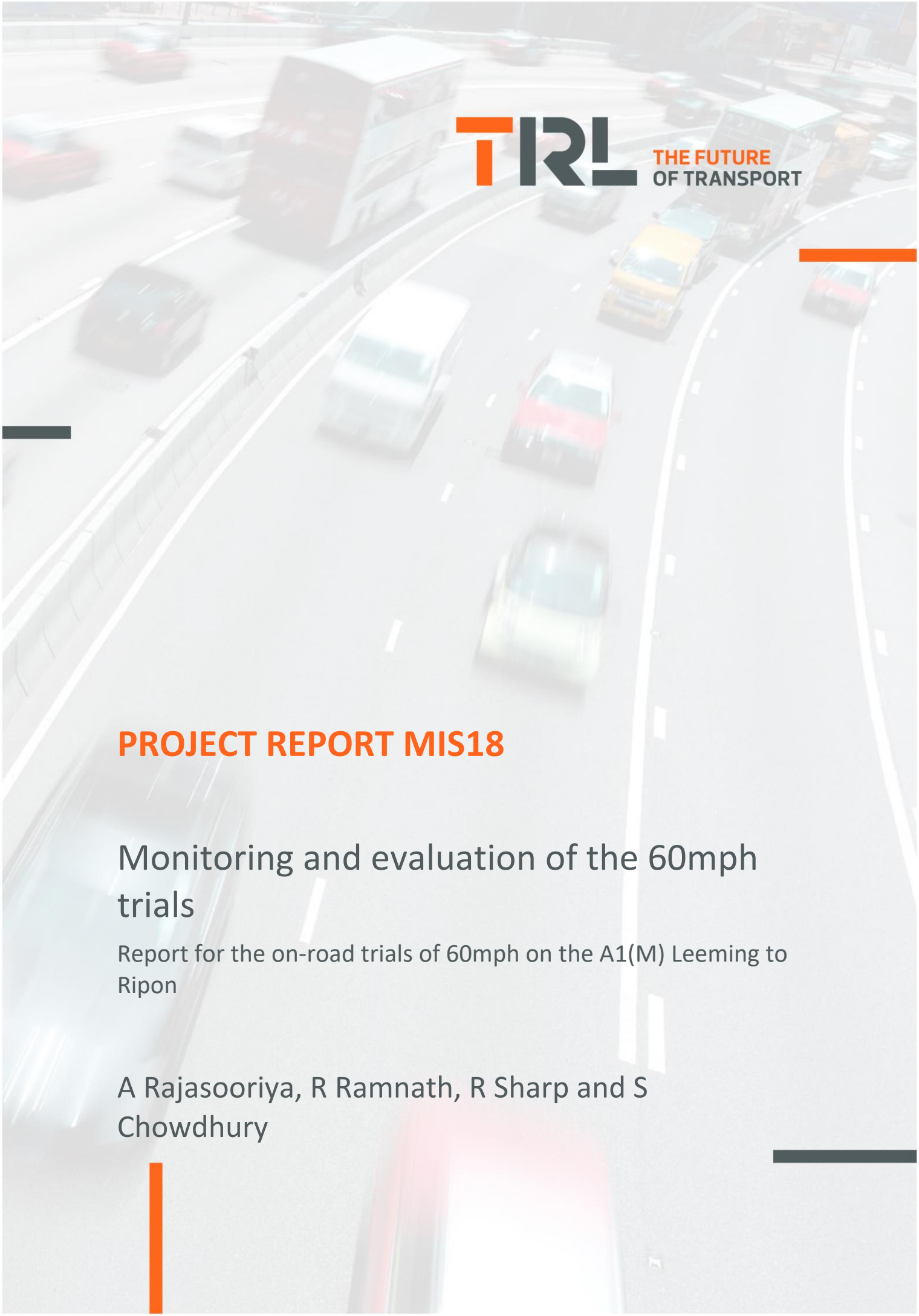

THE FUTURE OF TRANSPORT

PROJECT REPORT MIS18

Monitoring and evaluation of the 60mph trials

Report for the on-road trials of 60mph on the A1(M) Leeming to Ripon

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Executive summary

Temporary mandatory speed restrictions are considered for road works on high-speed roads 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 A1(M) Leeming to Ripon scheme. A 60mph speed restriction was implemented across both carriageways between junctions 50 and 51 within the road works. The impacts of this change on driver behaviour, customer satisfaction, scheme costs and scheme delivery were monitored over an eight-week 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 48mph before the speed restriction change, to 55mph after the speed restriction change. This resulted in an estimated journey time reduction of approximately 52 seconds per road user.
- This increase in average vehicle speed had a positive impact on the levels of speed compliance shown by road users, compliance observed in the 60mph speed restriction was higher than in 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 affected vehicle speeds and speed compliance.
- The proportion of HGVs engaged in close following (see Section 3.2.4) decreased due to the change in speed restriction, reducing by around 11% on average. The overall amount of close following observed was largely unaffected by the change in speed restriction.
- The number of incidents (road traffic collisions [RTCs] and breakdowns) was too small to enable statistical analysis. A decrease in the number of incidents was seen between the baseline and trial periods at the experimental location, but there was no statistical evidence to suggest the change in speed restriction had a substantial impact on the number of reported incidents observed at the scheme.
- Results from the workforce survey indicated that participants' perceptions of how both speed restrictions affected safety were mixed, although most participants felt that neither speed restriction affected their feelings of safety. Overall, the workforce survey participants indicated that both the 50mph and 60mph speed restrictions were about right in terms of safety.
- Responses to the customer satisfaction survey showed that most participants did not feel that either speed restriction or the lane widths affected their feelings of safety or journey satisfaction. During both the baseline and trial periods, most participants

felt the speed restriction and lane widths were about right in terms of safety and journey satisfaction.

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, and all auditors were aware of the speed restrictions in place.
- These same audits also showed that a couple of auditors wanted to see the 50mph speed restriction raised where the road was clear, whilst other auditors seemed satisfied with the 60mph speed restriction although they could only utilise the increased speed restriction at certain times due to traffic.
- A review of social media 'conversations' concluded that feedback was positive towards the increased speed restriction from those drivers who noticed the change. These drivers expressed desire for 60mph to be implemented on other road work stretches.

At the time of writing, further investigations into the use of 60mph speed restrictions are underway. 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 practical.

Following on from earlier 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 A1(M) Leeming to Ripon scheme during 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 method, 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 A1(M) Leeming to Ripon 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

To reduce congestion and smooth the flow of traffic across this key strategic route, works started in July 2019 on resurfacing the south bound carriageway A1(M) between Leeming to Ripon. The package of work was planned for two distinct phases and sections, with the timeline for the work on-site running until December 2019.

A contra-flow traffic management scenario on the north bound carriageway was chosen to investigate increasing the speed restriction from 50mph to 60mph. The speed restriction within the experimental location, north of junction 50 on the north bound carriageway was changed to 60mph for both directions of travel, while the speed restriction in the control location (south of junction 51) on both carriageways remained at 70mph.

An overview of the monitoring locations used in the investigation can be seen in Figure 1 below.

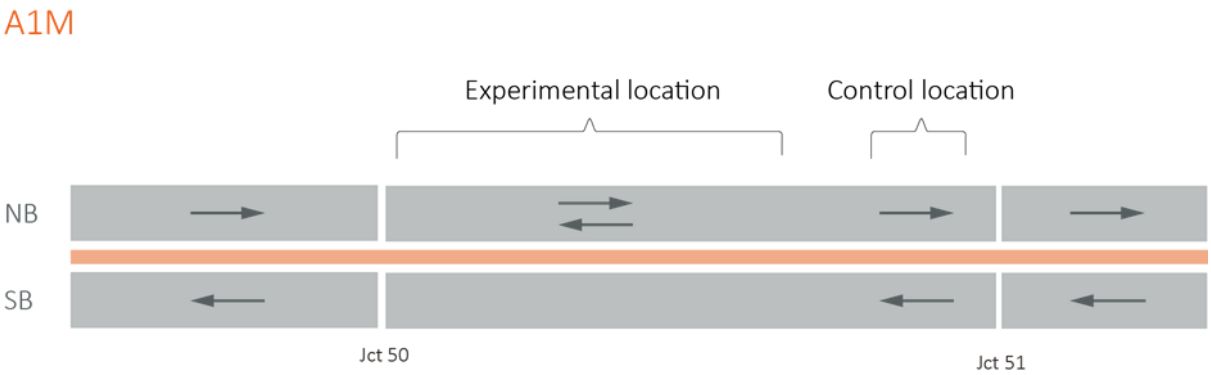


Figure 1: Overview of monitoring locations used on the A1(M) Leeming to Ripon scheme investigation (NB = north bound; SB = south bound)

2.2 Monitoring approach

The on-road investigation took place between the 8th August 2019 and 5th November 2019 and sought to monitor the effect of the change in speed restriction on driver behaviour and customer satisfaction. The monitoring covered two periods, the 'baseline' monitoring period during which the experimental monitoring locations retained a 50mph speed restriction and the control location had no speed restriction (70mph). This was followed by a 'trial' monitoring period in which the 60mph speed restriction was implemented on the experimental location while the control location remained with no speed restriction (see Table 1).

Table 1: Timelines for monitoring investigation

Dates	Description of activity	Traffic Management Phase	Control location (north of Junction 50)	Experimental location (north of Junction 51)
8th Aug 2019 23rd Sep 2019	Baseline monitoring period	Phase 3		
23rd Sep 2019 8th Oct 2019	Traffic Management switched from Phase 3 to Phase 3a			
8th Oct 2019 5th Nov 2019	Trial monitoring period	Phase 3a		

Throughout the baseline and trial monitoring periods the number of lanes open to traffic and the width of those lanes remained constant. The lane configuration had the following lane widths on the north bound carriageway for each direction of travel:

- Lane 1: 3.25m
- Lane 2: 2.85m

The placement of the traffic management varied during the trial, with two phases of contra-flow traffic management placed across different lengths of the carriageway between junction 50 and 51. The two phases, namely 'Phase 3' and 'Phase 3a' both included the use of a contra-flow system. These phases have been outlined within Figure 2 and Figure 3 below. In total, six running lanes were operational at the control location, with three lanes for each direction of travel with the below lane widths:

- Lane 1: 3.65m
- Lane 2: 3.70m
- Lane 3: 3.65m.

Delineation between opposing traffic flows was provided by a temporary vehicle restraint system (VRS) with a set-back distance of 600mm on both sides. Delineation between the work zone and the carriageway was provided by the existing permeant central reservation stepped concreate barrier.

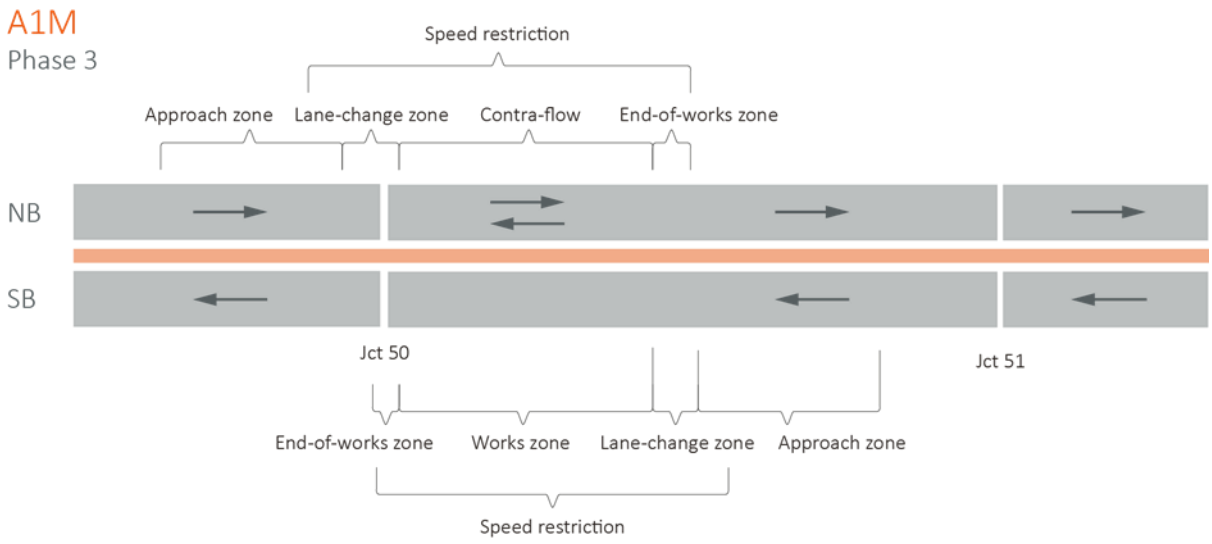


Figure 2: A1(M) Phase 3 scheme layout

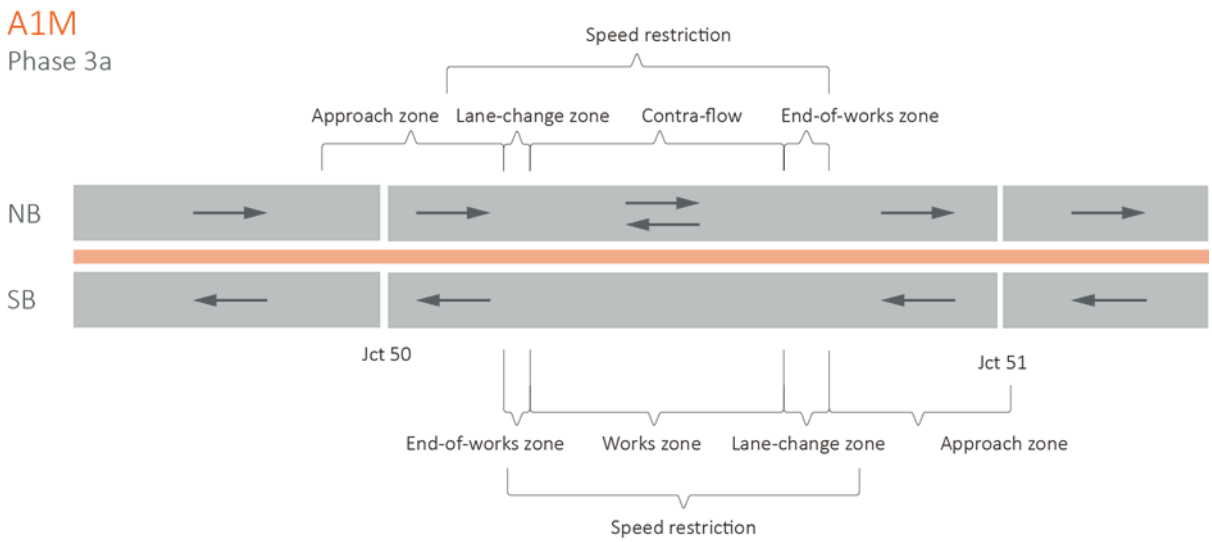


Figure 3: A1(M) Phase 3a scheme layout

The baseline monitoring period coincided with phase 3 of the schemes work schedule, whereas the trial monitoring period coincided with phase 3a.

The approach of having the experimental monitoring location within the road works and the control location outside the road works presents some important limitations which should be acknowledged. There will be some differences in driver behaviour between the control and experimental locations due to the presence or absence of road works infrastructure. This has been acknowledged during the data analysis and is further detailed in Section 3.

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. It 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 Consulting carried out a scheme-specific safety risk assessment in line with the 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 expected increase in vehicle speed as part of the investigation on the A1(M) Leeming to Ripon scheme.

This assessment concluded that if the change in speed restriction was adopted, the introduction of several other mitigations must accompany this change. 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 restriction for four weeks between junctions 50 and 51 on the north bound carriageway (for both directions of travel) from November 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 must 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 found 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 mitigations were implemented at the scheme prior to the start of the on-road investigations and are outlined below.

2.3.1.1 Vehicle recovery

Suitable and adequate vehicle recovery provision would be provided to ensure prompt attendance to broken down vehicles. It was expected that providing prompt attendance to broken down vehicles (with the use of an impact protection vehicle) would mitigate the risk posed to road users. Furthermore, 'gates'/Emergency Access Points (EAPs) were used within the safety barrier to allow stricken vehicles/debris to be removed from a live lane.

2.3.1.2 Variable message signs

Mobile Variable Message Signs (VMS) were positioned in advance of any change in speed restriction to warn approaching road users (Amey, 2019).

2.3.1.3 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 both a 50mph and 60mph speed restriction was put in place (Amey, 2019).

2.3.1.4 Carriageway markings

Clear demarcation of lane markings was achieved by using temporary markings that comply with characteristics set out in the Chief Highway Engineer's (CHE) memorandum 446/19:

- Minimum luminance coefficient under diffuse illumination 160 $mcd \cdot m^{-2} \cdot lx^{-1}$
- Minimum coefficient of retroreflected luminance in dry weather 200 $mcd \cdot m^{-2} \cdot lx^{-1}$
- Minimum coefficient of retroreflected luminance in wet weather 35 $mcd \cdot m^{-2} \cdot lx^{-1}$ (Amey, 2019).

Furthermore, all studs complied to Class PRT2 and lines to diagram 1012.1 that were used in conjunction with a temporary barrier system were 150mm wide.

2.3.1.5 Speed enforcement

Prior to the investigation, average speed camera enforcement was 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.

2.3.1.6 Other scheme specific mitigations

In addition to the above, the following mitigations were implemented:

- Contraflow guidance and signage in accordance with Chapter 8 of the Traffic Signs Manual.
- HGVs restricted to Lane 1.
- The use of temporary barrier specifications suitable for containing higher speed errant vehicles.
- Manned works access points with the employment of automated intrusion systems.
- Traffic management operatives and vehicle recovery operators reviewing working practices and method statements for use in association with 60mph speed restriction.
- Implementation of measures to identify stricken/stranded vehicles.
- Main contractor and temporary traffic management contractor supporting emergency services with on-call incident support.
- The provision of impact protection vehicles to respond promptly to any requests for support.

- Signing to advise the travelling public of the potential for queuing traffic.

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[1] periods, the proportion of vehicles over the posted speed restriction 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 4 below provides a summary.

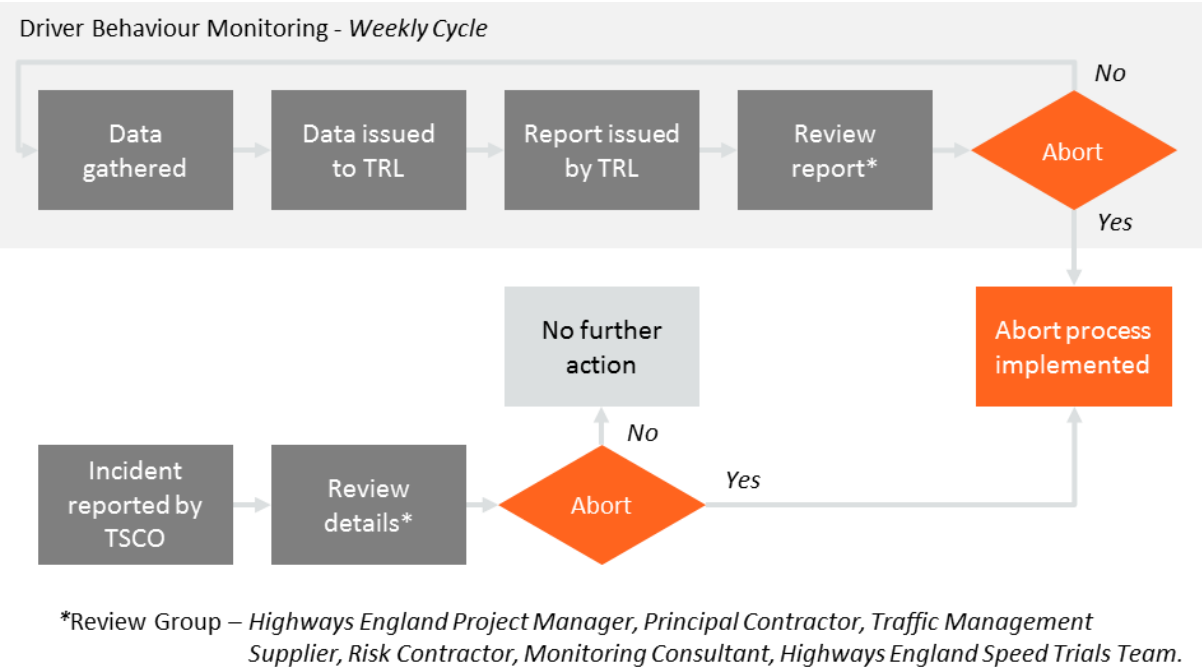


Figure 4: Abort process summary

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 conducted 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 4 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.

[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.

2.5 Data collection and statistical comparisons

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

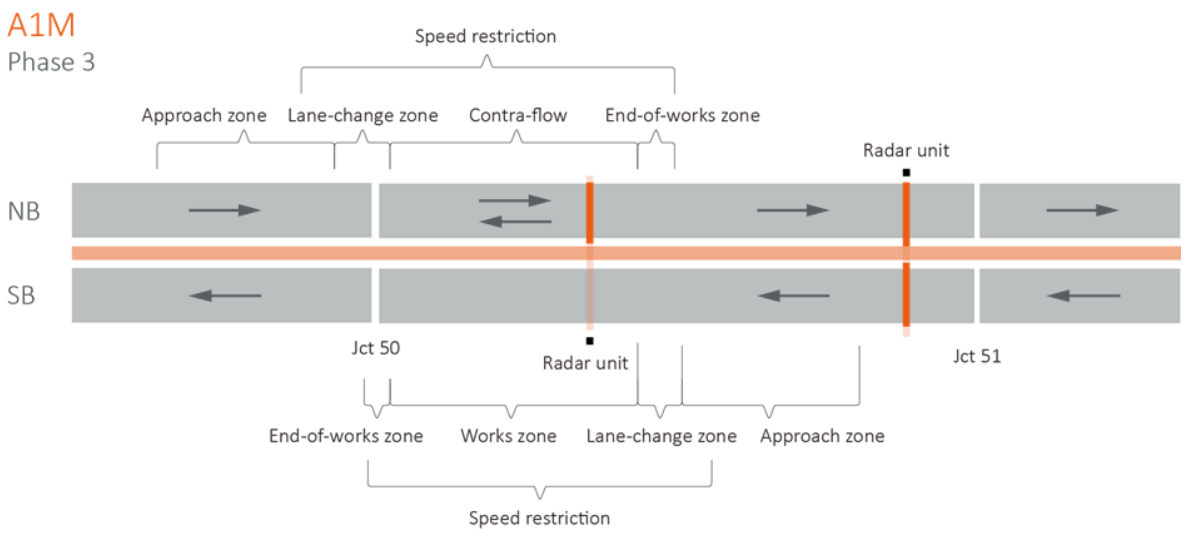
These data sources and any statistical comparisons which were made are outlined in more detail in the following sections. Suitable statistical comparisons were undertaken only when a sufficient sample of data was available.

