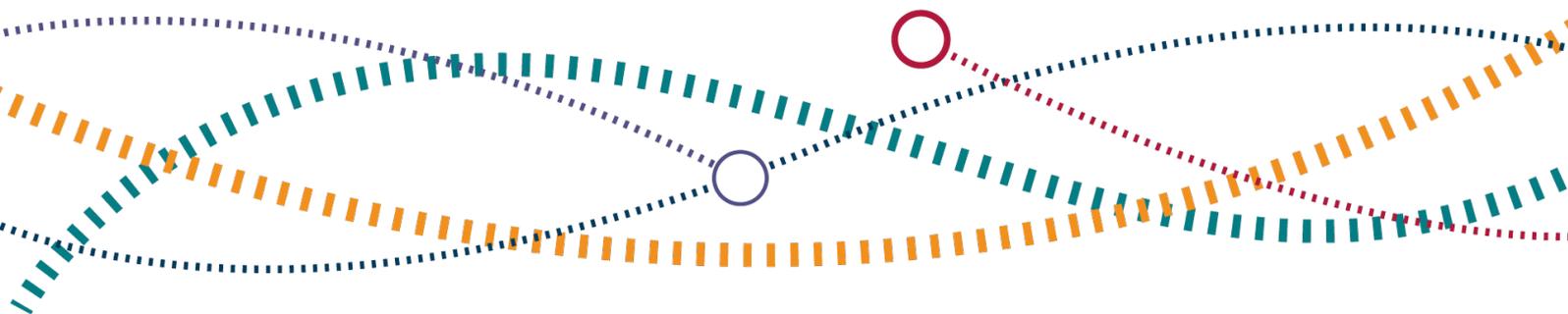




# Quality Assurance of All Lane Running Motorway data

Report for Secretary of State, Rt.  
Hon. Grant Shapps MP

28 June 2021



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## Background and document structure

- 1.1 This report is provided for the Secretary of State, Rt Hon Grant Shapps MP, in response to [his request](#) for ORR to undertake quality assurance of the data and evidence underpinning the conclusions arrived at regarding All Lane Running (ALR) motorways. We were specifically asked to address the following four questions:
- (a) are the data and evidence used in the stocktake and the progress report reliable and robust and in line with established/best practice;
  - (b) have comparisons been made in an appropriate way about the relative safety of ALR motorways, with reference to conventional motorways and other roads;
  - (c) are there any other data that could be used to enhance our understanding of the relative safety of ALR motorways, or to support the monitoring and evaluation of the effectiveness of the measures we are putting in place to improve safety and perceptions of safety; and
  - (d) are there data and evidence available which can compare the international experience of operating similar types of road?
- 1.2 In undertaking this work we have drawn on our experience and expertise as the monitor of England's strategic road network, the safety regulator of Britain's rail network and the publisher of official railway statistics. We have reviewed detailed information provided to us by Highways England and the Department for Transport (DfT). We have also interviewed relevant staff (via Microsoft Teams) at both organisations to better understand the data and evidence that underpins the conclusions being drawn on the relative safety of ALR motorways. We would like to thank them for their open and timely replies to our requests.
- 1.3 We have also reviewed the evidence submitted to the Transport Select Committee's Smart Motorway Inquiry to confirm whether there was anything material to our review. Out of the 88 submissions there were six which queried aspects of the analysis undertaken in the *Smart Motorway Safety Evidence Stocktake and Action Plan*; but none of the submissions specifically addressed the reliability and robustness of the underlying data.
- 1.4 To strengthen our work, we took independent advice from an expert econometrician at the consultancy Indepen to provide external challenge to our analytical approach. We also involved the non-executive chair of our Highways

Committee, Professor Stephen Glaister CBE, to provide additional expertise and challenge.

- 1.5 The remainder of this report describes the organisations involved in the review, the evidence we have considered, our findings in relation to the specific questions asked by the Secretary of State, and our recommendations for enhancing the data and evidence.
- 1.6 We have included our detailed findings in technical annexes to this report.

