 per years before the scheme was constructed. If the road had not been converted to a smart motorway, we estimate that the annual average number of personal injury collisions would have changed to between 27 and 63.

During the first 48 months of the M1 J31 to 32 Controlled Motorway being open there was an annual average of 8 personal injury collisions compared with an average of 6 per years before the scheme was constructed.

The number of personal injury collisions observed was lower than forecast within the business case for both the M1 J28 to 31 and M1 J32 to 35a schemes.

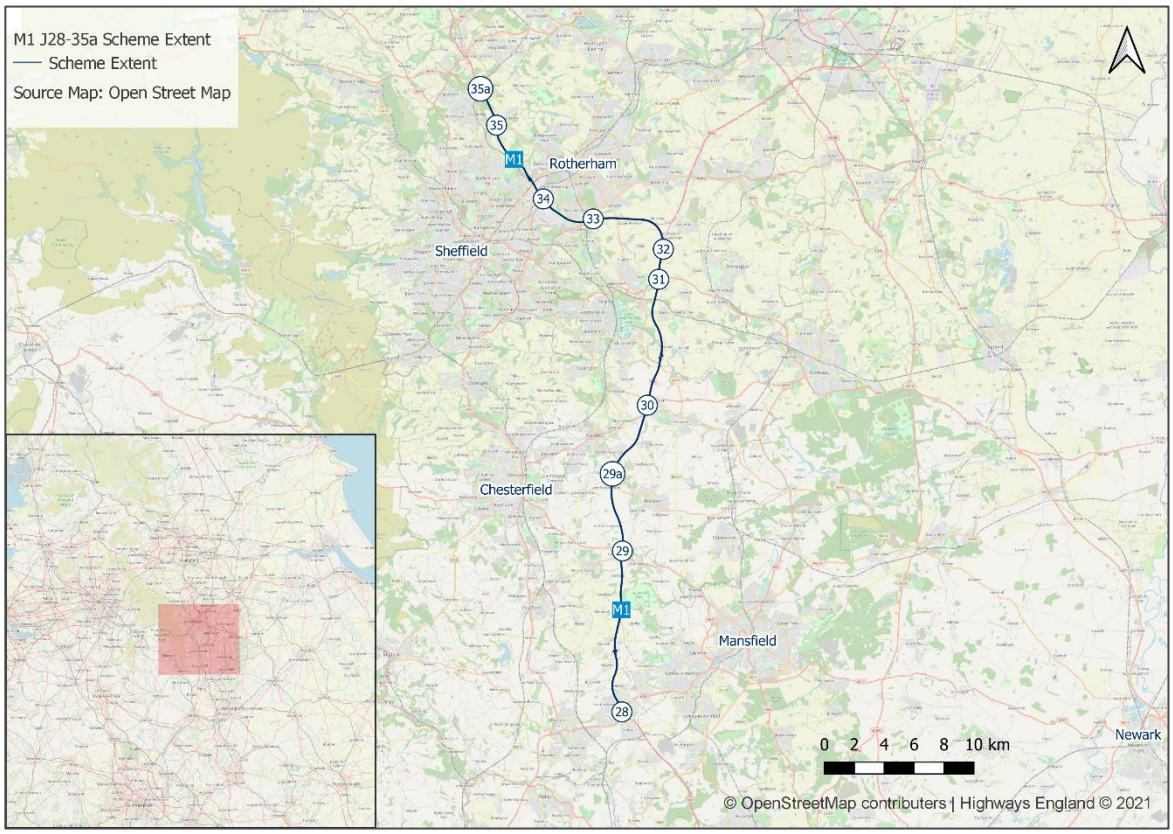
In the context of other findings in this report these are positive early signs. Collisions are reducing at a time where congestion is being released and traffic is moving quicker in some time periods. Traffic levels are set to increase in later years, however, and so results at the follow up evaluation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

The early indications are that the safety objective, is on track to be achieved. The analysis will be revisited in later years to assess the significance of the change and determine if these initial positive findings are a real trend or natural fluctuation.

5.2. Scope of the safety study area

The scheme extent is shown in Figure 13.

