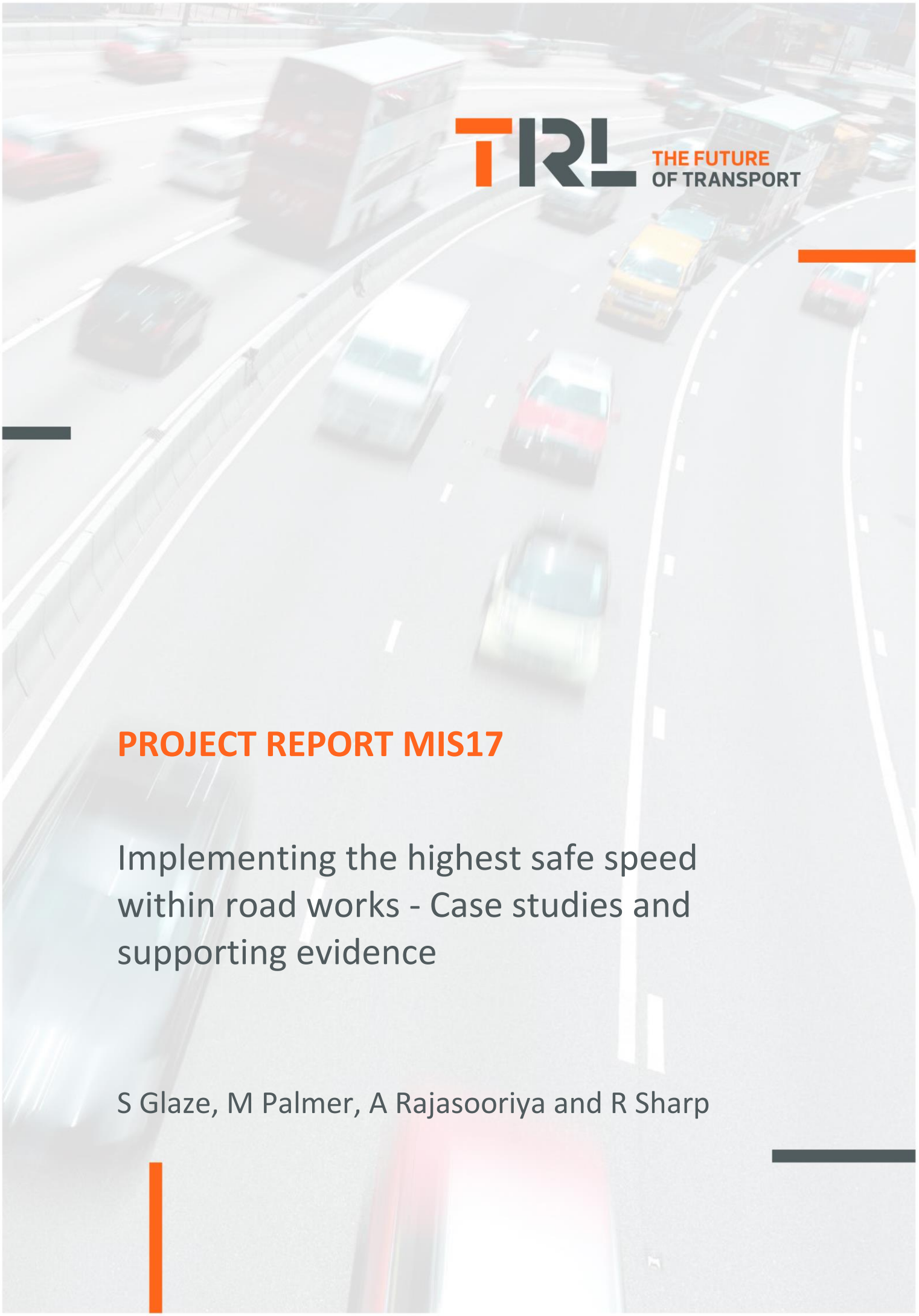

TRL THE FUTURE OF TRANSPORT

PROJECT REPORT MIS17

Implementing the highest safe speed within road works - Case studies and supporting evidence

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Report details

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This report has been amended and issued as follows:

Version	Date	Description	Editor	Technical Reviewer
1.0	16/03/2020	Final	SG	GB
2.0	21/09/2020	Update to include case studies and available evidence from Contra-flow and Dynamic scheme trials.	AR	GB

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1 Introduction

The Highways England Strategic Road Network (SRN) is going to be undergoing extensive improvement in the future, with greater government investment and an increase in road improvement schemes. However, Highways England recognises that, historically, customer satisfaction for roadworks has been substantially below satisfactory levels. Customers have told Transport Focus that they find roadworks frustrating and do not feel that 50mph is always an appropriate speed restriction.

> *Roadworks achieved a satisfaction score of 65 per cent, up from 63 per cent in 2017-18. Motorway scores rebounded to 62 per cent, but is still lower than the score in 2015-16; the score for major 'A' roads fell to 72 per cent from 75 per cent last year. Reasons for dissatisfaction were perceived lack of work going on within roadworks and the impact of roadworks on users.*
>
> Transport Focus (2019)[1]

As a result of these findings, Highways England has been undertaking a programme of work to address the issues which are believed to underpin those low ratings and is committed to improving the experience of road users when they are travelling through roadworks.

On high-speed roads, temporary mandatory speed restrictions may be put in place to reduce the level of risk posed to affected parties for the road works activities. However, in order to keep traffic flowing as freely as possible, temporary traffic management should be designed to allow the highest speed that can be safely implemented. A 60mph speed restriction can be considered as an appropriate speed within road works, alongside other speed restrictions such as 50mph, but it is essential that road works are designed to manage the level of risk posed to road workers and road users.

This report provides a set of case studies and supporting evidence gathered during an extensive series of trials where a temporary speed restriction of 60mph was implemented through several road works schemes. The findings from those trials relating to road user and road worker safety, driver behaviour and customer satisfaction have been summarised. The case studies outline design decisions taken and mitigations implemented by schemes during the trials. They have been provided to demonstrate that, by utilising existing working methods and risk management approaches, schemes operating under different business areas can be implemented on the SRN whilst using a 60mph speed restriction. Lessons learned from each trial are also provided to inform future use. The supporting evidence summarised in this report indicates that a 60mph speed restriction may be implementable within road works, subject to the scheme-specific constraints being considered as part of the scheme-specific safety risk assessment. This approach ensures risks posed to road workers and road users are effectively identified and managed to be as low as reasonably practicable (ALARP). Copies of all the research undertaken are available online from the Highways England web site[2].

[1] **Transport Focus (2019).** *National Road Users' Satisfaction Survey 2018-19*. London, UK: Transport Focus.

[2] https://highwaysengland.co.uk/industry/60mph-speed-limit-through-roadworks/

2 Case studies

The case studies cover three traffic management scenarios. These include:

- Permanent – Design the road works to operate with a 60mph speed restriction over a 24/7 time period. Dependent on the specific work activities taking place at the scheme to see whether a 60mph speed restriction could be used.
- Contra-flow – Design the road works to operate with a 60mph speed restriction. The 60mph speed restriction will only be in use on the opposing carriageway to the work zone, with a 50mph speed restriction in use on the carriageway adjacent to the works zone.
- Dynamic – Design the road works to operate with a 60mph speed restriction. The 60mph speed restriction will only be in use during non-working hours (overnight, Sundays, Bank Holidays and during holiday shutdowns).

2.1 Permanent

2.1.1 M49 Avonmouth

As part of the Regional Investment Programme, this scheme included the creation of a new junction. Due to the nature and characteristics of the scheme's existing programme of narrow lanes restrictions, an opportunity to change the existing temporary mandatory speed restriction from 50mph to 60mph was investigated. The design brief did not originally consider the requirement of a 60mph speed restriction, as such several challenges had to be overcome to retrofit the temporary traffic management (TTM) that was already in situ.

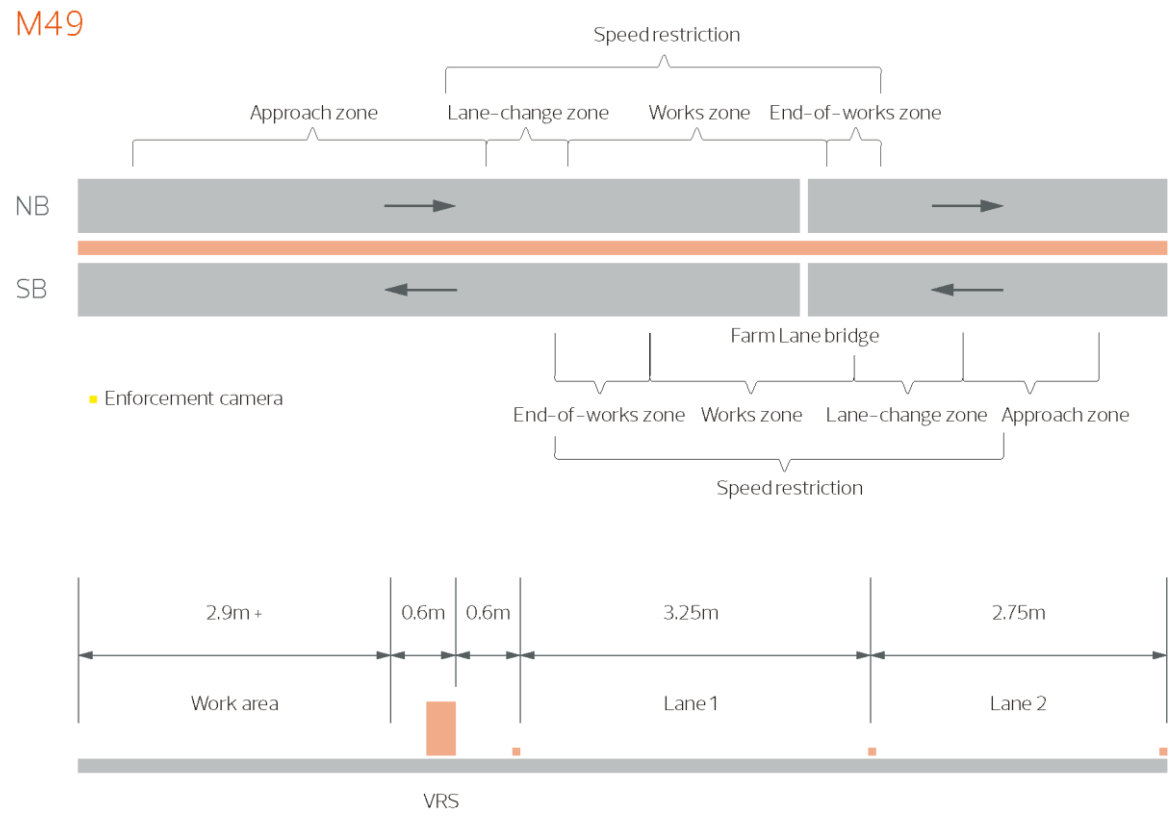


Figure 2-1: Layout and cross section of TTM used on the M49 Avonmouth scheme during the 60mph investigation

Specialist technical expertise was used by the scheme to support the development of a scheme-specific safety risk assessment in line with GG 104 standard. The assessment examined the risks posed to all affected parties from the proposed change in speed restriction, detailing required mitigation measures to address the potential increase in risk posed from the anticipated increase in vehicle speed. The assessment utilised information from the endorsed programme level risk assessment[3].