2.5.1 Radar data

To monitor speed, flow, headway and lane choice during the baseline and trial periods, two 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. The radar data from the first four weeks of the baseline monitoring period and all four weeks of the trial monitoring period were analysed and are presented in this report. The radar data from the last two weeks of the baseline monitoring period were excluded from the analysis as there were large quantities of missing data.

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 5 below.



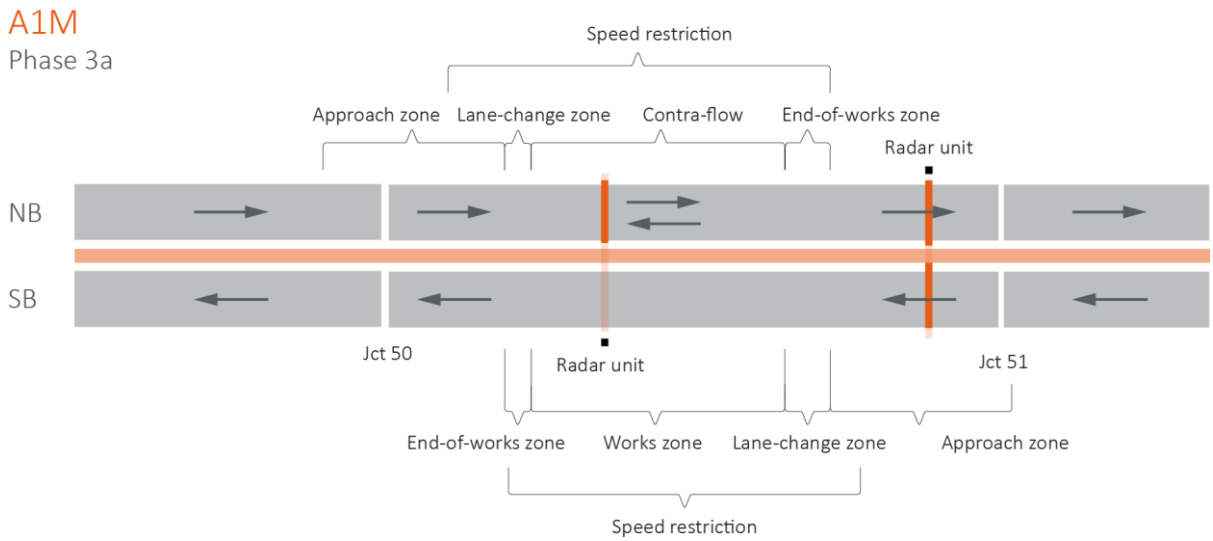


Figure 5: Location of radar installations

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

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, which required conditions with free-flowing traffic. Therefore, periods with congested traffic (when the average speed of vehicles in a lane across a minute was lower than 40mph) were removed.

This resulted in the removal of approximately 1.3% and 0.6% of the available data from the north bound and south bound directions, respectively, in the experimental location; and 2.7% of the available data from the south bound direction in the control location. No data was removed from the north bound direction at the control location.

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 affect 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 restriction 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[3] 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 (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

[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.

incidents (breakdowns and road traffic collisions) along with the location of the incident (carriageway and marker post number) and the date it took place.

Comparisons of the number of incidents between the first four weeks of the baseline and trial phase were made; a summary of these data is presented in Section 3.4. The data from the last two weeks of the baseline monitoring period were excluded from the analysis as there were large quantities of missing radar data.

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 restriction 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 or trial periods.

Targeting of these individuals was achieved using a social media advertising campaign, with individuals within a 50km radius of both junctions 50 and 51 of the A1(M) 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

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
- The scheme's delivery and cost

The main findings are summarised in Table 2 below, with full results from the detailed analysis presented in the succeeding sections.

Table 2: The key findings from the on-road trials of 60mph on the A1(M) Leeming to Ripon scheme

	North bound carriageway	South bound carriageway
Vehicle flow	There was no statistically significant difference in average vehicle flow between the control and experimental locations and between the baseline and trial periods. There was, however, some irregularity noticed during Week 2 and Week 4 of the trial period where larger flows were observed. The reasons for these increases are unknown.	There was a statistically significant difference in average vehicle flow between the baseline and trial period at the experimental location, with a small effect size of 0.06. There was also some irregularity noticed during Week 2 and Week 4 of the trial period where larger flows were observed. The reasons for these increases are unknown.
Vehicle speed	The compliance rates improved for all vehicles when the speed restriction was 60mph compared with 50mph. The levels of compliance also improved at the control location where the speed restriction remained unchanged at 70mph; this is probably due to the change in the traffic management layout between the two periods having an impact on driver behaviour.	
Congestion	There was minimal routine congestion at the scheme. During both monitoring periods, 1.3% and 0% of the total time was classified as congested at the experimental and control locations, respectively.	There was minimal routine congestion at the scheme. During both monitoring periods, 0.6% and 2.7% of the total time was classified as congested at the experimental and control locations respectively.
Close following	During the baseline period the proportion of vehicles close following was 36% at the experimental location, but slightly lower (27%) during the	During the baseline period the proportion of vehicles close following was 35% at the experimental location, but slightly

	North bound carriageway	South bound carriageway
	trial period. Likewise, the proportion of HGVs engaged in close following decreased from 35% during the baseline period, to 21% during the trial period. Statistically significant differences were identified, but the effect size was very small.	lower (34%) during the trial period. Likewise, the proportion of HGVs engaged in close following decreased from 36% during the baseline period, to 28% during the trial period. Statistically significant differences were identified, but the effect size was very small.
Incidents and breakdowns	No safety concerns were raised by the scheme around the number of reported incidents during the trial. The number of incidents (RTCs and breakdowns) was too small to enable statistical analysis. There was, however, a decrease in the number of incidents between the baseline and trial periods.	
Journey time	Increasing the speed restriction from 50mph to 60mph decreased the average journey time by around 52 seconds per driver.	
Workforce survey	For this survey, there were 14 responses relating to the 50mph speed restriction and 32 responses relating to the 60mph speed restriction. Most participants felt that neither speed restriction affected their feelings of safety. Overall, the participants indicated that both the 50mph and 60mph speed restrictions were about right in terms of safety.	
Customer satisfaction	For the customer satisfaction survey, 29 responses during the baseline period and 31 responses during the trial period were eligible for analysis. Most participants did not feel that either speed restriction or the lane widths affected their feelings of safety or journey satisfaction. During both the baseline and trial periods, most participants felt the speed restriction and lane widths were about right in terms of safety and journey satisfaction.	
Scheme delivery	Feedback from the scheme suggested that the delivery of the work activities was affected by the 60mph speed restriction.	
Scheme cost	An additional cost was incurred by the scheme to implement the trial of the 60mph speed restriction.	

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 6 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 A1(M).

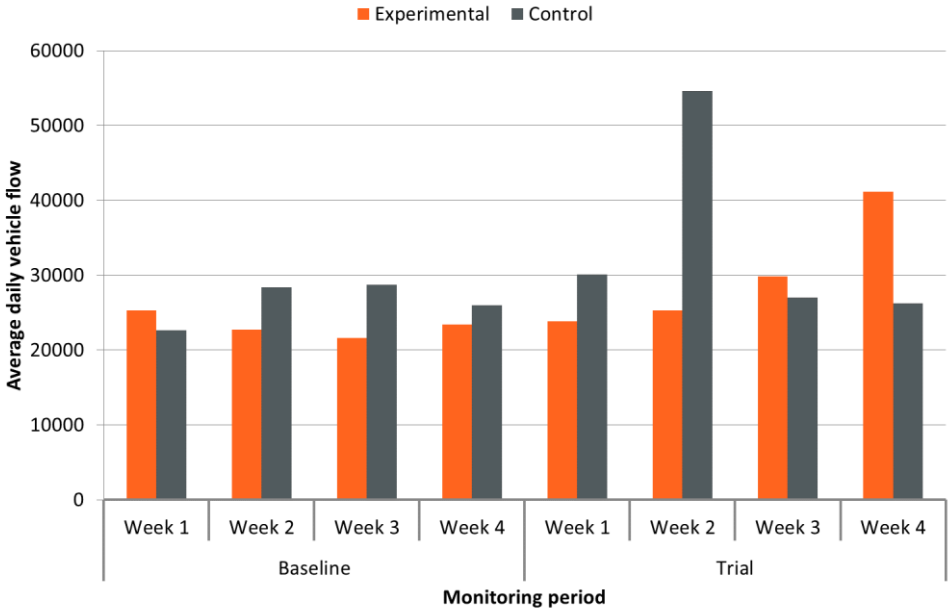


Figure 6: Average daily vehicle flow by location and monitoring period

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 26,431 during the baseline period and 34,492 during the trial period. The experimental location had lower average daily flows of 23,256 during the baseline period and 30,033 during the trial period. There was some irregularity noticed during Week 2 and Week 4 of the trial period where larger flows were observed. The reasons for these increases are unknown.

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=0.38). 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 7. 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 15% of all traffic during the baseline period and 16% during the trial period. The proportion of HGVs at the control period was slightly higher throughout the trial with an average of 21% during the baseline period and 24% during the trial period.

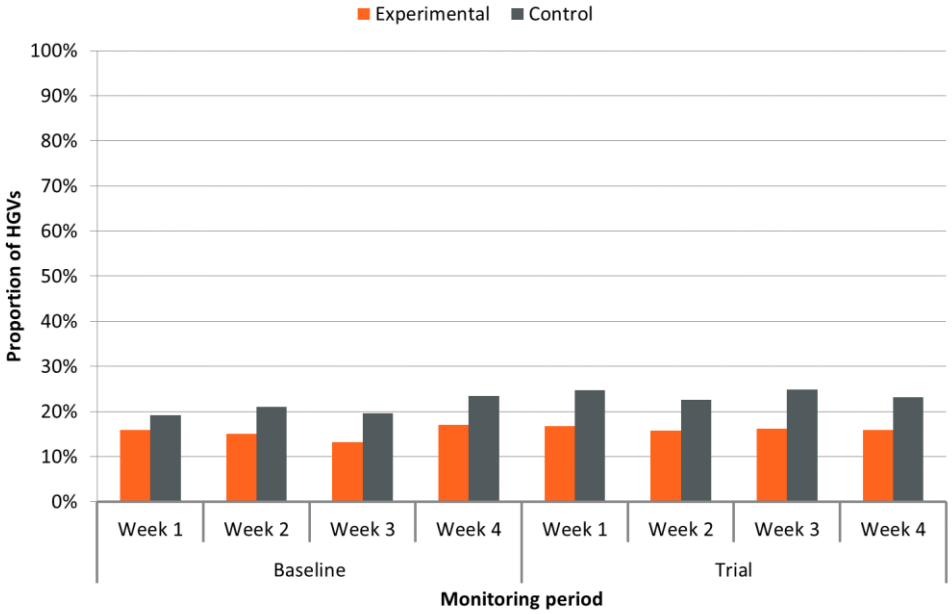


Figure 7: Proportion of HGVs by week and location

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 ($p<0.01$). 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 impacted on driver behaviour.

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

Table 3: Distribution of vehicles by lane and monitoring period at the experimental location

Monitoring period	Vehicle type	Lane 1	Lane 2
Baseline period	All vehicles	61%	39%
Trial period	All vehicles	57%	43%

The distribution of vehicles across the two 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 and Lane 2 within the experimental location is shown in Table 4.

Table 4: Composition of vehicle by lane and monitoring period at the experimental location

Monitoring period	Vehicle type	Lane 1	Lane 2
Baseline period	Cars + LGVs	77%	96%
	HGVs	23%	4%
Trial period	Cars + LGVs	72%	99%
	HGVs	28%	1%

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 ($p<0.01$) with a small effect size of 0.05.

Likewise, the composition of vehicles in Lane 2 remained reasonably constant between the baseline and trial periods. A chi-square test showed that there was a significant difference ($p<0.01$), with a small effect size of 0.09.

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, any changes identified in vehicle speeds and speed compliance are unlikely to have resulted from 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 8 shows the free-flow average speeds at the control and experimental locations across the two monitoring periods.

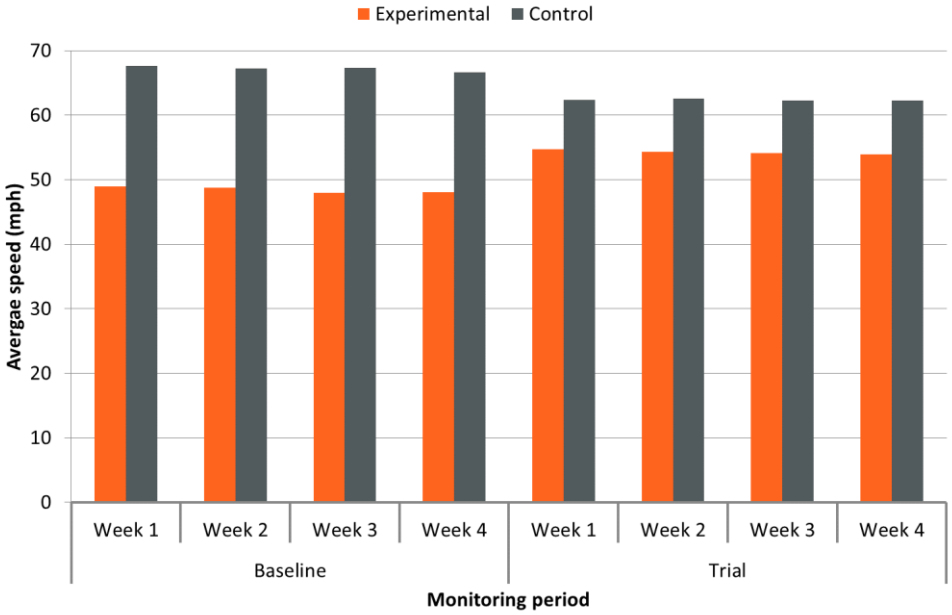


Figure 8: Free-flow average speed during the monitoring period by location

Free-flow average speed at the control location reduced from 67mph in the baseline period to 62mph in the trial period. This decrease in average speeds at the control location is likely due to the physical placement of traffic management varying during the trial. As outlined earlier in Section 2, the traffic management was located in closer proximity to the radar unit during the trial period in comparison to the baseline period. This may have attributed to the decrease in average speeds as there was a reduced distance over which drivers could transition from the 50mph to 70mph speed restriction.

At the experimental location, there was an increase in the free-flow average speed from around 48mph in the baseline period to around 54mph 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 98% of the total variance. There was a significant difference in average speeds between baseline and trial periods at the control location ($p<0.01$) explaining about 97% of the total variance.

The free-flow average speeds by lane are shown in Table 5.

Table 5: Free-flow average speed (mph) by monitoring period and lane at the experimental location

Monitoring period	Lane 1	Lane 2
Baseline period	47.9	49.4
Trial period	53.7	55.0

In both periods, speeds were higher in Lane 2 than in Lane 1. Table 5 shows that the free-flow average speed in Lane 1 at the experimental location increased by 5.8mph between the

baseline and trial periods and in Lane 2 there was increase of 5.6mph. In contrast, the average speeds in all three lanes at the control location decreased between the baseline and trial periods.

Figure 9 shows the comparison between the average speed for cars/LGVs and HGVs across the monitoring periods at the experimental location.

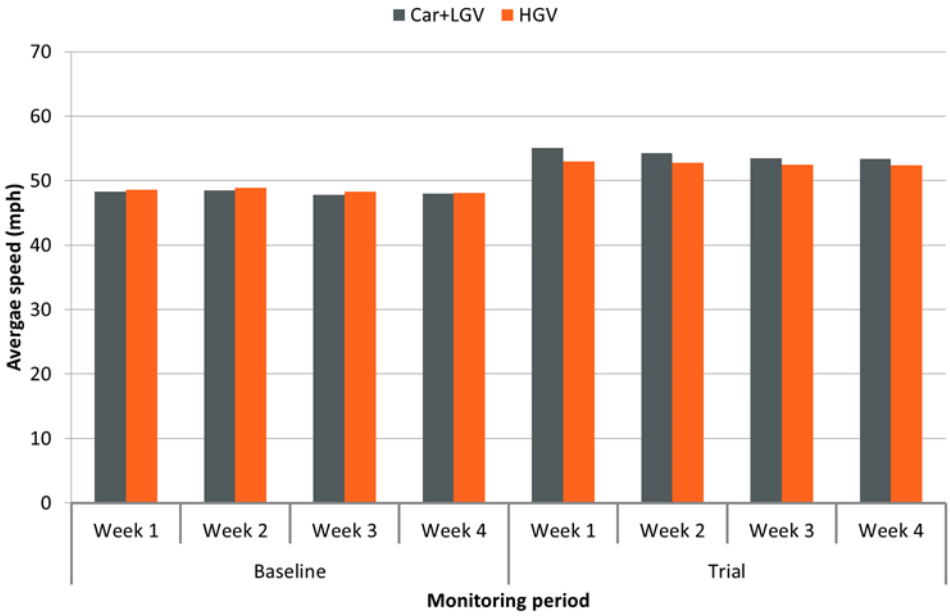


Figure 9: Average speed by vehicle type at the experimental location

The free-flow average speed of HGVs during the baseline period was around 48mph – the same as the free flow average speed of cars and LGVs. In the trial period, the free-flow average speed of HGVs increased to 53mph, while the free-flow average speed of cars and LGVs increased to 54mph.

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 restriction, above the speed restriction but below the enforcement limit, and above the enforcement limit (10% of speed restriction +2mph).

Figure 10 and Figure 11 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 restriction; the orange bars show the proportion of vehicles travelling above the speed restriction but below the enforcement threshold (10% of speed restriction+2 mph); and the red bars show vehicles travelling above the enforcement threshold.

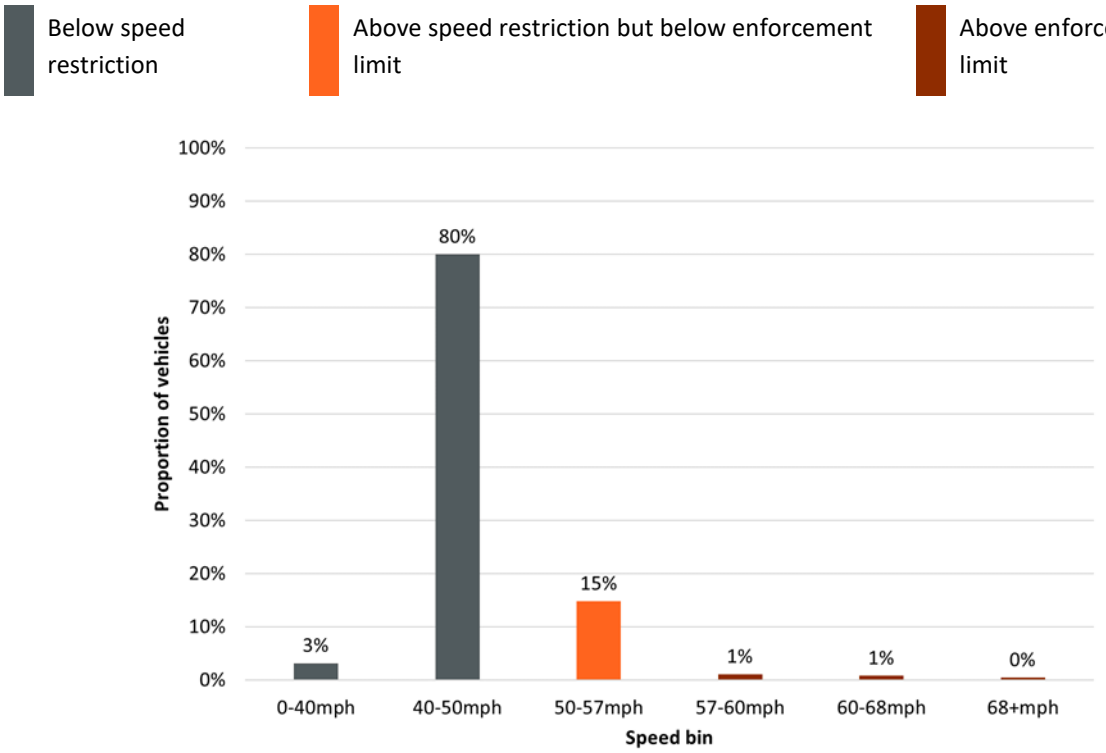


Figure 10: Proportion of vehicles in each speed bin during the baseline period (50mph) at the experimental location

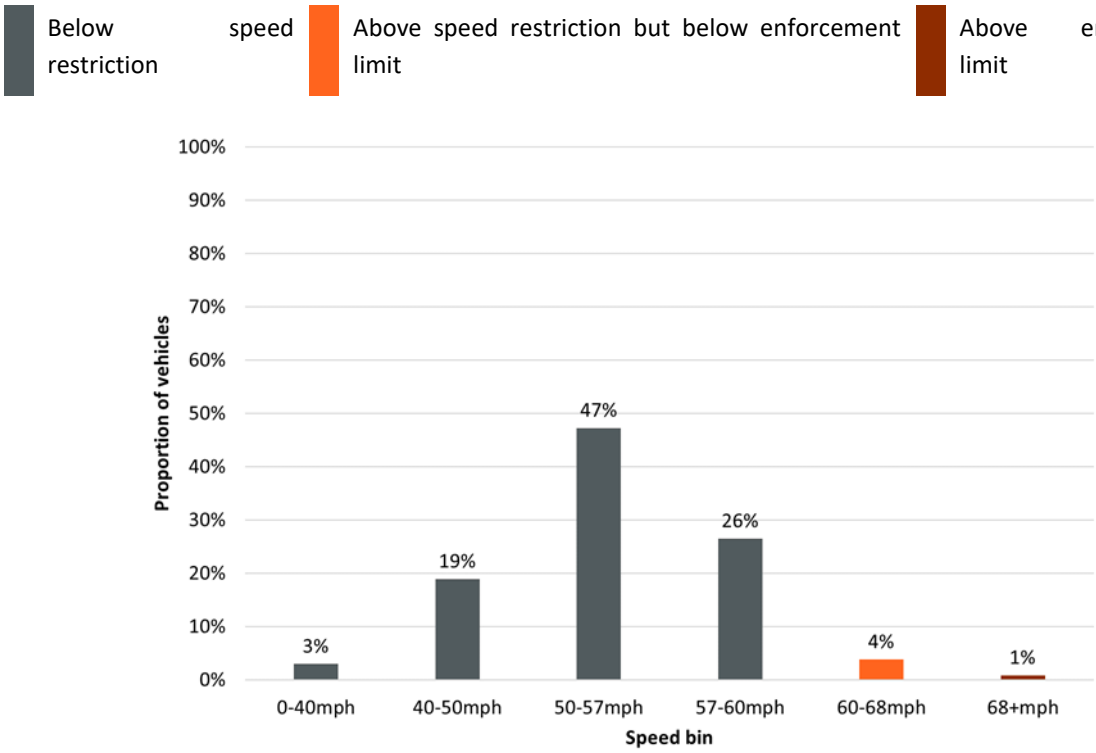


Figure 11: Proportion of vehicles in each speed bin during the trial period (60mph) at the experimental location

The proportion of vehicles travelling above the posted speed restriction at the experimental location changed considerably between the baseline and trial periods, dropping from 17% to 5%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 2% to 1% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed restriction, above speed restriction 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 0.44, 0.42 and 0.01, respectively.

