PROJECT REPORT

Monitoring and evaluation of the 60mph trials

Report for the on-road trials of 60mph on the M1 junction 13-16

S Glaze, R Ramnath, S Chowdhury and R Sharp
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Executive Summary

Temporary mandatory speed restrictions are considered for road works on high-speed roads in order to limit the risks posed to road users from specific traffic management features. Current guidance recommends a speed reduction of 20mph for many traffic management features. Where safe to do so, a change in the recommended speed reduction could bring about potential benefits to road users in the form of improved journey times and increased satisfaction.

This report presents the findings from the on-road investigation of a 60mph speed restriction on the M1 junction 13-16 scheme. A 60mph speed restriction was implemented across both carriageways between junction 13 and Newport Pagnell services within the road works. The impact of this change on driver behaviour, customer satisfaction and scheme costs and delivery was monitored over an 8 week monitoring period.

Analysis of the data collected during this monitoring period yielded the following findings:

- Road users responded to the change in speed restriction by increasing their speed; average speeds at the trial location increased from about 49mph before the speed limit change, to 55mph after the speed limit change. This resulted in an estimated journey time reduction of approximately 68 seconds per road user.

- This increase in average vehicle speed had a positive effect on the levels of speed compliance shown by road users, compliance observed with the 60mph speed restriction was higher than with the 50mph speed restriction.

- Some statistically significant variations in vehicle composition by lane were found, but these variations were very small in effect size. As such, differences in vehicle composition are unlikely to have impacted on vehicle speeds and speed compliance.

- The proportion of HGVs engaged in close following (see 3.2.4) decreased as a result of the change in speed restriction, reducing by around 8% on average. The overall amount of close following observed was not greatly affected by the change in speed restriction.

- The number of incidents (Road Traffic Collisions and breakdowns) was too small to enable statistical analysis. Some variability in the number of incidents was seen between the baseline and trial periods, but this was observed both at the control and experimental locations. As such, there was no evidence to suggest the change in speed restriction had a substantial impact on the number of reported incidents observed at the scheme.

- Overall survey respondents from the scheme’s workforce indicated the 60mph speed was ‘about right’. With the change in speed restriction having little impact on the respondent’s feelings of safety, with most responses to surveys indicating it either did not affect how safe they felt or made them feel safe.

- A sample of road users surveyed during the monitoring period suggested that the change in speed restriction overall did not influence how safe customers felt when asked. However, when asked about the appropriateness of either speed restriction, in
terms of safety, road users indicated that a combination of 60mph and 50mph speed restrictions was about right.

Based on these findings, the scheme subsequently looked to implement a 60mph speed restriction during future verge phases of work.

Results from other investigations undertaken by Highways England at the scheme were as follows:

- Customer audits concluded that all the speed restriction signage was clear and well positioned in all cases. All the signage was easily viewable, all auditors were aware of the speed restrictions in place.
- These same audits also suggested that where the road was clear at 50mph a couple of auditors wanted to see the speed limit raised, whilst at 60mph (where most traffic issues occurred) the auditors appeared satisfied even though they could only utilise the raised speed limit.
- A review of social media ‘conversations’, concluded that for those drivers who did notice the increase in speed to 60mph feedback was positive towards the change. A desire to further implement on other road work stretches was inherited.

At the time of writing, further investigations into the use of 60mph speed restrictions are underway, including a study into the impact of the change in speed restriction on customer satisfaction in real time using the M1 J13-16 scheme. Findings from these additional investigations will be collated with the current findings in a final project report.
1 Introduction

1.1 Background

Safety and customer satisfaction are critical components of Highways England’s vision for the future. As part of this vision, Highways England is committed to improving road user experience through road works by ensuring that road works are implemented with appropriate speed restrictions to minimise disruption for customers, whilst also ensuring risk to road users and road workers is as low as reasonably practicable.

Following on from previous investigations into varying speed restrictions within road works, consultation with stakeholders from across Highways England and the Supply Chain, this project was established to support the safe implementation and monitoring of three new trial scenarios. A key defining feature of many of these scenarios is the trial implementation of a 60mph speed restriction in road works with narrowed lane width restrictions.

1.2 Contents of this report

This report summarises the findings from the on-road trial of a 60mph speed restriction on the M1 junction 13-16 scheme during mid to late 2019.

The investigation took place across two sections of the scheme’s traffic management, on both the north bound and south bound carriageways. TRL was commissioned by Highways England to monitor driver behaviour (along with customer satisfaction and scheme cost/delivery) to ensure that the safety of road users and road workers was not compromised by the increase in speed restriction during the investigation.

This report outlines the scheme and data collection methodology, presents the results from the monitoring, summarises these findings and outlines the next steps required.

1.3 Study objectives

The key objectives of the research were to gather evidence of the impact of changing the speed restriction on the M1 junction 13-16 scheme from 50mph to 60mph on:

a) Lane distribution
b) Vehicle speeds
c) The number of non-compliant vehicles
d) The number of incidents
e) The levels of close following (vehicle headway)
f) Customer satisfaction
g) Scheme delivery and cost
2 Method

2.1 Overview of the scheme

In order to reduce congestion and smooth the flow of traffic across this key strategic route, works started in June 2018 on upgrading junctions 13 to 16 on the M1 to four lane running with no hard shoulder as part of the smart motorway programme. The package of work was planned for several distinct phases and sections, with the timeline for the work on-site running until March 2022.

Due to the design of the scheme – three narrow lanes open to traffic in each direction, free breakdown recovery service and 24-hour CCTV – there was an opportunity to change the existing speed restriction in place across a section of verge works from 50mph to 60mph for the purposes of the investigation.

The speed restriction between junction 13 and Newport Pagnell services on both the north and south bound carriageways was changed to 60mph, while the speed restriction across the rest of the scheme (junctions 14 to 16) on both carriageways remained at 50mph.

An overview of the scheme can be seen in Figure 1 below.

**Figure 1: Overview of the M1 junction 13 - 16 scheme (NB = north bound; SB = south bound)**
2.2 Monitoring approach

The on-road investigation sought to monitor the effect of the change in speed restriction on driver behaviour and customer satisfaction. An overview of monitoring locations used in the investigation can be seen in Figure 2 below.

Figure 2: Overview of the monitoring locations used on the M1 junction 13 - 16 scheme investigation (NB = north bound; SB = south bound)

Monitoring took place between the 25th June 2019 and 22nd Aug 2019, with speed restrictions in place as shown in Table 1 and Table 2. Due to different works programmes on each carriageway, the timing of monitoring periods differed across the two carriageways.

<table>
<thead>
<tr>
<th>Table 1: Timelines for monitoring north bound investigation</th>
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<tr>
<td>Dates</td>
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<td>25th Jun 2019 22nd Jul 2019</td>
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<tr>
<td>23rd Jul 2019 19th Aug 2019</td>
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</table>

<table>
<thead>
<tr>
<th>Table 2: Timelines for monitoring south bound investigation</th>
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<tbody>
<tr>
<td>Dates</td>
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<tr>
<td>28th Jun 2019 25th Jul 2019</td>
</tr>
<tr>
<td>26th Jul 2019 22nd Aug 2019</td>
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Throughout the baseline and trial monitoring periods the number of lanes open to traffic and the width of those lanes remained constant. The narrow lanes configuration used featured the following lane widths on both north and south bound carriageways:
Delineation between the work zone and the carriageway was provided by a mixture of cones and temporary vehicle restraint systems (VRS). The set-back between the VRS and the traffic lanes was 600mm.

The composition and placement of the traffic management did vary during the trial, details of this change have been outlined in Table 3 below.

**Table 3: Traffic management composition**

<table>
<thead>
<tr>
<th>Description of activity</th>
<th>Control location</th>
<th>Experimental location</th>
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<tr>
<td>Baseline monitoring period</td>
<td>Narrow lane restrictions (verge works)</td>
<td>Narrow lane restrictions (mixture of centre reservation and verge works)</td>
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<tr>
<td>Trial monitoring period</td>
<td>Narrow lane restrictions (verge works)</td>
<td>Narrow lane restrictions (verge works)</td>
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This difference in traffic management between monitoring phases and monitoring locations means that any variations in driver behaviour between the monitoring phases cannot be attributed solely to the change in speed restriction. Instead such variations must be attributed to a combination of change in speed restriction and change in traffic management phase (central vs. verge works).

### 2.3 Risk assessment

As part of the proposed risk management approach and safety governance for the trialling of 60mph speed restrictions within road works, a programme level safety risk assessment was produced by TRL. This assessment was informed by previous relevant on-road trials, simulator trials, and associated GG 104 risk assessment and was used to feed into the scheme-specific risk assessments carried out by participating schemes (Fordham & Glaze, 2019).

Prior to implementing the change in speed restriction, Amey-Arup carried out a scheme-specific safety risk assessment in line with GG 104 standards. This assessment examined the risks posed to all affected parties from the change in speed restriction, detailing required mitigation measures to address the potential increase in risks posed from the anticipated increase in vehicle speed as part of the investigation on the M1 junction 13-16 scheme.

This assessment concluded that if the change in speed restriction was adopted, it must be accompanied by the introduction of several additional mitigations. Details of these additional mitigations are outlined within the following section (2.3.1).
In accordance with the safety governance requirements outlined within GG 104, the schemes existing project safety control review group (PSCRG) reviewed the scheme-specific assessment. This led to a decision to trial a 60mph speed limit for four weeks between junctions 13 and Newport Pagnell services on both carriageways from mid July 2019.

The PSCRG is a cross-functional group that reviews ‘safety work’ to agree that the safety risks are correctly identified, reviewed and managed appropriately (Highways England, 2015). The group is required to comprise of principal and specialist members. Principal members collectively determine decisions taken and endorse evidence presented to the group. Specialist members provide additional subject matter specialism experience to the group. A list of required roles for each member type can be seen in Appendix A.

2.3.1 Scheme-specific mitigations

Several additional mitigations, above those already outlined within the programme level risk assessment, were identified as being required to manage risks as part of the scheme-specific risk assessment. These additional mitigations were implemented on the scheme prior to the start of the on-road investigations; they are outlined below.

2.3.1.1 Vehicle recovery

Suitable and adequate vehicle recovery provision would be provided to ensure the timely attendance to broken down vehicles. It was anticipated that by providing timely attendance to broken down vehicles the risk posed to road users would be tolerable.

In the case of this investigation, suitable and adequate vehicle recovery provision was deemed to be that stated within the scheme stage 6 traffic management plan.

2.3.1.2 Road safety audit

Prior to the implementation of the 60mph speed restriction a road safety audit (in accordance with Major Projects Instruction (MPI) 45 was undertaken and specifically considered any location or geometry reasons which would make a 60mph speed restriction unsafe (AmeyArup, 2019).

2.3.1.3 Variable message signs

Mobile Variable Message Signs (VMS) where to be positioned in advance of any change in speed restriction to warn approaching road users (AmeyArup, 2019), as outlined in Figure 4.

**Figure 4: Signage used around a step change in speed restriction**

It was anticipated that by providing advanced warning of a ‘step down’ in speed restriction (60mph to 50mph), compliance with the 50mph speed restriction would be maintained.
2.3.1.4  **Temporary traffic regulation order**

In order to facilitate an immediate changing of the 60mph speed restriction to a 50mph speed restriction, a temporary traffic order for the 50mph speed restriction was be put in place (AmeyArup, 2019).