## The roles of the organisations

- 1.7 **The Department for Transport (DfT)** provides the strategic direction and funding for the motorway network and major A-roads in England, known collectively as the Strategic Road Network (SRN). It sets the Road Investment Strategy (RIS) for Highways England which contains all the outputs Highways England must deliver within each five-year funding period (known as a Road Period). The Secretary of State for Transport has overall responsibility for the policies of DfT.
- 1.8 **Highways England** is a public company, answerable to DfT, which runs, maintains and develops the SRN in England. Highways England gets most of its funding from the taxpayer. It was formed in 2015 when the Highways Agency, an executive agency of DfT, was transformed into the Strategic Highways Company via the [Infrastructure Act \(2015\)](#). Highways England designs and builds All Lane Running motorways, a type of Smart Motorway (see below), and it is responsible for maintaining and operating the motorways built by its predecessor organisation.
- 1.9 **The Office of Rail and Road (ORR)** is a non-ministerial government department responsible for the monitoring of Highways England and for the economic and safety regulation of Britain's railways. ORR monitors Highways England's management of the SRN. We are also the publisher of official statistics for Britain's railways. The Secretary of State for Transport asked ORR to carry out this independent analytical assurance of ALR motorway data and evidence.

## All lane running (ALR) motorways

- 1.10 ALR motorways are a type of Smart Motorway and have been in operation on the SRN in England since 2014. Smart Motorways differ from conventional motorways in that they seek to regulate traffic to smooth its flow, accounting for the effects of congestion. There are three types of Smart Motorway in England:

- (a) **Controlled Motorway** (CM) – with three or more lanes, a hard shoulder and variable speed limits;
- (b) **Dynamic Hard Shoulder Running** (DHS) – with variable speed limits and the hard shoulder selectively opened as a running lane during periods when there is a lower speed limit in force, and emergency areas at regular intervals; and
- (c) **All Lane Running** (ALR) – with variable speed limits and the hard shoulder converted to a permanent running lane, and emergency areas at intervals.

These types of Smart Motorways, conventional motorways and SRN A-roads, and the trends observed on them, have been used to assess the relative safety of ALR motorways. The international publications we have examined as part of this review have also referenced another type of motorway, similar to DHS:

- (d) **Hard Shoulder Running** (HSR) – with variable speed limits and the hard shoulder opened at specific times of the day, and emergency areas at regular intervals.

## Data and evidence

1.11 In undertaking this analytical assurance, we have focused on the data, evidence, and conclusions presented in three publications:

- (a) [Smart Motorway All Lane Running Overarching Safety Report](#) published by Highways England in December 2019;
- (b) [Smart Motorway Safety Evidence Stocktake and Action Plan](#) published by DfT in March 2020; and
- (c) [Smart Motorways Stocktake: First year progress report](#) published by Highways England in April 2021.

1.12 ORR did not have a role in the development of any of these publications or the analysis that underpins them.

1.13 Of these publications the *Smart Motorway Safety Evidence Stocktake and Action Plan* is the most comprehensive, known hereafter as the *Stocktake*.

1.14 The nature of the data and evidence used in the *Stocktake* is complex. It is not entirely clear which, if any, of the sources of evidence were the most relied upon in

drawing conclusions, or whether it was the totality of the evidence combined. In summary, there were three broad sources:

- (a) **High-level statistics** – such as total number of casualties in a given year, which were examined in different ways (such as per-mile or per-billion vehicle miles) and matched to different road types. (This was the only source of evidence updated in the *Smart Motorways Stocktake: First year progress report*).
- (b) **‘Before and after’ studies** (with a counterfactual scenario – a hypothetical level of performance had the road not been converted to ALR) – which looked at stretches of motorway where a form of Smart Motorway has been introduced to provide a like for like comparison. The sources of evidence we looked at were the before and after analysis in the *Smart Motorway All Lane Running Overarching Safety Report*, [Post Opening Project Evaluation](#) (POPE) reports, and monitoring reports for the M25 ([J5-7](#) and [J23-27](#)).
- (c) **Modelling of potential and outturn risks** – which was intended to quantify the change in risk profile (both overall and for constituent ones). The conclusions in the *Stocktake* were based on Highways England’s Generic Hazard Log – which is a complex spreadsheet that seeks to identify and quantify hazards. (‘Hazard’ is a common term with health and safety practitioners and is defined by the Health and Safety Executive as a state or event that could cause injury or illness in a business). A hazard log is a standard tool used in other sectors. The hazard log used by Highways England was adapted from a log used to assess risk on conventional motorways. The outturn risk was assessed using a sub-set of high-level statistics and referenced against the potential risks identified in the hazard log.