Figure 12 and Figure 13 show the proportion of vehicles recorded in each speed bin across the two monitoring periods at the control location.

To understand the compliance of road users with the posted speed, data were separated into speed bins. These speed bins (0-40, 40-50, 50-60, 60-70, 70-79, 79+mph) allow for vehicles to be identified as travelling: below the speed restriction, above the speed restriction but below the enforcement limit, and above the enforcement limit (10% of speed restriction+2mph).

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

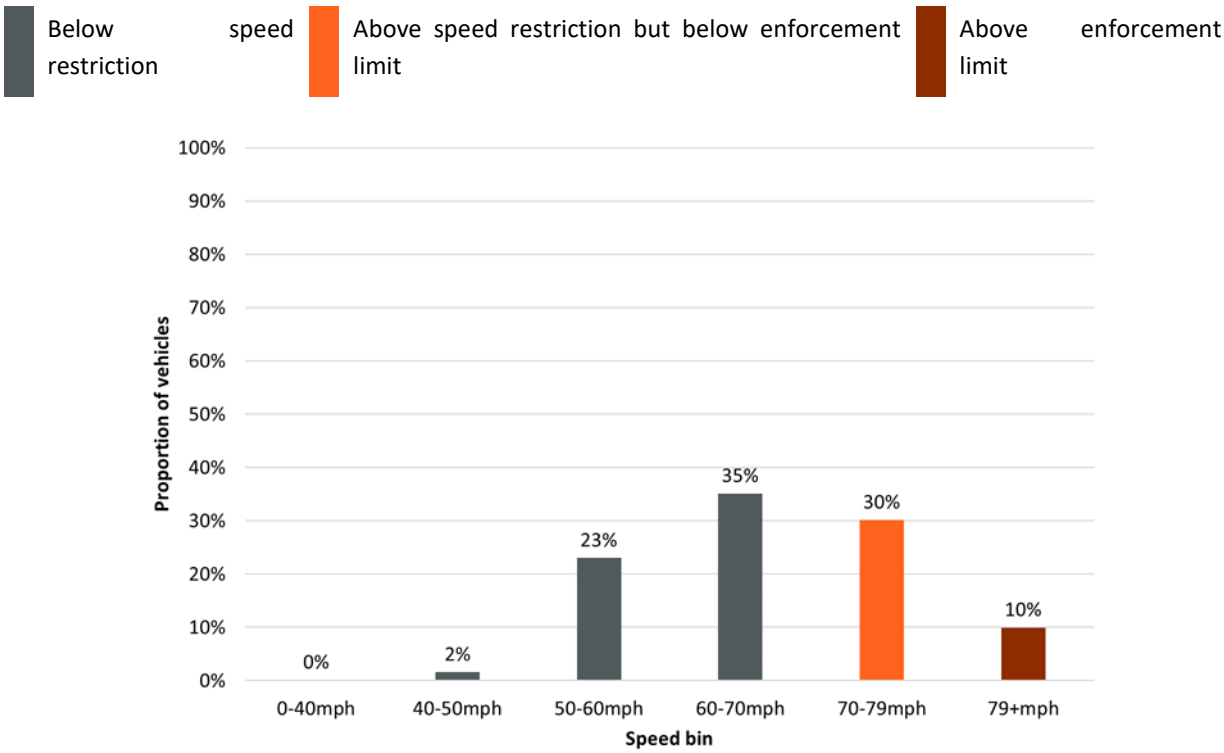


Figure 12: Proportion of vehicles in each speed bin during the baseline period at the control location

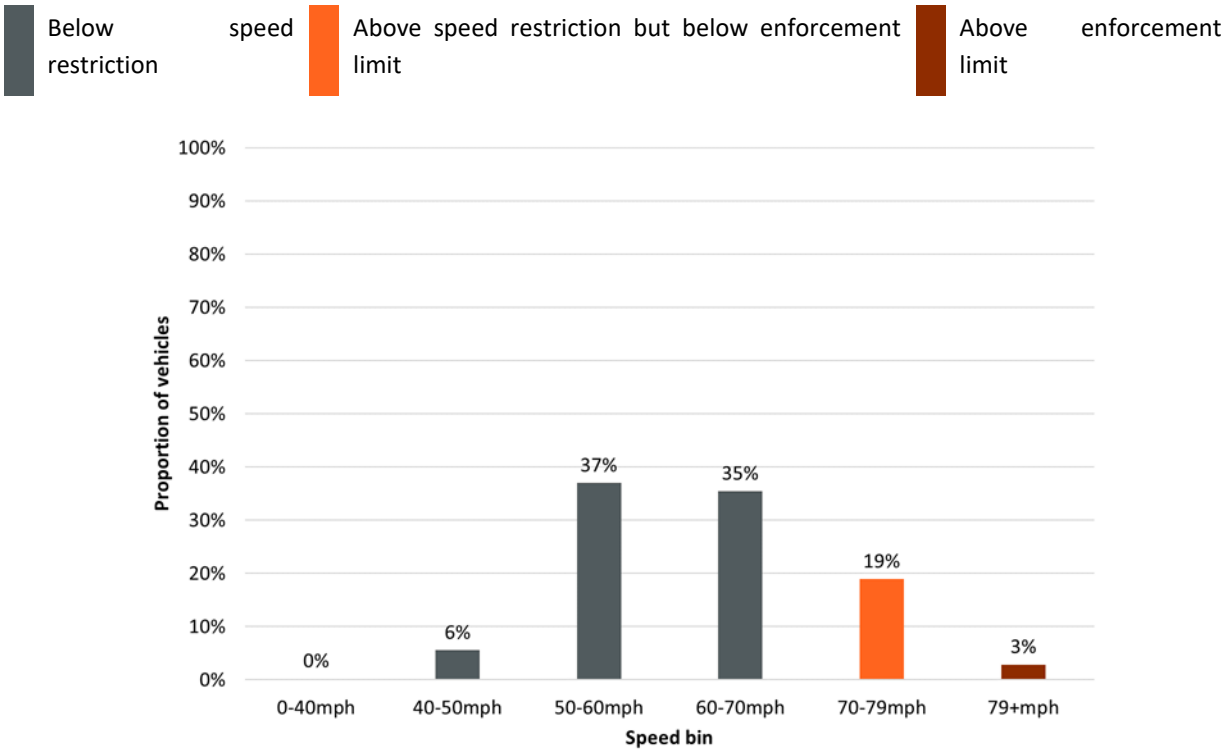


Figure 13: Proportion of vehicles in each speed bin during the trial period at the control location

The proportion of vehicles in each speed bin changed between the baseline and trial periods at the control location. The percentage of vehicles above the speed restriction (40%) reduced considerably, with 22% of vehicles driving over the speed restriction during the trial period. Again, this is probably due to the variation in the placement of traffic management relative to the radar position, outlined earlier in this section.

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, with medium effect sizes of 0.39. 0.25 and 0.29, respectively.

Figure 14 and Figure 15 show the proportion of cars and LGVs (the figures above repeated but with HGVs excluded) recorded in each speed bin across the two monitoring periods at the experimental location.

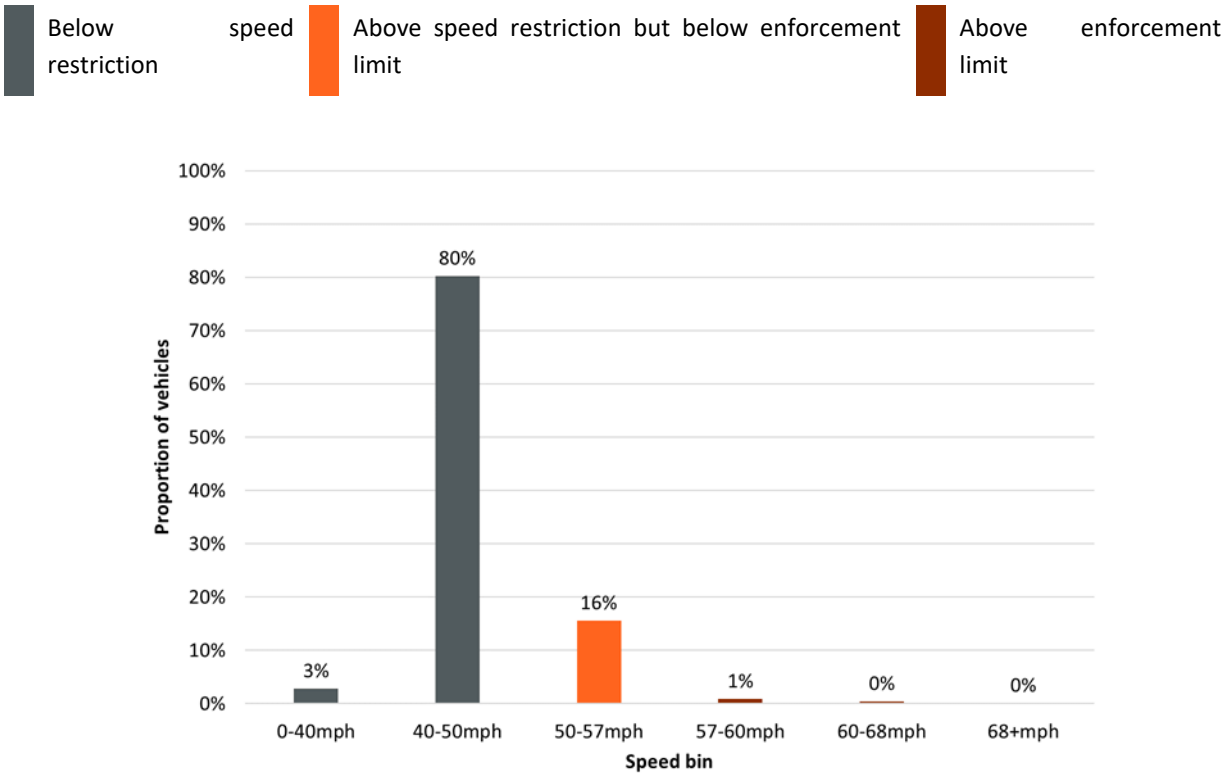


Figure 14: Proportion of cars and LGVs in each speed bin during the baseline period at the experimental location

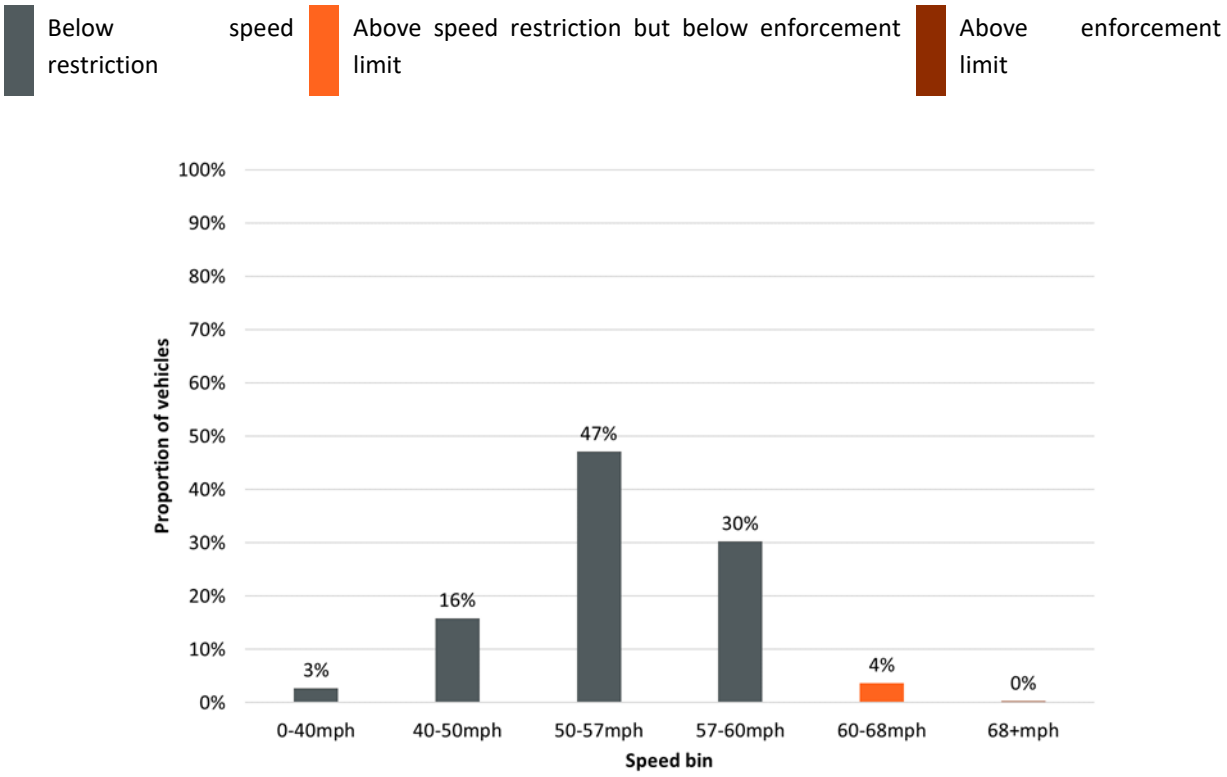


Figure 15: Proportion of cars and LGVs in each speed bin during the trial period at the experimental location

The proportion of cars and LGVs travelling above the posted speed restriction at the experimental location changed considerably between the baseline and trials periods, dropping from 17% to 4%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 1% to 0% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed restriction, above speed restriction 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 0.44, 0.42 and 0.20, respectively.

Figure 16 and Figure 17 show the proportion of HGVs recorded in each speed bin across the two monitoring periods at the experimental location.

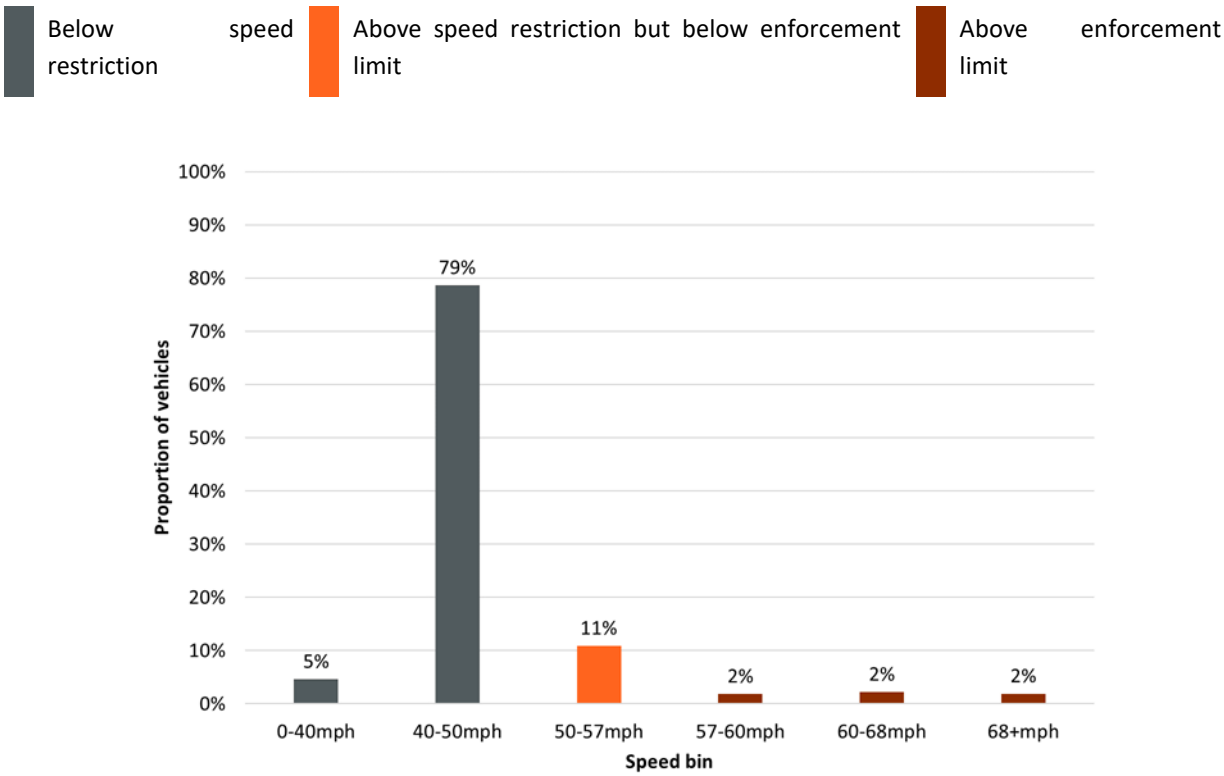


Figure 16: Proportion of HGVs in each speed bin during the baseline period at the experimental location

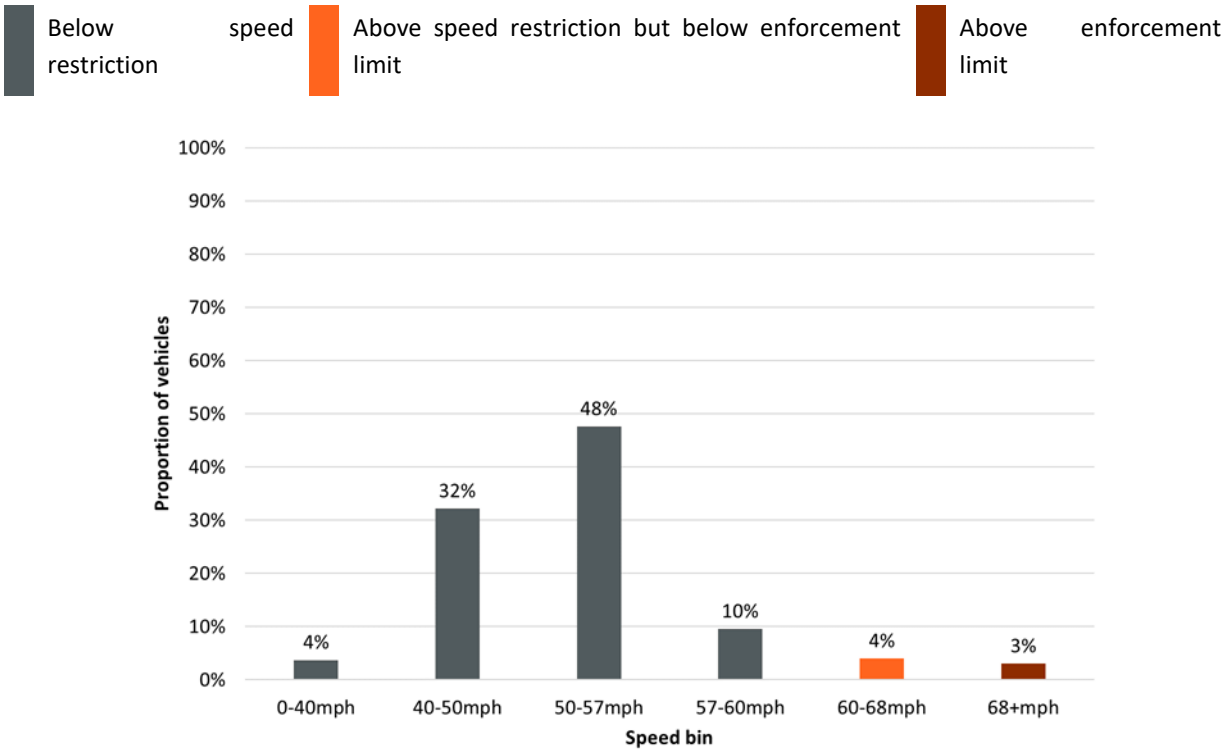


Figure 17: Proportion of HGVs in each speed bin during the trial period at the experimental location

The proportion of HGVs travelling above the posted speed restriction at the experimental location changed considerably between the baseline and trial periods, dropping from 17% to 7%. Similarly, the proportion of HGVs travelling above the enforcement limit decreased from 6% to 3% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed restriction, above speed restriction 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 0.31, 0.27 and 0.14, respectively.

In summary, the data shows that compliance rates improved for all vehicles when the speed restriction was 60mph compared with 50mph. The compliance at the control location, where the speed restriction remained unchanged at 70mph during both periods, also changed during the trial period, however this was likely a result of the variation in placement of traffic management relative to the position of the radar unit.

3.2.3 Congestion

A check was conducted on the total duration of congestion observed during the investigation. At the experimental location, 1.3% 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, 0.0% of the total

time was classified as congested. Figure 18 outlines the average speeds per hour of the day, by monitoring period and location.

This figure shows that average speed was generally higher during the night (between 22:00 and 06:00) and lower during the day at the experimental location. The opposite was seen at the control location, with higher speeds being recorded in the evening (between 15:00 and 20:00) and lower speeds recorded overnight. 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.

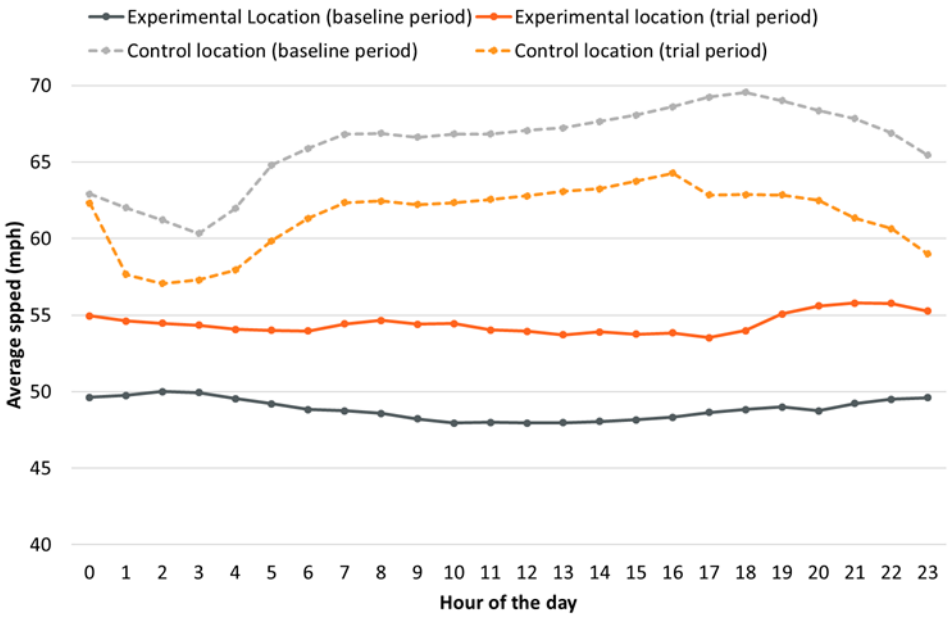


Figure 18: Average hourly vehicle speed by location and monitoring period

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 19 shows the proportion of total vehicles close following across the course of the trial at both the control and experimental locations.