2.3.1.5  **Carriageway markings**

Clear demarcation of lane markings was achieved with an increase in the width of the markings (from 100mm to 150mm wide for the 6+3 markings and from 100mm to 150mm for the edge of carriageway line) (AmeyArup, 2019). This was combined with the implementation of rib line road markings along the line of surface water channel, installed at least 300m in advance of any channel (AmeyArup, 2019).

2.3.1.6  **Speed enforcement**

Prior to the investigation, average speed camera enforcement systems were in place across the scheme, set with an appropriate enforcement threshold for the 50mph speed restriction. For sections with a 60mph speed restriction this threshold was changed to an appropriate level for the new speed restriction. Equipment and suitable signage remained in place throughout the course of the investigation.

2.4  **Safety reviews and abort process**

During the trial monitoring period, weekly safety reports were provided outlining changes in the average speed of vehicles during free-flow periods, the proportion of vehicles over the posted speed limit during free-flow periods and the proportion of vehicles over the enforcement threshold during free-flow periods. These weekly reports fed into an agreed abort process. The details of this process are outlined in the scheme-specific safety risk assessment; Figure 5 below provides a summary.

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1 ‘Free-flow’ was defined as any period where the one-minute averaged speed of all vehicles across the carriageway was greater or equal to 40mph.
Data from the radar units (outlined later in Section 2.5.1) were issued weekly to TRL (Tuesday mornings) and the Safety Reports were created and issued by TRL before the end of the working day. A scheduled review call was carried out the following day (Wednesdays) and during this call the review group discussed the reported safety proxies and any weekly incidents. These review calls acted as the abort decision points outlined within Figure 5 above. An emphasis was placed on any feedback from the Traffic Management Supplier and work crews.

During the four-week trial monitoring period on both investigations, the abort process was not implemented at any point.

2.5 Data collection and statistical comparisons

In order to achieve the objectives of this research (see Section 1.3), several different data sources were used:

- Radar data
- Incident data
- Survey data
- Workshop data

These data sources, and any statistical comparisons which were made, are outlined in more detail in the following sections. Suitable statistical comparisons were undertaken only when a sufficient sample of data was available.

2.5.1 Radar data

In order to monitor speed, flow, headway and lane choice during the baseline and trial periods, four temporary radar installations were installed at the scheme. Each radar installation was
capable of monitoring traffic on a single carriageway, down to the level of individual vehicles. For each investigation two separate installations were used to monitor the control and experimental locations.

2.5.1.1 Location of radar installations

The radar installations were situated on the side of their respective carriageways within the work zone. These positions are depicted in Figure 6 below.

![Figure 6: Location of radar installations](image)

2.5.1.2 Data collected

The radar installations provided data on vehicle flow, speed and headway\(^2\) for each carriageway and lane. These metrics were recorded for each vehicle passing the unit and captured data on vehicle length which was used to classify vehicle types.

2.5.1.3 Data processing

In order to understand the potential impact of the speed restriction change on vehicle speeds, data on driver behaviour were required for periods when drivers were free to choose their own speed. This required conditions with free-flowing traffic. Periods with congested traffic were therefore removed; defined as periods when the average speed of vehicles in a lane across a minute was lower than 40mph. This resulted in the removal of just over 5% of the available data.

In order to classify vehicles by type, the following definitions were used:

- Car/LGV (≤25ft)
- HGV (>25ft)

\(^2\) Headway was defined as the time separation between vehicles, measured from the front bumper of the first vehicle to the front bumper of the following vehicle, averaged over one-minute intervals.
2.5.1.4 Comparison of flow

It was essential to understand how vehicle flow changed between the baseline and trial periods, since any changes in vehicle flow can affect the behaviour of road users and impact their speed. The following comparisons were made:

1. A comparison of overall and daily average vehicle flows between the baseline and trial periods at both experimental and control locations.
2. A comparison of average vehicle flow split by vehicle class between the baseline and trial periods.
3. A comparison of average vehicle flow composition by lane at the experimental location.

The results of these comparisons are presented in sections 3.2.1 and 3.3.1.

2.5.1.5 Comparison of speed

The following comparisons were made using the one-minute average speed data collected from the radars:

1. A comparison of average speed between the baseline and trial periods by monitoring location.
2. Comparison of average speed by lane between the baseline and trial periods at the experimental location.
3. A comparison of average speed by vehicle type between the baseline and trial periods at the experimental location.
4. A comparison of compliance with the posted speed limit between the baseline and trial periods by monitoring location.

The results of these comparisons are presented in sections 3.2.2 and 3.3.2.

2.5.1.6 Comparison of congestion

Data collected during periods of congestion were removed from the comparisons of flow and vehicle speed. This allowed for the impact of the speed restriction change to be explored, since comparisons were focused on free-flow conditions where drivers had free choice of speed. It was however also important to understand the impact of the speed restriction change on the levels of congestion seen at the scheme. A comparison of average daily periods of congestion between the baseline and trial periods by monitoring location was made. The results of this comparison are presented in sections 3.2.3 and 3.3.3.

2.5.1.7 Comparison of close following

The following comparisons were made using the IVD collected from the radars:
1. A comparison of close following between the baseline and trial periods by monitoring location.

2. Comparison of close following by vehicle type between the baseline and trial periods at the experimental location.

The results of these comparisons are presented in sections 3.2.4 and 3.3.4.

### 2.5.1.8 Statistical comparisons

Appropriate statistical tests were used to test for significant differences between data recorded during the baseline and trial periods (i.e. to determine if driver behaviour changed following the implementation of the 60mph speed restriction). Three types of statistical tests were used, depending on the type of data available:

- **Chi-squared tests** were used to test for a difference in the distribution of categorical data, for example to test for a difference in the distribution of vehicle flows between the baseline and trial periods.

- **Analysis of Variance (ANOVA)** was used to test for a difference in the mean response between groups, for example to test for a difference in the average speed between the baseline and trial periods.

- **Two-proportion z-tests** were used to test for a difference in proportions, for example to test for a difference in percentage of vehicles close following.

Results were classified as ‘statistically significant’ if the p-value was less than 0.05 (a common standard in behavioural sciences). The p-value is a measure of probability, and a value of less than 0.05 implies that any differences between the groups being tested has a less than 5% chance that the difference occurred at random.

It must be noted that when the sample size is extremely large (as it is in this study), very small differences could result in statistical significance. In such cases, an effect size is calculated to measure the magnitude of the phenomenon or the degree of association between two variables. Generally, an effect size of less than 0.2 denotes a small effect, 0.5 is a medium effect and 0.8 denotes a large effect. Throughout the report, the effect size has been reported if any result is statistically significant to understand if the effect is due to large sample sizes or a strong relationship between two variables.

### 2.5.2 Incident data

Throughout both the baseline and trial phases of the investigation, incidents which occurred within the confines of the scheme traffic management were documented and collated by the scheme’s traffic management contractor. These logs identified the type of reported incidents (breakdowns and road traffic collisions) along with the location of the incident (carriageway and marker post number) and the date it took place.

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3 A vehicle was defined as engaging in ‘close following’ if there was a gap of less than two seconds to the vehicle in front.
Comparisons of the number of incidents between the baseline and trial phase were made; a summary of these data is presented in section 3.4.

2.5.3 Workforce survey data

To provide further insight into the potential impact of changing the speed restriction at the scheme from 50mph to 60mph, a workforce survey was conducted during the investigation. The survey aimed to capture insight from project managers, site workers and members of the workforce who operate within the carriageway environment.

Comparisons of the survey responses between the baseline and trial periods are presented in section 3.6.

2.5.4 Customer satisfaction survey data

Throughout the on-road investigation, surveys were used to collect information on the impact of increasing the speed limit on the satisfaction levels of road users travelling through the scheme. These surveys were administered to individuals who had identified themselves as having travelled through the scheme during either the baseline and trial periods.

Targeting of these individuals was achieved using a social media advertising campaign, with individuals within a 50km radius of both junctions 13 and 16 of the M1 being targeted to take part in the study. The adverts were also shared with multiple special interest groups on social media platforms. This approach ensured the recruitment of individuals who regularly drove the route over the duration of the investigation.

The surveys collected data on customers’ feelings of safety affected by both the posted speed restriction and the width of the scheme’s lanes. Levels of journey satisfaction and how they were affected by the posted speed restriction and the width of the lanes were also captured.

Comparisons of the survey responses between the baseline and trial periods are presented in section 3.7.

2.5.5 Delivery and cost impacts

In order to understand the impact of the change in speed restriction on the scheme’s delivery and costs, a lessons-learned workshop was held after the monitoring periods had ended. The session sought to capture details on any impacts to the scheme associated with implementing the change in speed restriction. Attendees included the scheme’s Highways England Project Manager, Principal Contractor, Traffic Management Supplier, Traffic Officers, Communications Manager and Risk Contractor.

A summary of the findings of this workshop is presented in Section 3.8.
3 Results

3.1 Overview

This section provides an overview of the findings from the on-road trial, and the impact of the change in speed restriction on:

- Driver behaviour;
- Incidents and breakdowns;
- Journey times;
- Welfare of the workforce;
- Customer satisfaction, and
- The scheme’s delivery and cost.

The main findings are summarised in Table 4 below, with full results from the detailed analysis presented in the succeeding sections.

Table 4: The key findings from the on-road trials of 60mph on the M1 J13-16 scheme

<table>
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<tr>
<th></th>
<th>North bound carriageway</th>
<th>South bound carriageway</th>
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<tbody>
<tr>
<td><strong>Vehicle flow</strong></td>
<td>There was no statistically significant difference in average vehicle flow between the control and experimental locations and between the baseline and trial periods.</td>
<td>There was no statistically significant difference in average vehicle flow between the baseline and trial period at the experimental location. Issues with data collection led to a loss of data at the control location.</td>
</tr>
<tr>
<td><strong>Vehicle speed</strong></td>
<td>The compliance rates improved for all vehicles when the speed restriction was 60mph compared with 50mph, and compliance remained relatively constant at the control location where the speed restriction remained at 50mph.</td>
<td></td>
</tr>
<tr>
<td><strong>Congestion</strong></td>
<td>There was minimal routine congestion at the scheme, on both the north bound and south bound carriageway, as the hourly average speed did not fall below 40 mph.</td>
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<tr>
<td><strong>Close following</strong></td>
<td>During the baseline period the proportion of vehicles close following was 40% at the control location but slightly lower (38%) at the experimental location. During the trial period, the proportion remained similar to the baseline period at both locations. Statistically significant differences were identified, but the effect size was very small.</td>
<td>During the baseline period the proportion of vehicles close following was 40% at the experimental location, but slightly lower (38%) at the control location. During the trial period, the proportion reduced to 37% at the experimental location and 27% at the control location – however data collection issues mean results should be interpreted with caution.</td>
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<td>Section</td>
<td>Description</td>
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<tr>
<td>Incidents and breakdowns</td>
<td>No safety concerns were raised by the scheme around the number of reported incidents during the trial. The number of incidents (Road Traffic Collisions and breakdowns) was too small to enable statistical analysis. Some variability in the number of incidents was seen between the baseline and trial periods, but this was observed both at the control and experimental locations.</td>
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<tr>
<td>Journey time</td>
<td>Increasing the speed restriction from 50mph to 60mph decreased the average journey time by around 68 seconds per driver.</td>
<td></td>
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<tr>
<td>Workforce survey</td>
<td>There was a broad spread in perceptions of safety across the workforce with most participants rating the 50mph (106 responses) and 60mph (19 responses) speed restrictions as ‘about right’.</td>
<td></td>
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<tr>
<td>Customer satisfaction</td>
<td>Data from a sample of road users surveyed during the monitoring period suggested that, overall, the change in speed restriction did not influence how safe customers felt when asked. When asked about the appropriateness of either speed restriction, in terms of safety, road users indicated that both the 60mph and 50mph speed restrictions were ‘about right’.</td>
<td></td>
</tr>
<tr>
<td>Scheme delivery</td>
<td>Feedback from the scheme suggested that the delivery of the work activities was not impacted by the 60mph speed restriction.</td>
<td></td>
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<tr>
<td>Scheme cost</td>
<td>An additional cost was incurred by the scheme in order to implement the trial of the 60mph speed restriction.</td>
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3.2 North bound driver behaviour

This section presents the driver behaviour data collected on the north bound carriageway.