1.15 We structured our assurance work accordingly and present our key findings from examining these sources under the four questions posed.

1.16 While our work was to review the data and evidence behind the original *Stocktake* and *Smart Motorways Stocktake: First year progress report*, it is important context to note that wider circumstances have changed and continue to change. Highways England has so far delivered its committed actions to improve the safety of ALR motorways since the *Stocktake* was published. Further measures to enhance safety were announced since then and these include a review into potential changes to the Highway Code relevant to driving on ALR motorways.

## Findings

### **Are the data and evidence used in the stocktake and the progress report reliable and robust and in line with established/best practice?**

- 1.17 From what we have seen, all the data that was available for analysis have been used. We found no errors in underlying calculations, for example formula errors in spreadsheets used to process raw data. However, there is a limited amount of data available. In 2019, there were only 141 miles of ALR motorway, the network having expanded from 29 miles in 2014. This means that only 29 miles of ALR has a full five years' worth of data associated with it, and much less data are available for the remaining 112 miles.

#### High-level statistics

- 1.18 These have been collected and analysed in line with best practice. They are official statistics and overseen by the Office for Statistics Regulation. The mapping of the statistics to the road network has been carried out in a robust way.
- 1.19 We tested alternative ways to analyse the data, but these approaches are no more robust than the methods that were employed.
- 1.20 The data have been collected over a relatively short time and there are few data points given the low frequency of incidents. Therefore, trends are volatile and highly sensitive to change when new data become available.

#### Before and after studies

- 1.21 These studies follow [Highways England's established practice](#). We tested construction of the counterfactual and the approach to significance testing as these were the components most critical to robustness. Overall, the approach can be considered reliable and robust, but we found some ways this source could be enhanced, which we explain later in this report.

#### Risk modelling

- 1.22 Highways England has wide ranging risk management processes in its business. For our assurance work we did a high-level review of one aspect, the Generic Hazard Log, as the outcome from this was used to inform the *Stocktake*. Overall, the process employed for constructing the Generic Hazard Log followed established practices that are commonly used in other sectors, principally facilitated workshops with conclusions validated by available evidence.

1.23 However, we consider that this source was not in line with best practice. We found that some elements of the log were incomplete and that there were some anomalies, particularly whether something was classified as a hazard or an underlying cause, although we found no evidence to suggest that these would have affected the outcome of the analysis. We also found that Highways England had not used complementary tools in constructing the Generic Hazard Log (such as fishbone analysis, which is a visual representation of a process to understand contributing factors).

**Have comparisons been made in an appropriate way about the relative safety of ALR motorways, with reference to conventional motorways and other roads?**

1.24 Overall, the comparisons about the relative safety of ALR motorways were made in an appropriate way.

1.25 However, in the high-level statistics, comparisons made between conventional motorways and Smart Motorways did not always separate the types of road (i.e. Controlled Motorways, DHS, ALR) which may have obscured the impact of the removal of the hard shoulder.

1.26 Also, we explain later how the counterfactual used in the 'Before and After' analysis could be strengthened. Future assessments of safety could be extended to cover DHS schemes as an additional point of comparison.

**Are there any other data that could be used to enhance our understanding of the relative safety of ALR motorways, or to support the monitoring and evaluation of the effectiveness of the measures we are putting in place to improve safety and perceptions of safety?**

1.27 The main source of evidence where different data could be more effectively used is risk modelling. This source relies considerably on expert judgement validated by wider information that is broader than the high-level statistics or 'Before and After' studies.

1.28 We note above (and recommend later) that Highways England should undertake additional forms of risk analysis to complement the approach taken in constructing the Generic Hazard Log. This would provide further evidence to validate the hazards.

1.29 In addition, there are fields within the [STATS19](#) data (the official statistics which the police provide about personal injury road traffic accidents) that could be made

available to Highways England so that it can better understand risk exposure to specific road users, for example vehicle origin or trends showing high-risk vehicle types.

- 1.30 Going further, Highways England could work with motor insurers to get access to information regarding no-injury collisions. This data could inform analysis of leading indicators of risk, something missing in the currently available data.