Figure 13: Safety study area



Source: Highways England and OpenStreetMap contributors

5.3. What are the emerging safety trends of the smart motorway?

Safety data for this evaluation was obtained from the Department for Transport Road Safety Data. This records incidents on public roads that are recorded by 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 scheme 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 scheme.

5.3.1.1. Junctions 28 to 31

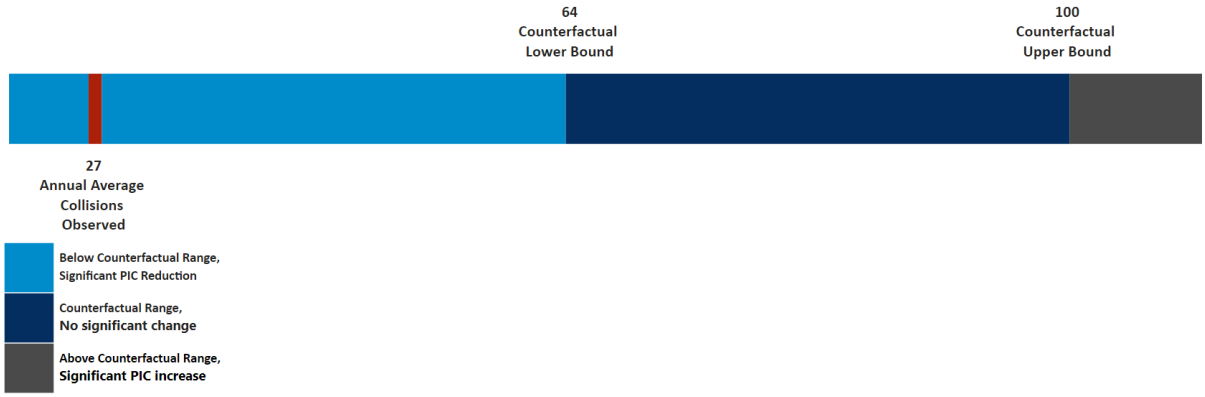
The analysis for M1 junctions 28 to 31 draws on the following data collection periods

- Pre-construction: 6 September 2008 to 5 September 2013;
- Construction: 6 September 2013 to 30 March 2016;
- Post-opening: 31 March 2016 to 30 March 2018

The early indications are that the number of personal injury collisions for the first two years of the smart motorway are lower than the period before construction began. The number of personal injury collisions reduced from an annual average of 98 to 27 personal injury collisions during the first 24[19] 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.

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 scheme 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. Based on this assessment we estimate that if the road had not been converted to a smart motorway the trend in the number of personal injury collisions would have changed over time period (to between 64 and100 PIC) but not by as much as we have observed for the smart motorway.

Figure 14: Annual average number of personal injury collisions J28 to31



Source: STATS19: 6th September 2008 to 30th March 2018

The business case for the scheme predicted that the conversion to the smart motorway would reduce the number of personal injury collisions by an average of 11 per year[20] . The results indicate that the smart motorway is on its way to achieving the objective to maintain, and where possible, improve safety standards. Another study will be conducted after the smart motorway has been open for a longer timeframe, allowing a more representative time-period, to determine if the safety objective has been achieved.

5.3.1.2. M1 J32-35a

The analysis for M1 J32-35a draws on the following data collection periods

[19] At the time of undertaking analysis there was 2 years of validated safety information available. In discussions with stakeholders a decision was made that it was appropriate to use this timescale.

[20] Based on a reduction of 688 personal injury collisions over a 60 year appraisal period for M1 J28-31

- Pre-construction: 30 June 2008 to 29 June 2013;
- Construction: 30 June 2013 to 29 March 2017;
- Post-opening: 30 March 2017 to 29 March 2018

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 number of personal injury collisions reduced from an annual average of 52 to 16 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.

Based on the counterfactual assessment we estimate that if the road had not been converted to a smart motorway the trend in the number of personal injury collisions would have changed over time period (to between 27 and 63 PIC) but not by as much as we have observed for the smart motorway.

Figure 15: Annual average number of personal injury collisions M1 J32-35a

Source: STATS19: 30th June 2008 to 29th March 2018

The business case for the scheme predicted that the conversion to the smart motorway would reduce the number of personal injury collisions by an average of 2 per year[21]. The results indicate that the smart motorway is on its way to achieving the objective to maintain, and where possible, improve safety standards. Another study will be conducted after the smart motorway has been open for a longer timeframe, allowing a more representative time-period, to determine if the safety objective has been achieved.