3.2.1 Vehicle flow

Figure 7 shows the average daily vehicle flow across the baseline and trial monitoring periods between the control and experimental monitoring locations on the north bound carriageway of the M1.

![Average daily vehicle flow by location and monitoring period](image)

The average daily vehicle flow varied over the course of the investigation at both the control and experimental locations. The control location had an average daily flow of 47,271 during the baseline period and 47,862 during the trial period. The experimental location had slightly higher average daily flows of 49,247 during the baseline period and 50,175 during the trial period.

A chi-square test was conducted to test for statistically significant differences between the average daily vehicle flow by monitoring period and location. The test found that there was no statistically significant difference in flow between the control and experimental locations and between the baseline and trial periods ($p=0.49$). This suggests that any changes in average speed or compliance with the change in speed restriction may be attributed to changes in driver behaviour rather than changes in flow.

A comparison of the proportion of HGVs by monitoring location and period is presented in Figure 8. This shows that the proportion of HGVs remained reasonably constant at both locations throughout the investigation. The average proportion of HGVs at the experimental location was 16% of all traffic during the baseline period and 17% during the trial period. The proportion of HGVs at the control period was similar throughout the trial with an average of 15% during the baseline period and 16% during the trial period.
A two-proportion z-test indicated that the small difference in the HGV proportions at the experimental location between the baseline and trial periods was statistically significant ($p < 0.02$). Tests also showed that there were significant differences ($p < 0.01$) in HGV proportion between the control and experimental locations during both periods. However, in both cases, the effect size was extremely small (0.02) and therefore, this difference is unlikely to have had a significant impact on driver behaviour.

The distribution of vehicles between Lane 1, Lane 2, and Lane 3 within the experimental location is shown in Table 5.

**Table 5: Distribution of vehicles by lane and monitoring period at the experimental location**

<table>
<thead>
<tr>
<th>Monitoring period</th>
<th>Vehicle type</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline period</strong></td>
<td>All vehicles</td>
<td>33%</td>
<td>39%</td>
<td>27%</td>
</tr>
<tr>
<td><strong>Trial period</strong></td>
<td>All vehicles</td>
<td>29%</td>
<td>40%</td>
<td>31%</td>
</tr>
</tbody>
</table>

The distribution of vehicles across the three available lanes at the experimental location changed slightly between the baseline and trial periods.

A chi-square test showed that the small variation in vehicle distribution between the baseline and trial periods at the experimental location was statistically significant ($p < 0.05$) but with a very small effect size of 0.04.

The proportions of each vehicle type in Lane 1, Lane 2, and Lane 3 within the experimental location is shown in.
Table 6: Composition of vehicle by lane and monitoring period at the experimental location

<table>
<thead>
<tr>
<th>Monitoring period</th>
<th>Vehicle type</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline period</td>
<td>Cars + LGVs</td>
<td>74%</td>
<td>86%</td>
<td>93%</td>
</tr>
<tr>
<td></td>
<td>HGVs</td>
<td>26%</td>
<td>14%</td>
<td>7%</td>
</tr>
<tr>
<td>Trial period</td>
<td>Cars + LGVs</td>
<td>71%</td>
<td>88%</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>HGVs</td>
<td>29%</td>
<td>12%</td>
<td>5%</td>
</tr>
</tbody>
</table>

The vehicle composition of Lane 1 at the experimental location remained similar between the baseline and trial periods. A chi-square test showed that the small variation in vehicle composition between the baseline and trial periods at the experimental location was statistically significant ($p < 0.01$) but with a very small effect size of 0.03.

Likewise, the composition of vehicles in Lane 2 remained reasonably constant between the baseline and trial periods. Like Lane 1, a chi-square test showed that there was a significant difference ($p < 0.01$), but with a small effect size of 0.03.

The composition of vehicles in Lane 3 also remained similar between baseline and trial periods. A chi-square test showed that there was a statistically significant difference ($p<0.05$), but the effect size was very small (0.02).

Taken together these results suggest that the statistical significance can be attributed to the large sample sizes rather than a large difference in vehicle composition between monitoring periods, as outlined earlier in section 2.5.1.8. As such, it is unlikely that any changes identified, later in this report, in vehicle speeds and speed compliance are as a result of differences in vehicle composition.

### 3.2.2 Vehicle speed

To ensure that comparisons of vehicle speed were not conflated by the presence of small numbers of high speed vehicles, the one-minute average speed data were weighted by vehicle flow. This ensured that more weight was given to data from periods when the flow was higher, compared to times when there were fewer vehicles (low flow), since averages calculated from small numbers of vehicles may be more greatly biased by high speed outliers.

Comparisons were made between control and experimental locations to account for background factors (aside from the speed restriction change) which may have influenced driver behaviour between the two monitoring periods.

Figure 9 shows the free-flow average speeds at the control and experimental locations across the two monitoring periods.
Figure 9: Free-flow average speed during the monitoring period by location

Free-flow average speed at the control location remained similar throughout the investigation, at around 49mph. At the experimental location, there was an increase in free-flow average speed from around 49mph in the baseline period to around 55mph in the trial period.

A statistical test (ANOVA) confirmed that there was a significant difference in free-flow average speed (p < 0.01) between the baseline and trial periods at the experimental location, explaining around 97% of the total variance. There was no significant difference in average speeds between baseline and trial periods at the control location (p = 0.12) as such no effect size can be reported.

As the difference in flow between monitoring periods and monitoring locations was not significant, changes in speed are unlikely to have been impacted by differences in flow.

The free-flow average speeds by lane are shown in Table 7.

Table 7: Free-flow average speed (mph) by monitoring period and lane at the experimental location

<table>
<thead>
<tr>
<th>Monitoring period</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline period</td>
<td>45.7</td>
<td>49.6</td>
<td>51.7</td>
</tr>
<tr>
<td>Trial period</td>
<td>50.2</td>
<td>55.8</td>
<td>58.0</td>
</tr>
</tbody>
</table>

In both periods, speeds were highest in Lane 3, followed by Lane 2 and then Lane 1. Table 7 shows that the free-flow average speed in Lane 1 at the experimental location increased by 4.5mph between the baseline and trial periods and in Lane 2 there was an increase of 6.2mph. Lane 3 had an increase of 6.3mph between the baseline and trial period. Although not shown here, there was little change in the average speeds by lane at the control location.
Figure 10 shows the comparison between the average speed for cars/LGVs and HGVs across the monitoring periods at the experimental location.

![Graph showing average speed by vehicle type at the experimental location](image)

**Figure 10: Average speed by vehicle type at the experimental location**

The free-flow average speed of HGVs during the baseline period was around 51mph - slightly higher than the free flow average speed of cars and LGVs at 49mph. In the trial period, both vehicle types were travelling at an average free-flow speed of 55mph.

In order to understand the compliance of road users with the posted speed, data were separated into speed bins. These speed bins (0-40, 40-50, 50-57, 57-60, 60-68, 68+mph) allow for vehicles to be identified as travelling: below the speed limit, above the speed limit but below the enforcement limit, and above the enforcement limit (10% of speed limit +2mph).

Figure 11 and Figure 12 show the proportion of vehicles recorded in each speed bin across the two monitoring periods at the experimental location.

The grey bars show the proportion of vehicles travelling below the speed limit; the orange bars show the proportion of vehicles travelling above the speed limit but below the enforcement threshold (10% of speed limit+2 mph); and the red bars show vehicles travelling above the enforcement threshold.

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4 This is based on the National Police Chiefs Council/Association of Chief Police Officers (ACPO) Speed Enforcement Policy Guidelines 2011-2015 (ACPO, 2013) which suggest that a Fixed Penalty or speed awareness education may be appropriate when the speed is 10% +2mph above the speed limit (see paragraph 9.6). These are only guidelines and a police officer/ force can decide to enforce at a speed lower than this limit assuming they have considered the tolerance of the measurement equipment (paragraph 9.7).
Figure 11: Proportion of vehicles in each speed bin during the baseline period at the experimental location

Figure 12: Proportion of vehicles in each speed bin during the trial period at the experimental location
The proportion of vehicles travelling above the posted speed limit at the experimental location changed considerably between the baseline and trial periods, dropping from 33% to 17%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 9% to 4% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed limit, above speed limit but below enforcement threshold and above enforcement threshold), two-proportion z-tests showed that, for all three categories, the proportion of vehicles in the category was significantly different (p<0.01) between the baseline and trial periods at the experimental location. Additionally, the three tests showed medium to small effect sizes of 0.37, 0.28 and 0.17, respectively.

Figure 13 and Figure 14 show the proportion of vehicles recorded in each speed bin across the two monitoring periods at the control location.

![Figure 13: Proportion of vehicles in each speed bin during the baseline period at the control location](image-url)
The proportion of vehicles in each speed bin at the control location remained fairly consistent between the baseline and trial periods. This is expected as the posted speed limit remained the same during both periods at the control location, and further demonstrates that the changes observed at the experimental location were due to the change in speed restriction.

Even though statistical tests showed that the proportion of vehicles in each of the three speed categories were significantly different (p<0.05) between the baseline and trial period, the effect sizes were negligible (0.02 for all three tests).

Figure 15 and Figure 16 show the proportion of cars and LGVs (i.e. the figures above repeated but with HGVs excluded) recorded in each speed bin across the two monitoring periods at the experimental location.
The proportion of cars and LGVs travelling above the posted speed limit at the experimental location changed considerably between the baseline and trial periods, dropping from 34% to
17%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 8% to 3% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed limit, above speed limit but below enforcement threshold and above enforcement threshold), two-proportion z-tests showed that, for all three categories, the proportion of vehicles in the category was significantly different (p<0.01) between the baseline and trial periods at the experimental location. Additionally, the three tests showed small to medium effect sizes of 0.37, 0.30 and 0.26, respectively.

Figure 17 and Figure 18 show the proportion of HGVs recorded in each speed bin across the two monitoring periods at the experimental location.

![Figure 17: Proportion of HGVs in each speed bin during the baseline period at the experimental location](image-url)
The proportion of HGVs travelling above the posted speed limit at the experimental location changed considerably between the baseline and trial periods, dropping from 34% to 16%. Similarly, the proportion of HGVs travelling above the enforcement limit decreased from 17% to 9% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed limit, above speed limit but below enforcement threshold and above enforcement threshold), two-proportion z-tests showed that, for all three categories, the proportion of vehicles in the category was significantly different (p<0.01) between the baseline and trial periods at the experimental location. The effect sizes were around 0.44, 0.34 and 0.21, respectively.

In summary, these data show that compliance rates improved for all vehicles when the speed restriction was 60mph compared with 50mph, and compliance remained relatively constant at the control location where the speed restriction remained at 50mph.

