Evaluation of the Potential Impacts of Increasing Speed Limits for HGVs in Scotland

Transport Scotland

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Quality information

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Executive Summary

Purpose and Aims of the Research

In 2012, the Scotland Act gave Scottish Ministers the power to determine the level of the national speed limits on dual carriageways and motorways. These powers also extend to the ability to set vehicle-specific speed limits, such as those for Heavy Good Vehicles (HGVs).

In April 2015, the speed limits for HGVs over 7.5 tonnes were increased in England and Wales; from 40 to 50 mph on single carriageways and from 50 to 60 mph on dual carriageways. Scottish Ministers did not mirror the 2015 increases and there are now different HGV speed limits in Scotland than those in place in England and Wales; in Scotland the limit for HGVs is 40 mph on single carriageways and 50 mph on dual carriageways.

Transport Scotland commissioned AECOM to consider the potential impacts of increasing HGV-specific speed limits on Scottish roads. No specific speed limit change was identified by Transport Scotland and the commissioning of the research did not indicate any intention or commitment to implement any revised speed limits.

Approach

The research was undertaken as four interlinked tasks:

- Literature review: to understand the evidence that exists regarding the impacts of speed limit changes on speed, safety, environment, and economic factors;
- Emerging evidence: AECOM is currently undertaking the evaluation of the impact of the HGV speed limit change in England and Wales. The first annual report was considered as part of this research;
- Audit of the Scottish Road Network: data was collated in order to build up an overview of the Scottish road network. This enabled an understanding of how similar the network is to that of England and Wales and hence how transferrable conclusions from the evaluation are; and
- Analysis of potential impact: using the evidence gathered in the previous tasks, AECOM then sought to provide reasoned conclusions on the potential impacts of an increase in HGV speed limits in Scotland. This included some limited use of transport modelling.

This research was limited in scope, and was not intended as a Scottish equivalent of the full Impact Assessment undertaken by the UK DfT prior to the introduction of the HGV speed limit increase in England and Wales. The consideration of impact quantification have paid due respect to the capabilities of the modelling software available, in particular the confidence in model outputs and margins of error.

Key Findings

Literature Review and Emerging Evidence

A review of existing evidence confirmed the assumed links between vehicle speeds, road safety and wider impacts on the environment and economy. Extensive academic and industry research outlined the impacts of increasing average speeds, particularly of HGVs, including increased risks of road traffic collisions and increased severity of casualties. An increase in HGV speeds also negatively impacts their stopping distances, which could contribute to collision risks.

However, evidence from studies undertaken by the Department for Transport (DfT) and Transport Scotland highlighted that an increase in HGV speeds could reduce the speed differential with other traffic, thereby reducing the occurrence of risky overtaking. Higher

HGV speeds, and reduced delay for other vehicles no longer travelling in platoons behind slower moving HGVs, could also generate journey time and vehicle operating cost benefits.

Audit of the Scottish Road Network and Analysis of Potential Impact

The evidence of the impacts of HGV speed increases on factors such as accident rate and severity was therefore clear. However, there was little empirical evidence on the impacts of HGV speed limit increases on HGV speeds. An important factor in such an analysis was the level of speed limit compliance in the before situation. To consider the potential impacts, a review was undertaken of the Scottish road network and evidence from the England and Wales year one evaluation.

The key findings for single carriageway trunk roads were:

- Single carriageway trunk roads make up approximately 4% of the Scottish rural road network and carry an estimated 14% of the HGV miles operated;
- The baseline (2016) average free flow speeds of HGVs on single carriageway trunk roads in Scotland was 48.2 mph. This is well in excess of the 40 mph speed limit that exists;
- In comparison, the baseline for England and Wales was 46.4 mph, which increased by approximately 1.5 mph following the speed limit change to 50 mph. The post speed limit change average speed was therefore still below the baseline value observed in Scotland; and
- There was no compelling evidence to indicate whether, or by how much, HGV average speeds could increase on Scottish single carriageway trunk roads should the speed limit increase to 50 mph. The high baseline average speed suggested that the speed limit is not the determining factor in HGV driver behaviour.

The main findings for single carriageway non-trunk roads were:

- Single carriageway non-trunk roads make up approximately 40% of the Scottish rural road network, and carry an estimated 30% of freight mileage;
- The baseline 2014 average HGV speed was lower (44.6 mph) for non-trunk than trunk, but this was still nearly 5 mph above the 40 mph speed limit; and
- The speed differential between HGVs (44.6mph) and light vehicles (48.9) was low in 2016, reflecting the slower average speeds on such roads and despite the limit of 60mph for non-HGVs. These free flow average speeds suggest that the characteristics and topography of these roads are likely to be contributing to constraining average speeds for both light and heavy vehicles.

The initial modelling work has indicated that should a change in speed limit on Scottish single carriageway roads result in a 1.5 mph increase in HGV average speeds (as per England and Wales), the travel time and vehicle operating benefits were within the margin of error of the national transport model (ie around zero). There are small safety benefits and CO2e emissions increases when restricting the speed limit change to trunk roads only. Conversely, when the speed limit increase is applied to all rural roads there are small safety disbenefits and CO2e reductions.

Furthermore, there was no compelling evidence that an increase in HGV speed limits in Scotland would result in such an increase in average vehicle speeds, with any change in driving behaviour considered likely to occur on a route-by-route basis. The impacts of the implementation of a speed limit increase across all single carriageway roads could effectively be limited to legitimising existing driving behaviour in terms of speed. It would though provide a consistency across Scotland, and in relation to limits in England and Wales.

The key findings for dual carriageways were:

- Dual carriageway trunk roads make up approximately 1% of the Scottish rural road network, and carry approximately 6% of freight mileage;
- The baseline HGV average speed for Scottish dual carriageway trunk roads was 47.8 mph, which was below the baseline speed limit across all road types; and
- The baseline HGV average speed of 52.2 mph in England and Wales was relatively high and above the baseline speed limit (50 mph). The England and Wales year one evaluation identified a 0.5 mph increase in average HGV speeds following a change in speed limit from 50 mph to 60 mph.

These numbers could indicate the potential to increase HGV speeds in Scotland. It could equally reflect existing constraints (e.g. topography or bendiness) on these roads that keep average speeds in Scotland below 50 mph. An increase of between 0.5 mph (England and Wales) and 4 mph (to match average speeds on Scottish motorways) could be anticipated following an increase in speed limit; the latter, although considered unrealistic, could have significant impacts on safety and the environment. Overall, with the relatively short length of the dual carriageway trunk road network, and the forecast economic benefits, relative to single carriageways, there is not compelling evidence to increase the HGV speed limit from 50 mph to 60 mph across all such roads.