5.3.1.3. M1 J31-32

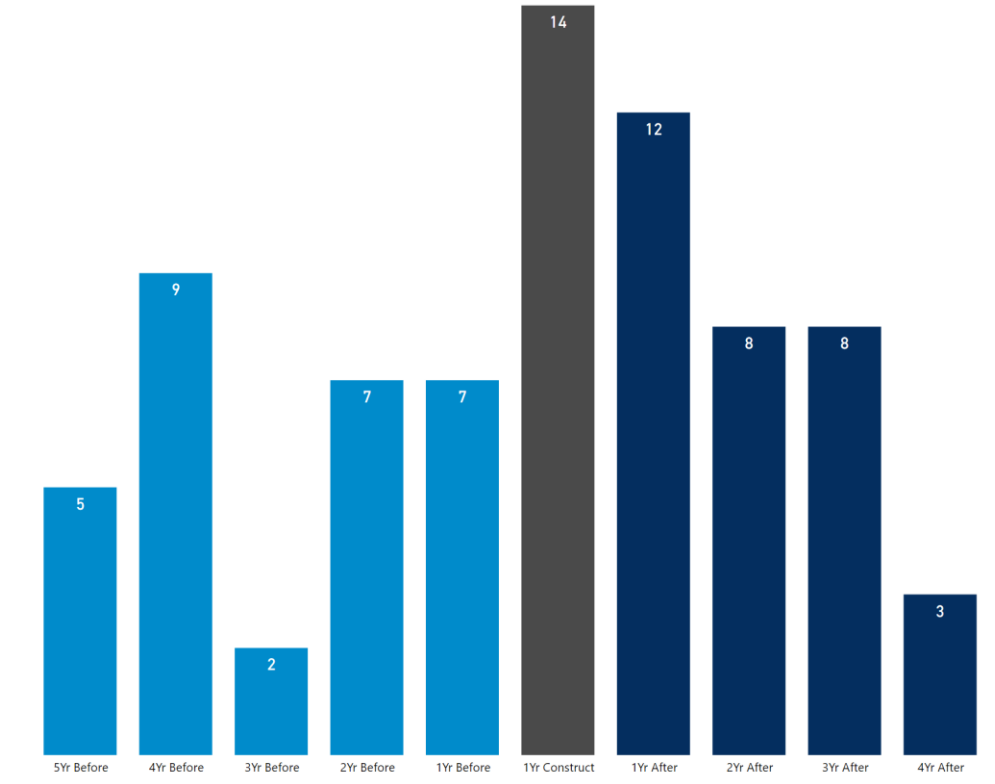
The analysis for M1 J31-32 draws on the following data collection periods

- Pre-construction: 1 February 2009 to 31 January 2014;
- Construction: 1 February 2014 to 31 October 2014;
- Post-opening: 1 November 2014 to 31 October 2018

[21] Based on a reduction of 115 personal injury collisions over a 60 year appraisal period for M1 J32 to 35a

The indications are there was an increase in the number of personal injury collisions for the first four years of the smart motorway than the period before construction began. The annual average number of personal injury collisions increased to 8 in the post opening period, compared to 6 in the five years before construction began[22].

Figure 16: Annual average number of personal injury collisions M1 J31-32



Source: STATS19: 1 February 2009 to 31 January 2018

5.4. How has traffic flow impacted 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 annual million vehicle kilometres (mvkm).