### 3.2.3 Congestion

A check was conducted on the total duration of congestion observed during the investigation. At the experimental location, 5.5% of the total time across both monitoring periods was classified as congested; defined as any period where the one-minute averaged speed of all vehicles in a lane was less than 40mph. At the control location, 2.1% of the total time was classified as congested. Figure 19 outlines the average speeds per hour of the day, by monitoring period and location.
This figure shows that, generally, average speed was higher during the night (between 22:00 and 06:00) and lower during the day. Although this was significant, the effect size was relatively small. This pattern appears consistent across the baseline period at both locations and during the trial period at the control location. During the trial period at the experimental location, however, the average speed was higher overall (as discussed in the previous section). As the hourly average speed did not fall below 40mph it can be concluded that there was minimal routine congestion at the scheme. As such the introduction of a 60mph speed restriction did not appear to have an impact on the amount of congestion seen through the scheme.

Figure 19: Average hourly vehicle speed by location and monitoring period

3.2.4 Close following

A vehicle was defined as engaging in ‘close following’ if there was a headway of less than two seconds to the vehicle in front. This section presents comparisons of close following between monitoring period and location; both for all vehicles and split by vehicle class.

Figure 20 shows the proportion of total vehicles close following across the course of the trial at both the control and experimental locations.
During the baseline period the proportion of vehicles close following was 40% at the control location but slightly lower (38%) at the experimental location. During the trial period, the proportion remained similar to the baseline period at both locations.

A two-proportion z-test indicated that the small difference in the proportion of vehicles close following at experimental location between the baseline and trial periods was statistically significant (p<0.01), but with a very small effect size of 0.04.

Figure 21 shows the split of HGVs and cars/LGVs close following at the experimental location. HGVs are defined as any vehicle over 25ft long.
A significantly higher proportion of cars/LGVs were close following at the experimental location (p<0.05) than HGVs, although the effect sizes were very small (0.08 during the baseline and 0.21 during the trial period). At the experimental location:

- 38% of cars/LGVs were close following in baseline period
- 39% of cars/LGVs were close following in the trial period
- 34% of HGVs were close following in the baseline period
- 29% of HGVs were close following in the trial period

A two-proportion z-test indicated that these differences were statistically significant (p<0.01) but with a very small effect size of 0.02.

3.3 South bound driver behaviour

This section presents the driver behaviour data collected on the north bound carriageway.

3.3.1 Vehicle flow

Figure 22 shows the average daily vehicle flow for the baseline and trial monitoring periods between the control and experimental monitoring locations.

![Figure 22: Average daily vehicle flow by location and monitoring period](image)

The average daily vehicle flow varied over the course of the investigation at both the control and experimental locations. The control location had an average daily flow of 48,727 during the baseline period and 24,841 during the trial period. Issues with the radar unit at the control locations resulted in a loss of data during the trial period, accounting for the reduction in vehicle flow observed – particularly in Week 2, 3, and 4 of the trial period. The experimental location had a higher average daily flow of 51,133 during the baseline period and 50,164 during the trial period.
Statistical tests showed that there was no significant difference (p=0.37) in average vehicle flow between the baseline and trial period at the experimental location. Due to the issues with data collection, no statistical tests were conducted with data from the control location.

A comparison of the proportion of HGVs by monitoring location and period is presented in Figure 23. This shows that the proportions of HGVs remained fairly constant at the experimental location throughout the trial, 15% during the baseline period and 14% during the trial period.

The proportion of HGVs increased at the control location, but due to the issues with the radar data this may be an artefact of the poor quality of the data.

![Figure 23: Proportion of HGVs by week and location](image)

A two-proportion z-test indicated that the difference in the HGV proportions at the experimental location between the baseline and trial periods was statistically significant (p<0.01). However, the effect size was small (0.02) and therefore, this difference is unlikely to have had a significant impact on driver behaviour.

The distribution of vehicles between Lane 1, Lane 2, and Lane 3 within the experimental location is shown in Table 8.

<table>
<thead>
<tr>
<th>Monitoring period</th>
<th>Vehicle type</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline period</td>
<td>All vehicles</td>
<td>37%</td>
<td>40%</td>
<td>26%</td>
</tr>
<tr>
<td>Trial period</td>
<td>All vehicles</td>
<td>31%</td>
<td>39%</td>
<td>29%</td>
</tr>
</tbody>
</table>

The distribution of vehicles across the three available lanes at the experimental location varied between the baseline and trial periods.
A chi-square test showed that the small variation in vehicle distribution between the baseline and trial periods at the experimental location was statistically significant (p<0.05) but with a very small effect size of 0.06.

The proportions of each vehicle type in Lane 1, Lane 2, and Lane 3 within the experimental location is shown in Table 9.

**Table 9: Composition of vehicle by lane and monitoring period at the experimental location**

<table>
<thead>
<tr>
<th>Monitoring period</th>
<th>Vehicle type</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline period</td>
<td>Cars + LGVs</td>
<td>77%</td>
<td>85%</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>HGVs</td>
<td>23%</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>Trial period</td>
<td>Cars + LGVs</td>
<td>73%</td>
<td>89%</td>
<td>96%</td>
</tr>
<tr>
<td></td>
<td>HGVs</td>
<td>27%</td>
<td>11%</td>
<td>4%</td>
</tr>
</tbody>
</table>

The vehicle composition in Lane 1 at the experimental location remained similar between the baseline and trial periods. A chi-square test showed that the small variation in vehicle composition between the baseline and trial periods at the experimental location was statistically significant (p < 0.01) but with a very small effect size of 0.05.

Similarly, the composition of vehicles in Lane 2 remained fairly consistent between the baseline and trial periods. Similar to Lane 1, a chi-square test showed that there was a significant difference in vehicle composition between the baseline and trial periods at the experimental location (p<0.01), but with a small effect size of 0.05.

The composition of vehicles in Lane 3 also remained similar between baseline and trial periods. A chi-square test showed that the difference was statistically significant (p<0.05). However, the effect size was very small (0.03).

As with the north bound data, the variations in vehicle composition by lane at the experimental location, even though statistically significant, were found to be very small in terms of effect size. As such, differences in vehicle composition are unlikely to have impacted on vehicle speeds and speed compliance.

### 3.3.2 Vehicle speed

As explained above, to ensure that comparisons of vehicle speed were not conflated by the presence of small numbers of high speed vehicles, the one-minute average speed data were weighted by vehicle flow.

Comparisons were made between control and experimental locations to account for background factors (aside from the speed restriction change) which may have influenced driver behaviour between the two monitoring periods.

Figure 24 shows the free-flow average speeds on the control and experimental locations across the two monitoring periods.
Report for the on-road trials of 60mph on the M1 junction 13-16

Free-flow average speed at the control location remained fairly constant throughout the investigation, at around 48mph. At the experimental location, there was an increase in the free-flow average speed from around 49mph in the baseline period to around 55mph in the trial period.

A statistical test (ANOVA) confirmed that there was a significant difference in free-flow average speed ($p<0.01$) between the baseline and trial periods at the experimental location, explaining around 96% of the total variance. There was no significant difference in average speeds between baseline and trial periods at the control location ($p=0.13$).

As the difference in flow between monitoring periods and monitoring locations was not significant, changes in speed are unlikely to have been impacted by differences in flow.

Free-flow average speeds by lane are shown in Table 10.

**Table 10: Free-flow average speed (mph) by monitoring period and lane at the experimental location**

<table>
<thead>
<tr>
<th>Monitoring period</th>
<th>Lane 1</th>
<th>Lane 2</th>
<th>Lane 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline period</td>
<td>46.4</td>
<td>49.9</td>
<td>52.0</td>
</tr>
<tr>
<td>Trial period</td>
<td>51.0</td>
<td>56.0</td>
<td>58.3</td>
</tr>
</tbody>
</table>

In both periods, speeds were highest in Lane 3, followed by Lane 2, and then Lane 1. Table 10 shows that the free-flow average speed in Lane 1 at the experimental location increased by 4.6mph between the baseline and trial periods. Lane 2 had an increase of 6.1mph between the two periods, while Lane 3 had a 6.3mph speed difference. Although not shown here, there was little change in the average speeds by lane in the control location.

Figure 25 shows the comparison between free-flow average speed for cars/LGVs and HGVs across the monitoring periods at the experimental location.
The free-flow average speed of HGVs during the baseline period was the same as the free-flow average speed of cars and LGVs at 49mph. In the trial period, free-flow average speed for cars and LGVs was 55mph, while HGVs were travelling at an average free-flow speed of 52mph.

In order to understand the compliance of road users with the posted speed, data were separated into speed bins. These speed bins (0-40, 40-50, 50-57, 57-60, 60-68, 68+mph) allow for vehicles to be identified as travelling: below the speed limit, above the speed limit but below the enforcement limit, and above the enforcement limit (10% of speed limit +2mph).

Figure 26 and Figure 27 show the proportion of vehicles recorded in each speed bin across the two monitoring periods at the experimental location.

The grey bars show the proportion of vehicles travelling below the speed limit; the orange bars show the proportion of vehicles travelling above the speed limit but below the enforcement threshold (10% of speed limit+2 mph); and the red bars show vehicles travelling above the enforcement threshold.
The proportion of vehicles travelling above the posted speed limit at the experimental location changed considerably between the baseline and trial periods, dropping from 28% to 10%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 4% to 1% between the two periods.
When looking at the differences in the proportion of vehicles in each category (below speed limit, above speed limit but below enforcement threshold and above enforcement threshold), two-proportion z-tests showed that, for all three categories, the proportion of vehicles in the category was significantly different (p < 0.01) between the baseline and trial periods at the experimental location. Additionally, the three tests showed small to medium effect sizes of 0.49, 0.41 and 0.26, respectively.

Figure 28 and Figure 29 show the proportion of vehicles recorded in each speed bin across the two monitoring periods at the control location.

![Proportion of vehicles in each speed bin during the baseline period at the control location](image)

**Figure 28: Proportion of vehicles in each speed bin during the baseline period at the control location**
Figure 29: Proportion of vehicles in each speed bin during the trial period at the control location

The proportion of vehicles recorded as traveling above the posted speed restriction at the control location changed from 22% to 14% between the baseline and trial periods. This change is likely the result of the data collection issues described in section 3.3.1.

Figure 30 and Figure 31 show the proportion of cars and LGVs recorded in each speed bin across the two monitoring periods at the experimental location.
The proportion of cars and LGVs travelling above the posted speed limit at the experimental location changed considerably between the baseline and trial periods, dropping from 30% to 10%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 4% to 0% between the two periods.
When looking at the differences in the proportion of vehicles in each category (below speed limit, above speed limit but below enforcement threshold and above enforcement threshold), two-proportion z-tests showed that, for all three categories, the proportion of vehicles in the category was significantly different (p < 0.01) between the baseline and trial periods at the experimental location. Additionally, the three tests showed small to medium effect sizes of 0.50, 0.42 and 0.27, respectively.

Figure 32 and Figure 33 show the proportion of HGVs recorded in each speed bin across the two monitoring periods at the experimental location.