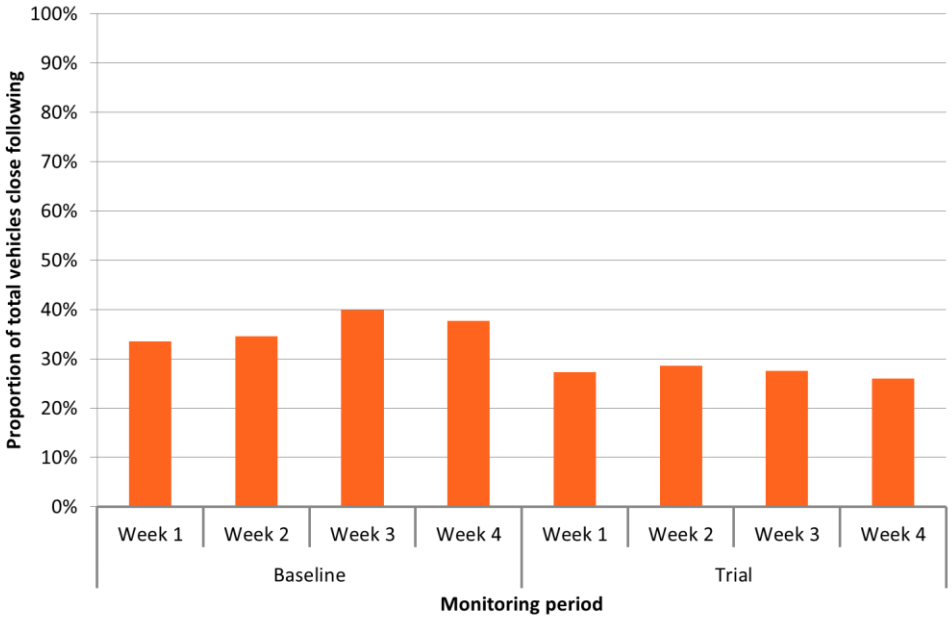


Figure 19: Proportion of vehicles close following by monitoring period at the experimental location

During the baseline period the proportion of vehicles close following was 36% at the experimental location. During the trial period, the proportion dropped to 27%, signifying less close following with the 60mph speed restriction.

A two-proportion z-test indicated that the 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 0.19.

Figure 20 shows the split of HGVs and cars/LGVs close following at the experimental location. HGVs are defined as any vehicle over 25ft long.

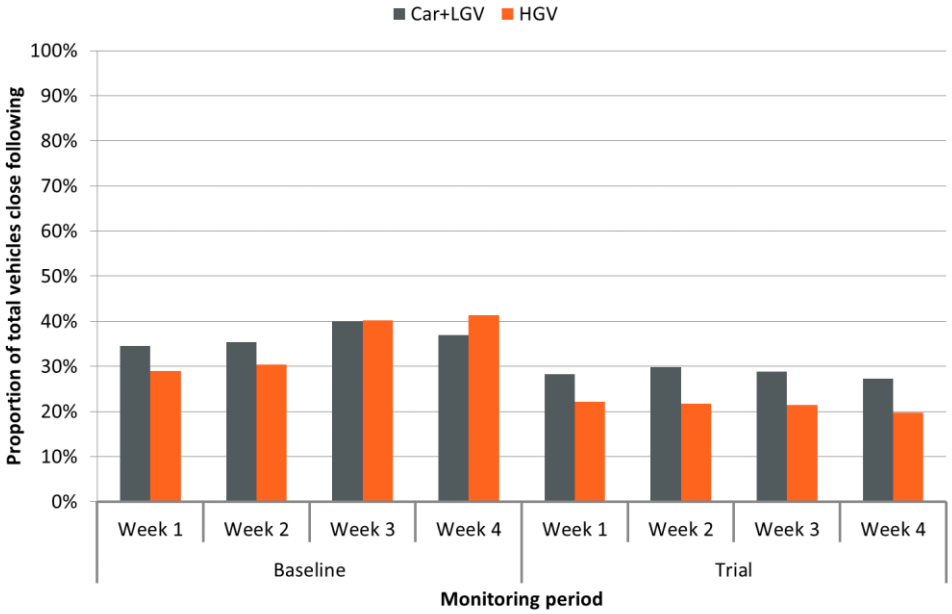


Figure 20: Proportion of vehicles close following by period and vehicle type at the experimental location

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 (0.03 during the baseline and 0.16 during the trial period). The figure further shows about 37% of cars/LGVs and 35% of HGVs were close following at the experimental location during the baseline period. These percentages changed during the trial period to 28% for cars/LGVs and 21% for HGVs. In summary, the data show that the proportion of vehicles engaged in close following improved for all vehicles when the speed restriction was 60mph compared with 50mph.

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

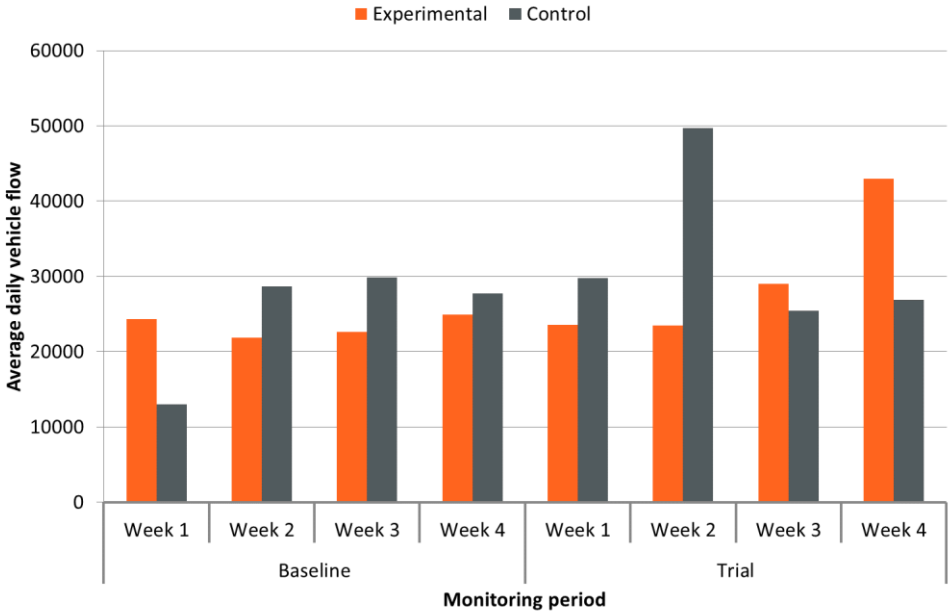


Figure 21: Average daily vehicle flow by location and monitoring period

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 25,262 during the baseline period and 32,980 during the trial period. The experimental location had a lower average daily flow of 23,441 during the baseline period and 29,756 during the trial period. As with the north bound carriageway, some irregularities were observed in Week 2 and 4 of the trial period where higher flows were recorded, but the reasons for this are unknown.

Statistical tests showed that there was a significant difference ($p<0.05$) in average vehicle flow between the baseline and trial period at the experimental location, with a small effect size of 0.06.

A comparison of the proportion of HGVs by monitoring location and period is presented in Figure 22. This shows that the proportions of HGVs remained fairly constant at the experimental location throughout the trial, 16% during the baseline period and 18% during the trial period.

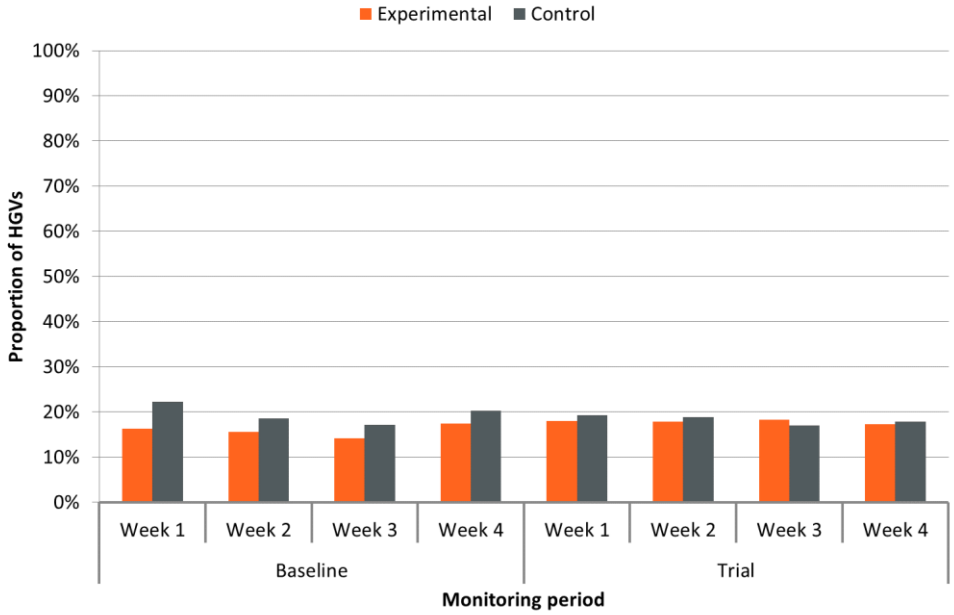


Figure 22: Proportion of HGVs by week and location

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 (0.05) and therefore, this difference is unlikely to have had a significant impact on driver behaviour.

The distribution of vehicles between Lane 1 and Lane 2 within the experimental location is shown in Table 6.

Table 6: Distribution of vehicle by lane and monitoring period at the experimental location

Monitoring period	Vehicle type	Lane 1	Lane 2
Baseline period	All vehicles	61%	39%
Trial period	All vehicles	64%	36%

The distribution of vehicles across the two 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 and Lane 2 within the experimental location is shown in Table 7.

Table 7: Composition of vehicle by lane and monitoring period at the experimental location

Monitoring period	Vehicle type	Lane 1	Lane 2
Baseline period	Cars + LGVs	77%	95%
	HGVs	23%	5%
Trial period	Cars + LGVs	74%	96%
	HGVs	26%	4%

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 ($p<0.05$) but with a very small effect size of 0.006.

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 0.01.

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 23 shows the free-flow average speeds on the control and experimental locations across the two monitoring periods.

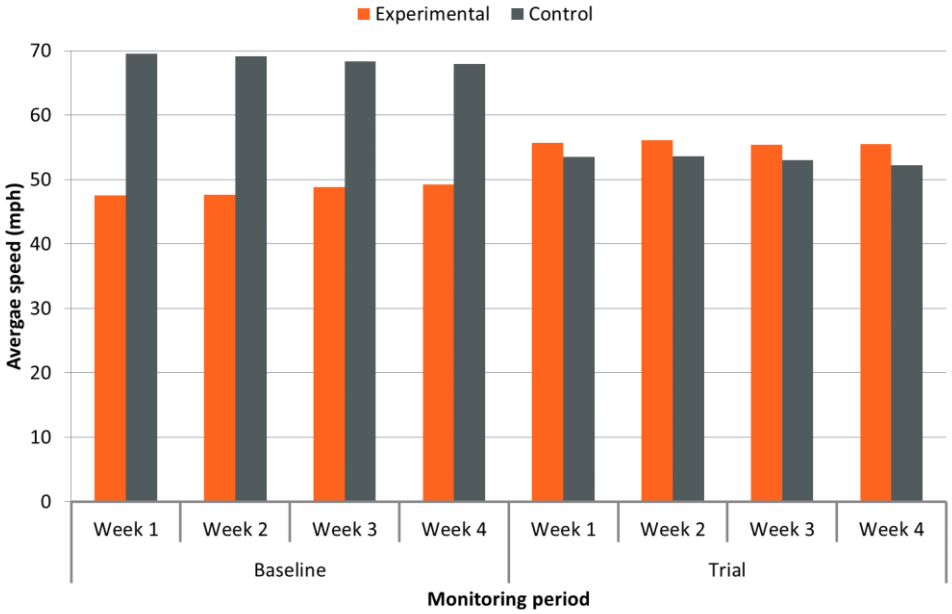


Figure 23: Free-flow average speed during the monitoring period by location

Free-flow average speed at the control location showed great variability throughout the investigation. During the baseline period, the average speed was approximately 69mph. This dropped to 53mph during the trial period despite the speed restriction remaining unchanged at 70mph. This is likely to be a result of the traffic management varying between the baseline and trial periods. As mentioned earlier in Section 2.5.1.1 and evident in Figure 5, the radar installation is located within the lane change zone during the trial period (Phase 3a) whereas it was not subject to any traffic management during the baseline period (Phase 3). This explains why the free-flow average speeds were lower in the trial period. At the experimental location, there was an increase in the free-flow average speed from around 48mph in the baseline period to around 56mph 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 also a significant difference in average speeds between baseline and trial periods at the control location ($p<0.01$) explaining about 98% of the variance.

Free-flow average speeds by lane are shown in Table 8.

Table 8: Free-flow average speed (mph) by monitoring period and lane at the experimental location

Monitoring period	Lane 1	Lane 2
Baseline period	47.9	49.0
Trial period	54.9	57.0

In both periods, speeds were higher in Lane 2 as compared to Lane 1. Table 8 shows that the free-flow average speed in Lane 1 at the experimental location increased by 7.0mph

between the baseline and trial periods. Lane 2 had an increase of 8.0mph between the two periods. In comparison, Table 9 below shows that the free-flow average speed significantly decreased between the baseline and trial periods at the control locations. This again, can be attributed to the radar installation being within the lane change zone during the trial period.

Table 9: Free-flow average speed (mph) by monitoring period and lane at the control location

Monitoring period	Lane 1	Lane 2	Lane 3
Baseline period	61.8	71.1	77.3
Trial period	52.3	54.4	73.8

Figure 24 shows the comparison between free-flow average speed for cars/LGVs and HGVs across the monitoring periods at the experimental location.

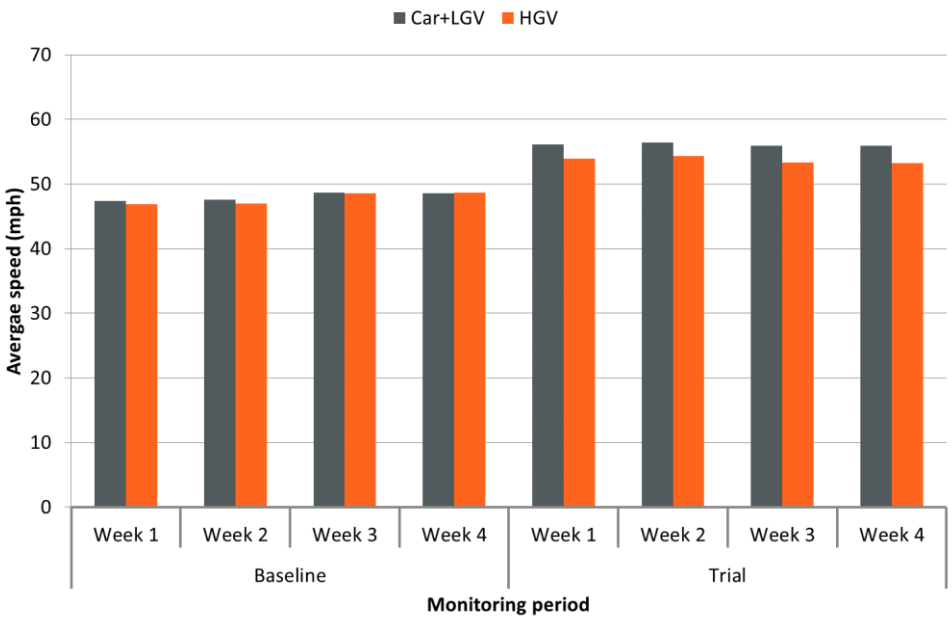


Figure 24: Free-flow average speed by vehicle type at the experimental location

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 48mph. In the trial period, free-flow average speed for cars and LGVs was 56mph, while HGVs were travelling at an average free-flow speed of 54mph.

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 restriction, above the speed restriction but below the enforcement limit, and above the enforcement limit (10% of speed restriction+2mph).

Figure 25 and Figure 26 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 restriction; the orange bars show the proportion of vehicles travelling above the speed restriction but below the enforcement threshold (10% of speed restriction+2 mph); and the red bars show vehicles travelling above the enforcement threshold.

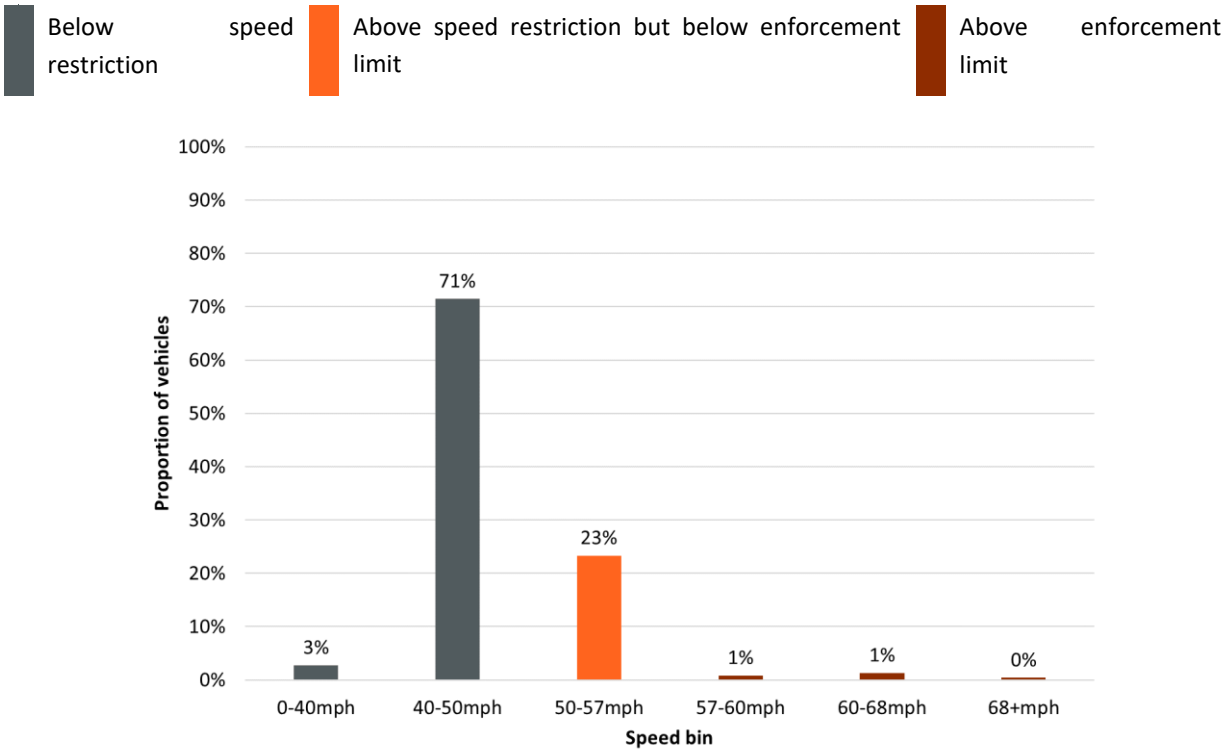


Figure 25: Proportion of vehicles in each speed bin during the baseline period at the experimental location

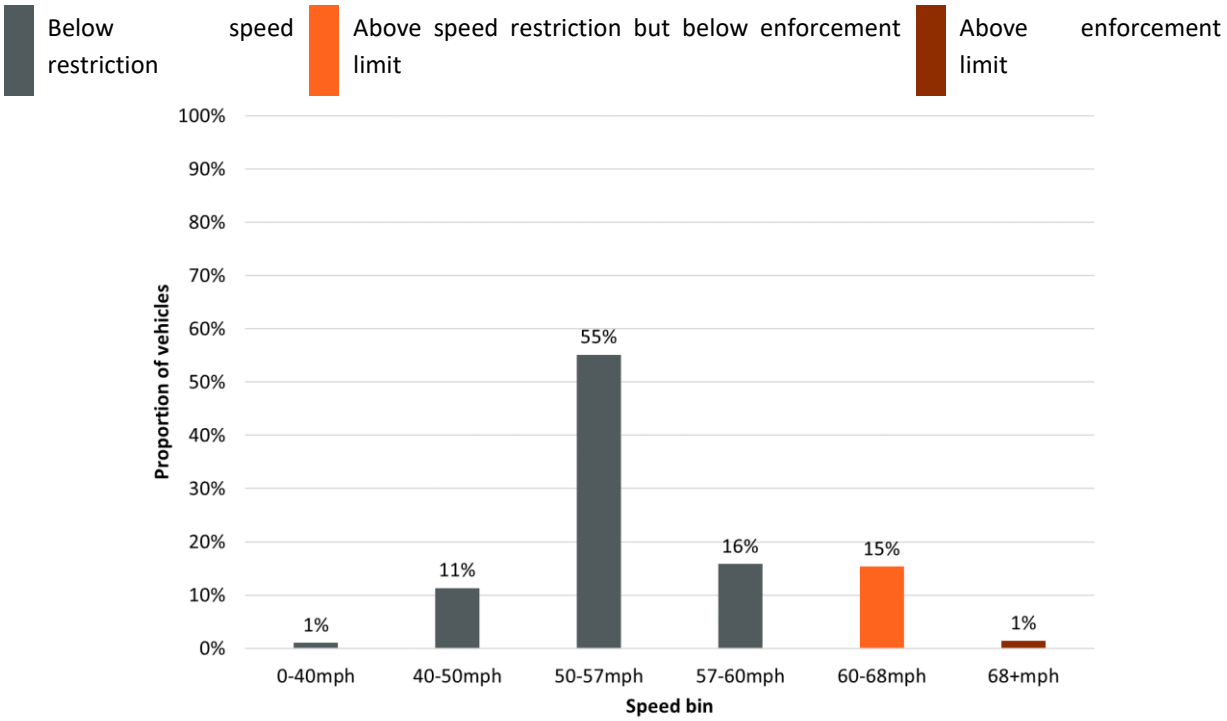


Figure 26: Proportion of vehicles in each speed bin during the trial period at the experimental location

The proportion of vehicles travelling above the posted speed restriction at the experimental location changed considerably between the baseline and trial periods, dropping from 25% to 16%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 2% to 1% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed restriction, above speed restriction 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 effect sizes of 0.22, 0.20 and 0.12, respectively.

Figure 27 and Figure 28 show the proportion of vehicles recorded in each speed bin across the two monitoring periods at the control location.