Engagement with various stakeholders and members of the design team was undertaken. Members included:

- Project Manager or Senior Responsible Owner
- Network Delivery and Development Senior User
- Customer Operations Senior User
- Design Safety or Operations Expert
- Project Construction Design and Management Coordinator
- Asset Support Contract representative

[3] **Fordham C, Glaze S and Jenkins D (2019).** *Programme level GG 104 risk assessment for 60mph trials through road works (RPN4305).* Crowthorne, UK: TRL Ltd.

- Maintenance representatives
- Stakeholder representative (such as other RCC or Traffic Officer Service representatives)

These sessions helped inform the development of a new safety risk assessment and TTM proposal.

As part of the risk assessment a safety objective was set. The objective was to ensure that the level of risk posed was not increased beyond the current, baseline, level of risk posed to road users and road workers.

Several key mitigations and design decisions were already included in the existing TTM design, whilst others were implemented as additional mitigations in line with the safety risk assessment.

The mitigations which were implemented included:

- Suitable temporary vehicle restraint systems provided delineation between the nearside work zone and the live carriageway whilst preventing errant vehicles from entering the works area
- Temporary vehicle restraint systems were set-back 600mm from the nearside running lanes
- Egress from the work zone was limited to a single end-of-works merge
- Fixed point average speed enforcement cameras and signage were provided across the length of the scheme
- Portable variable message signs were deployed upstream of the works to provide warning of stranded vehicles in live lanes

The safety risk assessment and proposed traffic management proposal was then endorsed as part of the safety governance process by the scheme's Project Safety Control Review Group (PSCRG) prior to implementation.

Incident management and support was provided by the Regional Operations Centre and Traffic Officers; the scheme reported that this support was pivotal to the success of the investigation. Space within the carriageway to deal with incidents or breakdowns was initially stated as a concern, but during the investigation the available carriageway space was reported as being adequate.

The effect of the change in speed restriction on the level of risk posed to road workers and road users through the analysis of driver behaviour, customer satisfaction, scheme cost and delivery was monitored over an eight-week period. Findings from this investigation, and others, are summarised in the trial report[4]. Upon completion of the trial, a review and validation exercise was undertaken. The scheme concluded that during the monitoring period there was no robust evidence of an increase in risk resulting from the change in speed

[4] **Glaze S, Chowdhury S and Ramnath R (2019).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the M49 Avonmouth (MIS8).* Crowthorne, UK: TRL Ltd.

restriction. Subsequently a 60mph temporary speed restriction was implemented across the scheme's entire TTM.

Further monitoring of reported incidents (including frequency and severity) was undertaken by the scheme to validate the risk assessment assumptions as part of 'business as usual' use of the 60mph speed restriction. If the safety baseline could not have been maintained, additional mitigations would have been implemented to reduce the risks posed to affected parties, for example reverting to a 50mph speed restriction.

2.1.2 M5 Willand

This Operations Directorate scheme's existing design brief featured a single phase of traffic management situated adjacent to the nearside of the carriageway to enable works to be undertaken on the noise barrier adjacent to the carriageway. The scheme investigated utilising a 60mph, instead of a 50mph, temporary speed restriction prior to its on-road implementation. This scheme benefited from incorporating the design requirements of using the highest safe speed into the design brief prior to on-road implementation. This resulted in many design features and mitigations being incorporated easily into the traffic management proposal without impacting on the works programme or incurring additional costs for upgrading existing traffic management equipment.

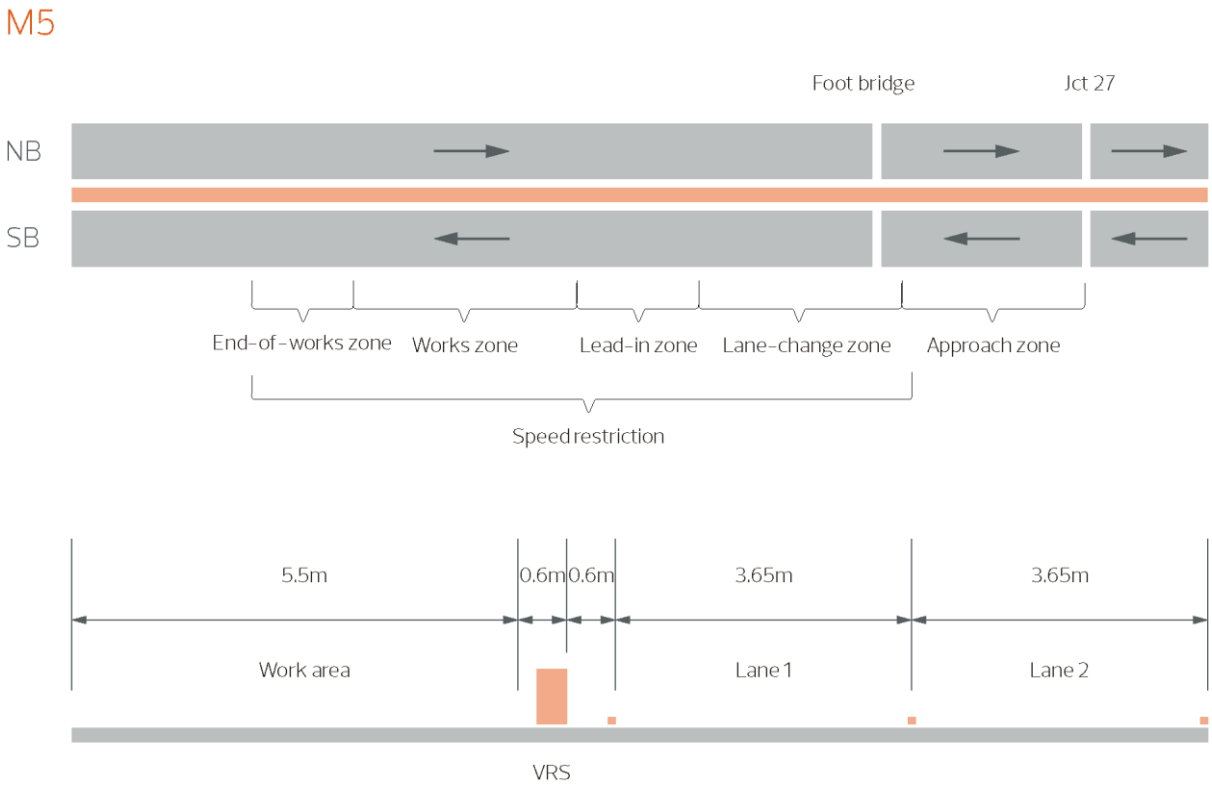


Figure 2-2: Layout and cross section of TTM used on the M5 Willand scheme during the 60mph investigation

Prior to implementing the works, a scheme-specific safety risk assessment in line with GG 104 standard was undertaken. Specialist technical expertise was used to support the development of the safety risk assessment. The assessment examined the risks posed to all affected parties

from the use of a 60mph speed restriction. The assessment detailed the mitigation measures required to address the potential increase in risk posed by increases in vehicle speed. Wider engagement with relevant stakeholders and members of the design team was undertaken to ensure that the management of risk was appropriate.

The design decisions and mitigations implemented by the scheme's designers included:

- The retention of two existing full width lanes
- Suitable vehicle restraint systems provided delineation between the nearside work zone and live carriageway
- Vehicle restraint systems were set-back 600mm from the nearside running lanes
- Egress from the work zone was limited to a single end-of-works merge
- A combination of police mobile speed enforcement and appropriate speed enforcement area signage was implemented
- Portable variable message signs were deployed upstream of the works to provide warning of stranded vehicles in live lanes

The safety risk assessment and proposed traffic management proposal was then endorsed as part of the safety governance process by the scheme's PSCRG.

The effect of the change in speed restriction on driver behaviour, customer satisfaction and the scheme's cost and delivery was monitored over a 10-week period. Findings from this investigation are summarised in the trial report[5].

The investigation ended at the same time as the overall programme of works finished, at which point the traffic management was removed along with the 60mph speed restriction.

2.1.3 M20 J10a

As part of the Regional Investment Programme, this scheme included the creation of a new junction, with most of the work activities taking place off the nearside of the main carriageway. Due to the nature and characteristics of the scheme's existing programme of traffic management, an opportunity to change the existing temporary speed restriction from 50mph to 60mph on one carriageway was investigated.

[5] **Glaze S, Hammond J, Ramnath R and Sharp R (2019).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the M5 Willand (MIS9).* Crowthorne, UK: TRL Ltd.