Recommendations

It is recommended that the evidence emerging from the year two England and Wales evaluation and A9 evaluation should be reviewed prior to any formal conclusions being drawn. This could be undertaken in Spring 2018 following the availability of A9 related data.

1. Introduction

1.1 Introduction

1.1.1 In late 2016 Transport Scotland commissioned a research project to collate evidence through which to consider the *potential* impacts of any increase in the speed limit for HGVs on single and dual carriageways in Scotland. The 2012 Scotland Act gave Scottish Ministers the power to determine the level of the national speed limits on dual carriageways and motorways (currently 70 mph) and single carriageway roads (currently 60 mph) as well as associated vehicle speed limits in Scotland (e.g. HGV speed limits of 40 mph on single carriageways and 50 mph on dual carriageways). The 2016 Scotland Act devolved all remaining powers to amend speed limits to the Scottish Parliament, including the national urban speed limit of 30 mph.

1.1.2 The powers that have been devolved were utilised, with effect from October 2014, to allow for the maximum speed limit for HGV's over 7.5 tonnes to be raised from 40 mph to 50 mph on single carriageway sections of the A9 between Perth and Inverness. The decision to implement this speed limit increase was taken due to the particular considerations applicable to that specific route and incorporated an Average Speed Camera system in order to mitigate any risks.

1.1.3 In April 2015, HGV speed limits were increased in England and Wales from 40 mph to 50 mph on single carriageway roads and 50 mph to 60 mph on dual carriageway roads for vehicles weighing more than 7.5 tonnes. The Department for Transport (DfT) published an impact assessment to accompany the increase which predicted a rise in fatalities and serious injuries as a result of the change. They have subsequently commissioned AECOM and Atkins to undertake a three year evaluative study of the speed limit changes which seeks to understand the impact of the increase on speeds, safety, the environment and the economy.

1.1.4 Scottish Ministers did not mirror the 2015 increase in HGV speed limits in England and Wales and, therefore, there are now different HGV speed limits in Scotland than those in place in England and Wales.

1.2 Scope of Research

1.2.1 The purpose of the research was to determine the potential impacts of any HGV speed limit changes, to inform future policy decisions. Any realised benefits in terms of reduced journey times and operating costs following a change in speed limits (assuming a change in average speeds resulted) would be expected to improve the operating conditions for the logistics sector. However, there are potentially negative air quality and safety impacts of any increase in speed limits.

1.2.2 This research consists of four elements:

- Literature Review – to provide context for future policy decisions, understand the evidence that exists regarding the impacts of speed limit changes on speed, safety, environment and economic factors;
- Emerging evidence from HGV Evaluation – a summary of the emerging evidence from evaluation of the impact of the change in HGV speed limit in

England and Wales (recognising that findings are emerging, with only the first annual report currently available), and evidence from the A9 between Perth and Inverness;

- Audit of Scottish Road Network – use data provided by Transport Scotland to summarise the characteristics of the Scottish road network. This is compared with baseline characteristics of England and Wales, in order to understand whether observed changes in England and Wales can with confidence be predicted to manifest similar observable changes in Scotland, should a speed limit change be implemented;
- Analysis of Potential Impact – analyse the Scottish road network in order to understand the potential impact of an increase in HGV speed limit. This includes some limited quantification using transport modelling.

1.3 Structure of this Report

1.3.1 This report contains the following sections:

- Section 2: Literature review and Emerging Evidence;
- Section 3: Highway network audit and Analysis of Potential Impact; and
- Section 4: Transport Modeling and Analysis.

1.3.2 The report also includes Appendices of supporting evidence and information.

2. Literature Review

2.1 Approach

2.1.1 The first task of this commission was to undertake a short literature review of evidence pertaining to the potential impacts of changes in HGV speed limits. This included the impacts of increasing HGV specific speed limits on key factors such as speed, flows and safety, and any differences in impacts between trunk road and non-trunk road networks.

2.1.2 In October 2015, the DfT commissioned AECOM/Atkins to undertake a three year evaluation of changes in HGV speed limits[1] in England and Wales. This work included a rapid evidence review, completed in March 2016[2]. This present commission therefore built on the 2016 work. An initial search was undertaken for newly published material, to supplement the previous evidence review. However, this search determined that very limited new material had been published nationally or internationally since March 2016. A full list of references is provided in Appendix A.

2.1.3 The focus of this initial task was therefore to report a short synthesis of the available evidence on the potential impacts of increasing speed limits for HGVs. This included the initial evidence from the DfT evaluation and data from the A9 speed limit and Average Speed Camera pilot. This will help to inform future considerations on HGV speed limits in Scotland. The findings of the literature review are presented under the following key areas of evidence on the potential impacts of changing HGV speed limits:

- Traffic flows and volumes;
- Speeds;
- Safety;
- Environment; and
- Economic factors.

[1] 50 mph on single carriageways (up from 40 mph) and 60 mph on dual carriageway (up from 50 mph) for HGVs over 7.5 tonnes.
[2] Evaluation of the national HGV Speed Limit Increase: Scoping Report, AECOM, Atkins 2016

2.2 Flows and Traffic Volumes

2.2.1 It could be hypothesised that an increase in HGV speed limits could lead to reduced delays for other vehicles, and thereby induce further travel demand. Traffic speeds and flow characteristics influence journey time, and may in turn influence route choice, and thereby flows on specific routes. However, there was no evidence found that directly linked an increase in speed limit and changes in traffic volumes.

2.2.2 The lack of empirical evidence of the impacts of speed limit changes on flows was supported by the emerging evidence from the DfT evaluation, where no significant changes in flows were identified following the limit uplift. Data from April to December 2014 were used to understand the baseline situation (before the speed limit changes). Data from April to December 2015 were used for the analysis of the initial impact of the speed limit changes.

2.2.3 The DfT evaluation commission will continue to monitor changes in traffic volumes at selected sites, against national trends in traffic growth, to provide an indication of changes. For some sites, parallel roads have been included in the study and it will be possible to compare flows on those routes before and after the introduction of speed limit changes. Further data will be added as part of the ongoing evaluation to extend the timeframe of the analysis and thereby provide increased confidence in the results.