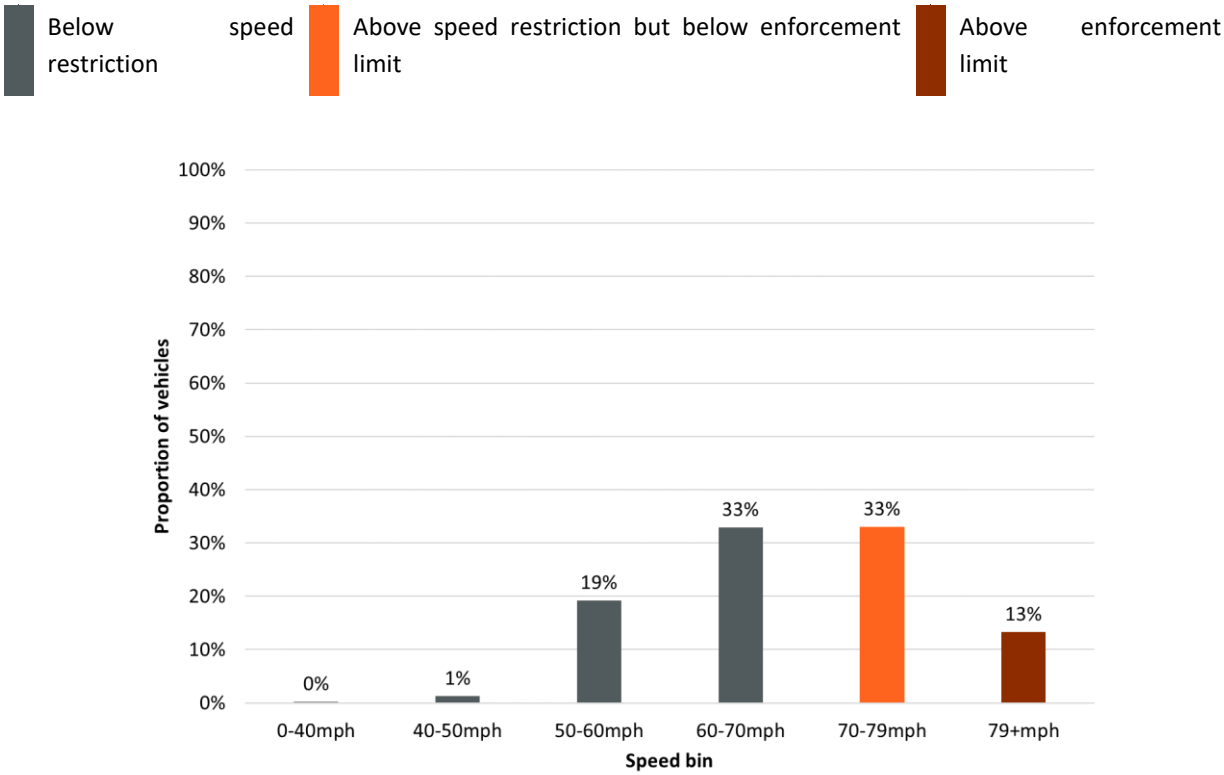


Figure 27: Proportion of vehicles in each speed bin during the baseline period at the control location

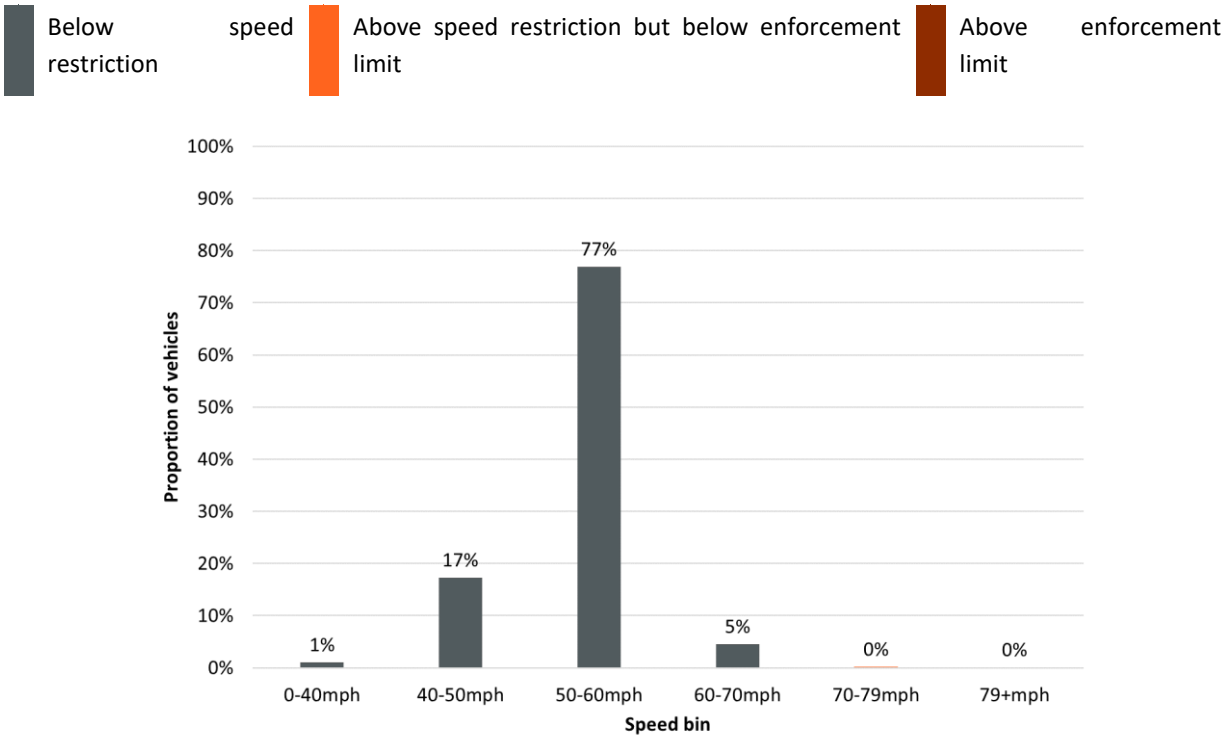


Figure 28: Proportion of vehicles in each speed bin during the trial period at the control location

The proportion of vehicles recorded as traveling above the posted speed restriction at the control location changed from 46% to 0% between the baseline and trial periods. Again, this change is likely to be the result of variations in the placement of traffic management between the baseline and trial periods, as previously shown in Figure 5. The radar unit was located within the approach zone during the trial period. This in contrast to the baseline period where the radar unit was located upstream of the approach zone. This may have attributed to the lower average speeds recorded during the trial period as drivers are likely to have responded to the warning signs located within the approach zone and slowed down in advance of the works zone.

Figure 29 and Figure 30 show the proportion of cars and LGVs recorded in each speed bin across the two monitoring periods at the experimental location.

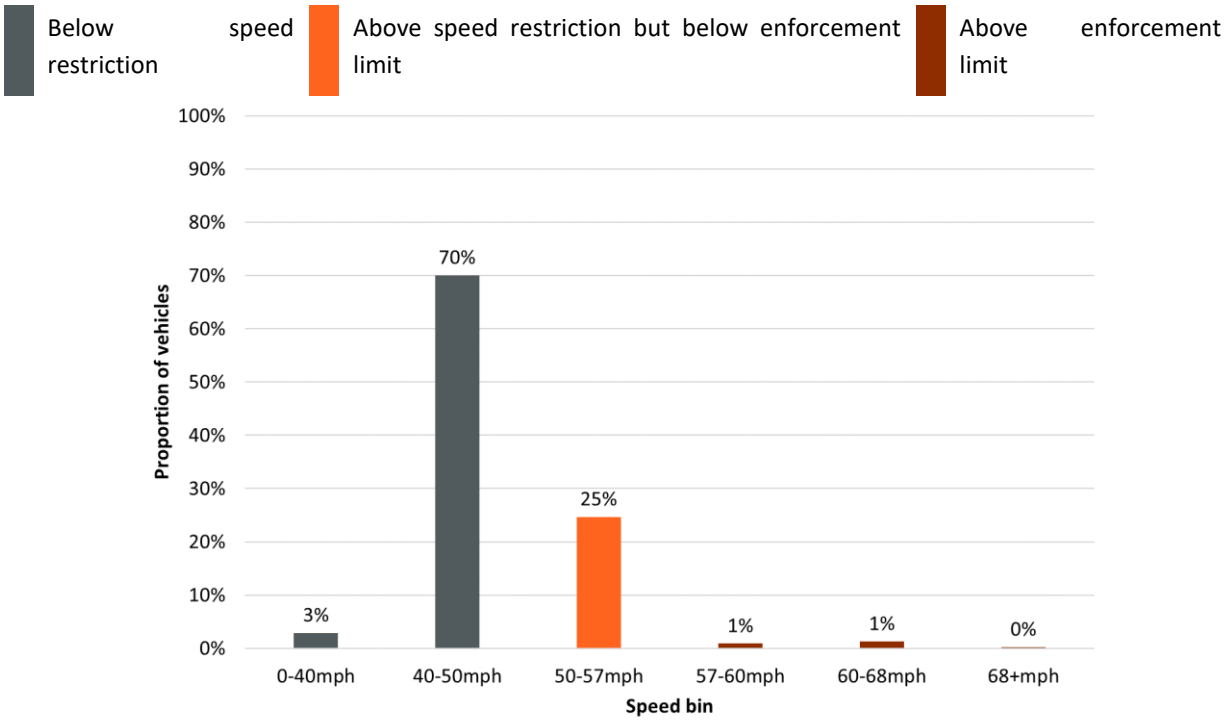


Figure 29: Proportion of cars and LGVs in each speed bin during the baseline period at the experimental location

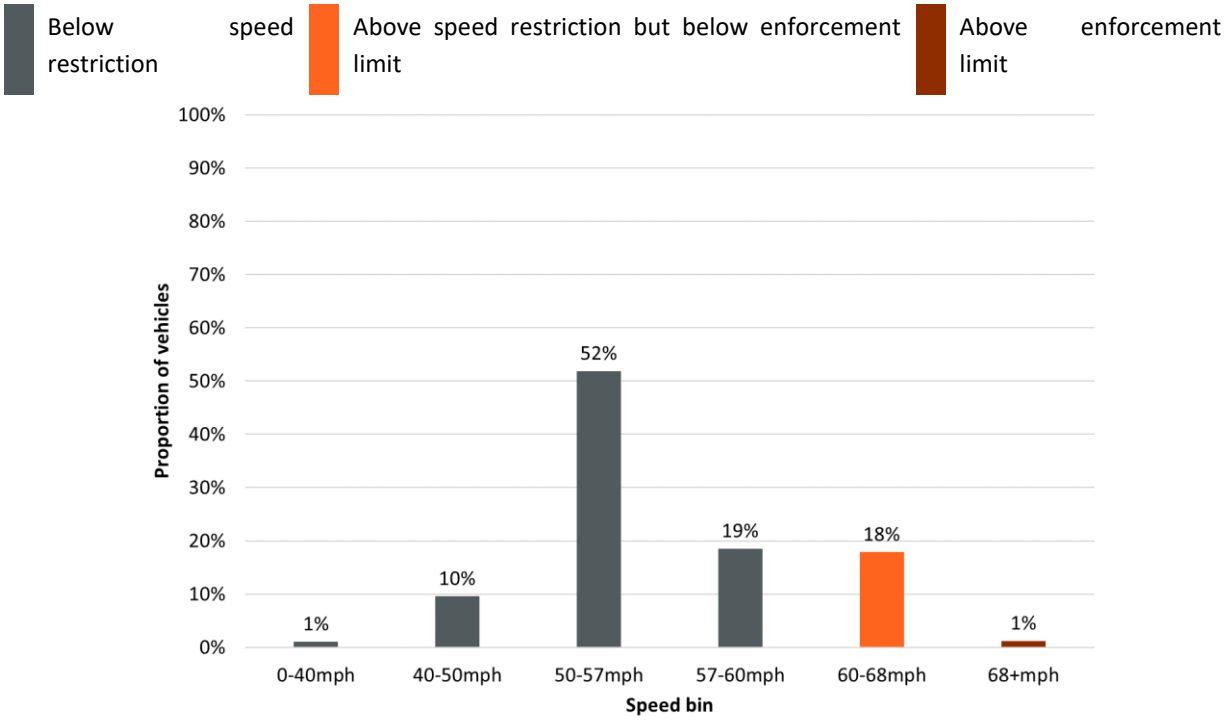


Figure 30: Proportion of cars and LGVs in each speed bin during the trial period at the experimental location

The proportion of cars and LGVs travelling above the posted speed restriction at the experimental location changed between the baseline and trial periods, dropping from 27% to 19%. Similarly, the proportion of vehicles travelling above the enforcement limit decreased from 2% to 1% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed restriction, above speed restriction 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 effect sizes of 0.16, 0.14 and 0.08, respectively

Figure 31 and Figure 32 show the proportion of HGVs recorded in each speed bin across the two monitoring periods at the experimental location.

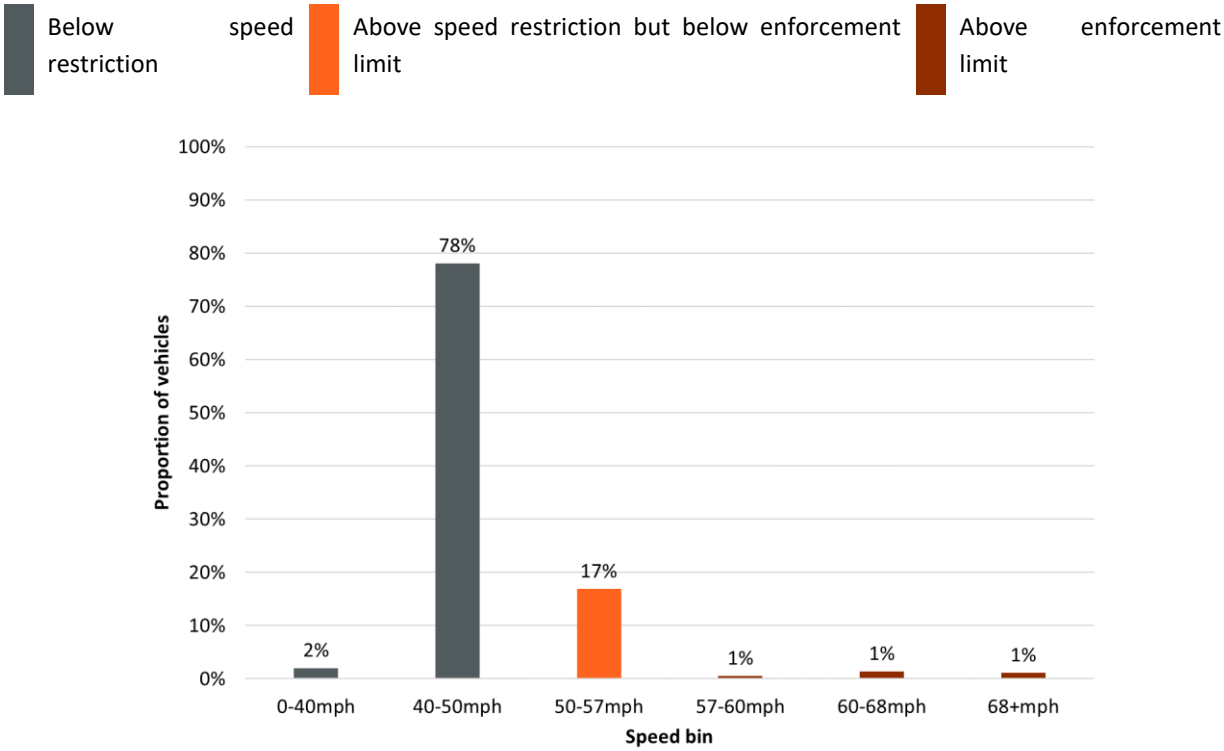


Figure 31: Proportion of HGVs in each speed bin during the baseline period at the experimental location

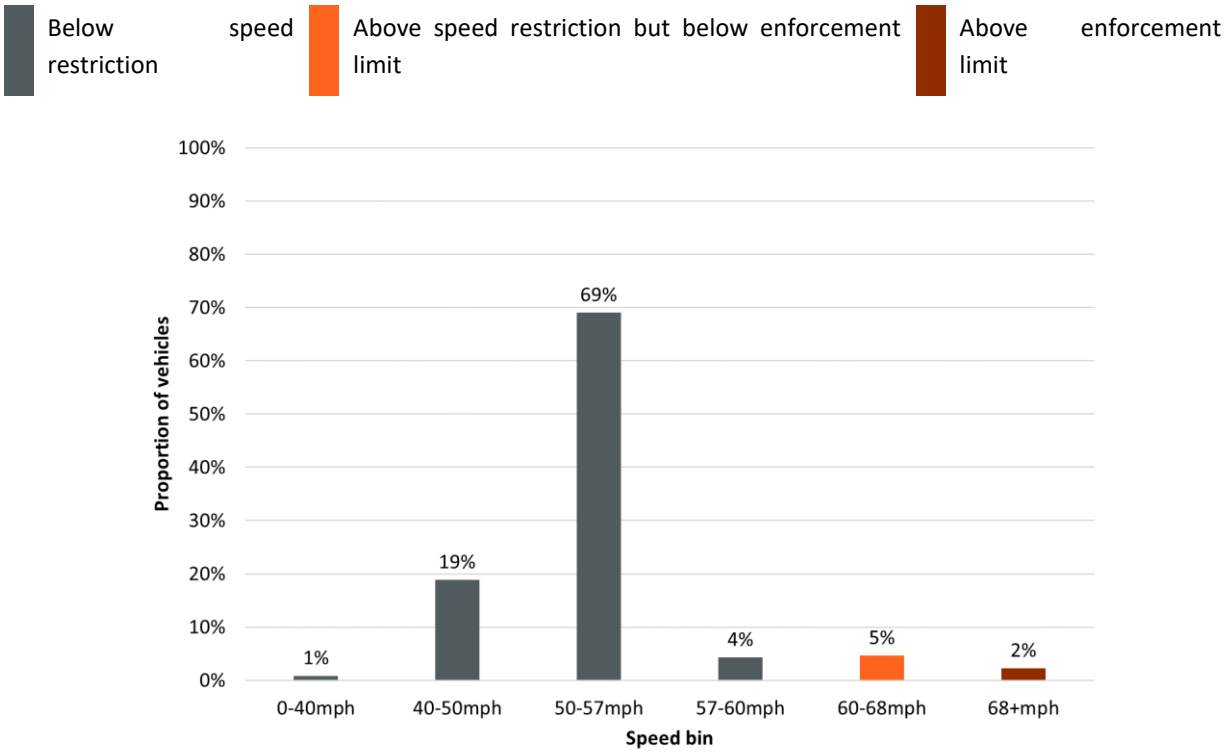


Figure 32: Proportion of HGVs in each speed bin during the trial period at the experimental location

The proportion of HGVs travelling above the posted speed restriction at the experimental location changed considerably between the baseline and trial periods, dropping from 20% to 7%. Similarly, the proportions of HGVs travelling above the enforcement limit decreased from 3% to 2% between the two periods.

When looking at the differences in the proportion of vehicles in each category (below speed restriction, above speed restriction 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 - 0.39, 0.42 and 0.06, respectively.

3.3.3 Congestion

A check was conducted on the total duration of congestion observed during the investigation. At the experimental location, 0.6% 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, 2.7% of the total time was classified as congested. Figure 33 outlines the average speeds per hour of the day, by monitoring period and location.

Figure 33 shows that average speed was generally higher during the night (between 20:00 and 06:00) and lower during the day. This pattern appears consistent across the baseline period at the experimental location and during the trial period at the both locations. The

control location during the baseline period saw a different trend with lower speeds overnight and higher speeds in the evening (between 15:00 and 18:00), however the reasons for this are unclear. 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.

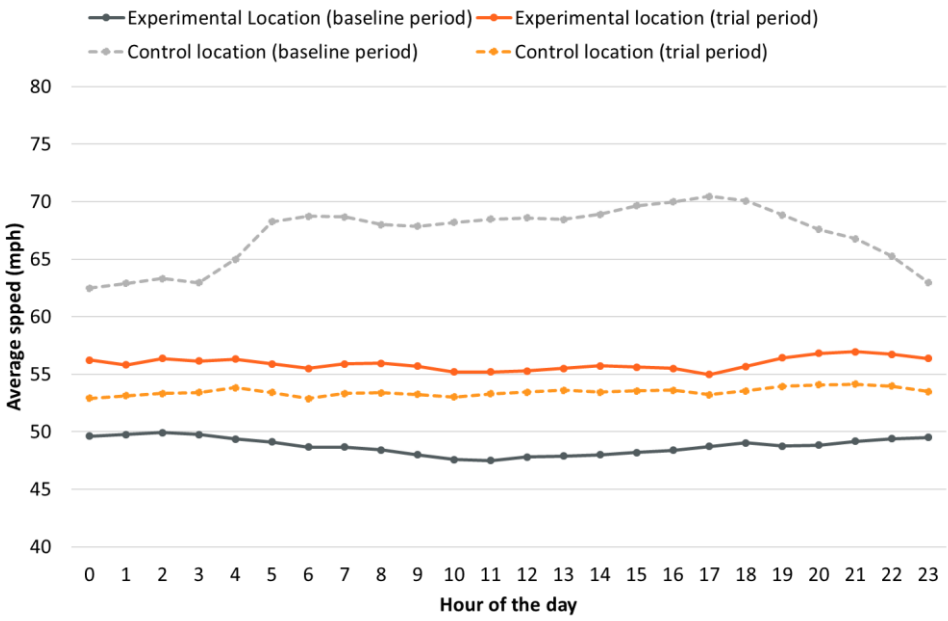


Figure 33: Average hourly vehicle speed by location and monitoring period

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 34 shows the proportion of total vehicles close following across the course of the trial at the experimental location.

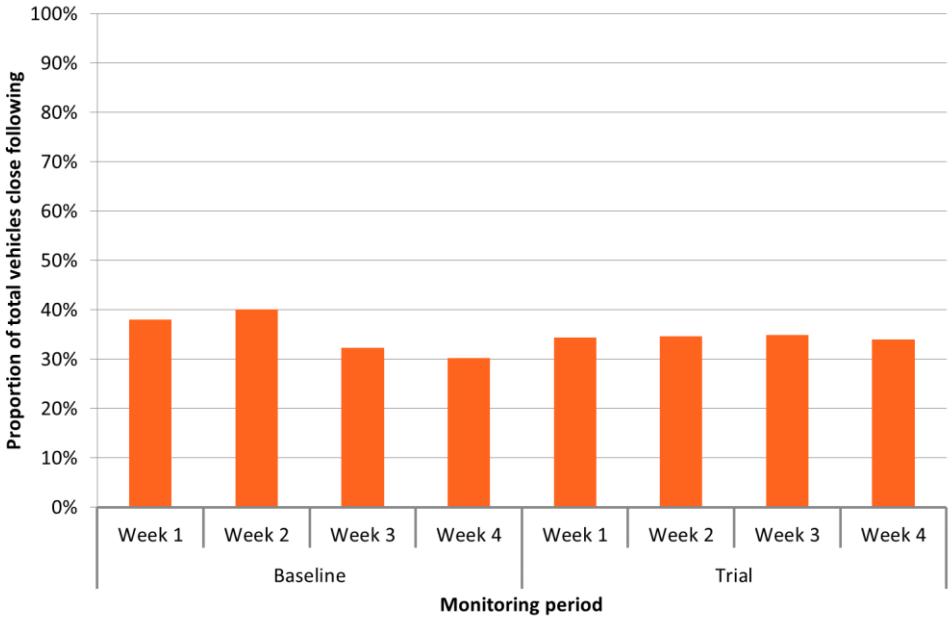


Figure 34: Proportion of vehicles close following by monitoring period at the experimental location

During the baseline period the proportion of vehicles close following was 35% at the experimental location, but slightly lower (34%) during the trial period.