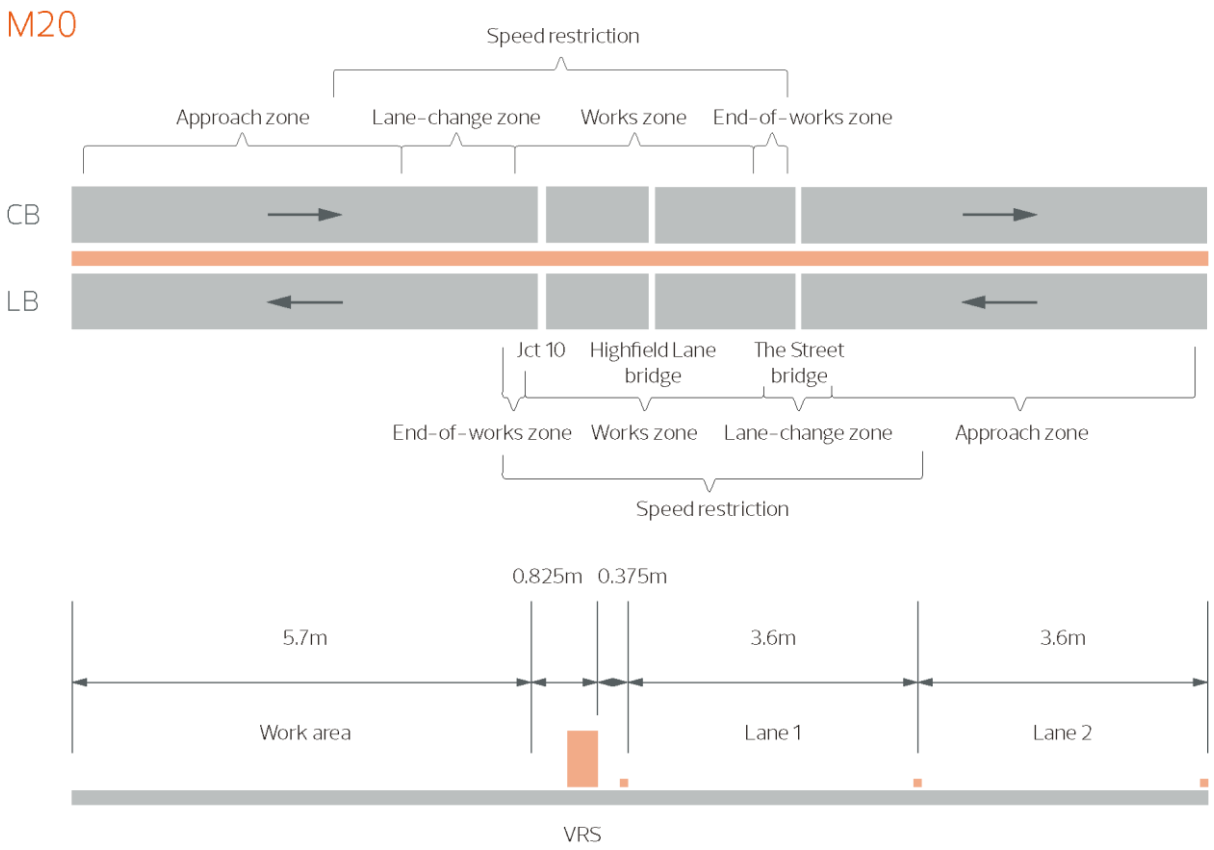


Figure 2-3: Layout and cross section of TTM used on the M20 J10a scheme during the 60mph investigation

Prior to implementing a change in speed restriction, a scheme-specific safety risk assessment in line with GG 104 standard was undertaken. Specialist technical expertise was used to support the development of the safety risk assessment. The assessment examined the risks posed to all affected parties from the change in speed restriction, detailing the mitigation measures required to address the potential increase in risk posed by increased vehicle speeds. As part of the assessment process, face-to-face workshops were held with representatives from various affected parties and the scheme. These workshops provided early engagement on hazard identification and analysis, as well as providing an opportunity for potential mitigations and risk decisions to be discussed prior to completion and endorsement of the assessment.

Several key mitigations and design decisions were already included in the existing TTM design implemented prior to the start of the investigation, whilst others were implemented as additional mitigations after the investigation commenced. These mitigations included:

- The use of two existing full width lanes
- Suitable vehicle restraint systems provided delineation between the nearside work zone and live carriageway
- Egress from the work zone was limited to a single end-of-works merge
- Fixed point average speed enforcement cameras and signage were provided across the length of the scheme

- Portable variable message signs were deployed upstream of the works to provide warning of stranded vehicles in live lanes
- On-site light vehicle recovery was provided and breakdowns were attended by an impact protection vehicle (rated to 60mph)

As the investigation looked to utilise the existing traffic management design already in place on the carriageway, with a set-back between the vehicle restraint system and the nearside traffic lanes of 375mm, a departure from standard TD19/06 was sought and agreed for the duration of the initial investigation. Full width running lanes were used to mitigate the risks posed to road users from the reduced set back between the vehicle restraint system and the nearside traffic lanes. Findings from this investigation are summarised in the trial report[6].

The safety risk assessment and proposed traffic management proposal was then endorsed as part of the safety governance process by the scheme's PSCRG prior to implementation.

Based on a review at the end of the trial monitoring, the continued use of the 60mph restriction was approved as well as the change of the remaining 50mph speed restrictions to 60mph speed restrictions across the entirety of the scheme's traffic management. A further departure from standard TD19/06 was sought and agreed for the remaining duration of that phase of traffic management. Further monitoring of reported incidents (including frequency and severity) was undertaken by the scheme in order to validate the risk assessment assumptions as part of 'business as usual' use of the 60mph speed restriction.

2.1.4 M1 J13-16

As part of the Smart Motorway Programme, this scheme's works included the conversion of the existing carriageway into a smart motorway. An opportunity to change the planned temporary speed restriction during the scheme's verge phase of works from 50mph to 60mph was investigated. Earlier phases of central reservation works were not considered suitable due to the risks associated with access and egress. However, a suitable phase of work was identified that enabled a 60mph speed restriction to be in place for a proportion of the scheme's duration, even though other phases of work (central reservation works) operated with a 50mph speed restriction.

[6] **Glaze S, Ramnath R, Hammond J and Sharp R (2019).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the M20 junction 10a (MIS7).* Crowthorne, UK: TRL Ltd.

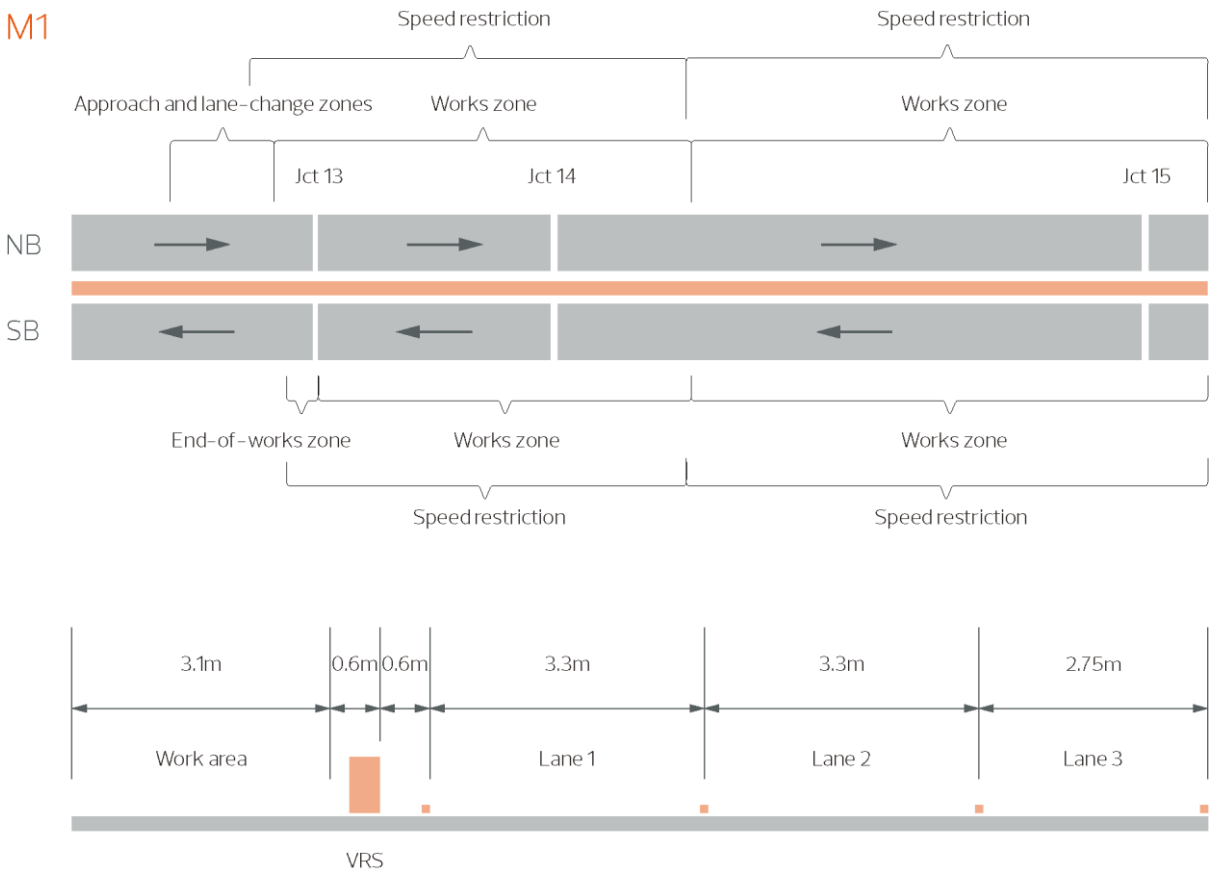


Figure 2-4: Layout and cross section of verge phase TTM used on the M1 J13-16 scheme during the 60mph investigation

A scheme-specific safety risk assessment in line with GG 104 standard was undertaken, supported by specialist technical expertise. The 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 risk.

Several key mitigations and TTM features were implemented as specific mitigations detailed in the safety risk assessment. These mitigations included:

- Suitable vehicle restraint systems provided delineation between the nearside work zone and live carriageway
- Vehicle restraint systems were set-back 600mm from the nearside running lanes
- Fixed point average speed enforcement cameras and signage were provided across the length of the scheme
- Portable variable message signs were deployed upstream of a ‘step’ change in speed restriction, from 60mph to 50mph, to provide additional warning to approaching road users of the change in speed restriction
- A road safety audit (in accordance with Major Project Instruction 45) was undertaken, specifically considering location-specific elements that would make the 60mph speed restriction unsuitable

The effect of the change in speed restriction on driver behaviour, customer satisfaction and the scheme's cost and delivery were monitored over an eight-week period. Findings from this investigation are summarised in the trial report[7].