![Bar chart showing speed bin categories and their proportions](image)

**Figure 32: Proportion of HGVs in each speed bin during the baseline period at the experimental location**
Below speed limit  | Above speed limit but below enforcement limit  | Above enforcement limit

![Proportion of HGVs in each speed bin during the trial period at the experimental location](image)

**Figure 33: Proportion of HGVs in each speed bin during the trial period at the experimental location**

The proportion of HGVs travelling above the posted speed limit at the experimental location changed considerably between the baseline and trial periods, dropping from 19% to 5%. Similarly, the proportions of HGVs travelling above the enforcement limit decreased from 4% to 2% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed limit, above speed limit but below enforcement threshold and above enforcement threshold), two-proportion z-tests showed that, for all three categories, the proportion of vehicles in the category was significantly different ($p < 0.01$) between the baseline and trial periods at the experimental location. The effect sizes were medium to small - 0.49, 0.41 and 0.11, respectively.

### 3.3.3 Congestion

A check was conducted on the total duration of congestion observed during the investigation. At the experimental location, 6.2% of the total time from both monitoring periods was classified as congested; defined as any period where the one-minute averaged speed of all vehicles across a lane was less than 40mph. At the control location, 6.6% of the total time was classified as congested. Figure 34 outlines the average speeds per hour of the day, by monitoring period and location.

Figure 34 shows that, generally, average speed was higher during the night (between 20:00 and 06:00) and lower during the day. This pattern appears consistent across the baseline period at both locations and during the trial period at the control location. During the trial period at the experimental location, however, the average speed was higher overall. As on average the hourly average speed did not fall below 40mph it can be concluded that there
was minimal routine congestion at the scheme. As such the introduction of a 60mph speed restriction did not appear to have an impact on the amount of congestion seen through the scheme.

![Average hourly vehicle speed by location and monitoring period](image)

**Figure 34: Average hourly vehicle speed by location and monitoring period**

### 3.3.4 Close following

A vehicle was defined as engaging in ‘close following’ if there was a headway of less than two seconds to the vehicle in front. This section presents comparisons of close following between monitoring period and location; both for all vehicles and split by vehicle class.

Figure 35 shows the proportion of total vehicles close following across the course of the trial at the experimental location.
Figure 35: Proportion of vehicles close following by monitoring period and location

During the baseline period the proportion of vehicles close following was 40% at the experimental location, but slightly lower (38%) at the control location. During the trial period, the proportion reduced to 37% at the experimental location and 27% at the control location. The control location data must be read with caution due to faulty radar in Week 2, Week 3, and Week 4 of the trial period, as previously mentioned.

A two-proportion z-test indicated that the small difference in the proportion of vehicles close following at experimental location between the baseline and trial periods was statistically significant (p < 0.01), but with a small effect size of 0.03.

Figure 36 shows the split of HGVs and cars/LGVs close following at the experimental location. HGVs are defined as any vehicle over 25ft long.
Figure 36: Proportion of vehicles close following by period and vehicle type at the experimental location

About 40% of cars/LGVs and 40% of HGVs were close following at the experimental location during the baseline period. These percentages reduced during the trial period to 38% for cars and LGVs and to 29% for HGVs.

A two-proportion z-test indicated that the difference in the proportion of both HGVs and cars/LGVs close following at the experimental location between the baseline and trial periods was statistically significant (p < 0.01) with a small effect size of 0.19.

3.4 Reported incidents

In total 531 incidents were reported across both investigations by the schemes temporary traffic management supplier: 252 of which were in the baseline monitoring periods, and 279 in the trial monitoring periods. A summary of these reported incidents is presented in Figure 37 and Figure 38.
The number of reported incidents varied between the baseline and trial period at both the control and experimental locations on the north bound carriageway. At the experimental location, where the speed restriction changed between monitoring periods, the total number of reported incidents was 59 during the baseline period and 66 during the trial period. At the control location, where the speed restriction remained consistent across the investigation, the total number of reported incidents was 80 during the baseline period and 86 during the trial period.

Looking specifically at road traffic collisions (RTCs), the figures showed 15 RTCs during the baseline period and 8 RTCs during the trial period. At the control location the number of reported RTCs was 11 during the baseline period and 8 during the trial period.
The number of reported incidents also varied between the baseline and trial period at both the control and experimental locations on the south bound carriageway. At the experimental location, where the speed restriction changed between monitoring periods, the total number of reported incidents was 55 during the baseline period and 68 during the trial period.

At the control location, where the speed restriction remained consistent across the investigation, the total number of reported incidents was 58 during the baseline period and 59 during the trial period.

Looking specifically at RTCs, at the experimental location there were 7 RTCs during the baseline period and 14 during the trial period. At the control location there were also 7 reported RTCs during the baseline period and 14 during the trial period.

During the trial no safety concerns were raised by the scheme around the number of reported incidents. On the north and south bound investigations, as a similar increase in reported incidents was observed at both monitoring locations during the investigation, it was concluded that there was a general increase in the number of incidents across the carriageway over the duration of the investigation rather than an increase solely attributable to the change in speed restriction.

3.5 Journey time

Estimates of the average journey time were calculated for both investigations based on the length of the speed restriction and a single aggregated free-flow average speed of vehicles, for each four week monitoring period, from the radar data.

Table 11 shows the estimated average journey time during the baseline and trial periods. All monitoring locations have been included for the purposes of comparison.

<table>
<thead>
<tr>
<th>Monitoring location</th>
<th>Length (km)</th>
<th>Average vehicle speed (mph)</th>
<th>Journey time (seconds)</th>
<th>Difference (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>23.6</td>
<td>Baseline 49.1</td>
<td>Trial 49</td>
<td>Baseline 1075.2</td>
</tr>
<tr>
<td>Experimental</td>
<td>14.4</td>
<td>Baseline 49.1</td>
<td>Trial 49</td>
<td>Baseline 660.1</td>
</tr>
<tr>
<td>Control</td>
<td>24.9</td>
<td>Baseline 48.6</td>
<td>Trial 54.7</td>
<td>Baseline 1146.1</td>
</tr>
<tr>
<td>Experimental</td>
<td>13.1</td>
<td>Baseline 49.1</td>
<td>Trial 55.1</td>
<td>Baseline 596.8</td>
</tr>
</tbody>
</table>

The results suggest that changing the speed restriction from 50mph to 60mph decreased the average journey time by around 68 seconds. Relative to the journey time through the 13-14km scheme, this represents about an 11% reduction in the trial period compared with the baseline period. When considering the approximately 100,000 drivers (50,000 per carriageway) who travelled through the scheme each day, the time savings are notable.
No real change in journey time was observed at the control location, the speed restriction remained consistent throughout both monitoring periods.

### 3.6 Workforce survey

In total, 193 individuals completed the workforce survey during the investigation; 167 responses reported on the 50mph speed restriction and 26 on the 60mph speed restriction. A summary of their responses is presented below. Due to the limit number of responses received reporting on the 60mph speed restriction, caution should be taken when interpreting these results.

Participants from the workforce were asked to rate how they thought the speed restriction affected their safety (see Figure 39).

![Figure 39](image.png)

**Figure 39: Responses to question “How do you think the speed restriction affected your safety? Did it make you feel…”**

In total 54 participants indicated the 50mph speed restriction did not affect how safe they felt, 57 indicated it made them feel safe and 56 indicated it made them feel unsafe. This suggests a broad spread in perceptions of safety across the workforce. Whilst overall response numbers were low, a similar spread was also observed in relation to the 60mph speed restriction – some felt the speed restriction made them feel unsafe (7) and for others it made them feel safe (9).

These same participants were then asked to rate how appropriate they thought the speed restriction was in terms of their own safety, responses are shown in Figure 40.
In total 19 participants indicated that the 60mph speed restriction was ‘about right’, with a further 7 indicating it was either too high (six) or too slow (one). The 50mph speed restriction was perceived as ‘about right’ by 106 participants, with the remaining 61 indicating the restriction was either too high (41) or too slow (20).

### 3.7 Customer satisfaction

In total, 66 participants were identified from the customer satisfaction survey as eligible for inclusion in the investigation. Of those, 45 reported their last journey as being through the scheme during the baseline period when only a 50mph speed restriction was in place. The remaining 14 participants reported that their last journey was through the scheme during the trial period. Due to the layout of the schemes’ speed restrictions, these participants would have included people who either only passed through the 60mph speed restriction or participants who travelled through both the 60mph and 50mph speed restrictions. As a result, any changes in customer satisfaction observed between the baseline and trial periods can only be associated with the change from a single 50mph speed restriction across the whole scheme, to a combination of a 60mph and a 50mph speed restriction at different parts of the scheme. This limitation should be considered when interpreting the results in this section.

A summary of their responses is presented below.
### 3.7.1 Feelings of safety

Participants were asked to rate how they thought the speed restriction affected their safety. Responses are shown in Figure 41.

![Figure 41: Responses to question: “How do you think the speed restriction affected your safety? Did it make you feel...”](image)

**Figure 41: Responses to question: “How do you think the speed restriction affected your safety? Did it make you feel...”**

Across the investigation:

- During the baseline period, 13 out of 25 individuals reported the speed restriction did not affect how safe they felt. During the trial period, 11 out of 14 individuals reported the speed restriction did not affect how safe they felt.
- During the baseline period, 5 out of 25 individuals reported the speed restriction made them feel either very or slightly unsafe. During the trial period, no individuals reported the speed restriction made them feel either very or slightly unsafe.
- During the baseline period, 7 out of 25 individuals reported the speed restriction made them feel either slightly or very safe. During the trial period, 3 out of 14 individuals reported the speed restriction made them feel either slightly or very safe during the trial period.

Participants were also asked to rate how appropriate they thought the speed restriction was, in terms of safety. Responses are shown in Figure 42.
Across the investigation:

- During the baseline period 12 individuals reported the speed restriction was about right in terms of safety. During the trial period 9 individuals reported the speed restriction was about right in terms of safety.

- During the baseline period 12 out of 25 individuals reported the speed restriction was too slow in terms of safety. During the trial period 5 out of 14 individuals reported the speed restriction was too slow in terms of safety.

- During the baseline period 1 out of 25 individuals reported the speed restriction was too high in terms of safety. During the trial period no individuals reported the speed restriction was too high in terms of safety.

As well as the effect of the speed restriction on perceived safety, participants were asked to comment on how the width of the running lanes within the scheme’s road works affected their feelings of safety. Responses are shown in Figure 43 and Figure 44.
Figure 43: Responses to question: “In terms of safety, do you think the width of the lanes was...”

Figure 44: Responses to question: “How do you think the lane widths affected your safety? Did it made you feel...”

In summary:

- During the baseline period 9 out of 25 individuals reported the lane widths, in terms of safety, were about right. During the trial period 12 out of 14 individuals reported they were about right.
During the baseline period 16 out of 25 individuals reported the lane widths, in terms of safety, were too narrow. During the trial period 2 out of 14 individuals reported they were too narrow.

No individual during either the baseline or trial periods reported the lane widths, in terms of safety, were too wide.

During the baseline period 8 out of 25 individuals reported the lane widths did not affect how safe they felt. During the trial period 11 out of 14 individuals reported the lane widths made them feel either very or slightly unsafe.

During the baseline period 15 out of 25 individuals reported the lane widths made them feel either very or slightly unsafe. During the trial period one individual reported the lane widths made them feel either very or slightly unsafe.

During the baseline period 2 out of 45 individuals reported the lane widths made them feel either slightly or very safe. During the trial period one individual reported the lane widths made them feel either slightly or very safe during the trial period.

Finally, in an open question, participants were asked to provide any further comments on their feelings of safety when they last drove between Junctions 13 and 16 of the M1. Table 12 shows themes that represent general patterns observed in participants’ qualitative responses.