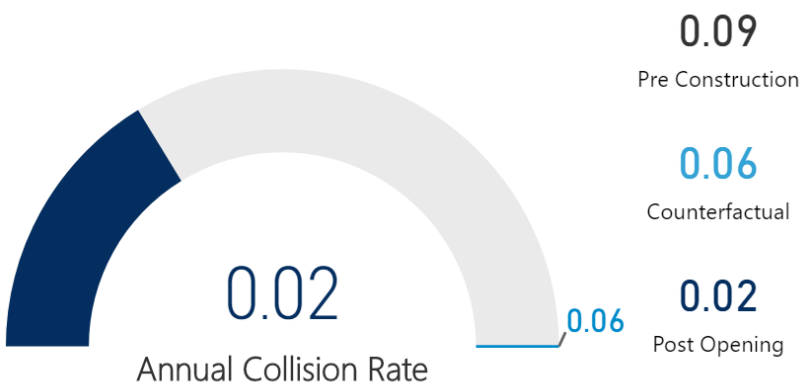
5.4.1.1. M1 J28-31

The average collision rate decreased to 0.02 per million vehicle kilometres. Before the scheme this figure stood as 0.09 per million vehicle km. The decrease is 0.07 personal injury collisions per million vehicle km (Figure 17).

A counterfactual test was undertaken. It found that the collision rate would likely have been 0.06 collisions per million vehicle km in the counterfactual period; above that of the first year after opening the smart motorway.

[22] Due to the low number of collisions that occur on this stretch of motorway we are unable to develop a counterfactual or perform statistical testing. A minimum threshold of 10 collisions is required.

Figure 17: Annual average number of personal injury collisions M1 J28-31



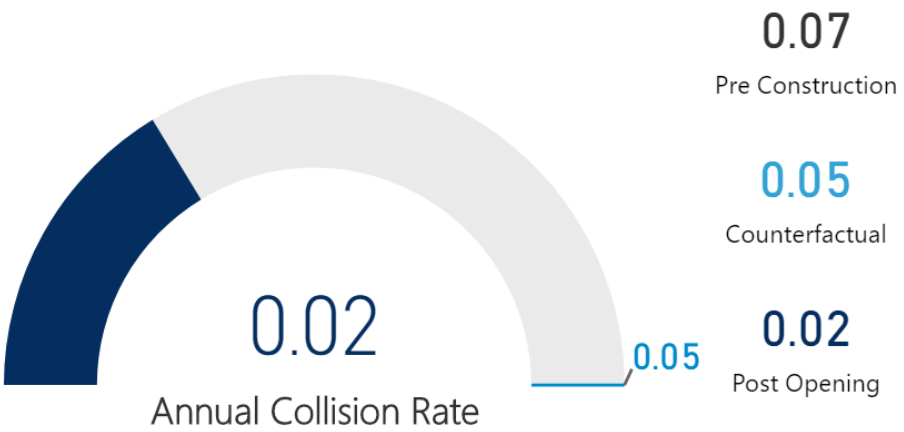
Source: STATS19: 6th September 2008 to 30th March 2018

5.4.1.2. M1 J32-35a

The average collision rate decreased to 0.02 per million vehicle kilometres. Before the scheme this figure stood as 0.07 per million vehicle km. The decrease is 0.05 personal injury collisions per million vehicle km (Figure 18).

A counterfactual test was undertaken. It found that the collision rate would likely have been 0.05 collisions per million vehicle km in the counterfactual period; above that of the first year after opening the smart motorway.

Figure 18: Annual average number of personal injury collisions M1 J32-35a



Source: STATS19: 30th June 2008 to 29th March 2018

Similar to collisions, therefore, collision rates are also lower than what we would have expected without the scheme. This is a positive initial indication: even though traffic levels have increased slightly, collisions have reduced. As these are the first two years' 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.

5.5. Why is analysis of collision severity not feasible?

The way the police record the severity of road safety collisions changed within the timeframes of the evaluation. There has been a shift to a standardised reporting tool known as CRASH – Collision Recording and Sharing. CRASH is an injury based reporting system, and as such severity is categorised automatically by the most severe injury. This has led to some disparity with the previous reporting methods, where severity was categorised by the attending police officer[23].

In this instance, one reporting mechanism was largely used prior to the smart motorway installation and another afterwards. As this will have an impact on severity categorisation for serious and slight collisions that is not attributable to the smart motorway; it would produce unreliable results at this stage. For more detail see Annex 2.

Fatal collisions are not affected by the transfer to CRASH and we are able to report these. For M1 junctions 28 to 31 seven fatal collisions were observed in the five-year period before the scheme and two in the first 24 months of operation.

For M1 junctions 32 to 35a five fatal collisions were observed in the five-year period before the scheme and one fatal collision occurred in the first 12 months of operation as represented in Table 4 below.