Based on this report, along with a period of extra monitoring, the future continued use of the 60mph restriction was approved across the trial sections of the scheme's traffic management. Further monitoring of reported incidents (including frequency and severity) was undertaken by the scheme in order to validate the risk assessment assumptions as part of 'business as usual' use of the 60mph speed restriction.

2.1.5 A1 Leeming to Barton

As part of the Regional Investment Programme, this scheme's works included the conversion of the existing A-road into a three-lane motorway. An opportunity to temporarily change the speed restriction from 50mph to 60mph across a section of the scheme's existing traffic management during the 2016-17 Christmas works embargo (whilst work was suspended) was investigated.

A scheme-specific safety risk assessment in line with GD04/12 standard (precursor to GG 104) was undertaken. The assessment examined the risks posed to all affected parties from the potential change of the temporary speed restriction and detailed mitigations.

Several key mitigations were implemented, including:

- A signed width restriction was applied to Lane 2 to restrict heavy good vehicles
- Portable variable message signs and portable vehicle activated signs were deployed around the 'step' changes in speed restriction to inform road users of the change in speed restriction (see diagram below)

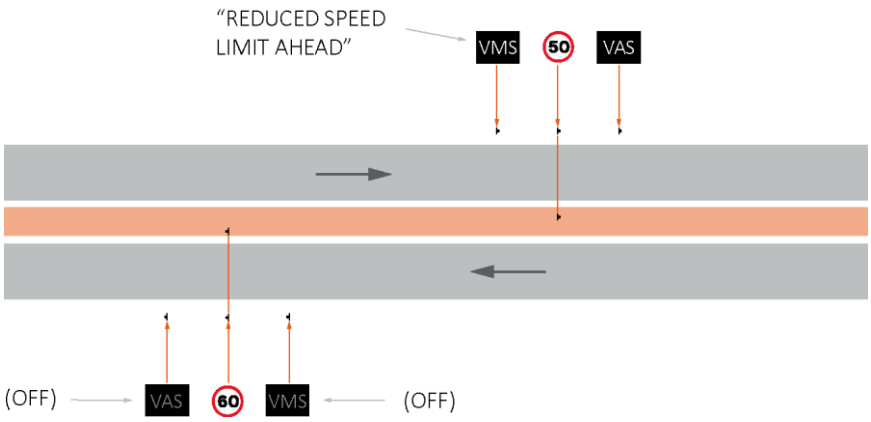


Figure 2-5: Layout for TTM used to sign 'step' changes in speed restriction

- Portable variable message signs were deployed upstream of the works to provide warning of incidents (in lieu of MS3/4 infrastructure)

[7] **Glaze S, Ramnath R, Chowdhury S and Sharp R (2019).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the M1 junction 13-16 (MIS11).* Crowthorne, UK: TRL Ltd.

- An impact protection vehicle appropriate for the higher expected speeds attended breakdowns
- Additional training for incident support was provided to CCTV operators and TSCOs

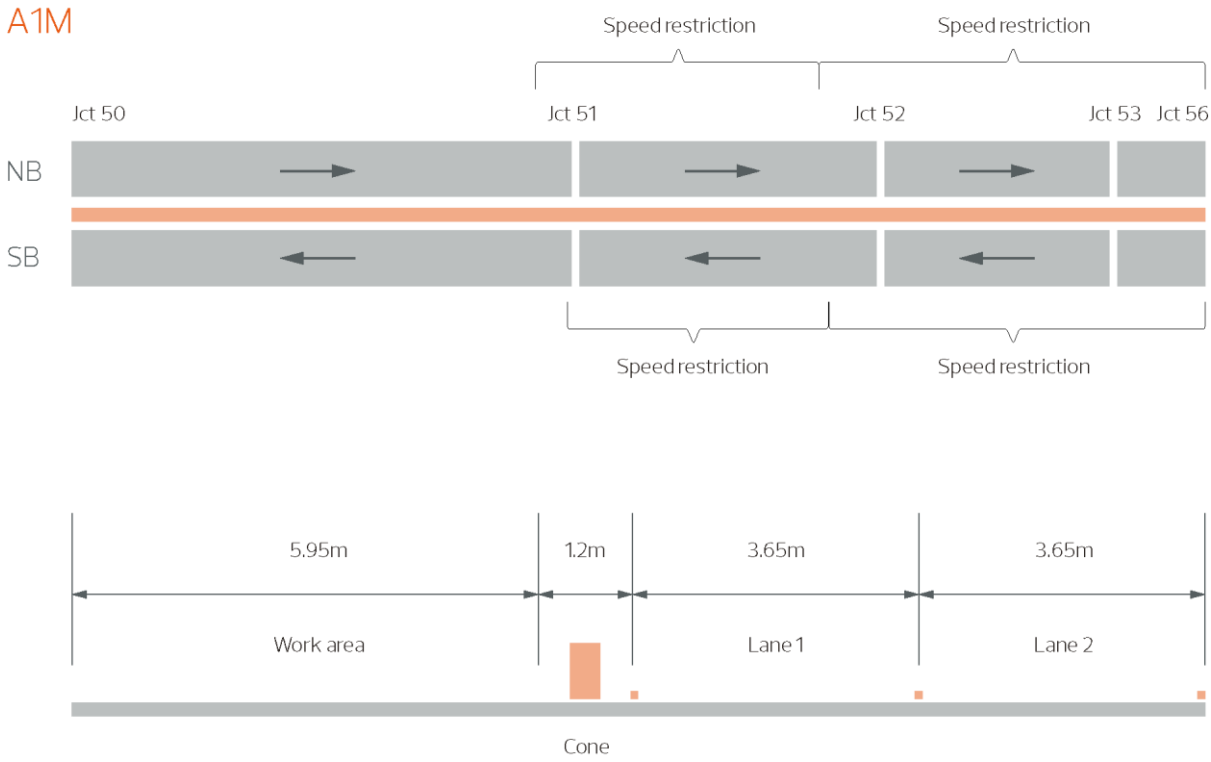


Figure 2-6: Layout and cross section of TTM used on the A1 Leeming to Barton scheme during the 60mph investigation

The effect of the change in speed restriction on driver behaviour and customer satisfaction was monitored over a four-week period. Findings from this investigation are summarised in the trial report[8].

2.1.6 M1 J32-35a

This scheme was part of the Smart Motorway Programme. The scheme's works included conversion of the existing carriageway into a smart motorway. An opportunity was investigated to change the planned temporary speed restriction during the scheme's technology pre-commissioning or operational testing phase of works from 50mph to 60mph.

Prior to implementing a change in the temporary speed restriction, a scheme-specific safety risk assessment in line with GD04/12 standard (precursor to GG 104) was undertaken. Specialist technical expertise already in place at the scheme supported the development of

[8] **Tailor A (2017).** *Monitoring and evaluation of the 55/60mph pilots - Results from stakeholder engagement following the on-road trials of 60mph at the A1 Leeming to Barton scheme (CPR2414).* Crowthorne, UK: TRL Ltd.

the safety risk assessment, which examined the risks posed to all affected parties and detailed mitigation measures that were required.

A single key mitigation was implemented:

- No construction works activities that significantly deviated from those expected during commissioning were undertaken, this included construction activities requiring a mobile elevating work platform

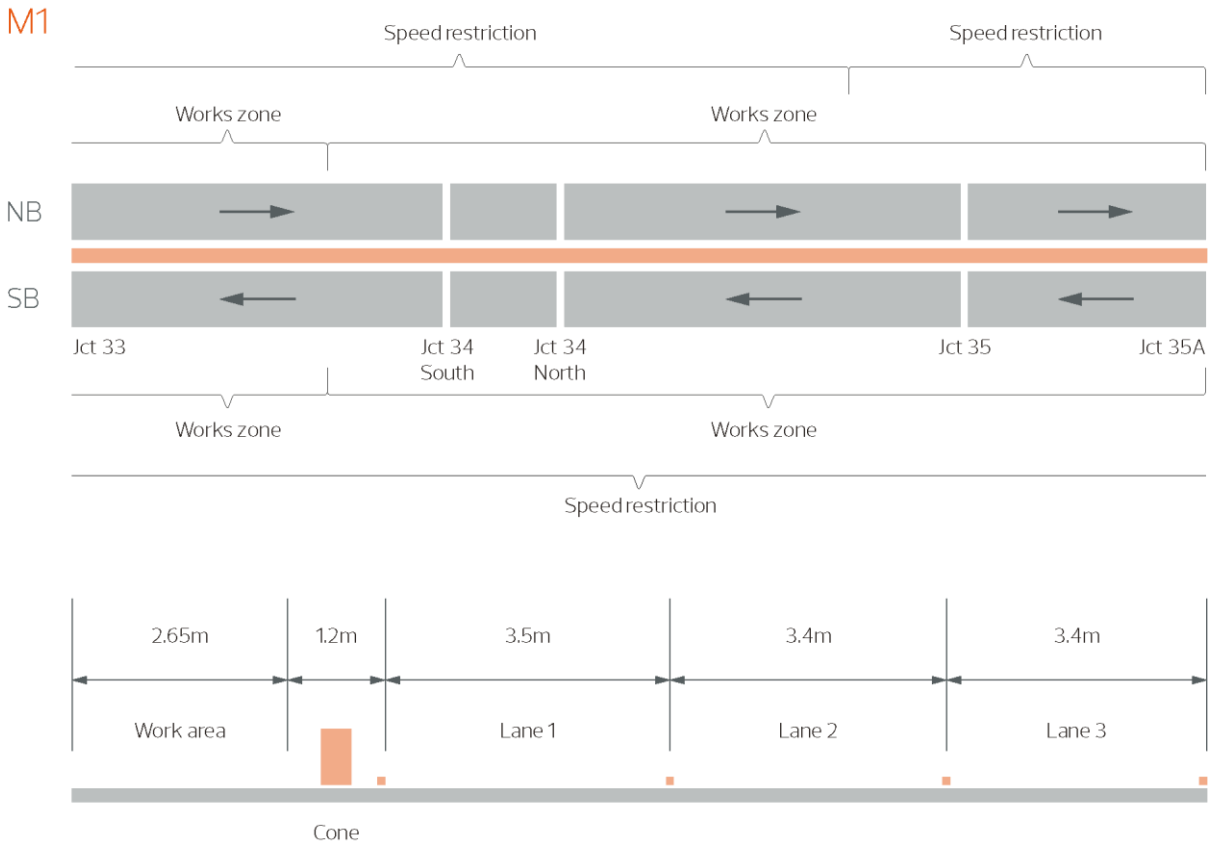


Figure 2-7: Layout and cross sections of TTM used on the M1 J32-35a scheme during the 60mph investigation

The effect of the change in speed restriction on driver behaviour and customer satisfaction was monitored over an eight week period. Findings from this investigation are summarised in the trial reports[9, 10].