Table 12: Themes from participants’ comments in relation to their feelings of safety

<table>
<thead>
<tr>
<th>Speed limits</th>
<th>Baseline period</th>
<th>Trial period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive comments</td>
<td></td>
<td>The speed limit encouraged safer driving behaviours.</td>
</tr>
<tr>
<td>Negative comments</td>
<td></td>
<td>The speed limit increased safety of the road workers and road users.</td>
</tr>
<tr>
<td></td>
<td>It took too much time to overtake other vehicles. Other drivers exceeded the speed limit. Speed limits on VMS were not updated quickly enough after congestion/ a collision.</td>
<td>The speed limit caused traffic to brake suddenly.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The speed limit changed too frequently on the same journey.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>There was not enough warning of a change in speed limit whilst on the journey.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other drivers drove well below the speed limit in nearside lanes, meaning HGV drivers could not overtake.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Width of lanes</th>
<th>Baseline period</th>
<th>Trial period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive comments</td>
<td></td>
<td>The narrowed lanes encouraged safer driving behaviours.</td>
</tr>
<tr>
<td>Negative comments</td>
<td>Overtaking HGVs in narrowed lanes did not feel safe. HGV drivers overtook other HGV drivers, limiting space for other vehicles.</td>
<td>The narrowed lanes made it unsafe for motorcyclists to ride between other vehicles.</td>
</tr>
</tbody>
</table>
Additionally, participants made other general comments and suggestions in relation to road works and safety. Two participants who drove through the scheme during the trial period reported that they felt safe on their journeys. Two participants who drove through the scheme at both the baseline and trial period indicated that the lack of hard shoulder made them feel unsafe because there would be nowhere for drivers to pull over in an emergency.

3.7.2 Journey satisfaction

Participants were asked to rate how they thought the speed restriction affected their journey satisfaction. Responses are shown in Figure 45.

![Figure 45: Responses to question: “How satisfied or dissatisfied were you with the speed restriction?”](image)

In summary:

- During the baseline period 10 out of 25 individuals reported the speed restriction did not affect their satisfaction. During the trial period 10 out of 14 individuals reported the speed restrictions did not affect their satisfaction.

- During the baseline period 11 out of 25 individuals reported the speed restriction made them feel either very or somewhat dissatisfied. During the trial period 3 out of 14 reported the speed restrictions made them feel either very or somewhat dissatisfied.

- During the baseline period 4 out of 25 individuals reported the speed restriction made them feel either very or somewhat satisfied. During the trial period 1 out of 14 reported the speed restrictions made them feel either very or somewhat satisfied.
Participants were also asked to rate how appropriate they thought the speed restriction was, in terms of their own journey satisfaction. Responses are shown in Figure 46.

![Graph showing survey responses to the question: “In terms of journey satisfaction, do you think the speed restriction was...”](image)

**Figure 46: Responses to question: “In terms of journey satisfaction, do you think the speed restriction was...”**

In summary:

- During the baseline period 11 out of 25 individuals reported the speed restriction was about right in terms of journey satisfaction. During the trial period 9 out of 14 individuals reported the speed restrictions did were about right.
- During the baseline period 13 out of 25 individuals reported the speed restriction was too slow. During the trial period 5 out of 14 reported the speed restrictions made them feel either very or somewhat dissatisfied.
- During the baseline period a single individual reported the speed restriction was too high. During the trial period no individual reported the speed restrictions were too high.

Participants were also asked to rate how appropriate they thought the lane widths were, in terms of their own journey satisfaction. Responses are shown in Figure 47.
Figure 47: Responses to question: “How satisfied or dissatisfied were you with the lane widths? ...”

In summary:

- During the baseline period 9 out of 25 individuals reported the lane widths did not affect their satisfaction. During the trial period 13 out of 14 individuals reported the lane widths did not affect their satisfaction.
- During the baseline period 15 out of 25 individuals reported the lane widths made them feel either very or somewhat dissatisfied. During the trial period only a single individual reported the lane widths made them feel either very or somewhat dissatisfied.
- During the baseline period a single individual reported the lane widths made them feel either very or somewhat satisfied. No individual reported the lane widths made them feel either very or somewhat satisfied during the trial period.

Participants were asked to rate how they thought the lane widths affected their satisfaction. Responses are shown in Figure 48.
In summary:

- During the baseline period 8 out of 25 individuals reported the lane widths were about right in terms of journey satisfaction. During the trial period 11 out of 14 individuals reported the lane widths were about right.
- During the baseline period 17 out of 25 individuals reported the lane widths were too narrow. During the trial period 3 out of 14 reported the lane widths were too narrow.
- During both the baseline period and trial period no individuals reported the lane widths were too wide.

Finally, participants were asked to comment on their journey satisfaction when they last drove between Juncions 13 and 14 of the M1. Table 13 shows themes that represent general patterns observed in participants’ qualitative responses.
### Table 13: Themes from participants’ comments in relation to their journey satisfaction

<table>
<thead>
<tr>
<th>Speed limits</th>
<th>Baseline period</th>
<th>Trial period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive comments</td>
<td>The speed limits kept traffic flowing.</td>
<td>The 60mph speed limit is better than a 50mph speed limit.</td>
</tr>
<tr>
<td>Negative comments</td>
<td>The speed limits were too low when traffic flow was light.</td>
<td>Took too long to overtake other vehicles.</td>
</tr>
<tr>
<td></td>
<td>The speed limit was unnecessary when no road workers were present.</td>
<td>The speed limit was unnecessary when no road workers were present.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Width of lanes</th>
<th>Baseline period</th>
<th>Trial period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative comments</td>
<td>Lanes were too narrow.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Overtaking HGVs in narrowed lanes did not feel safe.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Suggestions to improve journey satisfaction</th>
<th>Baseline period</th>
<th>Trial period</th>
</tr>
</thead>
<tbody>
<tr>
<td>HGV drivers should be permitted to use only the inside lane.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additionally, participants made other general comments and suggestions in relation to road works and journey satisfaction. One participant who drove through the scheme during the baseline period and one participant who drive through the scheme during the trial period felt that the road works take too much time to complete. Another participant who drove through the scheme during the trial period commented that the road works caused congestion.

### 3.8 Scheme delivery and cost

#### 3.8.1 Delivery

Overall the scheme indicated that delivery of the work activities was not impacted by the 60mph speed restriction. Discussions recorded as part of the lessons learned workshop concluded that the trial and implementation of a 60mph speed restriction had not impacted on the delivery schedule of the specific phase of work in question.

#### 3.8.2 Cost

In order to safely implement the 60mph speed restriction between junction 13 and Newport Pagnell services of the scheme’s traffic management, several additional key mitigations and activities were required. These included:

- Higher containment vehicle restraint systems and end terminals.
- Mobile variable message signs, used for incident management.
- Additional static signing (speed limit signs).

Along with the costs of these additional mitigations, an additional cost was incurred by the scheme in order to implement the trial of a 60mph speed restriction:

- Temporary radar installations used for monitoring traffic during the investigation.
4 Conclusions

This section summarises the conclusions from the investigation. These conclusions are based on the findings from a single investigation undertaken at a specific scheme. Both the design and implementation of the scheme’s traffic management and trial mitigations impact greatly on the behaviours identified. As such, caution should be taken when using these conclusions to inform decisions about implementing future 60mph speed restrictions on schemes with different designs.

As part of the final project report, the conclusions from this report will be brought together with those from other participating schemes. This final report has been outlined later in section 6.2.

4.1 Impact of change in speed restriction on driver behaviour

Analysis of driver behaviour during periods of free-flowing traffic showed that, on average, drivers appeared to respond to the increase in speed restriction from 50mph to 60mph by increasing their travelling speed (from about 49mph in the baseline period to 55mph in the trial period, on average). The increase in average vehicle speed was consistent across all three carriageway lanes with the offside lanes seeing the highest speeds. This increase in average vehicle speed resulted in an estimated average journey time reduction of around 32 seconds per driver.

The speed differentials between vehicle classes were also affected by the change in speed restriction. During the trial period, the difference between the observed average vehicle speeds of cars and LGVs compared to HGVs reduced. On the north bound investigation the speed differentials between the two classes of vehicles reduced by around 2.3mph, while the south bound investigation saw a reduction of around 1.6mph.

Whilst average speeds increased, overall compliance with the posted speed limit was higher in monitoring sections with the 60mph speed restriction than the 50mph speed restriction. About a third of the drivers observed during the investigation were travelling above 50mph in the baseline period (33% north bound, 28% south bound), but a lower proportion chose to travel above 60mph in the trial period (17% north bound, 10% south bound).

A similar trend was observed in the behaviours of HGV drivers; overall compliance with the posted speed limit was higher in the sections with a 60mph speed restriction than the 50mph speed restriction. On the north bound carriageway around 34% of HGV drivers travelled above 50mph in the baseline period, and the south bound section saw around 19% of HGVs travel above 50mph. A lower proportion (north bound 16%, south bound 5%) travelled above 60mph during the trial period.

The scheme in general experienced relatively consistent levels of close following between vehicles across the investigation, but there was a small change as a result of the change in speed restriction; around a 3% reduction. The proportion of HGVs close following also dropped marginally across the monitoring periods. The north bound investigation saw a drop from 34% in the baseline period to 29% in the trial period. The south bound investigation saw a drop from 40% to 29% between monitoring periods. This change was likely related to the difference in average vehicle speeds and compliance after the change of speed restriction. In
particular, the reduction in speed differentials between vehicle classes may explain the reduction in close following.

The change in speed restriction appeared to have no impact on the number of reported incidents during the investigation. The numbers of reported incidents increased during the investigation, but overall numbers of incidents were low, and both monitoring locations experienced similar increases suggesting it was unlikely to be a result of the change in speed restriction.

Overall, in terms of safety, survey respondents from the scheme’s workforce indicated the 50mph speed restriction was about right. The number of survey responses was too small to identify a clear pattern in perceptions of the 60mph speed restriction. There was a broad spread in perceptions of safety across the workforce; some indicated the speed restriction did not affect how safe they felt, for some it made them feel unsafe, and for others it made them feel safe. Due to a small number of responses from the workforce during the trial phase, it was not possible to identify statistically significant changes in perceptions between 50mph and 60mph.

4.2 Impact of change in speed restriction on customer satisfaction

For most survey respondents, the change in speed restriction did not influence how safe customers felt.

When questioned about the appropriateness of various speed restrictions, in terms of safety, most customers indicated that the 50mph restriction was either about right or too slow. Most respondents reported the 60mph restriction was about right, but overall numbers of responses were very low, meaning statistical analyses were not possible.

From the small number of survey responses received there is no robust evidence to show either an increase or a decrease in self-reported customer satisfaction as a result of the 60mph speed restriction. Qualitative feedback obtained from respondents suggests that the 60mph limit was welcomed by some, but concerns over safety were mentioned by others. A range of subjective opinions from customers is expected for a trial of this kind; but the key objective measures of driver behaviour (speed, compliance, close following and incidents) suggest there were no substantial increases in risk as a result of the trial (other than that associated with the increase traffic speeds).

4.3 Impact of change in speed restriction on scheme cost and delivery

Feedback from the scheme suggested that the introduction and application of a 60mph speed restriction had no negative impact on the schedule and delivery of the works. However, it was reported that due to delays caused by changing the established practice for risk assessments, less time for use of 60mph was available on the scheme.

Several large fixed costs were also incurred in order to implement additional risk mitigations, such as higher containment vehicle restraint systems.