2.2.4 Research on the A9 has focused on the change in HGV speed limit on single carriageways (from 40mph to 50mph). The work included three counting stations to collect data on traffic volumes; these sites are located between Perth and Inverness. The data is presented as a seven day annual average daily flow (AADF) which represents a standard format for these types of reports; the collection of traffic volume data has been interrupted by maintenance operations on the route. From the data available there is a suggestion that traffic growth is slowing on the stretch north of Aviemore when compared with the original baseline. As these figures take account of the peak summer months they can vary considerably during this period. To ensure that this information is correct, data will be extracted from other counter sites on this stretch for verification purposes and the outcome will be provided later in 2017[3]. Given the above evidence, attributing any observed changes in flows directly to the change in speed limit is considered extremely unlikely.

2.2.5 Overall, the effects of speed limit changes on traffic volumes is considered likely to be limited, although this will vary by location and road characteristics.

[3] In early 2017 Transport Scotland commissioned AECOM to undertake a full ex-post evaluation of the three year pilot, with reporting due in early 2018.

2.3 Speeds

2.3.1 The key potential impact area of changing HGV speed limits is the speeds of both HGVs and other vehicles. If flows remain constant the HGV speed limit increase could increase HGV speeds and reduce the speed differential between HGVs and cars. Furthermore, increases in HGV speeds could impact on their stopping distance and the prevalence and risks associated with overtaking. These factors assume an increase in speeds resulting from speed limit changes. To consider this, the research has reviewed available evidence on speed limit compliance and average speeds before and after limit changes.

Speed Compliance

2.3.2 The 2009 TRL appraisal made use of 190 Automatic Traffic Count sites representing free flow conditions maintained by the DfT, to consider the percentage of HGVs exceeding the pre-change limit. The estimated average speed of HGVs over 7.5 tonnes on single carriageways in England and Wales was in the range 43-45 mph, therefore over the 40mph limit. This finding was supported by research for DfT (AECOM/Atkins 2015 - ongoing), which estimated the free-flow speed of HGVs over 7.5 tonnes on single carriageways with a national speed limit of 40mph as 45.8 mph, and the equivalent average speed over a range of flows from 0 – 1,000 vehicles per hour as 44.2 mph.

2.3.3 For national speed limit (50mph) dual carriageways the free-flow speed was estimated as 52.2 mph and the average speed over a range of flows 0 – 1,600 vehicles per hour per lane was 52.6 mph. Again, above the baseline speed limit. This evidence is important context for potential speed changes following any speed limit increase, as HGVs were already exceeding pre-change limits.

2.3.4 The 2012 Speed Enforcement and Vehicle Speed Report on the A9 identified that the average HGV speeds on single carriageways before the speed limit change was 50.0 mph[4]; the figure for dual carriageways was 53.7 mph. This was therefore above the speed limit indicating a high level of non-compliance. The November 2016 monitoring report states that the introduction of the Average Speed Cameras in November 2014 has resulted in a reduction of over 63% in the number of drivers across all modes being detected speeding.

[4] It should be noted that only 3 of the A9 count sites had the capability to identify HGVs over 7.5 t and therefore this data is based on a small sample.

Average Speeds

2.3.5 The DfT Impact Assessment for the 2015 HGV speed limit change[5] indicated that an increased average speed would be expected for single carriageways but not on dual carriageways. Furthermore, a reduction in speed variance for HGVs would be expected on single carriageways, whilst it would be unchanged on dual carriageways. The results of the year one ex-post analysis of the HGV speed limit change in England and Wales indeed showed that average speeds for HGVs over 7.5 tonnes on single carriageway roads had increased between 2014 and 2015 by just over 1 mph calculated across a range of flow conditions. The equivalent figure for dual carriageways was an increase of less than 0.5 mph. Restricting the analysis to free flow conditions, the increases were 1.5mph and 0.7mph for single and dual carriageways, respectively. These results also showed that the average HGV speeds on single and dual carriageways were not both below the speed limit.

2.3.6 A separate study carried out by SIAS Limited and TRL, on behalf of Transport Scotland in May 2012, involved the development of a microsimulation model of the A9(T) covering 80 km between Dalwhinnie and Moy. The baseline data was derived from the 'Vehicle speed and speed enforcement summary report 2012' (Transport Scotland, May 2012). Additional data was collected via portable equipment positioned near the proposed speed camera sites; it should be noted that spot speed data were captured from the respective counters, not average speed. Furthermore, Bluetooth technology was used to measure journey times (and thereby speeds) along the A9. As part of this assessment, a scenario was modelled with increased speed limits for HGVs over 7.5 tonnes to 50mph on single and 60mph on dual carriageways. The assessment demonstrated that by increasing HGV speed limits, in association with average speed cameras, the following results should be expected:

- A slight increase in average HGV speeds and consequently a reduction in journey times. This is in line with the emerging DfT results;
- The average speed of all vehicles would reduce due to a reduction in the number of vehicles exceeding the speed limit; and
- The average speed of all vehicles would remain lower than the baseline, primarily because of the camera enforcement.

2.3.7 Monitoring on the A9 has determined that there was a large change in driving behaviour and speed limit compliance immediately following the implementation of the Average Speed Cameras. The data indicated that there has been very little change to the speed profile along the route following this, evidencing a sustained change in driver behaviour since the pilot started. The latest data continues to demonstrate high levels of speed limit compliance and the occurrence of vehicles travelling at more than 10mph above the speed limit continues to be low.

[5] DfT Impact Assessment for Single and Dual Carriageways:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/336315/hgv-single_-carriageway-impact-assessment.pdf
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/380984/Annex_D_-_Impact_Assessment_-_dual_carriageway_speed_limits_FINAL.pdf

Stopping Distances

2.3.8 There is evidence that increased HGV speeds impact on their stopping distances: at 40mph the distance is approximately 42m; and at 50mph it is approximately 62m (evidence from a pre-implementation appraisal of the potential impacts of HGV speed limit changes on traffic speeds undertaken by TRL in 2009)[6]. This increase of approximately 20m was supportive of the 2002 research (Knight et al 2002). However, as noted in the TRL work there are important technological developments that will assist in mitigating this risk:

'Electronic Braking Systems (EBS) reduce the reaction time within the braking system, improve the distribution of the braking force between the wheels and also incorporate self-diagnostic capability. The effect of EBS is an important consideration when looking at the potential effect of increasing the speed limit from 40mph to 50mph. As of 2009 EBS was not mandatory for HGVs. However, many new vehicles are voluntarily equipped with it and it will soon become mandatory to fit electronic stability control (ESC) to HGVs. All current ESC systems are only available for EBS equipped vehicles so it is likely that mandating ESC will result in almost 100% fitment of EBS without any further specific requirements.