Following this and other investigations, Interim Advice Note 182/14 'Major Schemes: Enabling Handover into Operation and Maintenance'[11] was updated to encourage schemes to consider

[9] **Wallbank C, Palmer M, Hammond J and Myers R (2017).** *Monitoring and evaluation of the 55/60mph pilots. Interim report for the on-road trials of 60mph on the M1 J32-35a scheme (CPR2383).* Crowthorne, UK: TRL Ltd.

[10] **Tailor A (2017).** *Monitoring and evaluation of the 55/60mph pilots: Results from stakeholder engagement following the on-road trial of 60mph on the M1 J32-35a scheme (CPR2418).* Crowthorne, UK: TRL Ltd.

[11] Superseded by GG 182 Major schemes: Enabling handover into operation and maintenance

operating with a 60mph temporary speed restriction (rather than a 50mph speed restriction) during the technology pre-commissioning phase of smart motorway construction.

2.1.7 M5 J4a-6

Part of the Smart Motorway Programme, this scheme's works included the conversion of the existing carriageway into a smart motorway. An opportunity to change the planned temporary speed restriction from 50mph to 60mph during the scheme's technology pre-commissioning or operational testing phase of works was investigated.

A scheme-specific safety risk assessment in line with GD04/12 standard (precursor to GG 104) was undertaken. Specialist technical expertise already in place at the scheme supported the development of the safety risk assessment. The assessment examined the risks posed to all affected parties from the change in speed restriction, detailing required mitigation measures. The mitigations which were implemented included:

- No construction works activities that significantly deviated from those expected during commissioning were undertaken
- Portable variable message signs were deployed around the 'step' changes in speed restriction to inform road users of the change in speed restriction

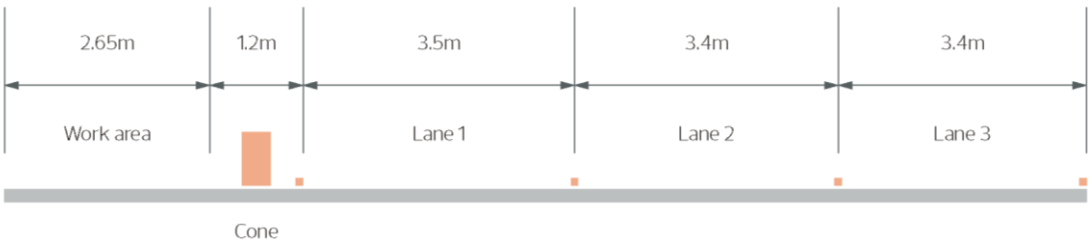


Figure 2-8: Layout and cross sections of TTM used on the M5 J4a-6 scheme during the 60mph investigation

The effect of the change in speed restriction on driver behaviour and customer satisfaction was monitored over a two-week period. Findings from this investigation are summarised in the trial report[12].

2.2 Contraflow

2.2.1 A1(M) Leeming to Ripon

A1(M) Leeming Ripon was an Operations Directorate scheme to reduce congestion and smooth the flow of traffic in which the works included resurfacing the southbound carriageway on the A1(M) between Leeming to Ripon. A contra-flow traffic management

[12] **Wallbank C, Chowdhury S, Fleetwood R and Myers R (2017).** *Monitoring and evaluation of the 55/60mph pilots. Interim report for the on-road trials of 60mph on the M5 Junction 4a to 6 scheme (CPR2417)*. Crowthorne, UK: TRL Ltd.

scenario on the northbound carriageway was chosen to investigate increasing the speed restriction from 50mph to 60mph.

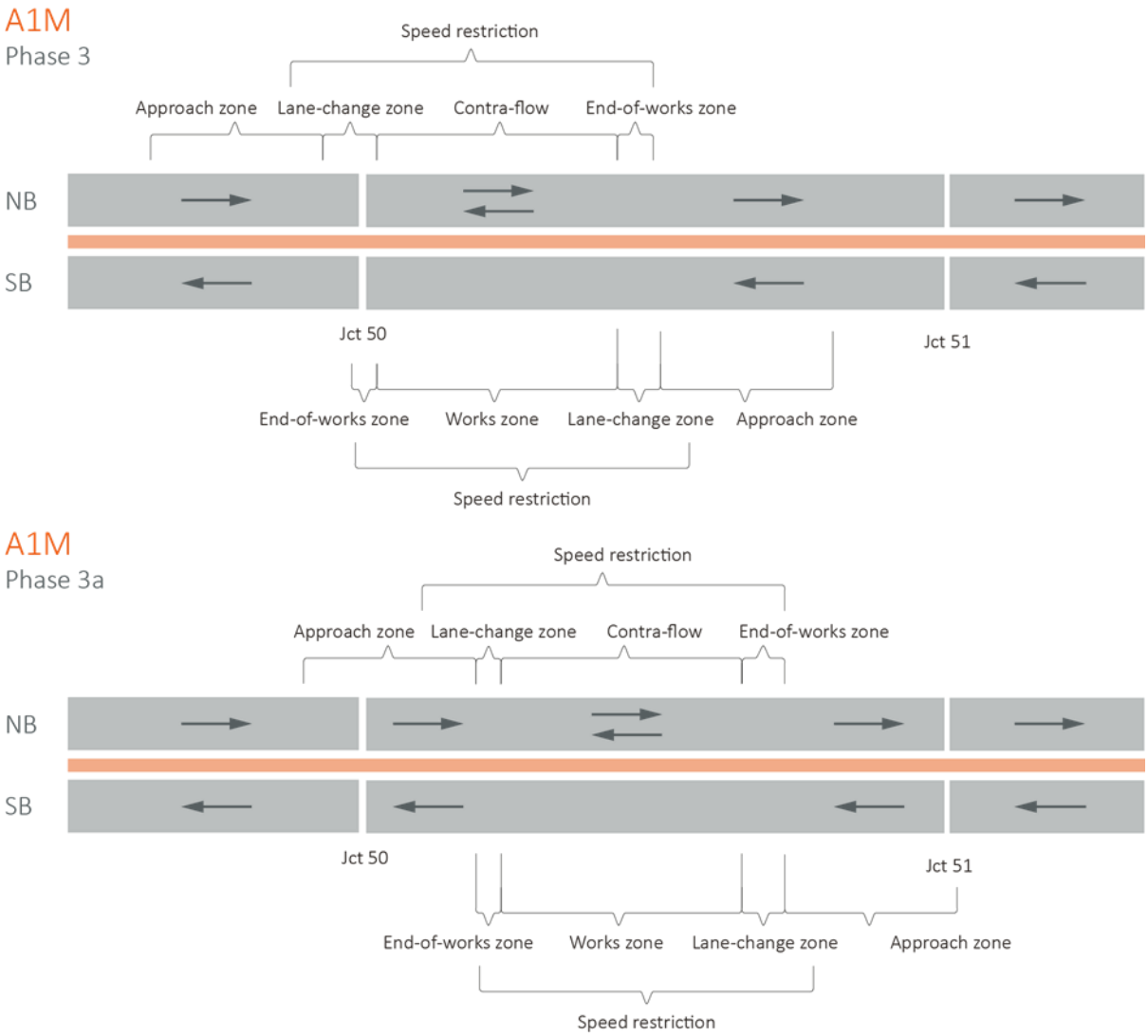


Figure 2-9: Layout of TTM used on the A1(M) Leeming to Ripon scheme during the 60mph investigation

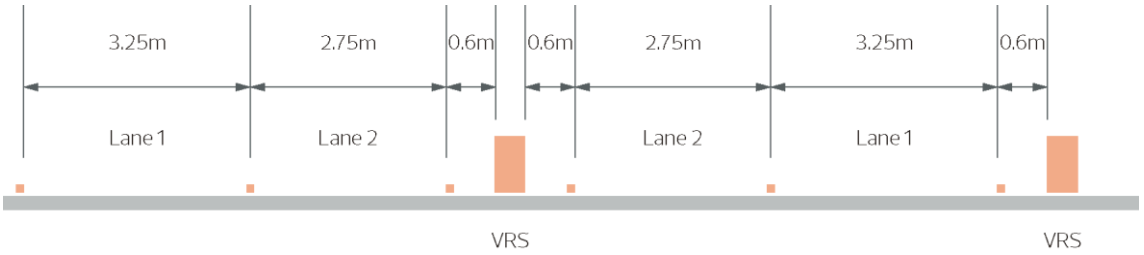


Figure 10: Cross section of TTM used on the A1(M) Leeming to Ripon scheme during the 60mph investigation

To enable the trial to proceed, a departure from TD19/06 Clause 8.22 Use of Temporary Safety Barriers in Contraflow Operations was approved. A scheme-specific safety risk assessment in line with GG 104 standard was undertaken. Specialist technical expertise already in place at

the scheme supported the development of the safety risk assessment. The assessment detailed the mitigation measures required to address the potential increase in risk posed by increases in vehicle speed. Wider engagement with relevant stakeholders and members of the design team was undertaken to ensure that the management of risk was appropriate.