This information will be used to inform future use of 60mph speed restrictions within road works and will be presented alongside future guidance material.
5 Other investigations

5.1 Highways England customer audits

Separate to this investigation, Highways England’s insight team investigated the impact of the change in speed restriction on customer satisfaction by undertaking customer audits of the scheme. For ease of reference, and with permission from Highways England, a copy of the report can be seen in Appendix D.

These customer audits, undertaken by Ipsos and Pell Frischmann, utilised briefed ‘Auditors’ (i.e. members of the public) who lived in the vicinity of the scheme. These Auditors were given a full written brief detailing where they needed to go, what they needed to look out for, and a preview of the survey questionnaire. Auditors were instructed to drive through the scheme and undertake a survey within 24 hours. These surveys sought to identify the impact of the speed restriction change on both customer safety and customer satisfaction. In total 36 surveys were completed, 20 whilst the scheme was in the baseline trial phase and 16 during the trial phase.

Survey responses were then reviewed via a quality control process by a validation team. This team looked for contradictions and irregularities within the responses of each survey. If completed surveys were deemed to be of poor quality, they would not be included in the top line results. No surveys were reported to have failed this quality control process for the investigations on the M1.

The headline findings from these customer audits are summarised below. Some caution is advised in the extrapolation of these results since a small sample of Auditors was used (29 in the control phase and 27 in the trial phase). In addition, no details are provided in the “Top Line Results” report with regard to whether statistically significant differences were identified between the 50mph and 60mph phases; therefore it is not possible to draw robust conclusions from these data regarding the impact of the increase speed restriction.

Key points noted in the “Top Line Results” report (Appendix D) are as follows:

- 17/20 Auditors (85%) felt 50mph was appropriate for the conditions, and 16/16 Auditors (100%) felt 60mph was appropriate.
- 20/20 Auditors (100%) reported that the signage was easy to see in the control (50mph) phase, and 16/16 (100%) reported it was easy to see in the trial (60mph) phase.
- 20/20 Auditors (100%) indicated that they felt safe in 50mph, and 16/16 (100%) said they felt safe in 60mph.
- 10/20 Auditors (50%) were very satisfied with the 50mph speed limit, and 12/16 (75%) were very satisfied with 60mph.
- 18/20 Auditors (90%) felt 50mph was about right, and 2 Auditors (10%) felt it was too slow. 16/16 Auditors (100%) felt 60mph was about right.
The report concluded that the results collected from the surveys suggest that, unlike previous speed trials, the M1 results were not affected in scale by the traffic conditions. Where the road was clear at 50mph a couple of auditors did want the speed raising. Whilst at 60mph (where most of the traffic issues occurred) the auditors appeared satisfied even though they could only utilise the raised speed limit on occasion due to traffic.

5.2 Highways England social media listening

Separate to this investigation Highways England’s insight team investigated the impact of the change in speed restriction on customer satisfaction by monitoring social media postings using a ‘TalkWalker’; a specialist social listening tool. The tool utilised a search query, containing the following key words:

- M1 J13-16
- M1 J13-16 Smart Motorway
- M1 J13
- M1 J14
- Increased speed from 50mph to 60mph

During the investigation, in total, 9 relevant mentions in relation to the speed restriction were found. Most mentions found within the date range of the investigation suggested the speed restriction was still 50mph (not the newly implemented 60mph restriction). This may indicate driver confusion or misleading signage (Highways England, 2019). For those drivers who did notice the increase in speed to 60mph, feedback was positive towards the change, and a desire to further implement on other roadwork stretches was inherited (Highways England, 2019).
Next steps

6.1 Continued use of 60mph at the M1 junction 13-16 scheme

Upon completion of the trial of 60mph between junctions 13 and 14, a review and validation exercise was undertaken by the scheme in order to determine if the 60mph speed restriction could be implemented across the remainder of the verge phase of works.

In line with the agreed monitoring process, detailed in the scheme-specific risk assessment, available data were reviewed in order to determine if the safety objectives had been met during the trial. Based on this review the continued use of the 60mph speed restriction between junctions 13 and 14 was approved, however data from outside the summer holiday period was requested ahead of a further roll out across future verge side phases of works.

This additional data can be seen in Appendix B.

6.2 Implementation of 60mph at other schemes

This is the fourth investigation of a 60mph speed restriction within road works as part of this project. TRL is working closely with Highways England to implement 60mph speed restrictions at other schemes on the Strategic Road Network. Several additional lessons learned were captured as part of this investigation; these have been outlined in Appendix C and should be considered when implementing the 60mph speed restriction on other schemes in the future.

The results from future investigations (each to be presented in their own report) will be collated together (in a final report) once the monitoring programme is complete.

The final report will enable robust recommendations to be made on the basis of a large and substantial evidence base, with findings being used to inform guidance material into the used of appropriate speed restrictions within road works.
Acknowledgements
The following individuals (or organisations) contributed directly to the investigation of a 60mph speed restriction within the M1 junction 13-16 road works:

- Pascal Baptista, Andy Bannister, Mal Bell, Tony Carr, Daniel Chilcott, Howard Dukes and Kevin Edwards – CostainGallifordtry
- Daniel Craig - Chevron
- Peter Bewley and Marius Grigoras – AmeyArup
- Debraj De, James Sedgwick, Paul Unwin and Lorraine Butler – Highways England

References
AmeyArup. (2019). *M1 Junction 13 to 16 GG104 Risk assessment for 60mph trial through roadworks*.


Appendix A  PSCRG Members

Principal members:

- A senior Highways England Project Manager and/or Senior Responsible Owner
- Lead consultancy support, with relevant risk assessment knowledge, competence, design understanding and experience with Highways England safety governance procedures
- Network Delivery and Development Senior User
- Customer Operations Senior User
- Competent Designer Safety / Operations Expert
- Project Construction, Design and Management Coordinator
- Contractor representative (when appointed)
- Professional and Technical Solutions Safety Risk and Governance representative

Specialist members:

- Additional technical support (Professional and Technical Solutions specialists or external subject matter experts, as required)
- The Design Team Project Manager
- Asset Support Contract representative
- Maintenance representative, including technology
- Stakeholder representative (e.g. other RCC/Traffic Officer Service representatives)
Appendix B  Additional monitoring

For the purposes of the trial four suitable sites were identified within the scheme for control and experimental locations (two of each). The on-road monitoring covered two periods: the ‘baseline’ monitoring period and the ‘trial’ monitoring period, details of the monitoring locations and periods can be seen below in Table 14 and Table 15.

An additional five weeks of monitoring was requested by the scheme in order to understand the difference in expected behaviour outside of the summer holiday period.

**Table 14: Monitoring activities (north bound carriageway)**

<table>
<thead>
<tr>
<th>Dates</th>
<th>Trial weeks</th>
<th>Description of activity</th>
<th>Experimental location</th>
<th>Control location</th>
</tr>
</thead>
<tbody>
<tr>
<td>25th June 2019</td>
<td>1-4</td>
<td>Baseline monitoring period</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>22nd July 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23rd July 2019</td>
<td>5-8</td>
<td>Trial monitoring period</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>19th Aug 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20th Aug 2019</td>
<td>9-13</td>
<td>Additional monitoring period</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>23rd Sept 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 15: Monitoring activities (south bound carriageway)**

<table>
<thead>
<tr>
<th>Dates</th>
<th>Trial weeks</th>
<th>Description of activity</th>
<th>Experimental location</th>
<th>Control location</th>
</tr>
</thead>
<tbody>
<tr>
<td>28th June 2019</td>
<td>1-4</td>
<td>Baseline monitoring period</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>25th July 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26th July 2019</td>
<td>5-8</td>
<td>Trial monitoring period</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>22nd Aug 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23rd Aug 2019</td>
<td>9-13</td>
<td>Additional monitoring period</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>23rd Sept 2019</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B.1 North bound carriageway

![Graph showing average vehicle speeds during free-flow periods (north bound carriageway)](image)

**Figure 49: Average vehicle speeds during free-flow periods (north bound carriageway)**

**Experimental location**

The average speed of vehicles, when choice of speed was not restricted by congestion, during the baseline monitoring period was 48.7mph. During the four week trial period, the average speed of vehicles increased to 54.6mph when compared to the baseline period. Weekly averages remained consistently at this level across the four weeks of safety monitoring, ranging from 54mph to 55.4mph.

During the additional five week monitoring period, the average speed of vehicles was 55.1mph, ranging from 54.9mph to 55.4mph. Similar to levels observed within the trial subsequent monitoring period.

**Control location**

The average speed of vehicles, when choice of speed was not restricted by congestion, during the baseline period at the control location was 49.2mph, slightly above the levels seen at the experimental location during the same time period.

The average speed of vehicles during the trial period remained similar with the four week average being 49.2mph, reflecting the consistency in speed restriction applied at that location between the monitoring periods.

This pattern continued into the additional five week monitoring period, with an average speed of vehicles of 48.7mph.
Experimental location
The average proportion of vehicles over the speed limit, when choice of speed was not restricted by congestion, during the baseline monitoring period was 33%. A step-change in the proportion of vehicles over the speed limit was seen between the baseline and trial periods, with the proportion of vehicles over the speed limit reducing from an average to 17% during the four week trial period. Weekly proportions remained relatively consistent around this level across the four weeks of safety monitoring, ranging from 15% to 18%.

During the additional five weeks of monitoring, the average proportion of vehicles over the speed limit was 18%. Weekly proportions remained relatively consistent around this level across the five weeks of monitoring, ranging from 17% to 19%.

Control location
The proportion of vehicles over the speed limit, when choice of speed was not restricted by congestion, during the baseline monitoring period was 24%. These proportions are lower than those at the experimental location during the same period.

The proportion of vehicles over the speed limit during the trial period remained similar with the four week average being 24%, reflecting the consistency in speed restriction applied at that location between the monitoring periods.

During the additional five weeks of monitoring, the average proportion of vehicles over the speed limit was 19%.
Figure 51: Proportion of vehicles over the enforcement threshold during free-flow periods (north bound carriageway)

**Experimental location**
The average proportion of vehicles over the enforcement threshold, when choice of speed was not restricted by congestion, during the baseline monitoring period was 8%. During the four week trial period the average proportion of vehicles over the enforcement threshold reduced to 4%. Weekly proportions remained consistently at this level across the four weeks of safety monitoring.

During the additional five weeks of monitoring, after the trial period, the average proportion of vehicles over the enforcement threshold was around 4%.

**Control location**
The average proportion of vehicles over the enforcement threshold, when choice of speed was not restricted by congestion, during the baseline monitoring period at the control location was 2%, well below levels seen at the experimental location.

The proportion of vehicles over the enforcement threshold during the trial period remained similar at the control location, with the four week proportion being 2%, reflecting the consistency in speed restriction applied at that location between the monitoring periods.

During the five weeks of additional monitoring the average proportion of vehicles over the enforcement threshold was around 2%, consistent with behaviours from the trial weeks.
B.2 South bound carriageway

Figure 52: Average vehicle speeds during free-flow periods (south bound carriageway)

**Experimental location**

The average speed of vehicles, when choice of speed was not restricted by congestion, during the baseline monitoring period was 49.1mph. During the four week trial period, the average speed of vehicles increased to 55.1mph when compared to the baseline period. Weekly averages remained consistently at this level across the four weeks of safety monitoring, ranging from 54.8mph to 55.5mph.

During the additional five week monitoring period, the average speed of vehicles was 55.6mph, ranging from 55.4mph to 56mph. Similar to levels observed within the trial subsequent monitoring period.