**Are there data and evidence available which can compare the international experience of operating similar types of road?**

- 1.31 We have not found any readily available data and evidence relating to ALR operation internationally. We have found examples of Hard Shoulder Running (or Dynamic Hard Shoulder Running). We have seen some examples of good practice in the before and after studies from other countries that Highways England could learn from but have found nothing that would obviously have assisted the analysis done in the *Stocktake* or that is readily available in the short term.
- 1.32 The Conference of European Directors of Roads (CEDR) is a forum with which Highways England should continue to engage, specifically to improve its understanding of the risks associated with the removal of the Hard Shoulder.

## Conclusions

- 1.33 Overall, the data and evidence that were available for analysis have been used. We found no errors in underlying calculations and the comparisons about the relative safety of ALR motorways were made in an appropriate way. There were some issues in the tools used to underpin risk modelling that Highways England should address. We make some further recommendations to deepen the use of comparisons and enhance the understanding of risk exposure.
- 1.34 The evidence presented to the Transport Select Committee's inquiry into smart motorways demonstrates a wide set of views from both experts and members of the public.
- 1.35 The limitations of available data will not be solved in the short term and therefore presents an immediate challenge in addressing the concerns expressed by stakeholders regarding the safety of ALR motorways.
- 1.36 The data for all sources of evidence should continue to be evaluated regularly as more data or better analytical techniques become available.

Specific to the High-level statistics

- 1.37 The *Stocktake* presents the high-level statistics in many different ways.
- 1.38 **We recommend that a smaller number of ‘headline’ metrics should be used to communicate safety.**

Specific to the Before and After studies

- 1.39 The counterfactual could be improved to reflect the specifics of each scheme rather than the use of national trends. Highways England has already recognised that this can be enhanced by disaggregating its analysis to account for regionalised trends. Some of the international literature we have seen describes simple regression models that control for factors such as traffic level and composition. This could inform Highways England’s approach.
- 1.40 The relative lack of data means that carrying out significance testing (whether we can be confident that changes over time in the data are because of the implementation of ALR) is not straightforward. Highways England has used a complex method for calculating the significance and this could be simplified to make the assessment more transparent.
- 1.41 The Post Opening Project Evaluation (POPE) process, a key part of the before and after analysis, primarily assesses schemes by comparing the business case assumptions made before construction to what actually happened at one and five years after the scheme opened for traffic.
- 1.42 **The counterfactual used is relatively simple and based on national trends. We recommend that steps are taken to refine the counterfactual and strengthen it.**
- 1.43 **We also recommend that Highways England considers a review of whether the timing of the safety evaluation at one- and five-years of new highways schemes remains appropriate.**

Specific to the Risk modelling

- 1.44 **We recommend that the ALR Generic Hazard Log is completed with the relevant information inputted into the missing fields.**
- 1.45 **In any regular review of the log, Highways England should specifically consider whether hazards are becoming inaptly fractionalised (i.e. dividing hazards into a number of sub-hazards that are principally the same).**

1.46 **Highways England should use further risk analysis tools (such as a fishbone analysis), to verify the expert views which have been used to populate the log.** The outcome of this analysis could also inform whether there are other metrics that act as precursor indicators. This should be verified independently of Highways England, to provide stakeholders with greater confidence in the conclusions.

*Specific to Perceptions and communication*

1.47 To improve perceptions of safety we make two recommendations:

- (a) **the publication of data relating to the safety of ALR should continue, and the before and after analysis should be updated regularly, including the overarching assessment of ALR as a concept.**
- (b) communication to date has not focused enough on the specific risks introduced by ALR motorways. It is difficult on an open system to reach all users, but in the communication campaigns Highways England has not specifically referenced ALR motorways when communicating the actions that users need to take to mitigate risk. When changes to road infrastructure are implemented a gap exists on how updated mandatory rules and guidance are communicated to both domestic and international road users. **We recommend that, in addition to the actions taken in response to the Stocktake, DfT and Highways England review how future changes to the infrastructure and road rules are communicated to both the domestic and international road user.**

1.48 It is important that those performing the analysis and evaluations continue to retain an open mind about new evidence which could challenge and strengthen existing analysis.

Figure 1.1 All Lane Running on the M1





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