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 0.02.

Figure 35 shows the split of HGVs and cars/LGVs close following at the experimental location. HGVs are defined as any vehicle over 25ft long.

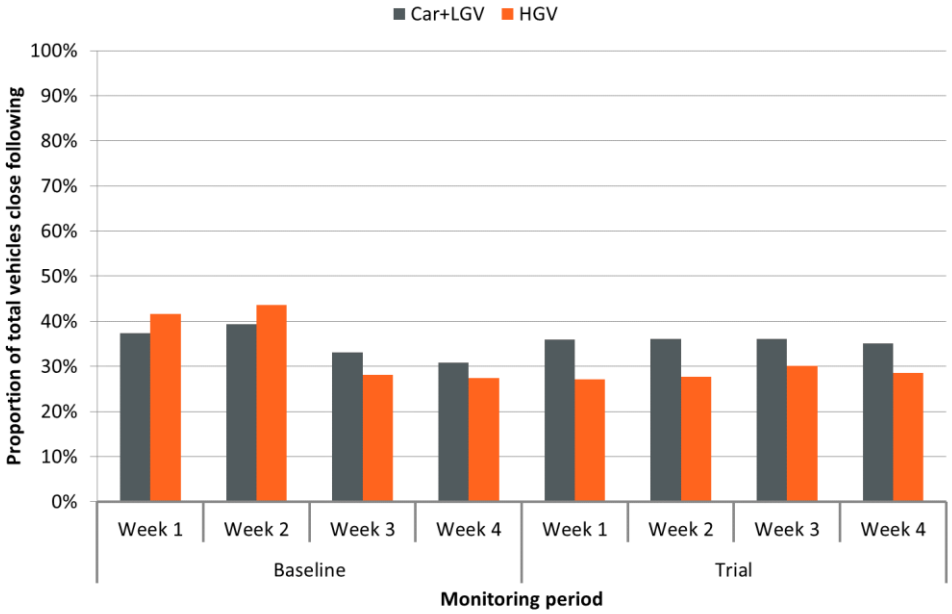


Figure 35: Proportion of vehicles close following by period and vehicle type at the experimental location

About 35% of cars/LGVs and 35% of HGVs were close following at the experimental location during the baseline period. These percentages changed during the trial period to 36% for cars and LGVs and to 28% 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 0.02 and 0.15, respectively. In summary, the data show that compliance rates improved for all vehicles when the speed restriction was 60mph compared with 50mph.

3.4 Incidents and breakdowns

In total 127 incidents were reported across both investigations: 82 of which were in the baseline monitoring periods and 45 in the trial monitoring periods. A summary of these reported incidents is presented in Figure 36.

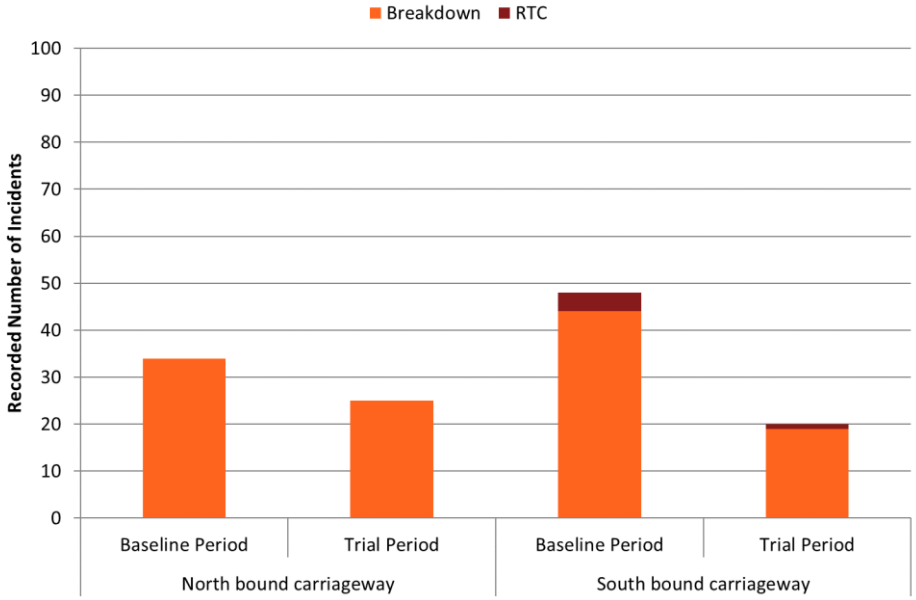


Figure 36: Reported incidents on north bound carriageway

The number of reported incidents varied between the baseline and trial period on the north bound carriageway. At the experimental location, where the speed restriction changed between monitoring periods, the total number of reported incidents was 34 during the baseline period and 25 during the trial period. Looking specifically at road traffic collisions (RTCs), the figures showed no RTCs during both the baseline period and the trial period.

The number of reported incidents also varied between the baseline and trial period on the south bound carriageway. At the experimental location, the total number of reported incidents was 48 during the baseline period and 20 during the trial period.

Looking specifically at RTCs, at the experimental location there were 4 RTCs during the baseline period and 1 during the trial period. Given the small sample size, statistical tests were not carried out. The decrease in the number of reported RTCs on both the north bound and south bound carriageways cannot be confidently attributed to the change in the 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 10 shows the estimated average journey time during the baseline and trial periods.

Table 10: Journey time estimates by monitoring period

	Monitoring period	Length (km)	Average vehicle speed (mph)	Journey time (seconds)	Difference (seconds)
North bound	Baseline	9.0	48	420	-46.7 (-13%)
	Trial	9.0	54	373.3	
South bound	Baseline	8.6	48	397.5	-56.8 (-14%)
	Trial	8.6	56	340.7	

The results suggest that changing the speed restriction from 50mph to 60mph decreased the average journey time by around 52 seconds. Relative to the journey time through the 8-9km scheme, this represents a 14% 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.

3.6 Workforce survey

In total, 41 individuals completed the workforce survey during the investigation; 14 responses reported on the 50mph speed restriction and 32 responses reported on the 60mph speed restriction. A summary of their responses is presented below. Due to the limited number of responses, it was not possible to conduct any statistical analyses and caution should be taken when interpreting the results presented in this section.

Participants from the workforce were asked to rate how they thought the speed restriction affected their safety (see Figure 37).

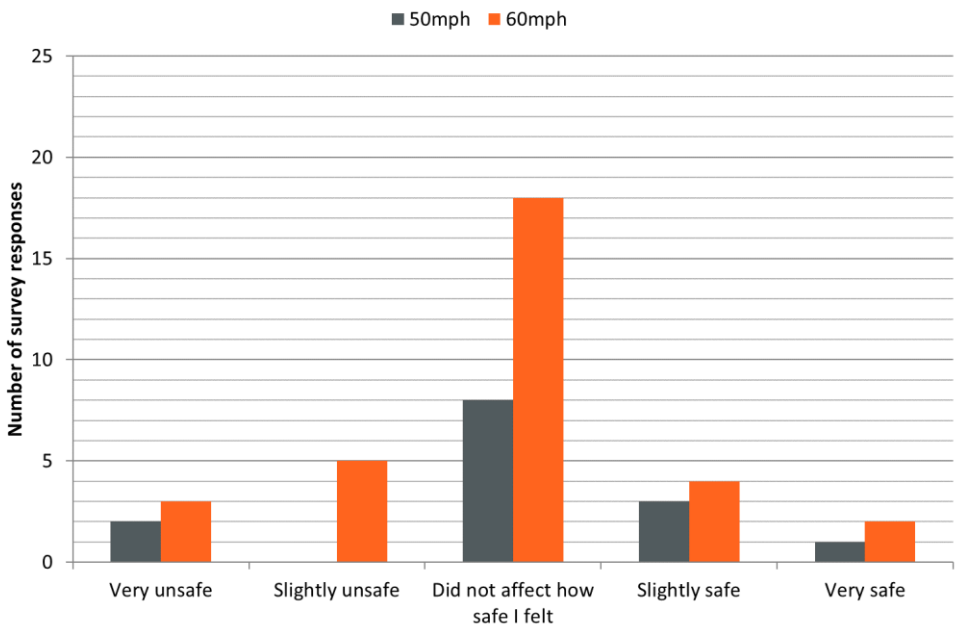


Figure 37: Responses to question "How do you think the speed restriction affected your safety? Did it make you feel…?"

Across the investigation:

- 8 out of 14 participants reported the 50mph speed restriction did not affect how safe they felt and 18 out of 32 participants reported the 60mph speed restriction did not affect how safe they felt.
- 2 out of 14 participants reported the 50mph speed restriction made them feel either very or slightly unsafe and 8 out of 32 participants the 60mph speed restriction made them feel either very or slightly unsafe.
- 4 out of 14 participants reported the 50mph speed restriction made them feel either slightly or very safe and 6 out of 32 participants reported the 60mph speed restriction made them feel either slightly or very safe.

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 38.

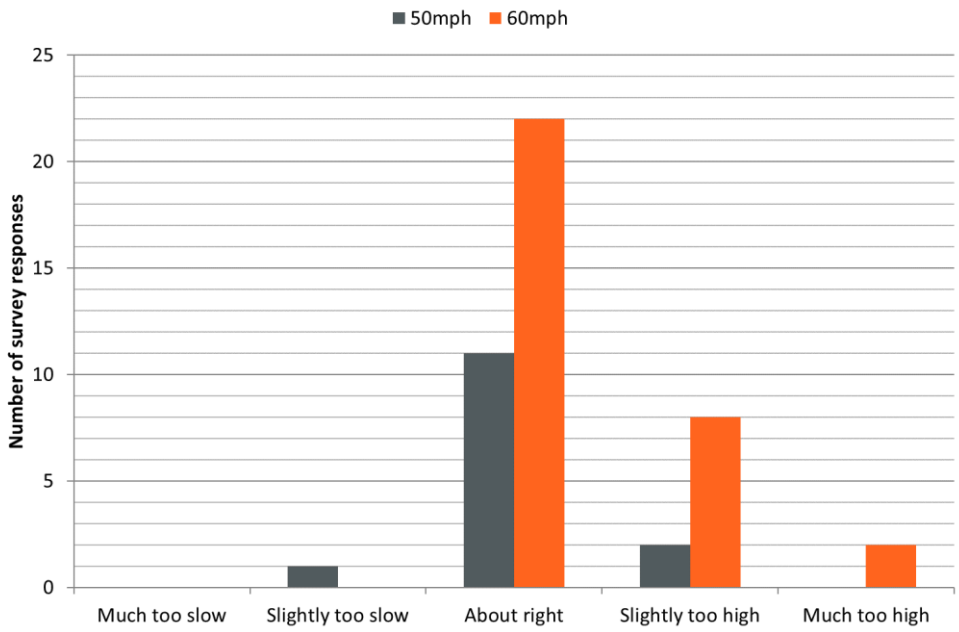


Figure 38: Responses to question "In terms of your safety, do you think the speed restriction was…?"

Across the investigation:

- 11 out of 14 participants reported the 50mph speed restriction was about right in terms of safety and 22 out of 32 participants reported the 60mph speed restriction was about right in terms of safety.
- 1 out of 14 participants reported the 50mph speed restriction was too slow in terms of safety and no participants reported the 60mph speed restriction was too slow in terms of safety.
- 2 out of 14 participants reported the 50mph speed restriction was too high in terms of safety and 10 out of 32 participants reported the 60mph speed restriction was too high in terms of safety.

Finally, in an open question, participants were asked to provide further comments on how the speed restriction affected their feelings of safety when they last worked on the scheme.

Table **11** shows themes that represent general patterns observed in participants' qualitative responses.

Table 11: Themes from participants' comments on the effects of the speed restrictions on their feelings of safety when they last worked on the scheme

	50mph speed restriction	60mph speed restriction
Positive comments	Combined with the use of average speed cameras, the speed restriction encouraged safe driving behaviours through the road works.	Compared with a 50mph speed restriction, the 60mph speed restriction improved traffic flow.
Negative comments	Compared with higher speed restrictions, the 50mph speed restriction encouraged more instances of unauthorised access into the road works by members of the public.	Compared with a 50mph speed restriction, the 60mph speed restriction reduced feelings of safety. Compared with a 50mph speed restriction, the 60mph speed restriction meant drivers had less time to react (for instance, to debris in the road or to other broken-down vehicles). Some drivers drove well below the speed restriction, which encouraged HGV drivers to overtake. Compared with a 50mph speed restriction, the 60mph speed restriction made it more difficult for works vehicles to slow down before entering the road works.
Suggestions to improve safety	Reduce the speed restriction to 40mph when traffic is separated from the road works using traffic cones. Maintain a 70mph speed restriction when traffic is separated from the road works using concrete barriers.	Implement more signage to increase drivers' awareness of the increased speed restriction.

Two participants suggested that their feelings of safety improved when concreate barriers are used to separate traffic from road works compared to other measures (such as cones), regardless of the speed restriction.

3.7 Customer satisfaction

In total, 60 participants were identified from the customer satisfaction survey as eligible for inclusion in the investigation. Of those, 29 reported their last journey as being through the scheme during the baseline period when only a 50mph speed restriction was in place. The remaining 31 participants reported that their last journey was through the scheme during

the trial period, when only a 60mph speed restriction was in place. A summary of their responses is presented below. Other survey responses were excluded for the following reasons:

- Participants reported that they did not regularly drive through the experimental location
- Participants reported that their most recent journey through the scheme was neither during the baseline period nor the trial period
- Participants reported that they did not drive through the experimental location or it was not possible to determine whether they had driven through the experimental location (based on their responses to the survey questions that ask where they joined and exited the motorway)
- Participants reported that they did not clearly remember the journey

Due to the limited number of responses, it was not possible to conduct any statistical analyses and caution should be taken when interpreting the results presented in this section.

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 39.

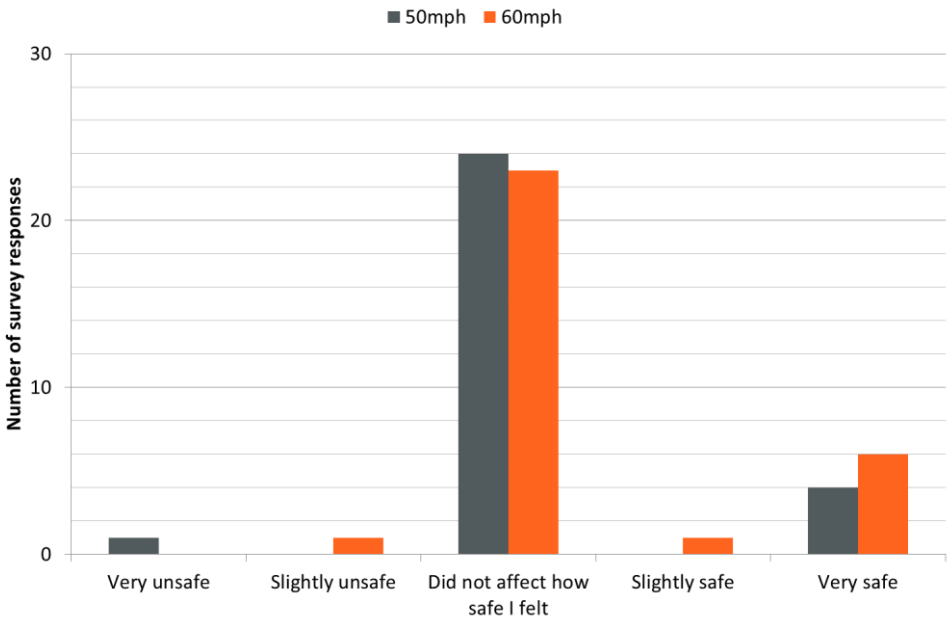


Figure 39: Responses to question: "How do you think the speed restriction affected your safety? Did it make you feel…?"

Across the investigation:

- During the baseline period, 24 out of 29 individuals reported the speed restriction did not affect how safe they felt. During the trial period, 23 out of 31 individuals reported the speed restriction did not affect how safe they felt.

- During the baseline period, 1 out of 29 individuals reported the speed restriction made them feel either very or slightly unsafe. During the trial period, 1 out of 31 individuals reported the speed restriction made them feel either very or slightly unsafe.
- During the baseline period, 4 out of 29 individuals reported the speed restriction made them feel either slightly or very safe. During the trial period, 7 out of 31 individuals reported the speed restriction made them feel either slightly or very safe.

Participants were also asked to rate how appropriate they thought the speed restriction was, in terms of safety. Responses are shown in Figure 40.

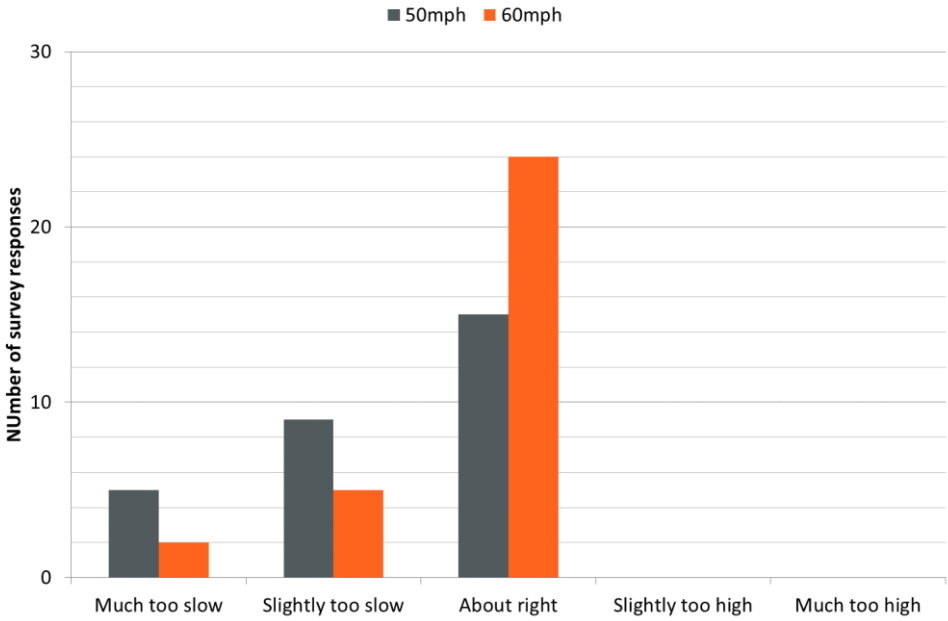


Figure 40: Responses to question "In terms of safety, do you think the speed restriction was…?"

Across the investigation:

- During the baseline period, 15 out of 29 individuals reported the speed restriction was about right in terms of safety. During the trial period, 24 out of 31 individuals reported the speed restriction was about right in terms of safety.
- During the baseline period, 14 out of 29 individuals reported the speed restriction was too slow in terms of safety. During the trial period, 7 out of 31 individuals reported the speed restriction was too slow in terms of safety.
- During both the baseline and 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 41.

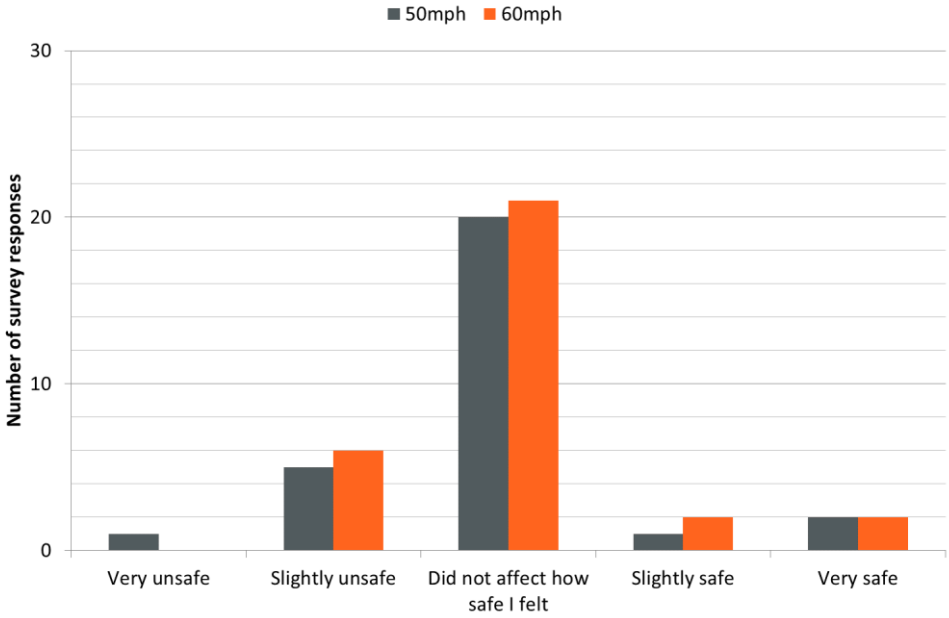


Figure 41: Responses to question: "How do you think the lane widths affected your safety? Did it made you feel…?"

Across the investigation:

- During the baseline period, 21 out of 29 individuals reported the lane widths did not affect how safe they felt. During the trial period, 21 out of 31 individuals reported the lane widths did not affect how safe they felt.
- During the baseline period, 6 out of 29 individuals reported the lane widths made them feel either very or slightly unsafe. During the trial period, 6 out of 31 individuals reported the lane widths made them feel either very or slightly unsafe.
- During the baseline period, 3 out of 29 individuals reported the lane widths made them feel either slightly or very safe. During the trial period, 4 out of 31 individuals reported the lane widths made them feel either slightly or very safe.

Participants were also asked to rate how appropriate they thought the lane widths were in terms of safety. Responses are shown in Figure 42.

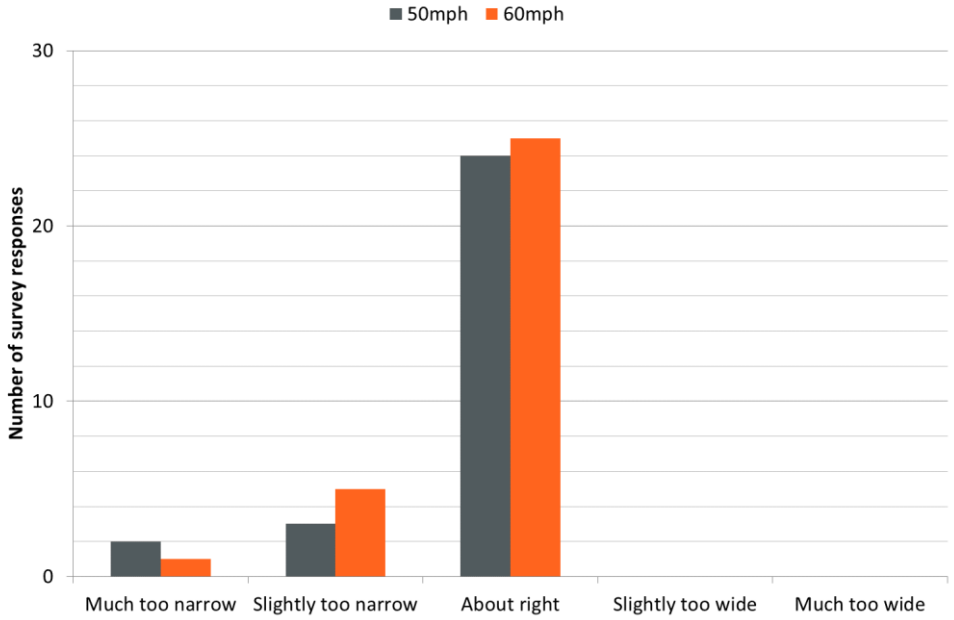


Figure 42: Responses to question: "In terms of safety, do you think the width of the lanes was…?"