No fatal collisions have been recorded in the five-years before and 48 months of operation on M1 junctions 31 to 32.

Table 4: Fatal Collisions M1 J28-35a

Observation Year	M1 J28-31	M1 J32-35a
Before 5	3	1
Before 4	1	3
Before 3	2	0
Before 2	1	0
Before 1	0	1
After 1	0	1
After 2	2	-

Source: STATS19: 30th June 2008 to 30th March 2018

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

6. Environment Evaluation

6.1. Summary

The evaluation of environmental impacts uses information on the predicted impacts gathered from the environmental appraisal and the environmental assessment report and compares them with findings obtained one year after the schemes opened for traffic.

The evaluation of the environmental effects of smart motorways at one year after focuses on the key traffic related environmental objectives using the traffic analysis. Other environmental objectives will be considered at the final evaluation stage when a site visit will be undertaken. This approach reflects the fact that the effects of the scheme arise from impacts occurring within the highway boundary and the timeframe required to observe the maturity of the mitigation planting. This is considered to be a proportionate approach. The appraisal of the junctions 31 to 32 pinch point scheme did not report to have any environmental impacts.

The environmental assessment that was undertaken informed the evolution of the scheme operating regime. The traditional 70mph 24 hours a day seven days a week regime that was originally appraised was determined to cause significant adverse air quality effects. Operating the scheme at 60mph between 7am and 7pm seven days a week was found to mitigate these effects and was progressed during construction. This approach was refined, with additional air quality assessments undertaken, so that when the scheme opened, the schemes were able to operate the 60 mph speed limits in a more targeted way. The operating regime at one year after was 60mph during Monday to Friday morning peak periods (7am to 9am) and evening peak (3pm to 6pm).

A programme of air quality monitoring is underway to assess the operational impacts and the continuing need for mitigation. The air quality objective has not been evaluated at one year after but instead will be evaluated at five years after when the outcome of the monitoring is understood. Our evaluation of the traffic data indicates that noise impacts are broadly as expected however it is too early to draw conclusions on greenhouse gas emissions.

6.2. Noise

The assessment considered both the smart motorway schemes together (M1 junctions 28 to 31 and M1 junctions 32 to 35a). It reported that in the short-term there would be negligible to moderate decreases in traffic noise impacts at the majority of receptors due to the application of a low noise surface. At opening year this would outweigh the impact of traffic being brought closer to properties.

The long-term the assessment showed that majority of receptors would experience negligible decreases with the implementation of the proposed scheme and resulting traffic growth over a 15-year period.

The predicted noise impacts of the scheme were originally assessed based on the 70mph, 7 days a week operating regime and then updated when the regime was

changed to 60mph 7am to 7pm, 7 days a week. However, this is not the operating regime currently in place at one year after.

We have considered the forecast flows against those observed and the observed flows are lower than the forecasts across most time periods. However, the difference between the forecast and observed flows, are not low enough to have a noticeable effect and therefore the noise impacts within the first year were likely to be broadly as expected by the appraisal. However, it should be noted that direct comparisons between the predicted impacts and those observed are limited as the operating regimes are different. We will revisit these findings when we consider the other environmental objectives at the final evaluation stage.

6.3. Greenhouse Gases

To evaluate the greenhouse gas emissions of the appraised schemes, forecast and observed traffic data is required for the appraised study area. It is not always feasible to observe impacts across large geographical areas and typically traffic analysis is focused on the scheme and its local area. This means that the evaluation considers just the opening year emissions directly on the M1 J28-31 and M1 32-35a. This approach has limitations as it means direct comparisons with the forecast emissions reported in the appraisal which are for the wider area cannot be made.

The observed traffic flows at one year after were less than those forecast for most time periods and locations. However, the forecast was not for the operating regime in place when the scheme opened to road users. In view of these limitations, it is not possible to determine with any certainty the changes in greenhouse gases brought about by changes in traffic flows associated with the schemes.