The assessment examined the risks posed to all affected parties from the change in speed restriction, detailing required mitigation measures. The mitigations which were implemented included:

- Vehicle recovery provisions to promptly attend broken down vehicles (with the use of an impact protection vehicle). Furthermore, 'gates' or Emergency Access Points (EAPs) were used within the safety barrier to allow stricken vehicles or debris to be removed from the live lane.
- Mobile variable message signs were positioned in advance of any change in speed restriction to inform road users of the change in speed restriction.
- 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.
- 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. 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.
- 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.
- Contraflow guidance and signage was implemented in accordance with Chapter 8 of the Traffic Signs Manual.
- HGVs were restricted to Lane 1.
- Temporary barriers were implemented with specifications suitable for containing higher speed errant vehicles.
- Manned works access points were implemented with automated intrusion systems.
- Traffic management operatives and vehicle recovery operators reviewed working practices and method statements for use in association with the 60mph speed restriction.
- Measures to identify stricken or stranded vehicles were implemented.
- The main contractor and temporary traffic management contractor supported emergency services with on-call incident support.
- Impact protection vehicles were provided to respond promptly to any requests for support.

- Signage was implemented to advise the travelling public of the potential for queuing traffic.

The safety risk assessment and proposed traffic management proposal was then endorsed as part of the safety governance process by the scheme's PSCRG prior to implementation.

The effect of the change in speed restriction on driver behaviour and customer satisfaction was monitored over an eight-week period. Based on a review at the end of the trial monitoring, the scheme concluded that there was no robust evidence of an increase in risk resulting from the change in speed restriction on the southbound and northbound 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 southbound and northbound carriageways until the 17th and 19th November respectively (for an additional two weeks from the conclusion of the trial). Findings from this investigation are summarised in the trial report[13].

2.2.2 M6 J13-15

As part of the Smart Motorway Programme, this scheme's works included the conversion of the existing carriageway into a smart motorway. The design of the scheme provided an opportunity to use a contra-flow traffic management scenario to investigate changing the speed restriction from 50mph to 60mph.

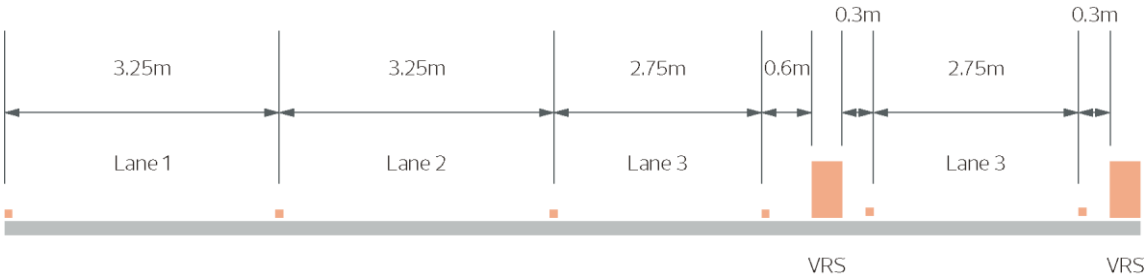


Figure 11: Cross section of TTM used on the M6 J13-15 scheme during the 60mph investigation

To enable the trial to proceed, a departure from TD19/06 Clause 8.22 Use of Temporary Safety Barriers in Contraflow Operations was approved.

A scheme-specific safety risk assessment in line with GG 104 standard was undertaken. Specialist technical expertise already in place at the scheme supported the development of the safety risk assessment. The assessment examined the risks posed to all affected parties from the change in speed restriction, detailing required mitigation measures. The mitigations which were implemented included:

[13] **Rajasooriya A, Ramnath R, Sharp R and Chowdhury S (2020).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the A1(M) Leeming to Ripon (MIS18).* Crowthorne, UK: TRL Ltd.

- A road restraint risk assessment process (RRRAP) was completed to identify and control verge hazards at both 50mph and 60mph.
- A road safety audit (RSA) was completed in accordance with the Major Projects Instruction for Smart Motorway Programme schemes to consider any location or geometry-related reason which would make a 60mph speed restriction unsafe.
- In order to facilitate an immediate change of the 60mph speed restriction to a 50mph speed restriction, a temporary traffic order for the 50mph speed restriction was put in place.
- Mobile Variable Message Signs (VMS) were positioned in advance of any change in speed restriction to warn approaching road users

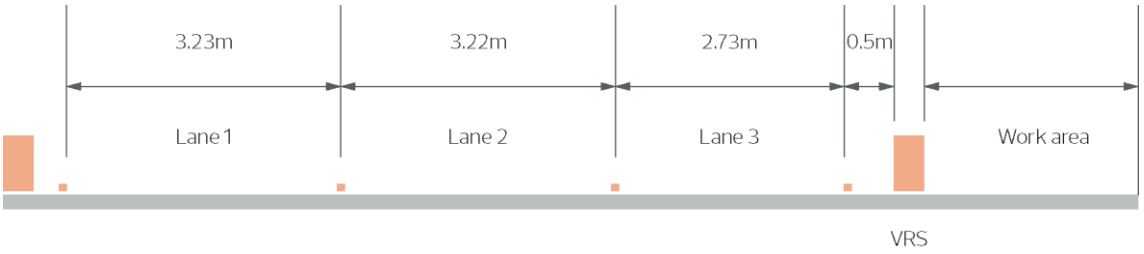
The effect of the change in speed restriction on driver behaviour and customer satisfaction was monitored over an eight-week period, the penultimate week of which was during the UK COVID-19 pandemic restrictions where traffic volumes were substantially reduced. Findings from this investigation are summarised in the trial report[14].

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 continued use of the 60mph speed restriction was approved, including for a new section on the northbound carriageway between junctions 14 and 15.

2.3 Dynamic

2.3.1 M6 J2-4

As part of the Smart Motorway Programme, this scheme's works included the conversion of the existing carriageway into a smart motorway. The design of the scheme provided an opportunity to use a dynamic traffic management scenario to investigate changing the speed restriction from 50mph to 60mph. The road works were designed to operate with a 60mph speed restriction during the implemented traffic management; but was only used during Sundays where minimal work was carried out. To serve as a comparison, the metrics monitored on the Sundays were also monitored the following Monday, where the 50mph speed restriction was reinstated. Additional monitoring was carried out during the Christmas embargo period (where a 60mph speed restriction was in place for an extended period).



[14] **Rajasooriya A, Ramnath R, Chowdhury S and Sharp R (2020).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the M6 J13-15 scheme (CPR2784).* Crowthorne, UK: TRL Ltd.

Figure 12: Cross section of TTM used on the M6 J2-4 scheme during the 60mph investigation

A scheme-specific safety risk assessment in line with GG 104 standard was undertaken. Specialist technical expertise already in place at the scheme supported the development of the safety risk assessment. The assessment examined the risks posed to all affected parties from the change in speed restriction, detailing required mitigation measures. The mitigations which were implemented included:

- Remote-controlled speed restriction signs were provided to reduce the exposure of road workers working alongside live traffic.
- A N2W2 containment vehicle restraint system (VRS) in conjunction with a Quest or VECU-STOP crash cushion was installed to contain higher speed errant vehicles.
- Signage was implemented to advise wide vehicles to span Lanes 1 and 2, consistent with normal D3M operations.
- VMS provided additional information to motorists without compromising the impact of the trial.

The safety risk assessment and proposed traffic management proposal was then endorsed as part of the safety governance process by the scheme's PSCRG prior to implementation.

The effect of the change in speed restriction on driver behaviour and customer satisfaction was monitored over a four-month period from the 15th of September 2019 until the 13th of January 2020. The findings from the embargo period produced results that closely resembled the main trial monitoring period (summarised below in Section 3) and detailed further in the trial report[15].

Two incidents that required the speed restriction to be dynamically lowered to 50mph during the embargo period were studied to examine responsive changes in driver behaviour. However, it was found that there was no significant change in average speeds as a result of the incidents and change in speed restriction.

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 continued use of the 60mph speed restriction between junctions 2 and 4 was approved and confirmation was received that the scheme further implemented a 60mph speed restriction on Sunday, 23rd February 2020 for a full 24-hour period.

2.3.2 M4 J3-12

As part of the Smart Motorway Programme, this scheme's works included the conversion of the existing carriageway into a smart motorway. The design of the scheme provided an opportunity to use a dynamic traffic management scenario to investigate changing the speed

[15] **Rajasooriya A, Ramnath R, Chowdhury S, Sharp R and Wallbank C (2020).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the M6 junction 2-4 (MIS20).* Crowthorne, UK: TRL Ltd.

restriction from 50mph to 60mph. The road works were designed to operate with a 60mph speed restriction during the implemented traffic management; but was only used during overnight weekdays and weekends where minimal work was carried out.

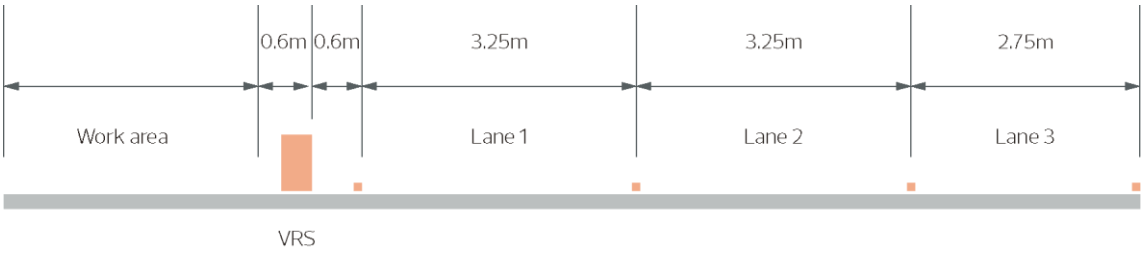


Figure 13: Cross section of TTM used on the M4 J3-12 scheme during the 60mph investigation

A scheme-specific safety risk assessment in line with GG 104 standard was undertaken. Specialist technical expertise already in place at the scheme supported the development of the safety risk assessment. The assessment examined the risks posed to all affected parties from the change in speed restriction, detailing required mitigation measures. The mitigations which were implemented included:

- Temporary Stopped Vehicle Detection (SVD) was implemented to provide early warning to the scheme traffic control centre so action could be taken more promptly when an incident takes place. This enabled the dispatch of an on-site recovery vehicle accompanied by an Impact Protection Vehicle (IPV) as soon as an incident was reported. The IPV was also designed to work in a 60mph speed environment.
- Construction traffic was restricted from exiting the works into the live lane during 60mph operations. This included the implementation of a process to confirm no vehicles were waiting to exit the works zone, prior to the activation of 60mph signs.
- Terminal end crash cushions were used which were compliant with an operating speed of 60mph or above.
- Portable variable message signs (p-VMS) were used to warn road users approaching any reported incident within the road works
- Appropriate consultation with the supply-chain workforce was carried out prior to the commencement of the trial.
- The perception of average speed enforcement to maintain speed compliance. This included the presence of average speed cameras visible to drivers within the trial section.
- The speed restriction was lowered to 50mph until an incident had been cleared, and when any road works took place.
- Clear signage was used to indicate the applicable speed restriction through the road works. This included the use of variable speed signs to interchangeably display 50mph and 60mph.
- Overnight lane closures were minimised from 6-7 days a week to 3-4 days a week during non-60mph night operations.