2.3.9 The levels of change observed in average HGV speeds from the DfT and A9 evaluations suggest that there will only be a minimal impact on stopping distances.

Overtaking

2.3.10 Summersgill et al (2009) included research on the impacts of vehicle speeds on overtaking manoeuvres. A distinction was made between an 'accelerative' and 'flying' overtaking manoeuvre, where an accelerative overtake is defined as one where the following vehicle has slowed to around the speed of the vehicle in front and therefore has to accelerate to overtake, and a flying overtake is defined as one where the following vehicle does not slow before overtaking and overtakes at a similar speed to its approach speed. The former is considered more relevant as this is the most likely form of overtaking for the majority of road conditions, other than those where traffic flows are very low.

2.3.11 The research highlighted the large increase in distances (sight distance, gap in oncoming traffic and road distance) required for an overtaking manoeuvre as the speed of the vehicle to be overtaken increases. For example, a vehicle driving at 35 mph would require a distance of 118m to complete an overtaking manoeuvre, with a site distance of approximately 300m. This is compared to a vehicle travelling at 55 mph that would require a distance of 600m and a site distance of over 1,000m. Maycock et al (1998) concluded that the required sight distance would increase by 35m for every 2.2 mph increase in speed of the vehicle to be overtaken.

2.3.12 The SIAS work also forecast that the change in speed limit would reduce the occurrence of long platoons, which could in turn reduce the desire to overtake.

[6] Summersgill et al 2009

Other Evidence

2.3.13 The DfT evaluation also included interviews with HGV drivers. HGV drivers noted the opinion that the ability to drive up to 50 mph on single carriageways had, or will, reduce collisions involving the overtaking of HGVs. The research determined that all individuals consulted were aware of the speed limit changes on single carriageways, but not all were aware of the changes on dual carriageways. Conversely, 25% of non-HGV drivers were aware of the changes. The level of awareness among residents living adjacent to roads affected by the speed limit changes was also very low.

Summary

2.3.14 The emerging evidence of changes in average HGV speeds following speed limit changes in England & Wales and on the A9 show a small increase in speeds on single carriageways in free flow conditions. There was a very small increase on dual carriageways, largely in line with appraisal forecasts. The analysis of speed and flow data will be repeated in the DfT study in 2017 and 2018, extending the timeframe and quantity of data, thereby improving understanding of the impact of the speed limit changes. These levels of average speed change would indicate that stopping instances and overtaking impacts will be low. However, this does not preclude some HGVs increasing their speeds significantly, thereby contributing to the aforementioned impacts.

2.4 Safety

2.4.1 A central consideration of the increase in HGV speed limits is the consequent impacts on safety. There are both positive and negative potential impacts. An increase in HGV speeds, leading to the reduced speed variance between HGVs and general traffic, could reduce overtaking. However, increased speeds could potentially increase the severity of accidents involving HGVs.

2.4.2 Research (documented by Finch et al 1994) concluded that higher speeds are associated with more accidents. Elvik (2009) also concluded that high speed and variations in speed, increase the probability of accidents and serious personal injuries. However, none of the existing research has been directly related to changes in HGV speed limits. It has also been forecast that accidents resulting from overtaking manoeuvres are the most likely type of collisions to be affected by a change of speed limits for HGVs (Summersgill 2009 and Heydecker 2013).

2.4.3 For research on the A9, baseline safety data was taken from the 1st January through to 31st December, for each calendar year between 2011 and 2013. Data from 2014 has been excluded due to the seven month construction programme for the speed cameras, ensuring the associated activities would not influence the baseline data. The forecast safety impact of increasing the HGV speed limit in isolation on the A9 was inconclusive. However, accident benefits were consistently predicted when an increase in HGV speed limits was combined with speed enforcement measures and significant cost savings were estimated. The 2016 post speed limit change Monitoring Report shows a sustained drop in injury collisions and casualties across the route compared with the 2011-13 baseline. The main findings include:

- The number of fatal casualties between Dunblane and Inverness is down by almost 43% compared to the baseline average;
- The number of 'fatal and serious' collisions between Dunblane and Inverness overall is down by almost 45%, with fatal and serious casualties down by almost 63%;
- There have been no fatal collisions between Dunblane and Perth with the number of serious collisions down by over 60% and serious casualties down by over 47%;
- The number of 'fatal and serious' collisions between Perth and Inverness is down by over 33%, with fatal and serious casualties down by 59%;
- The number of serious injury casualties between Perth and Inverness is down by almost 69%;
- The overall number of casualties of all classes between Dunblane and Inverness is down by 45%; and
- Since the last report there have been no fatal collisions on the A9 within the monitoring area.

2.4.4 Although it is not possible to attribute the above results to the change in speed limits for HGVs against the impact generated by introducing the speed camera enforcement system, it is evident that the increased level of speed compliance and reduced speed differential will have contributed to the improved safety.

2.4.5 The initial analysis undertaken as part of the DfT's evaluation[7] on safety data between 2005 and 2015 identified that:

- Historically, up to 17% of all reported collisions in England and Wales have occurred on single carriageway (50 mph and 60 mph speed limit) and dual carriageway (60 mph and 70 mph speed limit) roads;
- 7.6% of the total collisions on these roads were reported to involve HGVs;
- Before the introduction of the new speed limits there had already been a trend of collisions reducing on these roads, though the rate of reduction had slowed in recent years; and
- In the period following the introduction of the new HGV speed limits there is preliminary evidence of a reduction in HGV collisions estimated to be between 10% and 36%, however, it is not possible to assign this directly to the speed limit changes as opposed to other road safety policies or campaigns.

2.5 Environment

2.5.1 The potential environmental impacts of increasing HGV speed limits are, in part, related to the influence on average speeds and flow characteristics (e.g. acceleration and deceleration). The DfT Impact Assessment for the 2015 HGV speed limit change forecast that an increase in mean speeds for HGVs on single carriageways of approximately 4 mph would be associated with the following costs and benefits (using standard DfT values of cost):

- A benefit in terms of NO_x, with a net present value (NPV) estimated to be £0.9m;
- A cost in terms of PM_{10} with a NPV of -£0.1m;
- A cost in terms of CO_2 with a NPV of -£14.9m; and
- A cost in terms of noise, with a NPV of -£7.3m.