Across the investigation:

- During the baseline period, 24 out of 29 individuals reported the lane widths were about right in terms of safety. During the trial period, 25 out of 31 individuals reported the lane widths were about right in terms of safety.
- During the baseline period, 5 out of 29 individuals reported the lane widths were too narrow in terms of safety. During the trial period, 6 out of 31 individuals reported the lane widths were too narrow in terms of safety.
- During both the baseline and trial period, no individuals reported the lane widths were too wide in terms of safety.

Finally, in an open question, participants were asked to provide further comments on their feelings of safety when they last drove between Junctions 50 and 51 of the A1(M). 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

		Baseline period	Trial period
Speed restriction	Positive comments		Compared with a 50mph speed restriction, the 60mph speed restriction encouraged drivers to be more vigilant. Compared with a 50mph speed restriction, the 60mph speed restriction discouraged close following.
	Negative comments	The speed restriction encouraged all drivers to drive at the same speed, which felt unsafe. Other drivers drove well below the speed restriction in nearside lanes and HGV drivers are not permitted to overtake them.	HGV drivers exceeded the speed restriction. The speed restriction encouraged HGV drivers to tailgate other vehicles.
Width of lanes	Positive comments	The lanes were sufficiently wide.	
	Negative comments	The lanes were too narrow. Driving alongside HGVs in narrowed lanes did not feel safe.	
	Suggestions to improve safety	HGVs should be restricted to a lower speed, so it is easier for other drivers to overtake them.	

Additionally, two participants who drove through the scheme during the baseline period made other general comments and suggestions in relation to the road works and safety. These comments were as follows:

- The reduced number of lanes did not feel safe
- The concrete barriers between the carriageways felt safer than measures that are typically used (such as traffic cones)
- The crossover points were "sufficiently progressive"

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 43.

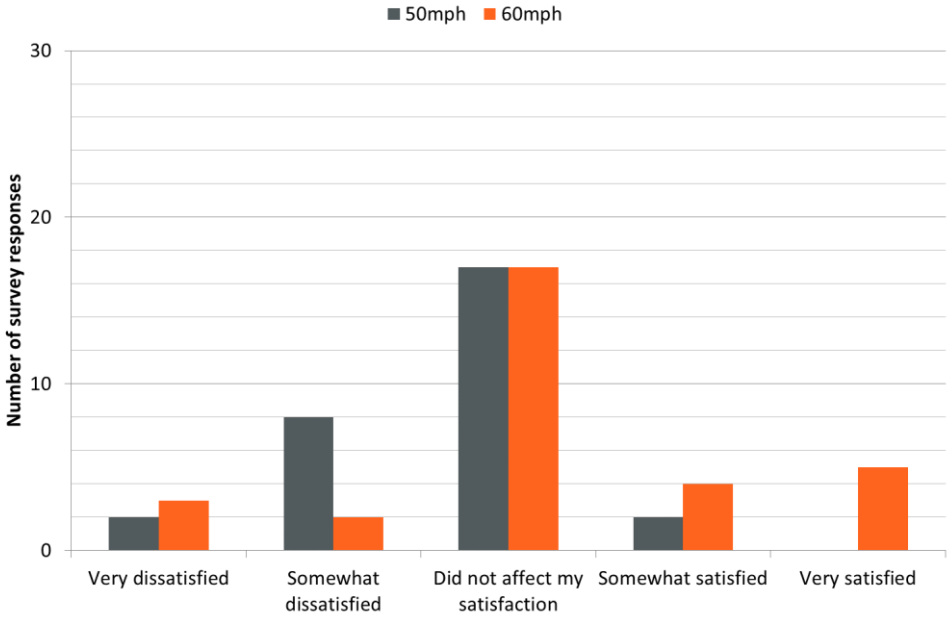


Figure 43: Responses to question: "How satisfied or dissatisfied were you with the speed restriction?"

Across the investigation:

- During the baseline period, 17 out of 29 individuals reported the speed restriction did not affect their journey satisfaction. During the trial period, 17 out of 31 individuals reported the speed restriction did not affect their journey satisfaction.
- During the baseline period, 10 out of 29 individuals reported the speed restriction made them feel either very or somewhat dissatisfied. During the trial period, 5 out of 31 individuals reported the speed restriction made them feel either very or somewhat dissatisfied.
- During the baseline period, 2 out of 29 individuals reported the speed restriction made them feel either very or somewhat satisfied. During the trial period, 9 out of 31 individuals 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 44.

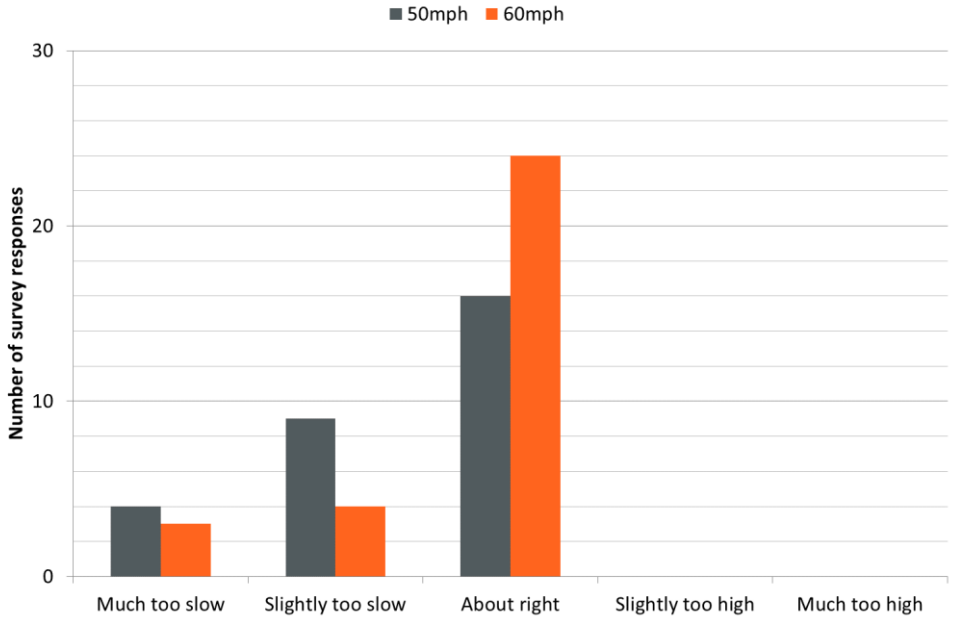


Figure 44: Responses to question: "In terms of journey satisfaction, do you think the speed restriction was…?"

Across the investigation:

- During the baseline period, 16 out of 29 individuals reported the speed restriction was about right in terms of journey satisfaction. During the trial period, 24 out of 31 individuals reported the speed restriction was about right in terms of journey satisfaction.
- During the baseline period, 13 out of 29 individuals reported the speed restriction was too slow in terms of journey satisfaction. During the trial period, 7 out of 31 individuals reported the speed restriction was too slow in terms of journey satisfaction.
- During both the baseline and trial periods, no individuals reported the speed restrictions were too high in terms of journey satisfaction.

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

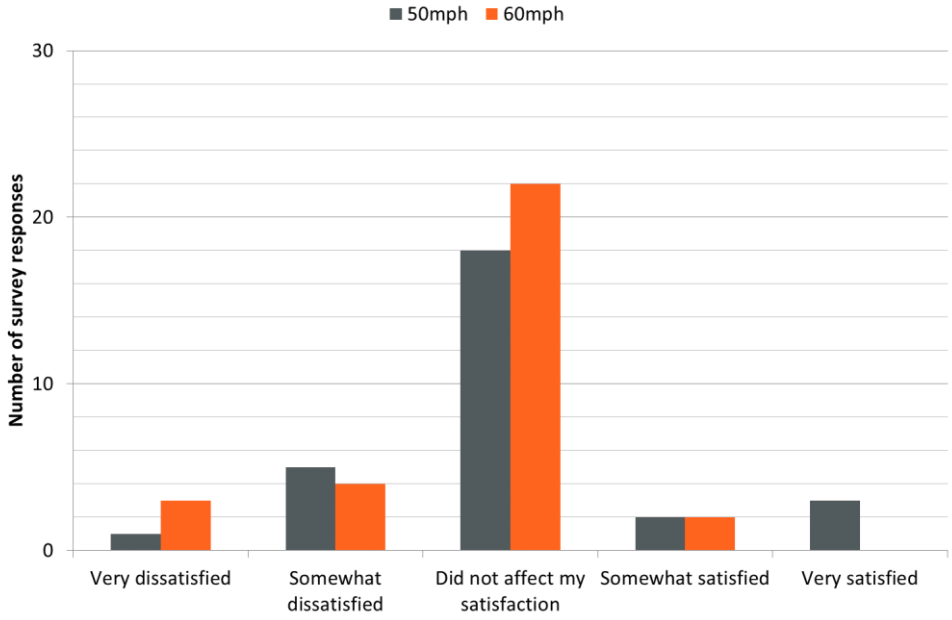


Figure 45: Responses to question: "How satisfied or dissatisfied were you with the lane widths?"

Across the investigation:

- During the baseline period, 18 out of 29 individuals reported the lane widths did not affect their journey satisfaction. During the trial period, 22 out of 31 individuals reported the lane widths did not affect their journey satisfaction.
- During the baseline period, 6 out of 29 individuals reported the lane widths made them feel either very or somewhat dissatisfied. During the trial period, 7 out of 31 individuals reported the lane widths made them feel either very or somewhat dissatisfied.
- During the baseline period, 5 out of 29 individuals reported the lane widths made them feel either very or somewhat satisfied. During the trial period, 2 out of 31 individuals reported the lane widths made them feel either very or somewhat satisfied.

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 46.

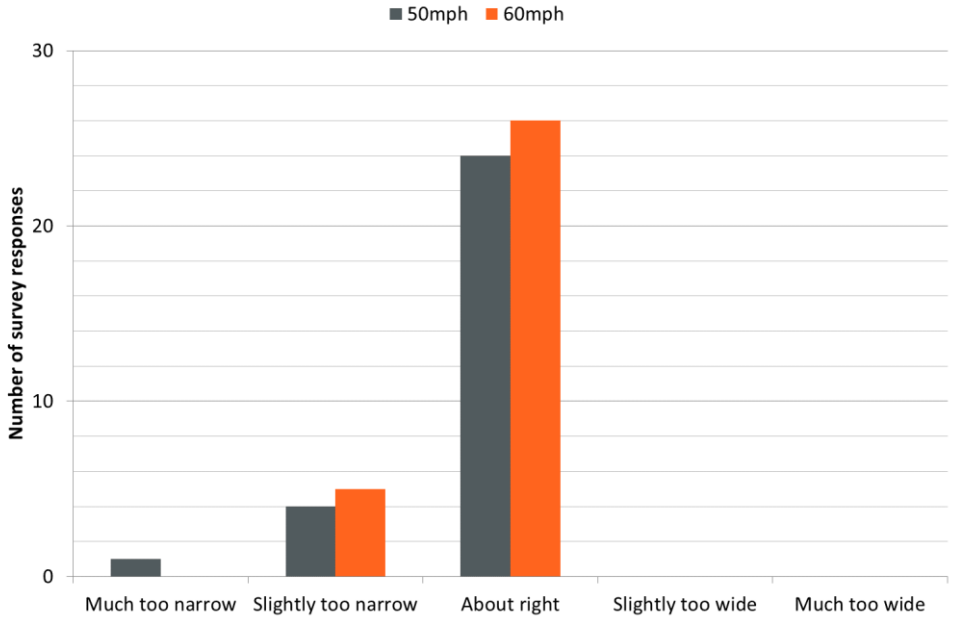


Figure 46: Responses to question: "In terms of journey satisfaction, do you think the lane widths were…?"

Across the investigation:

- During the baseline period, 24 out of 29 individuals reported the lane widths were about right in terms of journey satisfaction. During the trial period, 26 out of 31 individuals reported the lane widths were about right in terms of journey satisfaction.
- During the baseline period, 5 out of 29 individuals reported the lane widths were too narrow in terms of journey satisfaction. During the trial period, 5 out of 31 individuals reported the lane widths were too narrow in terms of journey satisfaction.
- During both the baseline and trial periods, no individuals reported the lane widths were too wide in terms of journey satisfaction.

Finally, participants were asked to comment on their journey satisfaction when they last drove between Junctions 50 and 51 of the A1(M). 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

		Baseline period	Trial period
Speed restriction	Positive comments		Compared with a 50mph speed restriction, the 60mph speed restriction improved journey satisfaction (including reduced feelings of frustration). Compared with a 50mph speed restriction, the 60mph improved traffic flow.
	Negative comments		HGV drivers exceeded the speed restriction. The speed restriction encouraged HGV drivers to tailgate other vehicles.
Width of lanes	Negative comments		The lanes were too narrow for larger vehicles. HGV drivers overtook other HGV drivers, which limited space for other vehicles to overtake and led to congestion.
	Suggestions to improve journey satisfaction	Having enough running lanes should be prioritised over lane width to ensure journey times are minimised.	

Additionally, one participant who drove through the scheme during the baseline period felt that there are generally too many road works.

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

To safely implement the 60mph speed restriction between Leeming and Ripon, 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 restriction signs).

Along with the costs of these additional mitigations, an additional cost for temporary radar installations used for monitoring traffic during the investigation was incurred by the scheme to implement the trial of a 60mph speed restriction.

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

The change in speed restriction appeared to have no impact on the number of reported incidents during the investigation. There was a decrease in the number of reported incidents on both the north bound and south bound carriageways; but statistical tests were not carried out given the small sample size. The changes in the number of reported incidents cannot, therefore, be confidently attributed to the change in speed restrictions.

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 48mph in the baseline period to 55mph in the trial period, on average). The increase in average vehicle speed was consistent across all four 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 52 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 increased. On the north bound investigation, the speed differentials between the two classes of vehicles increased by around 1mph, while the south bound investigation saw an increase of around 2mph.

Whilst average speeds increased, overall compliance with the posted speed restriction 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 (17% north bound, 26% south bound), but a lower proportion chose to travel above 60mph in the trial period (5% north bound, 16% south bound).

A similar trend was observed in the behaviours of HGV drivers; overall compliance with the posted speed restriction 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 5%, south bound 16%) 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 slight change due to the change in speed restriction; around a 5% reduction. The proportion of HGVs close following also dropped across the monitoring periods. The north bound investigation saw a drop from 35% in the baseline period to 21% in the trial period. The south bound investigation saw a drop from 35% to 28% 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.

4.2 Impact of change in speed restriction on workforce and customer satisfaction

Overall, responses to the workforce survey indicated that participants felt both the 50mph and 60mph speed restrictions were about right in terms of safety. There was a broad spread in perceptions of safety across the workforce; most participants reported that neither speed restriction affected how safe they felt, whereas other participants reported that the speed restrictions made them feel either unsafe or safe.

For the customer satisfaction survey, most participants indicated that the posted speed restriction and lane widths did not influence how safe they felt or their journey satisfaction. During both the baseline and trial periods, most participants felt the speed restriction and lane widths were about right in terms of safety and journey satisfaction, with all other participants suggesting the speed restriction was too slow or that the lanes were too narrow.

Qualitative feedback obtained during the customer satisfaction survey suggests that the 60mph speed restriction was welcomed by some participants 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).

Due to the small number of responses for both the workforce survey and customer satisfaction survey, it was not possible to test for any statistically significant changes in perceptions between the 50mph and 60mph speed restrictions. Therefore, there is no robust evidence to show either an increase or a decrease in self-reported customer satisfaction due to the 60mph speed restriction.

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 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 B.

These customer audits, undertaken by Ipsos and Pell Frischmann, utilised briefed 'Auditors' (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 period and 16 during the trial period.

Survey responses were then filtered 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 A1(M).

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 (20 in the control phase and 16 in the trial phase). In addition, no details are provided in the "Top Line Results" report on 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 B) are as follows:

- 20/20 Auditors (100%) 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.
- 18/20 Auditors (90%) were very satisfied with the 50mph speed restriction and 7/16 (44%) were very satisfied with 60mph.
- 20/20 Auditors (100%) felt 50mph was about right. 16/16 Auditors (100%) felt 60mph was about right.

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:

- "51" or "52" or "J51" or "J52" or "Jcn51" or "Jcn52" or "Jn51" or "Jn52" or "Leeming" or "Ripon"; and
- "A1" or "A1M" or "A1(M)"

During the investigation 2 relevant mentions in relation to the speed restriction were found. There were no mentions of the change in speed restriction from 50mph to 60mph, although the comments suggested a lack of understanding about why the speed restriction was in operation. Additionally, customers expressed frustrations with the lack of visible workforce and queried why the roadworks were being repeated (as they only took place a year previously).

6 Next steps

6.1 Continued use of 60mph at the A1(M) Leeming to Ripon scheme

Upon completion of the trial of 60mph between Leeming to Ripon, a review and validation exercise was undertaken by the scheme to determine if the 60mph speed restriction could be implemented across the remainder of the works until the scheme's completion. In line with the agreed monitoring process, detailed in the scheme-specific risk assessment, available data were reviewed to determine if the safety objectives had been met during the trial. Based on this review, the scheme concluded that there was no robust evidence of an increase in risk resulting from the change in speed restriction on the south bound and north bound carriageway during the monitoring periods (other than the inherent increased risk associated with the increase in average vehicle speeds).

The scheme implemented the 60mph speed restriction on the south bound and north bound carriageways until the 17th and 19th of November respectively.

6.2 Implementation of 60mph at other schemes

This is the fifth investigation of a 60mph speed restriction within road works as part of the wider 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 based on 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 A1(M) Leeming to Ripon road works:

- Andy Ward – Aggregate
- Richard Coote and Andy Murray - Tarmac
- Ken Wake – Amey
- Ted Chamberlain, Stephen Strong, David Wheatley, Hayden Green, Paul Fleming, Stephen Luke and Hannah Brierley – Highways England

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Glaze, S., Chowdhury, S., Fleetwood, R., & Lodge, C. (2018). *Narrow Lanes Simulations 55mph and 60mph.*

Highways England. (2015). *NSCRG and PSCRG Remit for Organisation and Governance.*

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Ipsos. (2019). *Customer Audit - Speed Trials - A1 Leeming to Ripon - Top Line Results.*

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 Ipsos Customer Audits

Contents

- Introduction & Methodology
- Results
- Conclusions & Recommendations

Ipsos

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Research Methodology

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Schemes

Customer Audits conducted across the following schemes:

- A1 Leeming to Ripon over the August to end of November 2019.
- Highways England have been trailing a new 60mph speed limits whilst going through the A1 Leeming to Ripon 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

A1 Leeming to Ripon n=36

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

Ipsos

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.