- The revised site guidance (April 2019) was used for handling vehicle incursions to site and their return to the live lane.

The effect of the change in speed restriction on driver behaviour and customer satisfaction was monitored over a 6 month period. The penultimate weeks of the trial monitoring period fell during the UK COVID-19 pandemic restrictions, which substantially reduced traffic volumes through the scheme.

Additionally, the weekday and weekend data were analysed separately to account for anticipated differences in driver behaviour and vehicle flow. In total, 203 weekday hours and 471 weekend hours were collected during the baseline period, in comparison to 17 weekday hours and 82 weekend hours of data that was collected during the trial period. Findings from this investigation are summarised in the trial report[16].

Upon completion of the trial of 60mph between junctions 11 and 12, a review and validation exercise was undertaken by the scheme to determine if the 60mph speed restriction could be further implemented. Based on this review in May 2020, the schemes PSCRG reviewed and accepted the recommendation to continue dynamically using the 60mph speed restriction between junctions 11 and 12 on the westbound carriageway, in addition to extending its use at the same location on the eastbound carriageway for duration of narrow lane verge works.

[16] **Rajasooriya A, Ramnath R, Chowdhury S and Sharp R (2020).** *Monitoring and evaluation of the 60mph trials: report for the on-road trials of 60mph on the M4 junction 3-12 (CPR4835).* Crowthorne, UK: TRL Ltd.

3 Documented available evidence

3.1 Changes in driver behaviour

3.1.1 Vehicle speeds

When in free-flow conditions, road users responded to the change in temporary speed restriction (from 50mph to 60mph) by increasing the travelling speed of their vehicles. Increases in average speed were observed following the implementation of the 60mph speed restriction, but these averages typically remained below 60mph.

Evidence from on-road investigations indicated that this increase in average speed had a positive effect on the levels of speed compliance shown by road users; compliance observed with the 60mph speed restriction was higher than with the 50mph restriction.

Table 1: Summary of results from the on-road trials of 60mph speed restrictions (changes relative to 50mph baseline)

Case study	Scenario	Average vehicle speed	Non-compliance with posted speed restriction
M49 Avonmouth	Permanent	10% increase	Reduced from 53% to 21%
M5 Willand	Permanent	13% increase	Reduced from 51% to 28%
M20 J10a	Permanent	12% increase	Reduced from 57% to 27%
M1 J13-16	Permanent	12% increase	Reduced from 31% to 13%
A1 Leeming to Barton	Permanent	13% increase	Reduced from 50% to 23%
M1 J32-35a	Permanent	8% increase	*No data available*
M5 J4a-6	Permanent	10% increase	Reduced from 54% to 18%
A1(M) Leeming to Ripon (northbound)	Contraflow	15% increase	Reduced from 17% to 5%
A1(M) Leeming to Ripon (southbound)	Contraflow	15% increase	Reduced from 25% to 16%
M6 J13-15	Contraflow	9% increase	Reduced from 11% to 2%
M6 J2-4	Dynamic	9% increase	Reduced from 2% to near 0%
M4 J3-12 (weekday)	Dynamic	8% increase	Reduced from 22% to 7%
M4 J3-12 (weekend)	Dynamic	13% increase	Reduced from 17% to 9%

When changes in speed restrictions were used within the same scheme, compliance with a ‘step down’ in speed restriction was good, with average speeds having reduced to below the lower speed restriction within a few hundred metres downstream of the speed restriction reduction. These changes in speed restrictions were highlighted by a variable message sign displaying the message “reduced speed limit ahead” and a vehicle activated sign shortly after the terminal signs. This combination of additional signage is likely to have contributed to the high levels of compliance that were observed.

3.1.2 Vehicle headway and close following

There was no evidence that average headways (the average distance between vehicles in the same lane) were compromised as a result of the 60mph speed restriction. Results from previous investigations suggest that headway is more likely to be influenced by changes to

vehicle flow than changes to the speed restriction. The headway of all road users (cars and HGVs) was typically higher throughout the monitoring period than the minimum two second headway recommended by the Highway Code.

Where data were available, the proportions of HGVs engaged in close following (defined as a headway of less than two seconds to the vehicle in front) decreased as a result of a change in speed restriction from 50mph to 60mph (see Table 2).

Table 2: Summary of results from the on-road trials of 60mph speed restrictions (changes relative to 50mph baseline)

Case study	Scenario	Proportion of HGVs close following[17]
M49 Avonmouth	Permanent	*No data available*
M5 Willand	Permanent	*No data available*
M20 J10a	Permanent	Reduced by 2%
M1 J13-16	Permanent	Reduced by 8%
A1 Leeming to Barton	Permanent	*No data available*
M1 J32-35a	Permanent	*No data available*
M5 J4a-6	Permanent	Reduced by 15%
A1(M) Leeming to Ripon	Contraflow	Reduced by 14%
M6 J13-15	Contraflow	Reduced by 2%
M6 J2-4	Dynamic	Reduced by 5%
M4 J3-12 (weekday)	Dynamic	Reduced by 4%
M4 J3-12 (weekend)	Dynamic	Reduced by 21%

Comparisons between customer perceptions showed that there were fewer concerns by road users with overtaking manoeuvres performed by all user groups (cars, vans and HGVs) in the 60mph areas compared with the 50mph areas. Results of surveys with road users indicated that changes in HGV behaviour allowed car drivers to choose their lane and to manoeuvre more freely.

3.1.3 Lane choice and position

When only two lanes in each direction were available within the TTM, the distribution of vehicles across those two running lanes was not greatly affected by the change in speed restriction.

When three lanes in each direction were available within the TTM, the distribution of vehicles across the running lanes was marginally affected by the change in speed restriction. A small number of vehicles were redistributed to the off-side lanes when the 60mph speed restriction was implemented.

Simulation studies[18] indicated that, when comparing road user behaviour within road works with either a 50mph or 60mph speed restriction, the average lane position of vehicles within

[17] A vehicle was defined as engaging in 'close following' if there was a headway of less than two seconds to the vehicle in front.

[18] **Glaze S, Chowdhury S, Fleetwood R and Lodge C (2018).** *Narrow lanes simulations 55mph and 60mph (RPN4122).* Crowthorne, UK: TRL Ltd.

desirable width lanes was very similar. For both cars and HGVs, the speed restriction appeared to have minimal influence on the ability of drivers to safely position and navigate their vehicle within the narrow lanes. Any variations in the position of their vehicle within the lane appeared to be linked with other factors, such as the presence of other vehicles or the width of the lane, rather than being a direct result of a change in posted speed restriction.

3.1.4 Workload

Simulation studies indicated that there appears to be little effect on car and HGV participants' cognitive workload when comparing travelling in 60mph scenarios with narrow lane restrictions to 50mph scenarios. Neither individual workload subscales and total workload (measured using the NASA-Task Load Index, a standardised instrument used to measure perceived workload) were significantly influenced by the change in posted speed restriction.

An earlier simulation study[19] concluded that, on average, the total time spent looking at the speedometer was significantly lower in the 60mph speed restriction scenario than in the 50mph scenario. Workload was also found to be relatively unaffected by the speed restriction.

3.1.5 Driver shyness

A pilot investigation[20] was undertaken in June 2019 on the M20 Junction 10a scheme (see section 2.1.3) of a 375mm set-back to the temporary vehicle restraint system (VRS) in conjunction with a 60mph speed restriction. The impact of this combination of speed restriction and traffic management design on the position of road users within Lane 1 was monitored for a short duration (3.75hrs). For comparison a second location, featuring a 375mm set-back to the temporary VRS in conjunction with a 50mph speed restriction on the same scheme, was monitored over the same time period.

Analysis of the data collected during this monitoring period suggests that, compared with a 50mph speed restriction, the use of a 375mm set-back with the 60mph speed restriction had the following impacts:

- Road users within Lane 1 travelled, on average, 0.2m further away from the temporary VRS in the 60mph speed restriction.
- On average the distance travelled from the temporary VRS was not impacted on whether other vehicles were present in the adjacent lane (Lane 2).

3.2 Changes in road worker safety

During each on-road investigation the design and implementation of the TTM ensured that the risks posed to road workers were effectively as low as reasonably practicable. In order to

[19] **Wallbank C, Balfe N and Chowdhury S (2017).** *Monitoring and evaluation of the 55/60mph pilots. Interim report for the simulator trial of 55 and 60mph through roadworks – A follow-on study (CPR2416).* Crowthorne, UK: TRL Ltd.

[20] **Glaze S and Kent J (2019).** *Pilot investigation - Driver shyness in relation to temporary vehicle restraint systems: Report of the on-road trials of 60mph on the M20 junction 10a scheme (MIS10).* Crowthorne, UK: TRL Ltd.

understand the impact of the change in speed restriction on road worker safety, changes in driver behaviour and the number of road traffic collisions (RTCs) were monitored. Hazardous events resulting in road work injury are rare, any deterioration in driver behaviours was used to inform the assessment of potential likelihood of hazardous events involving road workers occurring.

Incidents, road user breakdowns and road traffic collisions (RTCs) were monitored as part of the trials using the schemes' reporting logs (see Table 3). The varying approaches between schemes meant that the number of RTCs was the only consistent metric which was recorded.