[7] https://www.gov.uk/government/publications/increased-speed-limit-for-heavy-goods-vehicles-over-75-tonnes-initial-summary-report/evaluation-of-the-national-hgv-speed-limit-increase-in-england-and-wales-year-1-interim-summary-september-2016#contents

2.5.2 The increase in carbon emissions were due to the increased fuel consumption of HGVs, and the increased forecast speeds would result in an increase in noise. Conversely, the benefits in terms of local air quality forecast for NOx were related to vehicle emission curves improving as HGV speeds increase. However, particulate matter emission curves forecast a slight cost associated with an increase in speeds. Overall, there was a forecast cost of £21.4m associated with single carriageways.

2.5.3 No change was forecast for dual carriageways in either average speed or, therefore, emissions. This again highlights the importance of identifying the actual change in speeds, taking into account the high pre-change averages compared to the actual speed limits. The literature review found no evidence that a change in speed limits for heavy vehicles resulting in large changes in overall noise levels.

2.5.4 Results on the A9 included a small reduction in overall tailpipe emissions (all vehicles combined) in conjunction with speed enforcement measurements. A slight, general increase in emissions for slow moving/heavy vehicles was also forecast to be offset by reductions in emissions for all other vehicle types.

2.6 Economic Factors

2.6.1 The economic benefits will be derived by reducing journey times and accidents. Operational improvements on the A9 from an increase in HGV speed was expected to be counter balanced by the cost of the speed enforcement measures. However, the reduced number of accidents would help off-set any operational disbenefits. Further work will be undertaken as part of the DfT evaluation in 2018 to estimate the economic implications of changing the speed limits for HGVs.

3. Highway Network Audit and Analysis

3.1 Introduction

3.1.1 The literature review has highlighted the importance of any increase in average speeds, resulting from speed limit changes, on the range of impact areas. Although the DfT and A9 data indicated no significant increase in average speeds, the former combines data from multiple sites of varied characteristics, and the latter has the Average Speed Camera complexity. To assess the potential impact on Scottish roads it was necessary to review the baseline speed and flow characteristics.

3.1.2 This section therefore contains the results of an audit of the Scottish road network undertaken for the purpose of understanding the existing situation in regards to traffic flows, speeds and accidents. Some analysis and discussion has been produced herein to consider what indications the existing situation provides about the possible impact of an increase in the speed limit for HGVs on Scottish roads. Where possible, a comparison with the England & Wales network, prior to the introduction of increased speed limits for HGVs, has been made in order to establish the level of comparability between the base cases in the two locations,

3.1.3 Establishing the level of comparability allows the level of confidence with which observed differences in the England & Wales network post-implementation of the HGV speed limit could be expected to occur in Scotland to be assessed. As the effect of any policy change relating to the speed limits for HGVs on Scottish roads is considered likely to principally affect rural roads, the audit has generally focused on this road type.

3.1.4 The discussions contained in this section are focused around three of the research questions outlined in the project scope of services:

- What proportion of HGV traffic is currently using roads which would be affected by an increase in the HGV speed limit (distinguishing between national speed limit trunk roads and non-trunk roads)?
- What is the average speed of HGVs > 7.5 tonnes on the different road types in Scotland and how does this compare with the England and Wales averages prior to April 2015? and
- What proportion of accidents on national speed limit single carriageways and dual carriageways involve an HGV and how does this compare with the England and Wales averages prior to April 2015?

3.2 Road Network and Traffic Flows

Road Network Classification

3.2.1 Table 1 presents a summary of the length of the Scotland and England & Wales road networks in 2016, based on DfT statistics[8]. Scotland has a rural road network of just under 29,000 miles, roughly a quarter of the length of the rural road network in England & Wales (128,323). For both Scotland (78.9%) and England & Wales (85.7%) a large proportion of the rural network is made up of minor rural roads, which include road types affected by the policy change in England & Wales (predominantly single carriageway roads where the national speed limit applies).

3.2.2 Around 1% of Scotland's rural roads are motorways, lower than the 1.5% in England & Wales; however, trunk roads form a greater proportion of the rural network in Scotland overall, at around 6% compared with 3% in England & Wales.

3.2.3 The reported categorisation of road types does not include speed limits, so it is difficult to quantify the length of the rural road network in Scotland which would be affected by any possible policy change. However, around 28,700 miles of the rural Scottish network are either single or dual carriageway, and of these around 1,700 miles are trunk roads.

Table 1. Summary of Road Lengths in Scotland and England & Wales

	Scotland		England and Wales	
	Miles	% of Rural Network	Miles	% of Rural Network
Motorway	283	1.0%	1,984	1.5%
Rural A Trunk Single	1,406	4.9%	1,611	1.3%
Rural A Trunk Dual	276	1.0%	1,713	1.3%
Rural A Principal Single	4,078	14.1%	11,945	9.3%
Rural A Principal Dual	57	0.2%	1,111	0.9%
Minor Rural	22,838	78.9%	109,959	85.7%
All Rural Roads	**28,937**	**100%**	**128,323**	**100%**
All Roads	**36,888**		**209,622**	

[8] Department for Transport Road Lengths Statistics – RDL0101 Road Lengths (miles) by Road Type and Region and Country in Great Britain, 2016 https://www.gov.uk/government/statistical-data-sets/rdl01-road-lengths-miles

Road Traffic Flows

3.2.4 Traffic Estimates for Great Britain 2016[9] indicated that for both Scotland and England & Wales, the motorway network carries a significant proportion of total vehicle miles[10], notwithstanding the fact that it represents a small part of the total length of the rural road network (Table 2). This proportion is more than a third in England & Wales (34.3%) and slightly less than a quarter in Scotland (23.9%). Comparing the number of vehicle miles with the physical length of the motorway network allows for a rudimentary estimate of annual average daily flows (AADFs) on motorway links (2-way) with estimates of 87,000 vehicles AADF for England & Wales and 46,000 vehicles AADF for Scotland. The difference at least partly reflects the fact that a large proportion of the Scottish motorway network is two-lane, whereas a large proportion of the network in England & Wales is three or more lanes.

Table 2. Vehicle Miles in Scotland and England & Wales by Road Type (from DfT Table TRA0103)

	Scotland		England and Wales	
	Billion Vehicle Miles	% of Rural Road Miles	Billion Vehicle Miles	% of Rural Road Miles
Motorway	4.8	23.9%	63.0	34.3%
Rural A Trunk	5.6	27.9%	33.2	18.1%
Rural A Principal	5.1	25.4%	49.9	27.15
Minor Rural	4.6	22.9%	37.7	20.5%
All Rural Roads	**20.1**	**100%**	**183.8**	**100%**
All Roads	**28.6**		**295.0**	

3.2.5 The remainder of the trunk road network in Scotland carries a higher proportion of traffic than in England & Wales, 28% compared with 18%, whilst the proportion of traffic on principal A-roads and minor roads is similar across both areas. In all cases an estimate of the average traffic flows on links indicates that average traffic flows on rural roads in Scotland are substantially lower than those in England & Wales.