The appraisal predicted that the schemes operating with a 60mph speed limit, seven days a week, 7am to 7pm would have an adverse impact on carbon emissions. The evaluation has found that observed traffic flows are lower than forecast along the mainline. This may suggest lower emissions than forecast. However, as we are unable to assess the impact across the wider study area (e.g. local roads adjoining the M1) it is not possible to determine with certainty the level of changes in greenhouse gases brought about by changes in traffic flows associated with the schemes. Greenhouse gas emissions will be reconsidered during the final evaluation to determine if further analysis is possible.

7. Value for money

When a scheme is appraised, an economic assessment is used to determine the scheme's value for money. The assessment is based on an estimation of costs and benefits from different sources, including Transport Economic Efficient (TEE) benefits (savings related to travel times, vehicle operating costs and user charges), accident costs (savings related to numbers and severity level of accidents) and costs to users due to delays during construction and future maintenance periods.

This is out of scope for the one year after evaluation, but the economic performance of these schemes will be considered after the longer-term assessment of the schemes impacts has been completed.

Annex 1: Counterfactual Methodology

Personal injury collisions (hereafter referred to as 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 scheme.

To establish whether any change in collision numbers is due to the scheme or part of wider regional trends we have established a test we call the Counterfactual. The Counterfactual answers the question: What would have likely occurred without the scheme being implemented? To answer this question, we estimate the range of collisions that could have occurred without the scheme in place. Previous Post Opening Project Evaluations answered this question by looking at national trends in collisions. Adjustments have been made to the methodology for estimating the Counterfactual. These have been made to address the following areas:

Amended Data Collection Method

- Revised method for identifying collisions that occurred on the network.
- Only validated STATS19 information is used for reporting purposes

Adjusting for Traffic Flows

- Baseline traffic flows are an important factor when determining the counterfactual. We now assume that without the changes made to the network, the trends would follow regional background traffic growth patterns
- We can now calculate the collision rate for the busiest stretches of conventional motorways.

Better Differentiation between different types of Motorway

- The existing methodology only had one definition of motorway
- The new method allows us to differentiate between conventional motorways, conventional motorways with high traffic flows and smart motorways.

Assessing Regional Trends

- The new method uses regional rather than national trends for collision rates and background traffic growth, which provides greater granularity and makes the hypotheses more realistic.

We have found that the adjustments have resulted in a slight change from the previous methodology. We still have confidence in the accuracy of the previous methodology but believe we have made suitable changes that will ensure a methodology fit for purpose for the future.

Since this scheme, smart motorways have evolved. More recent all lane running schemes have demonstrated that they are making journeys more reliable for those travelling during congested periods, enabling us to operate the road at a higher speed limit for longer periods, whilst maintaining safety.

Annex 2: Incident Reporting Mechanisms

Police forces choose how they collect STATS19 data. Some police forces do this electronically, for example using mobile devices, while others complete paper forms which are later digitised. In addition, some collisions are reported by members of the public after the event. Since 2016, new data collection systems (called CRaSH and COPA) have been introduced by some police forces.

Before these new systems, reporting police officers categorised the severity of non-killed casualties as either serious or slight according to their own judgment of the injuries sustained. This was based on information available within a short time of the collision, and often did not reflect the results of medical examination. This sometimes led to casualties being incorrectly classified as slight injuries when they were serious, or vice versa.

In January 2016 South Yorkshire police constabulary transferred from Stats19 to CRaSH (Collision Recording and Sharing) system for reporting personal injury collisions. In CRaSH reporting, police officers record the types of injuries suffered by the casualty rather than the severity. In previous systems the determination of severity was at the discretion of the reporting police officer. CRaSH automatically converted the injury type to a severity classification. This led to implications for reporting on collision severity as there had been an increase in the number of serious collisions recorded[24].

These changes make it difficult to monitor trends in the number of KSI casualties over time or between different police forces. To help with this, the Office for National Statistics (ONS) has undertaken research to identify methods of estimating and adjusting for the increased recording of serious injuries in the new systems. Based on this work, DfT have published an adjusted time series of KSIs at the national level and statistical adjustments at the record level. These adjustments are based on estimates of how casualty severities may have been recorded had injury-based severity reporting systems always been used.

The adjustments will be reviewed by the ONS and DfT as more data becomes available, and it is possible that further refinements will be made to the adjustment methodology in the future. Currently it is not possible to reliably adjust collision severity information at the granular level required for this scheme.

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

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