Table 3: Summary of reported road traffic collisions (RTCs) from the on-road trials of 60mph speed restrictions (incidents baselined against 50mph numbers)

Case study	Scenario	Average daily number of reported RTCs		Average daily vehicle flow
		50mph	60mph	
M49 Avonmouth	Permanent	*No data available*		10,400
M5 Willand	Permanent	*No data available*		30,000
M20 J10a	Permanent	0.1	0.1	19,000
M1 J13-16[21]	Permanent	0.4	0.4	100,000
A1 Leeming to Barton[21]	Permanent	0.5	0.0	40,000
M1 J32-35a	Permanent	0.2	0.3	45,000
M5 J4a-6	Permanent	0.1	0.0	55,000
A1(M) Leeming to Ripon (northbound)	Contraflow	0.0	0.0	28,000
A1(M) Leeming to Ripon (southbound)	Contraflow	0.2	0.0	27,000
M6 J13-15	Contraflow	0.2	0.1	35,000
M6 J2-4	Dynamic	0.25	0.0	33,000
M4 J3-12 (weekday)	Dynamic	0.0	0.0	485 vehicles per hour
M4 J3-12 (weekend)	Dynamic	0.1	0.1	595 vehicles per hour

The change in speed restriction during the various investigations did not appear to have an impact on the number of reported RTCs at each scheme. During the investigations, no safety concerns were raised by the various schemes around the number of reported RTCs.

Even so, the increase in vehicle speeds was perceived as inherently less safe by some road workers, with concerns raised over the likelihood of increased incident severity from vehicles travelling faster within the road works. Overall, samples of scheme workforce representatives who responded to surveys (including project managers, on-site workforce and on-carriageway workforce) indicated that the changes in driver behaviour were generally considered to have no impact on their feelings of safety (see Table 4).

[21] Investigation utilised 60mph speed restrictions on both the north bound and southbound carriageways

Table 4: Summary of workforce survey results from the on-road trials of 60mph speed restrictions (How do you think the speed restriction affected your safety? Did it make you feel…?)

Case study	Scenario	No.	Unsafe	No affect	Safe
M49 Avonmouth	Permanent	15	47%	53%	-
M5 Willand	Permanent	8	-	100%	-
M20 J10a	Permanent	*No data available*			
M1 J13-16	Permanent	26	27%	38%	35%
A1 Leeming to Barton	Permanent	*No data available*			
M1 J32-35a	Permanent	*No data available*			
M5 J4a-6	Permanent	*No data available*			
A1(M) Leeming to Ripon	Contraflow	32	25%	56%	19%
M6 J13-15	Contraflow	22	23%	45%	32%
M6 J2-4	Dynamic	4	50%	50%	0%
M4 J3-12	Dynamic	53	38%	22%	40%

Most road workers felt the speed restriction was 'about right', although a larger share felt it was 'too high' than 'too slow' (see Table 5). Road workers who undertake works activities within the carriageway are most at risk; when surveyed, some indicated that the overall the change in speed restriction made them feel unsafe.

Table 5: Summary of workforce surveys from the on-road trials of 60mph speed restrictions (In terms of your safety, do you think the speed restriction was…?)

Case study	Scenario	No.	Too high	About right	Too slow
M49 Avonmouth	Permanent	15	33%	60%	7%
M5 Willand	Permanent	8	-	100%	-
M20 J10a	Permanent	*No data available*			
M1 J13-16	Permanent	26	23%	73%	4%
A1 Leeming to Barton	Permanent	*No data available*			
M1 J32-35a	Permanent	*No data available*			
M5 J4a-6	Permanent	*No data available*			
A1(M) Leeming to Ripon	Contraflow	32	31%	69%	0%
M6 J13-15	Contraflow	22	32%	68%	0%
M6 J2-4	Dynamic	4	50%	50%	0%
M4 J3-12	Dynamic	53	36%	58%	6%

Communication with road workers around the intended application of the highest safe speed and the importance of their safety is necessary if the implementation of 60mph at other schemes is to be successful. During recent investigations, the schemes, along with other adjacent road works schemes, were consulted on the implementation of a 60mph speed restriction, the likely effects on road user behaviour and the additional mitigations that would be implemented to reduce risks posed to them.

This consultation encompassed involvement of the scheme's workforce with:

- The development of safety risk assessments
- 'Toolbox' talks prior to implementation of 60mph speed restrictions
- Demonstrations and training with additional TTM equipment introduced as part of the trials

3.3 Changes in customer satisfaction

3.3.1 Driver experience

Initial investigations into the use of 60mph in road works suggested that drivers typically perceived the 60mph speed restriction positively, both in terms of overall satisfaction and perceptions of journey time. However, analysis of pooled customer survey data (including data from more recent investigations on the M6, M4, A1(M) and M1) concluded that:

1. **There was no significant effect of speed restriction (50mph vs 60mph) on customers' self-reported perceptions of safety.**

   Generally, most participants indicated that the speed restriction did not affect how safe they felt, irrespective of whether it was 50mph or 60mph. Most participants in both the 50mph and 60mph groups indicated that they felt the speed restrictions were 'about right' in terms of safety.

2. **There was no significant effect of speed restriction (50mph vs. 60mph) on customers' self-reported perceptions of journey satisfaction.**

   Most participants indicated that the speed restriction did not affect their levels of journey satisfaction. In terms of journey satisfaction, most customers indicated that the speed restriction was 'about right', irrespective of whether it was 50mph or 60mph.

3.3.2 Journey times

The introduction of a 60mph speed restriction did not appear to influence the amount of congestion recorded. This was observed at each of the schemes involved in trialling a 60mph speed restriction. As such, the realised increase in average vehicle speed in free-flowing traffic resulted in reductions in journey times. The average journey time saving for each driver during the investigations is presented in Table 6 below:

Table 6: Summary of journey time reduces from the on-road trials of 60mph speed restrictions (changes relative to 50mph baseline)

Case study	Scenario	Average journey time
M49 Avonmouth	Permanent	9% decrease
M5 Willand	Permanent	10% decrease
M20 J10a	Permanent	10% decrease
M1 J13-16	Permanent	10% decrease
A1 Leeming to Barton	Permanent	11% decrease
M1 J32-35a	Permanent	9% decrease
M5 J4a-6	Permanent	11% decrease
A1(M) Leeming to Ripon	Contraflow	14% decrease
M6 J13-15	Contraflow	8% decrease
M6 J2-4	Dynamic	8% decrease
M4 J3-12 (weekday)	Dynamic	8% decrease
M4 J3-12 (weekend)	Dynamic	11% decrease

When summed over the many thousands of drivers who used the schemes each day, the economic benefits (due to time saved) are considerable.

3.3.3 Results of audits

Table 7 summarises the customer audit results from all on-road trials. Auditors' feedback on the 60mph speed restriction is presented, relative to the feedback on the 50mph speed restriction.

Table 7: Summary of customer audit results from the on-road trials of 60mph speed restrictions (changes relative to 50mph baseline)

Case study	Scenario	Feelings of safety	Level of satisfaction[22]	Appropriate for the conditions[23]	Suitability of speed restriction
M49 Avonmouth	Permanent	4% decrease	No change	8% increase	6% increase
M5 Willand	Permanent	No change	2% decrease	No change	10% increase
M20 J10a	Permanent	No change	17% increase	13% increase	14% increase
M1 J13-16	Permanent	No change	4% increase	15% increase	10% increase
A1 Leeming to Barton	Permanent	*No data available*			
M1 J32-35a	Permanent	*No data available*			
M5 J4a-6	Permanent	*No data available*			
A1(M) Leeming to Ripon	Contraflow	No change	6% decrease	No change	No change
M6 J13-15	Contraflow	5% increase	No change	4% decrease	No change
M6 J2-4	Dynamic	No change	15% decrease	16% decrease	16% decrease
M4 J3-12	Dynamic	*No data available*			

Overall, the vast majority of auditors (99%) on all seven schemes where data were available felt safe driving at both the 50mph and 60mph speed restrictions. An average of 73% of auditors were satisfied with the 50mph speed restriction and 71% were satisfied with the 60mph speed restriction.

Furthermore, most auditors felt that both the 50mph (92%) and 60mph speed restriction (94%) were appropriate for the conditions on all schemes. Most auditors also felt that both

[22] The level of satisfaction is calculated based on the feedback provided by auditors who responded either 'satisfied' or 'very satisfied' in the customer audits.

[23] Auditors were not specifically briefed on what was meant by the term 'conditions'. As such, the impact of changes in weather and vehicle flow (which were not controlled for as part of the investigation) cannot be isolated from the impact of the change in speed restriction.

the 50mph (91%) and 60mph speed restriction (95%) were ‘about right’, although 9% and 4% felt the 50mph and 60mph speed restriction was too slow, respectively. Only 1% of all auditors felt the 60mph speed restriction was too high, whereas no auditors felt the 50mph speed restriction was too high.

Generally, traffic conditions did not greatly affect the auditors’ perceptions of the speed restrictions. However, some auditors wanted to travel through the schemes at a higher speed when traffic was light. Additionally, some auditors stated that they could only utilise the 60mph speed restriction in the absence of congestion. On all schemes, auditors generally felt the signage was clear and well-positioned.

The respective trial reports include a detailed summary of the customer audits.

A review of social media conversations concluded that for those drivers who did notice the increase in speed to 60mph feedback was positive towards the change. A desire for further implementation on other road works stretches was stated.

Implementing the highest safe speed within road works - Case studies and supporting evidence

On our high-speed roads (with a permanent speed limit of 50mph or more) temporary mandatory speed restrictions can be put in place to reduce the level of risk posed. In order to keep traffic flowing as freely as possible, Temporary Traffic Management should be designed to allow the highest speed that can be safely implemented.

This document provides a set of case studies and supporting evidence, gathered during the extensive series of on-road trials, where a temporary speed restriction of 60mph was implemented within road works.

Other titles from this subject area

MIS16 Implementing the highest safe speed within road works – Guidance. S Glaze. 2020

MIS19 Implementing the highest safe speed within road works – Hazard assessment guidance. R Wilford, A Rajasooriya and S Glaze. 2020

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