3.2.6 Overall, the Scottish rural road network vehicle miles is just under 11% of that in England & Wales (20.1 billion miles versus 183.8 billion miles) despite having a network which is around a quarter of the length.

[9] Department for Transport Road Traffic Estimates Table TRA0103 Motor Vehicle Traffic (vehicle miles) by Road Class and Region and Country in Great Britain, annual 2016
https://www.gov.uk/government/statistics/road-traffic-estimates-in-great-britain-2016
[10] There is no data available on the percentage of HGVs in terms of vehicle flow.

3.2.7 The DfT also reports goods moved in million tonne miles by country (DfT Table RFS0140). This data source has been used to compare the amount of freight moved on the Scottish road network compared with the England & Wales network. In 2015 there were 8,631 million tonne miles of road freight movements from Scotland to other parts of the United Kingdom and 85,681 million tonne miles of corresponding road freight movements from England & Wales. Whilst international movements are not included in these totals, these domestic movements represent around 90% of the total freight movements of vehicles registered in the United Kingdom.

3.2.8 In terms of the level of HGV traffic using roads that could be influenced by any speed limit change (assuming a similar policy to that applied in England & Wales) it is not possible to answer this question directly from the data obtained. The reported classification of roads for DfT and Transport Scotland statistics does not match directly with the road classes where a change in speed limit could be applied. In any case, where vehicle miles are reported by vehicle type they also do not distinguish between different road types.

3.2.9 However, a rudimentary estimate has been made based on the statistics for all vehicle traffic across the Scottish road network and linking this with the million tonne miles of freight moved in Scotland (Table 3). This estimate indicates that around a third (35.6%) of HGVs > 7.5t traffic in Scotland could be impacted by a speed limit increase for that vehicle type (depending on the scope of any policy change). However, the estimate required a number of assumptions and should be viewed with a high degree of caution:

- HGV vehicle proportions are consistent across road types;
- All trunk single and dual carriageway roads are within scope (have speed limits high enough to be impacted by any policy change);
- All principal[11] dual and 75% of principal single roads are within scope;
- 50% of minor rural roads are within scope and all are assumed to be single carriageway;
- Dual carriageway roads carry on average twice the traffic flows of single carriageway roads.

Table 3. Estimate of % of Heavy Vehicle Miles on Roads which could be Affected by any Increase in Speed Limit

Extent of speed limit increase	Estimate of proportion of road network	Estimate of proportion of total heavy vehicle miles	Million tonne miles
Trunk Single Carriageways	3.8%	14.1%	1,214
Trunk Single and Dual Carriageways	4.6%	19.6%	1,690
All Single Carriageways	43.1%	35.1%	3,031
All Single and Dual Carriageways	44.0%	35.6%	3,072

[11] Transport Scotland define principal roads as the main strategic non-trunk road section. These do not include all minor roads.

3.3 Average Vehicle Speeds

3.3.1 An audit of average vehicle speeds has been undertaken using speed data collected from automatic traffic counters on the Scottish road network (in 2016). The results of this audit have been compared with the results of the baseline work from the England & Wales study (2014). The results are used to consider the average speed of HGVs > 7.5 tonnes on the different road types in Scotland.

3.3.2 The analysis involved processing data from a large number of sites with observations covering the whole of 2016. As such, the work involved was complex and there were a number of assumptions and limitations applied. These are covered in more detail in Appendix B. This element of the audit set out to consider average speeds for different road types, including those which would be affected by any policy change, and also by vehicle type. The work is summarised in Table 4 and Table 5 covering free flow speeds (the average speeds of vehicles when unrestricted by other traffic) and average speeds across a range of flows respectively. The speed limits for light and HGVs are shown in brackets for each row.

3.3.3 The analysis shown in Table 4 indicates that free flow speeds on motorways and dual carriageways are faster in England & Wales than in Scotland for both light vehicles and HGVs > 7.5t. On motorways the difference for speeds of light vehicles is pronounced – close to 10 mph with speeds in Scotland of 62 mph. For HGVs > 7.5t the difference is much smaller at 2 mph, with average speeds in Scotland of 52 mph. One important consideration in comparing results across the two networks is the nature of the motorway network in Scotland which is predominantly two-lane. Other research has shown that this does restrict vehicle speeds because heavy vehicles can use the outside lane to overtake thereby limiting the speeds of other vehicles in some situations.

Table 4. Average Free Flow Speeds in Scotland and England & Wales by Road and Vehicle Type

		Scotland 2016		England and Wales 2014	
		Estimated average free flow speed (mph)		Estimated average free flow speed (mph)	
		Light vehicles	HGVs > 7.5t	Light vehicles	HGVs > 7.5t
Motorway (HGV limit 60mph)	70 mph 2-lane	61.6	52.1	71.2	54.1
Dual Carriage-way (HGV limit 50mph)	Trunk 70 mph 2-lane	57.8	47.8	65.4	52.2
Single Carriage-way (HGV limit 40mph)	Trunk 60 mph	53.8	48.2	53.2	46.4
	Non-Trunk 60 mph	48.9	44.6	50.4	45.2

3.3.4 The average speeds were also different on trunk road dual carriageways, where average speeds of light vehicles in England & Wales were nearly 8 mph faster than those in Scotland, with a lower speed differential of more than 4 mph for HGVs > 7.5t.

3.3.5 The two road types described to this point should generally be the most consistent, i.e. the motorway network and much of the trunk dual carriageway is built to highway design standards. On this basis, one possible conclusion is that drivers in England & Wales choose to drive at higher speeds. However, this does not reflect the full picture as even on these road types, factors such as the varied topography of Scotland and the different prevailing weather conditions are likely to influence driver behaviour.

3.3.6 For trunk road single carriageways (excluding the A9 where the speed limit for HGVs > 7.5t is 50 mph) the comparison indicates very similar average free flow speeds for light vehicles. However, HGVs > 7.5t were recorded as travelling around 2 mph faster on Scottish roads (48.2mph) than in England & Wales (46.4mph).