**Control location**

The average speed of vehicles, when choice of speed was not restricted by congestion, during the baseline period at the control location was 48.6mph. The average speed of vehicles during the trial period remained similar with the four week average being 47.2mph, reflecting the consistency in speed restriction applied at that location between the monitoring periods.

This pattern continued into the additional five week monitoring period, with an average speed of vehicles of 46.7mph.
Figure 53: Proportion of vehicles over the posted speed limit during free-flow periods (south bound carriageway)

**Experimental location**

The average proportion of vehicles over the speed limit, when choice of speed was not restricted by congestion, during the baseline monitoring period was 22%. A step-change in the proportion of vehicles over the speed limit was seen between the baseline and trial periods, with the proportion of vehicles over the speed limit reducing from an average to 10% during the four week trial period. Weekly proportions remained relatively consistent around this level across the four weeks of safety monitoring, ranging from 10% to 11%.

During the additional five weeks of monitoring, the average proportion of vehicles over the speed limit was 11%. Weekly proportions remained relatively consistent around this level across the five weeks of monitoring, ranging from 11% to 12%.

**Control location**

The proportion of vehicles over the speed limit, when choice of speed was not restricted by congestion, during the baseline monitoring period was 22%. The proportion of vehicles over the speed limit during the trial period remained similar with the four week average being 11%, reflecting the issues reported on in the main report with the monitoring unit during the investigation.

During the additional five weeks of monitoring, the average proportion of vehicles over the speed limit was 8%.
The average proportion of vehicles over the enforcement threshold, when choice of speed was not restricted by congestion, during the baseline monitoring period was 4%. During the four week trial period the average proportion of vehicles over the enforcement threshold reduced to 1%.

During the additional five weeks of monitoring, after the trial period, the average proportion of vehicles over the enforcement threshold was around 1%.

The average proportion of vehicles over the enforcement threshold, when choice of speed was not restricted by congestion, during the baseline monitoring period at the control location was 4%, well below levels seen at the experimental location.

The proportion of vehicles over the enforcement threshold during the trial period remained similar at the control location, with the four week proportion being 2%, reflecting the issues reported on in the main report with the monitoring unit during the investigation.

During the five weeks of additional monitoring the average proportion of vehicles over the enforcement threshold was around 1%, consistent with behaviours from the trial weeks.
Appendix C  Lessons learned

In order to understand the impact of the change in speed restriction on the scheme’s delivery and costs, a lessons-learned webinar was held after the trial had ended. This session sought to capture details on any impacts to the scheme associated with implementing the change in speed restriction. Attendees included: the scheme’s Highways England Project Manager, Principal Contractor, Traffic Management Supplier and Risk Contractor. This document reports the key points identified during the workshop and may not be reflective of the views from all industry stakeholders.

The following questions were posed to attendees.

Question: How do you feel that the investigation went on a general level? What worked well? What didn’t? Why?

Summary of key points made:

- It was helpful to have several options to choose from when deciding on how to implement the change in speed restriction for this scheme.

- Face-to-face meetings and weekly phone calls helped with understanding perspectives of others (especially those of emergency services) and sharing knowledge. However, fewer stakeholders attended the meetings over time, which later led to some becoming confused about how previous decisions had been made. In future, it may be useful if a regular set of key stakeholders attend the meetings, or consulted individually if they cannot attend.

- Having access to the dashboard was helpful during meetings and for reassuring others who were concerned about the change in speed restriction.

- Identifying locations for the radars that would not be obstructed was challenging.

- There were difficulties with construction which took a long time (e.g. pinning the barriers and taking care not to scar the carriageway). To alleviate time pressures, the road works plans should be continuously updated.

- Space in the road works zone has been compromised due to widening the carriageway lanes, which has been workable but not ideal. This resulted in additional lane closures being necessary.

- The enforcement team was concerned about the change in speed restriction (i.e. changing the speed restriction over time on the same stretch of road and implementing different speed restrictions on successive stretches of road), as they expected it would encourage challenges from the public.

- The timings of data collection were not ideal; some of the data could be skewed due to data being collected during school holidays. Additionally, data to analyse collisions at a given location is usually collected over a period of five years rather than several weeks.
Question: Early on some potential concerns in relation to changing the speed restriction for this scheme were raised. Were any of them realised? If so, how?

Summary of key points made:

- Drivers generally complied with both the 50mph and 60mph speed restrictions.
- The scheme felt there were fewer incidents and breakdowns overall, with more incidents and breakdowns occurring in the 50mph section of road works rather than the 60mph section. However, there are currently no statistics on collision severity.
- There was no increased risk when road workers entered or exited the work zone after changing the speed restriction. [NB nearside works, so works vehicles not attempting to enter lane 3].

Question: Was any additional traffic management equipment required to make the scheme suitable for 60mph speed restriction? If so, what?

Summary of key points made:

- It is assumed that permanent line markings must be used and traffic studs cannot be used for carriageways where there is a 60mph speed restriction, neither of which are desirable. Permanent line markings increase the likelihood of scarring the road surface. In future works, early planning and works sequencing could reduce the amount of scarring caused.
- Pinned barriers were implemented, which can withstand an impact from a vehicle traveling at 60mph. This knowledge helped to reassure the workforce. The barrier manufacturer provided briefings for the workforce at ‘lunch and learn’ sessions.

Question: Did you have to make any modifications to risk assessments or method statements?

Summary of key points made:

- Changing an established practice for risk assessments (rather than creating a new practice) took more time. These changes were not completed far-enough in advance, which meant less time was left for implementation.
- There were miscommunications during handovers when decisions about the risk assessment changed hands.

Question: Were additional staff required to implement the use of a 60mph speed restriction? If so, what was the impact of this on budget compared to if the scheme has not been running at 60mph?

Summary of key points made:

- There is potential for timescales to be compressed which can require extra resources to be allocated to deliver the construction work at short notice before the change in speed restriction, which incurred additional costs. The reduction in working space resulted in additional TM resource for installation of lane closures.
Question: In summary, what were your feelings on the impact of using a speed restriction of 60mph, rather than 50mph, within the scheme on: the safety of both road users and road workers? The satisfaction of customers? The delivery schedule of the scheme?

Summary of key points made:

- No issues were raised in terms of road user or road worker safety.

- The scheme received anecdotal evidence to suggest that customer responses to the change in speed restriction were mainly positive, such as reported lower levels of close following and feelings of ‘normal’ motorway driving (as opposed to feelings of driving through road works). Negative feedback included concerns about the potential for increased collision severity risk. Traffic Management staff also had concerns about safety near the beginning of the trial, but these concerns have lessened over time.

- Due to the delays caused by changing the established practice for risk assessments to accommodate the 60mph speed restriction for this scheme, there was less time for the implementation of the scheme.
Appendix D  Ipsos Customer Audits

Highways England
Customer Audits – Speed Trials – M1 13-16
Top Line Results
September 2019
Contents

• Introduction & Methodology
• Results
• Conclusions & Recommendations
Research Methodology

Schemes

Customer Audits conducted across the following schemes:
- M1 J13-16 over May to the end of August 2019
- Highways England have been trialing a new 60mph speed limit on the M1 J13-16 scheme.
- Auditors were specifically briefed to undertake the usual customer audit but also look out for/observe the speed limit and provide their perception on the limits.

Measurement

Scheme audits assessing:
- The auditors perception of the 50mph/60mph speed limit that was in place.
- The audits were split evenly to gain an understanding of a customers perception of both speed limits

Sample Base

M1 J13-16 n=36

50mph Tests n=20
60mph Tests n=16
(4 visits were unable to be complete within the timeframe for the 60mph tests)

This work was carried out in accordance with the requirements of the international quality standard for market research, ISO 20252 and with the Ipsos MORI Terms and Conditions.
Results
The 60mph tests were seen as more appropriate for the conditions

Did you feel the speed limit in place was appropriate for the conditions?

50 MPH

% Yes

85%

"Speed limit too low - causing delays due to heavy traffic."

60 MPH

% Yes

100%

"The speed limit in place was appropriate for the current works being carried out and that it was an all lane running roadworks project."

Base: n=20

Base: n=16
In addition, the signage was easy to see

Was the signage displaying the speed limit easy to see?

50 MPH

% Yes

100%

“Speed limits were easy to see and regular”

60 MPH

% Yes

100%

“The speed limit signs that were in place were clear and easy to see at each side of the road every few yards.”

Base: n=20

Base: n=16
The higher speed limit felt as safe as the lower limit, but heavy traffic effected the average speed of the 60mph tests.

Did you feel safe travelling at the speed limit through the scheme?

50 MPH
% Yes
100%

60 MPH
% Yes
100%

Average speed recorded by the auditor = 48 mph

Average speed recorded by the auditor = 50 mph

The average speed was provided by the auditors verbatim based on what they recorded during the journey.
The auditors felt that the 50mph limits were at times too slow

Did you think the speed limit was too high / too low / about right?

50 MPH
% About Right

90%

“The speed limit could have been higher”

10% stated the speed limit was too slow

60 MPH
% About Right

100%

“I felt safe traveling through the road works at the current speed as all the lanes were open and the lanes were not particularly narrow either.”

Base: n=20

Base: n=16
Traffic didn’t effect the 50mph tests frequently but it did play a part more often in the 60mph audits. None the less, when they were able to travel at the speed limit the 60mph auditor were more satisfied.

**How satisfied where they with the speed limit?**

**50 MPH**

- Very Satisfied: 50%
- Satisfied: 40%
- Neither Satisfied: 10%

"All very safe - the speed limit was suitable for the conditions (raining)"

**60 MPH**

- Very Satisfied: 75%
- Satisfied: 19%
- Neither Satisfied: 6%

"When I was able to travel at the speed limit I was very satisfied and felt it was appropriate for the type of road and the works currently being carried out."

Base: n=20

Base: n=16
Recommendations & Conclusions
Recommendations & Conclusions

The traffic conditions on the M1 J13-16 didn’t greatly effect the perceptions of the speed limits

Unlike previous speed trials the M1 results were not affected in scale by the traffic conditions. Where the road was clear at 50mph a couple of auditors did want the speed raising. Whilst at 60mph (where most of the traffic issues occurred) the auditors appeared satisfied even though they could only utilise the raised speed limit on occasion due to traffic.

Signage was clear and well positioned in all cases

All signage was viewed easily and all auditors were aware of the speed limits in place. Even when traffic was heavy the signage was very easy to see. It was specifically noted that the limits were on both sides of the road. Making it much easier to view.
Monitoring and evaluation of the 60mph trials

The purpose of this trial was to understand the impact of changing the speed restriction within the M1 13-16 scheme from 50mph to 60mph on driver behaviour, customer satisfaction and the scheme’s cost and delivery. The findings from this investigation will be used, along with other investigations, to inform the development of guidance material for future road works design.

The investigation involved monitoring of data from ‘control’ and ‘experimental’ locations positioned within the road works scheme. Several different data sources were used for both locations across a ‘baseline period’ (when both locations were subject to a 50mph speed restriction) and a ‘trial period’ (when the control location was subject to a 50mph speed restriction and the experimental location was subject to a 60mph speed restriction). These data sources included roadside radar data, scheme incident logs, and online surveys from both customers and the scheme workforce. Feedback from the workforce was also gathered during workshops with scheme representatives.

The change in speed restriction resulted in increased average speeds, reduced average journey times, and reductions in the proportion of drivers travelling over the speed limit. Little impact on drivers’ self-reported levels.