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Results

Ipsos

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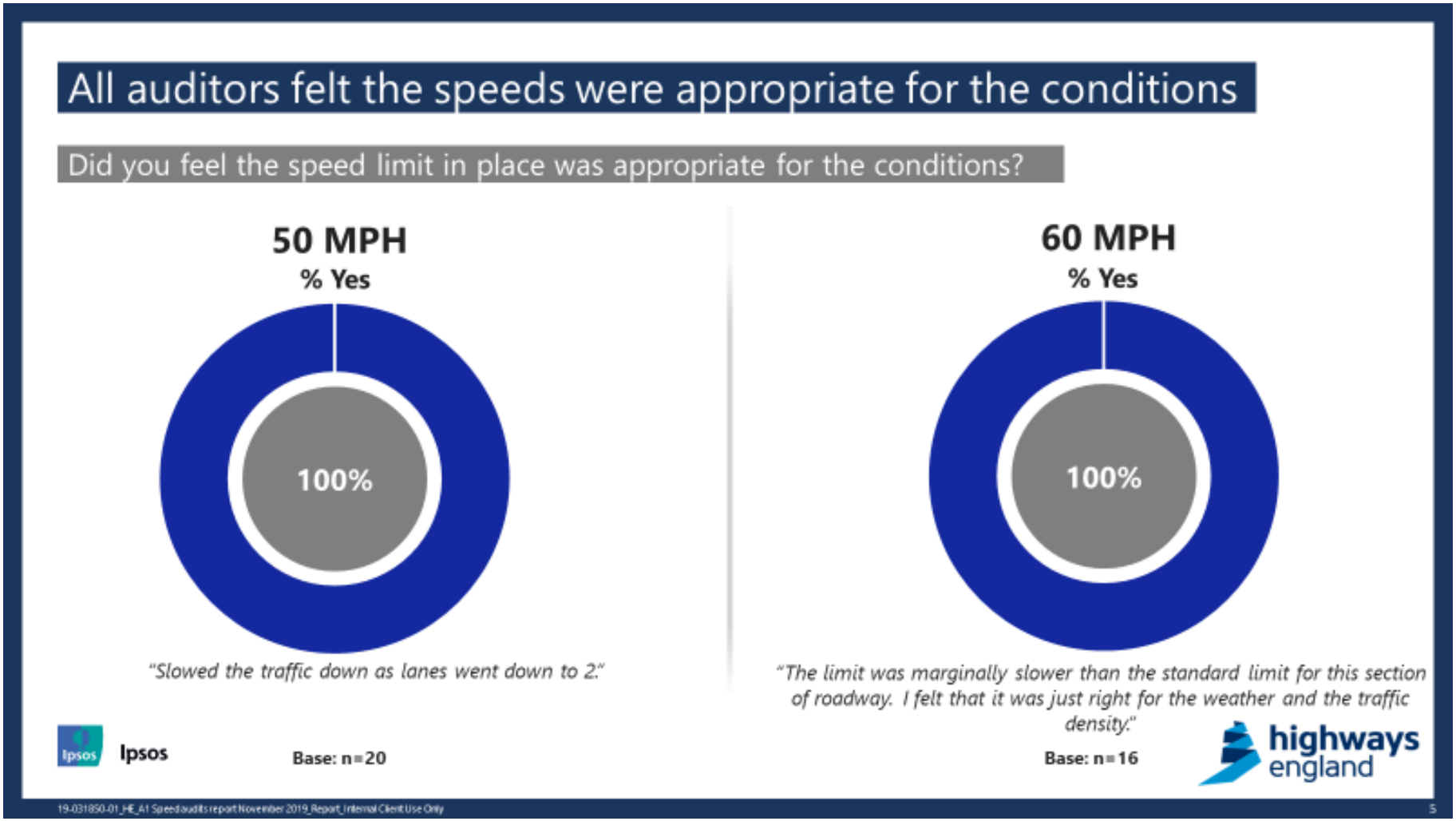
All auditors felt the speeds were appropriate for the conditions
Did you feel the speed limit in place was appropriate for the conditions?
50 MPH
% Yes
100%
"Slowed the traffic down as lanes went down to 2."
Ipsos
Base: n=20
60 MPH
% Yes
100%
"The limit was marginally slower than the standard limit for this section of roadway. I felt that it was just right for the weather and the traffic density."
Base: n=16
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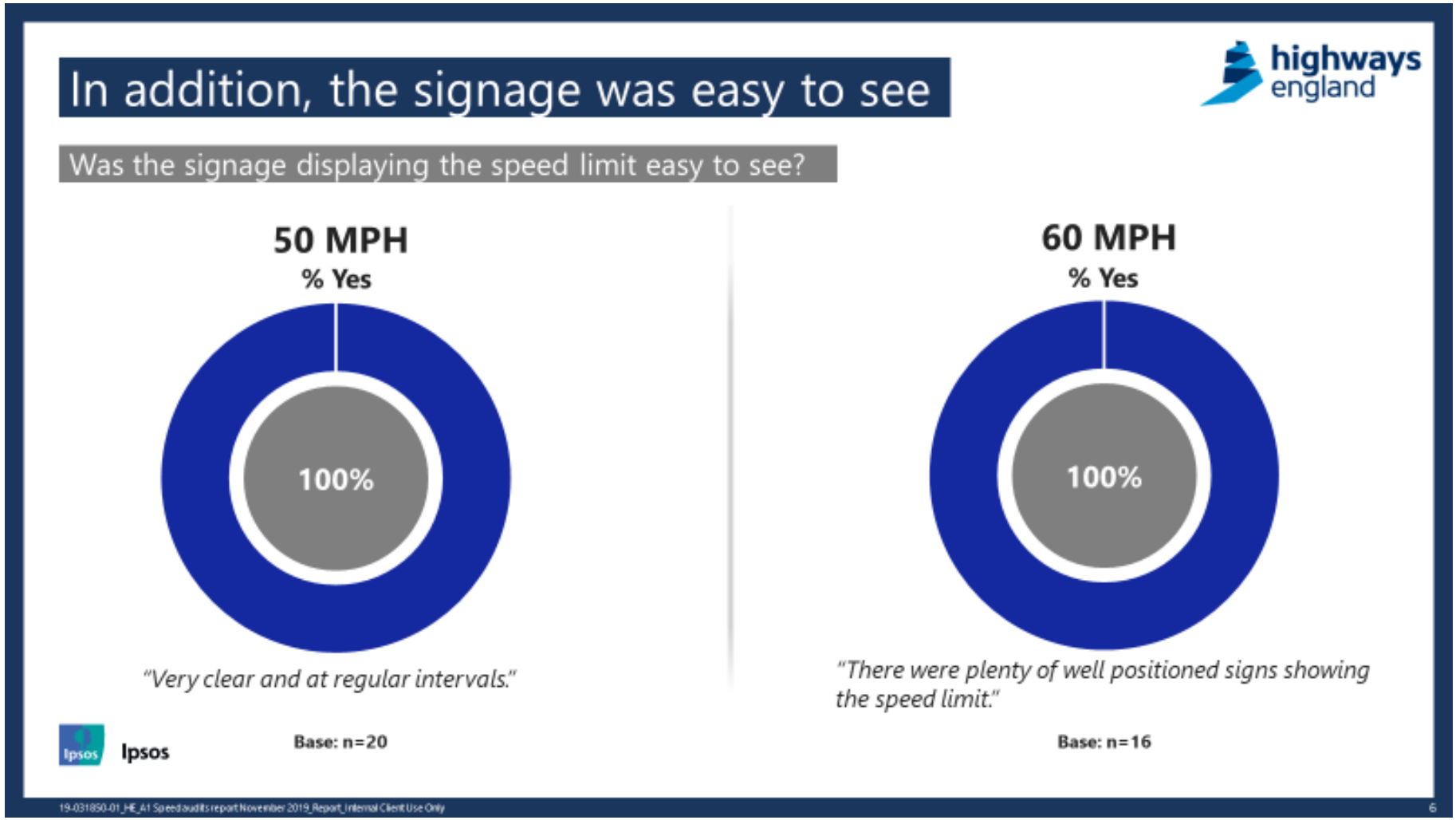
In addition, the signage was easy to see
highways england
Was the signage displaying the speed limit easy to see?
50 MPH
% Yes
100%
"Very clear and at regular intervals."
Ipsos
Base: n=20
60 MPH
% Yes
100%
"There were plenty of well positioned signs showing the speed limit."
Base: n=16
19-031850-01_HE_A1 Speed audits report November 2019_Report_Internal Client Use Only
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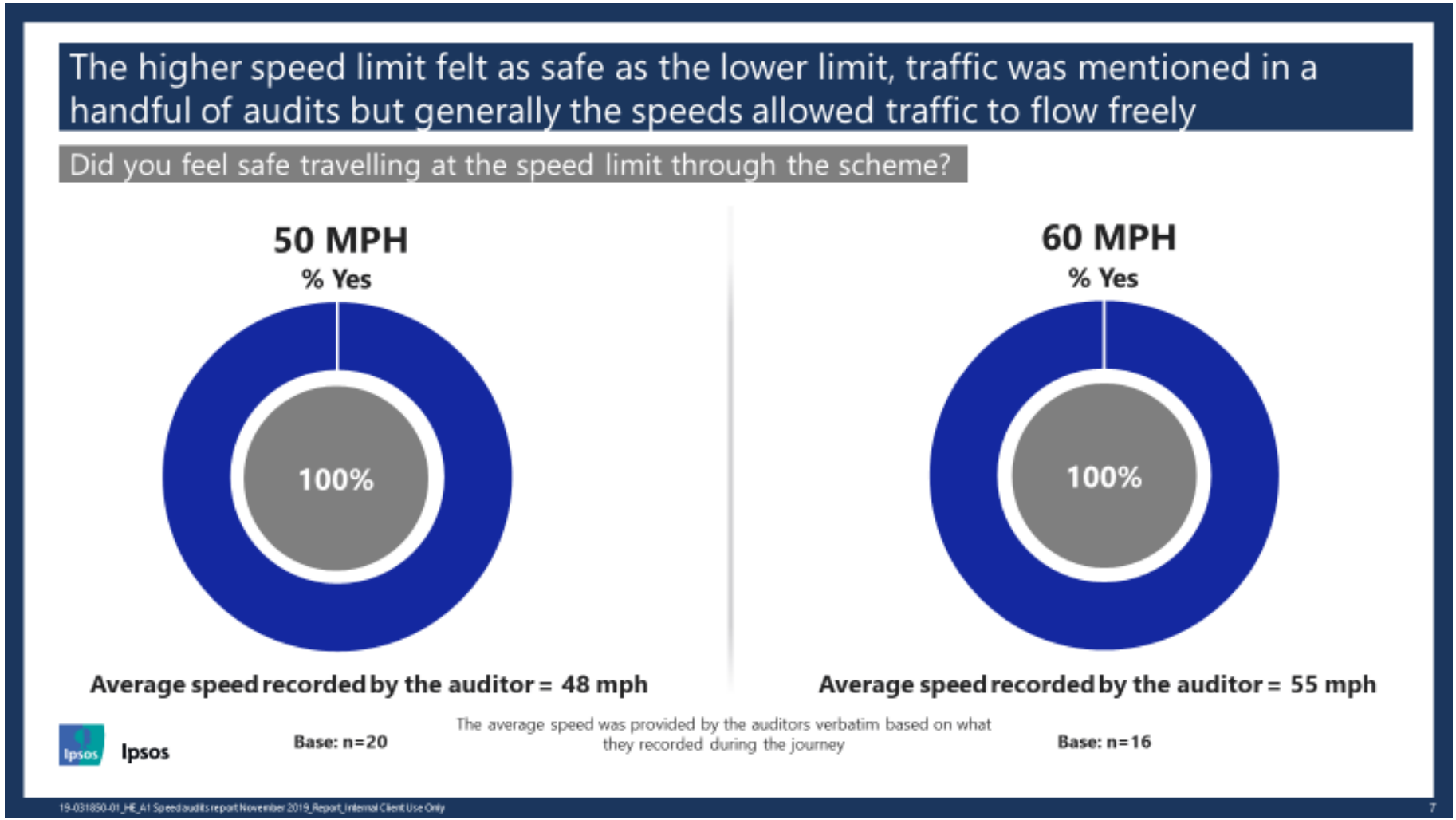
The higher speed limit felt as safe as the lower limit, traffic was mentioned in a handful of audits but generally the speeds allowed traffic to flow freely
Did you feel safe travelling at the speed limit through the scheme?
50 MPH
% Yes
100%
Average speed recorded by the auditor = 48 mph
60 MPH
% Yes
100%
Average speed recorded by the auditor = 55 mph
Ipsos
Base: n=20
The average speed was provided by the auditors verbatim based on what they recorded during the journey
Base: n=16
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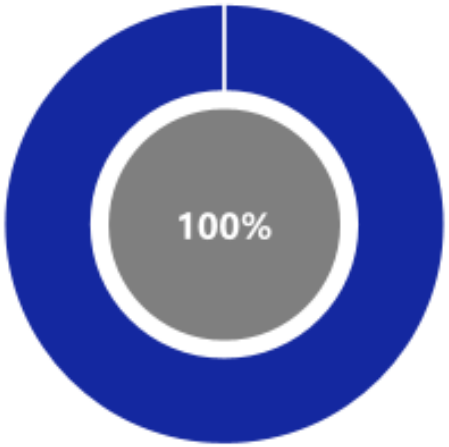
The auditors felt that both limits were right for the scheme

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

50 MPH

% About Right



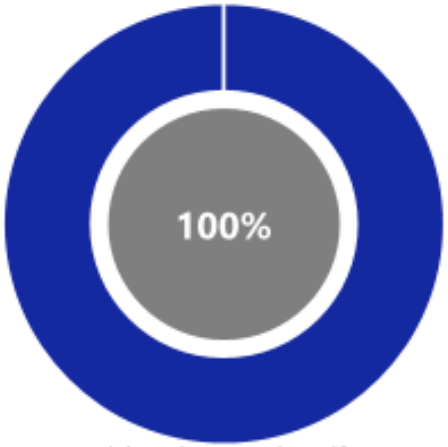
"The volume of work being done clearly necessitated a reduction in speed, but not by much."

Ipsos

Base: n=20

60 MPH

% About Right



"60mph meant I wasn't delayed as much as if 40 or 50 had been in place. It struck a balance between slower safer driving and keeping the traffic moving. As stated, in heavier traffic I could see a 50mph limit working and potentially seeming safer especially for construction workers"

Base: n=16

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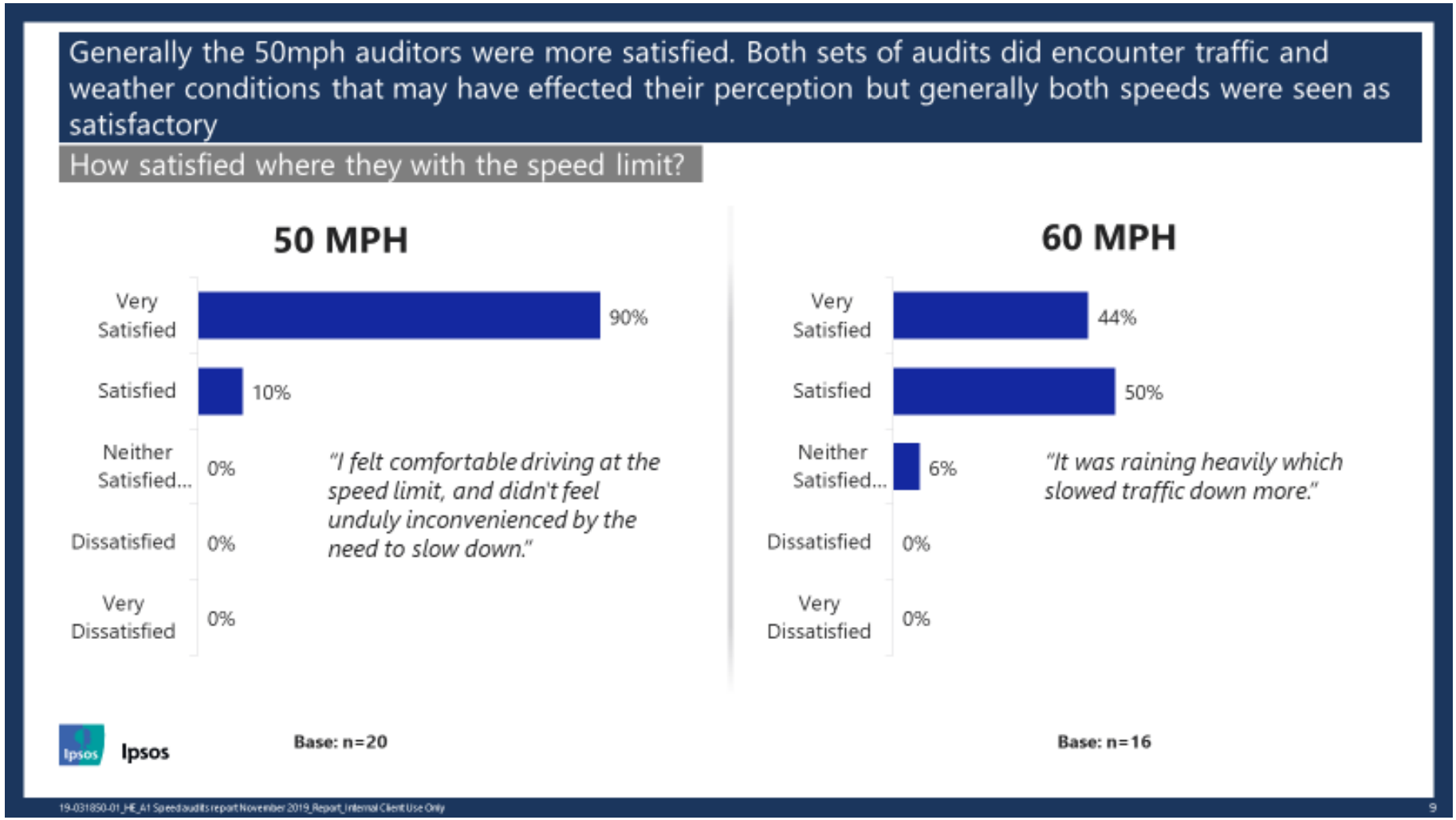
Generally the 50mph auditors were more satisfied. Both sets of audits did encounter traffic and weather conditions that may have effected their perception but generally both speeds were seen as satisfactory
How satisfied where they with the speed limit?
50 MPH
Very Satisfied
90%
Satisfied
10%
Neither Satisfied...
0%
Dissatisfied
0%
Very Dissatisfied
0%
"I felt comfortable driving at the speed limit, and didn't feel unduly inconvenienced by the need to slow down."
60 MPH
Very Satisfied
44%
Satisfied
50%
Neither Satisfied...
6%
Dissatisfied
0%
Very Dissatisfied
0%
"It was raining heavily which slowed traffic down more."
Ipsos
Base: n=20
Base: n=16
19-031850-01_HE_A1 Speed audits report November 2019_Report_Internal Client Use Only
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Recommendations & Conclusions

Ipsos

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Recommendations & Conclusions

highways england

The traffic conditions on the scheme didn't greatly effect the perceptions of the speed limits

Where the road was clear at 50mph a couple of auditors did mention that it may be possible to raise the speed but did not ultimately recommend this. Whilst at 60mph 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.

Ipsos

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Appendix C Lessons Learned

To understand the impact of the change in speed restriction on the scheme's delivery and costs, a lessons-learned meeting 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 meeting 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 trial went on a general level? What worked well? What didn't? Why?

Summary of key points made:

- There was a consensus among attendees that the trial went well, which was anecdotally echoed by Traffic Officers who worked at the scheme.
- Implementation of the trial was reviewed weekly, which minimised the risk of issues occurring.
- The recovery services worked well. There were recovery services on both the northbound and southbound carriageways, which decreased response times to breakdowns and incidents. From a single base, the response times would have been longer for many incidents. The recovery organisation employed for this scheme was efficient, responded to breakdowns and incidents quickly, and communicated clearly with the scheme using daily reports that provided causes of breakdowns and incidents.
- There was a substantial amount of time and effort spent on planning, risk management and project management. In particular, implementing crossovers meant additional time and effort was spent on the construction program. This incurred extra costs.
- Obtaining radar units to undertake the main monitoring programme was difficult. This was exacerbated when the scheme discovered they needed to locate two radar units instead of one unit just three days before the trial went live due to miscommunications. One of the radar units also needed to be relocated, which duplicated effort.
- Regardless of the speed restriction, having two running lanes instead of three worsened traffic flow and congestion.
- Some attendees mentioned that traffic flow and customer satisfaction may have been affected by the poor weather conditions (heavy rain) during the trial period.
- The running lanes felt narrow when driving wider vehicles, although this may be due to concrete barriers making the space feel smaller than it actually was, particularly when travelling alongside HGVs.

- The CCTV system managed by a third-party did not work well for this scheme. The workforce noticed many breakdowns and incidents which were not picked up by the third-party; attendees were unsure whether this was due to the poor quality of the CCTV equipment, unclear CCTV footage, or inadequate monitoring of the CCTV. However, this problem lessened once the scheme raised the issue with the third-party.

Question: During early discussions, did you have concerns relating to changing the speed restriction for this scheme? Were any of them realised? If so, how?

Summary of key points made:

- For this scheme, to avoid damaging the existing carriageway, lane markings were not removed and there were concerns about how customers would react to the markings. However, customers reacted well.
- There were initial concerns around workers entering and exiting the works safely due to the increased posted speed restriction, but these concerns were not realised due to their locations within the scheme.
- There were initial concerns that customers would not comply with the 50mph or 60mph speed restriction, but these concerns were not realised.

Question: What could have helped you overcome your concerns? What would you have like to have done?

Summary of key points made:

- To combat the issues around obtaining radar units for the main monitoring and correctly locating the units, the scheme would have preferred to have received information or instruction about the radar units further in advance of the trial going live.
- If there are plans to have fewer than three running lanes (as with this scheme), new roads should have crossing points designed for future maintenance with hardened central reserve crossover locations and removable temporary barrier systems should be implemented.
- The CCTV system should be improved (such as having one central CCTV monitoring post for all breakdowns and incidents). An improved CCTV system would allow Traffic Officers to respond to breakdowns and incidents more quickly and would have reduced the length of time taken to complete the road works, both resulting in improved customer satisfaction. Alongside the CCTV monitoring system, additional methods of incident detection (such as stopped vehicle detection) would be beneficial.
- Traffic Officers recommended portable VMS so that the speed restriction could have been reduced from 60mph to 50mph in the event of a breakdown or incident. However, implementing VMS would have incurred additional costs and VMS cannot be used to display mandatory or enforceable speed restrictions.

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:

- Signs: There were a few issues with signs being blown over by strong winds, but this was not a major issue.
- Studs: The studs needed to be replaced to implement the pinned barriers, which incurred additional costs.
- Tape: Taping the ribbed lane markings incurred additional costs but worked well and the tape was sufficiently conspicuous (especially compared with alternative materials), stayed in place for the duration of the trial and was relatively easy to remove once the works were complete. The only damage to taping occurred at crossovers.
- Concrete barriers: The barriers which were used incurred additional costs. However, as these unpinned barriers are now approved for use with a 60mph speed restriction and may become standard for road works with this speed restriction, it should become easier and quicker to implement these types of barriers for future schemes.
- Frames for the central reservation: Sign frames had to be compatible with concrete barriers and were sandbagged differently to usual (although sockets in the barriers would be preferred, this was deemed too difficult to implement, so saddles that clamped onto the frames were made). Changes to the construction of concrete barriers mean that built-in sockets may now be feasible.
- Selection of lane widths had cost implications. A 25mm narrower lane width would have allowed retention of existing marker studs, avoiding damage to the carriageway during reinstatement. Installation of temporary barriers over stud locations may have reduced the effectiveness of the barriers.

Question: Were there any additional maintenance activities undertaken during the use of a 60mph speed restriction?

No additional maintenance activities were required.

Question: Were any modifications to risk assessments and method statements required?

Summary of key points made:

- Planning and risk assessment processes were affected by the change in speed restriction, but implementation of the works was not.
- No modifications required for the recovery services, as recovery organisations provide the same services regardless of the speed restriction.
- Traffic Officers commented that they were working without easy access to a place of relative safety. However, they felt that the lower (600mm) concrete barriers would have been easier to cross if necessary.

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:

- More staff time was required to design the scheme and conduct the risk assessment. Work for the scheme started four months in advance of the road works, instead of the usual two weeks. However, this meant that planning was conducted quite far in advance of the scheme which was beneficial (this was attempted for previous schemes, but there were barriers to planning and design).
- Design of crossovers for 60mph took additional staff resource.
- More staff time was also required to source and supply the materials. A new design for the concrete barriers was used for this scheme. However, obtaining the barriers should be easier and quicker for future schemes as the suppliers now have these designs and sufficient knowledge to use them where appropriate.

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 cost of the scheme's road works? The delivery schedule of the scheme?

Summary of key points made:

- There were no significant safety issues, particularly because works were not being conducted near the section of the scheme with a 60mph speed restriction. The emergency access gates at this scheme were designed into the TM layout but were not needed at any point.
- There were 20 customer complaints during the scheme, which was the lowest number of complaints received across all road works schemes on the A1(M). These complaints were predominantly about the absence of road workers on site and there were very few queries about why the speed restriction was increased from 50mph to 60mph. The number of complaints increased when the speed restriction returned to 50mph from 60mph, with some customers querying why the speed restriction had been reduced. Having a prepared Highways England 'Q&A' document was helpful when responding to customer complaints and queries.
- Working in two sections, rather than along the full length of the scheme, extended the duration of works. It was estimated that implementing works along the full length could have reduced the works duration by eight weeks. It was recognised that there would have been implications for customer satisfaction. However, 60mph could not have been implemented for the full length of the scheme due to the central barrier not being fully integral.
- Attendees agreed that implementing a 60mph speed restriction through road works always costs more than implementing a 50mph speed restriction.
- Driver education is required to move public perception away from 'roadworks = 50mph' to an understanding that appropriate speed restrictions will be in place.
- Following the lessons learned meeting, those who were unable to attend the session were emailed and offered the opportunity to provide comments. However, no responses were received.

Monitoring and evaluation of the 60mph trials

The purpose of this trial was to understand the impact of changing the speed restriction within the A1M 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 road side 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 of satisfaction was identified. Further findings are detailed within the report.

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