3.3.7 It is worth noting that the estimated average free flow speed of HGVs >7.5t in Scotland on trunk road single carriageways is over 48 mph and therefore less than 2 mph below the threshold which would be set by an increase in the speed limit for this vehicle type. In fact, the average recorded free flow speed of HGVs > 7.5t on this road type is slightly greater than for trunk road dual carriageways, which is a counterintuitive result and likely to reflect a wide margin of error in the calibration of recorded speeds by the traffic count equipment.

3.3.8 For non-trunk single carriageways the comparison across the two networks is again similar for light vehicles and also in this case for HGVs > 7.5t. Both Scotland and England & Wales speeds were over the 40 mph speed limit. In general speeds on non-trunk single carriageways are a little lower than on their trunk road counterparts, a result which matches expectations based on the generally higher standard of trunk road links. Although it could be hypothesised that an increase in HGV speed limit from 40mph to 50mph on non-trunk single carriageways could increase average speeds, it should be noted that some of these roads are likely to have speeds constrained by the topography and characteristics.

3.3.9 The results for average speeds across a full range of flows shown in Table 5 (0 – 1,000 vehicles per hour per lane for single carriageways, 0 – 1,600 vehicles per hour per lane for dual carriageways and 0 – 1,800 vehicles per hour per lane for motorways) are generally in line with the results for free flow speeds. The lower speeds reflect conditions where the speed of individual vehicles is restricted by the overall traffic stream.

3.3.10 There are some occasions when the speeds across the full range of flows are the same or slightly higher than the free flow speeds and this reflects the fact that the low flow conditions used for calculating the free flow speeds often correspond with night-time conditions where drive behaviour is different, particularly on unlit roads.

Table 5. Average Speeds for a range of flows in Scotland and England & Wales by Road and Vehicle Type

		Scotland 2016		England and Wales 2014	
		Estimated average speed for range of flows (mph)		Estimated average speed for range of flows (mph)	
		Light vehicles	HGVs > 7.5t	Light vehicles	HGVs > 7.5t
Motorway (HGV limit 60mph)	70 mph 2-lane	59.9	52.1	71.9	54.2
Dual Carriage-way (HGV limit 50mph)	Trunk 70 mph 2-lane	55.6	47.8	65.7	52.6
Single Carriage-way (HGV limit 40mph)	Trunk 60 mph	50.9	46.7	47.1	43.6
	[Trunk A9 60 mph sites (not included in above)]	53.6	50.9	N/A	N/A
	Non-Trunk 60 mph	46.3	43.3	49.1	44.8

3.3.11 The detailed discussion around average speeds, leads to the following broad conclusions:

- The average speed of HGVs > 7.5t on motorways in Scotland is approximately 4 mph higher than on dual carriageway trunk roads. This could be interpreted that the maximum increase in HGV > 7.5t speeds on dual carriageways in Scotland following any speed limit increase would be likely to be a maximum of 4 mph;
- The average speed of HGVs > 7.5t on dual carriageway trunk roads in Scotland is approximately 2 mph lower than the existing 50 mph speed limit and also lower than the equivalent speed on dual carriageways in England & Wales;
- The reported average speed of HGVs > 7.5t on single carriageway trunk roads in Scotland is considerably higher than the 40 mph existing limit (46.7 mph over the full range of flows) and also higher than on roads in England & Wales; and
- On non-trunk road single carriageways, the average speeds of HGVs > 7.5t in Scotland are lower than dual or trunk road single carriageways but still greater than the current 40 mph limit. For this road type Scottish speeds are lower than the England & Wales averages which may reflect the more varied topography and challenging weather conditions found on average on Scottish roads.

3.4 Accidents on the Scottish Road Network

3.4.1 This section discusses the results of analysis of five years' worth of STATS19 records covering all collisions in Scotland with the aim of identifying the proportion of accidents on national speed limit single carriageways and dual carriageways that involve an HGV. Table 6 summarises the analysis of STATS19 records for Scotland covering a full five years from 2011 to 2015. Collisions have been assigned to each road classification on the basis of a calculation of the proximity of accident locations with the Scottish road network in GIS.

Table 6. Summary of 2011 – 2015 Collisions on Scottish Road Network

	Collisions		Collisions involving HGV > 7.5t		Proportion of Collisions involving HGV > 7.5t		
Road Type	Slight	Serious & Fatal	Slight	Serious & Fatal	Slight	Serious & Fatal	All
Motorway	1,628	227	208	50	12.8%	22.0%	13.9%
Dual Carriageway (60[12] or 70 mph) Trunk	1,091	272	97	40	8.9%	14.7%	10.1%
Dual Carriageway (60 or 70 mph) All	1,427	370	109	44	7.6%	11.9%	8.5%
Single Carriageway (50 or 60 mph) Trunk	2,029	765	127	74	6.3%	9.7%	7.2%
Single Carriageway (50 or 60 mph) All	8,688	3,089	322	175	3.7%	5.7%	4.2%
All Study Roads	11,743	3,686	639	269	5.4%	7.3%	5.9%
All Collisions	**37,344**	**8,530**	**1,020**	**384**	**2.7%**	**4.5%**	**3.1%**
Study Road Collisions as % of Whole	31%	43%	63%	70%			
	34%		65%				

[12] The speed limits lists in Table 6 are the maximum limit for the road type, and not specific to HGVs. The presence of two limits in a row indicates the range of roads within the category, including those with national speed limits and those with lower limits.

3.4.2 Across all roads within the scope of a policy change (single carriageways with 50 and 60 mph speed limits and dual carriageways with 60 and 70 mph speed limits) there were 11,743 slight injury collisions and 3,686 serious and fatal collisions on the Scottish road network between 2011 and 2015. This accounts for around 34% of the total collisions on Scottish roads in that period. This proportion is much higher than observed in the DfT evaluation work in England & Wales where, over a period of ten years running up to April 2015; collisions on these road types constituted between 15% and 17% of all collisions.

3.4.3 The analysis indicates that HGVs > 7.5t are involved in more than 10% of collisions on trunk road dual carriageways and 8.5% of collisions across all dual carriageway roads. On single carriageways HGVs > 7.5t are involved in more than 7% of collisions on trunk roads and more than 4% of collisions across all roads. Considering all roads within the scope of a policy change, HGVs are involved in 5.9 of collisions. This proportion is comparable with the DfT evaluation work in England & Wales, which identified that collisions involving an HGV >7.5t constituted between 5.5 to 7.6% of collisions on these road types.

3.5 Summary

3.5.1 In relation to the three research questions set out in paragraph 3.1.3 the following conclusions can be drawn:

- 35.6% of the Scottish HGV mileage is on roads which would be affected by speed limit changes similar to those adopted in England & Wales;
- Average HGV speeds (across a range of flows) were:
  - 47.8 mph on dual carriageways was 48 mph therefore 2 mph below the present speed limit;
  - 46.7 mph on single carriageway trunk roads, therefore over the existing 40 mph speed limit;
  - 43.3 mph on non-trunk single carriageways; and
- The proportion of road traffic collisions involving HGVs were:
  - 10% on dual carriageways;
  - 7% on single carriageway trunk roads;
  - 4% on non-trunk single carriageways; and
  - Compared to between 5.5% and 7.6% on roads in England & Wales.

3.5.2 The analysis presented above indicates significant differences between observed behaviour on the Scottish road network and that of England & Wales. This leads to the conclusion that it cannot be predicted with any confidence that the emerging evidence from the evaluation of the impact of the change in HGV speed limits in England & Wales will be repeated in Scotland, should such a policy change be implemented.

4. Model Assessment and Analysis

4.1 Introduction

4.1.1 In considering the potential impacts of increasing HGV speed limits it has been necessary to postulate the nature of any such policy decision. Four possible policy change options have been considered for Scotland:

- An increase in the maximum speed limit of HGVs > 7.5t on all single carriageway roads from 40 mph to 50 mph;
- An increase in the maximum speed limit of HGVs > 7.5t on single carriageway trunk roads from 40 mph to 50 mph;
- An increase in the maximum speed limit of HGVs > 7.5t on all single carriageway roads from 40 mph to 50 mph and on all dual carriageway roads from 50 mph to 60 mph (this is the policy change as applied in England & Wales in April 2015); and
- An increase in the maximum speed limit of HGVs > 7.5t on single carriageway trunk roads from 40 mph to 50 mph and on dual carriageway trunk roads from 50 mph to 60 mph.

4.1.2 These options are considered the most likely, in part because they could align Scottish limits with those in England & Wales. To consider these options this section synthesises evidence on single carriageway trunk, single carriageway non-trunk and dual carriageway trunk roads. This combines evidence from the previous sections and outputs from the use of the Transport Model for Scotland.

4.2 Modelling Using Transport Model for Scotland

4.2.1 Modelling using the Transport Model for Scotland (TMfS14) was undertaken in order to address the following research question outlined in the project scope of services:

- What is the potential impact on Transport Economic Efficiency (TEE) of an increase in the speed limit for HGVs on single carriageway and dual carriageway roads in Scotland (based upon the evidence from the literature review and emerging from the England and Wales study)?

4.2.2 In order to interpret the information in this chapter correctly, it is important to understand what a TEE assessment contains and, equally, what it does not contain. The central principle of TEE analysis is to estimate the welfare gain to society which results from transport investment, as measured by individuals' willingness to pay for such an improvement and the financial impact on private sector transport operators. This does not measure the direct monetary impact of interventions on business balance sheets, and so does not provide an assessment of the impact of changing HGV speed limits on freight industry profitability.

4.2.3 As it is driven by the outputs of transport modelling, the assessment can only include the impact of behavioural responses that are included in that modelling. For example, TMfS14 only models the re-routing effects of the speed limit changes on HGVs. It does not include possible longer term demand responses from HGV operators, or potential business impacts that could be achieved through modified HGV schedules. Neither can the model include how accident rates may change on roads if the speed limit changes.

4.2.4 TEE analysis presents the key effects disaggregated by particular groups, the purpose of the trip being made, and by impact (journey time, vehicle operating costs, and user costs). Standard methodologies, as defined in Scottish Transport Appraisal Guidance (STAG)[13], and Transport Appraisal Guidance (WebTAG)[14] monetise these benefits. The following paragraphs give a very brief summary of the methods. For a more detailed discussion the reader should consult the above sources.

4.2.5 Journey time impacts are assessed for the modelled vehicles, and then transformed into money values through the application of 'occupancy factors', to take account of the number of people in vehicles, and 'Values of Time', in terms of pounds per hour (£/hr). Standard values are listed in WebTAG: this is the case for all values discussed in this section. WebTAG also provides forecasts for how occupancy factors and Values of Time will change over time.

4.2.6 Vehicle operating costs are calculated separately for fuel and non-fuel costs through the application of standard formulae. The non-fuel vehicle operating costs include the cost of 'wear and tear'.

4.2.7 The costs are then calculated through the application of adjustments for changes in engine efficiency, the composition of the vehicle fleet in terms of fuel type, and the cost of fuel, all of which are forecast in WebTAG.

4.2.8 In order to calculate the TEE, a model scenario *without* the tested intervention is compared with a scenario that includes the intervention. It is then extremely important that the difference between the scenario results is then predominantly attributable to the impact of the scheme. There is a certain degree of random fluctuation within transport models, which is measured through a statistic called 'convergence'. In general, the smaller in impact the intervention that is tested, the more 'converged' the model needs to be to ensure that the resulting differences in the model output are due to the scheme.

4.2.9 The values in a TEE are expressed in monetary terms, with adjustments applied to discount the values back to 2010, and adjust the prices to account for inflation. These "2010 pounds" are summed over a 60 year appraisal period to provide a Present Value of Benefits.

4.2.10 The forecast changes in the amount of fuel vehicles require will also affect the amount of indirect tax collected by the UK Government. This is also included in the TEE table presented. It should be noted that standard Scottish guidance on

[13] https://www.transport.gov.scot/our-approach/industry-guidance/scottish-transport-analysis-guide-scot-tag/#42948
[14] https://www.gov.uk/guidance/transport-analysis-guidance-webtag

expressing Cost to Government in these tables states that the indirect taxation impacts should be included, despite this being a UK issue[15].

4.2.11 An assessment of global air quality impact is also included in the TEE, calculated through the application of forecasts for carbon dioxide emissions per litre of fuel burnt/used, by type of fuel, and then forecast values of CO_2 equivalent.

4.2.12 A separate safety assessment can also be undertaken, using standard accident rates by type of road; as noted in paragraph 4.3.2 the modelling was not able to determine any change in accident rates resulting from the speed limit change and therefore standard values were used. Numbers of accidents and injuries (by severity) can then be calculated for the with and without intervention case, and standard valuations applied (again provided by WebTAG).

4.3 TEE Outputs

4.3.1 As noted above, a model scenario *without* the tested intervention is required. This is known as the 'Do Minimum'. TMfS14 currently restricts HGVs to 40mph on single carriageways and 50mph on rural dual carriageways, which are the legal speed limits. However, as outlined in paragraph 2.3.2 these are not the observed average speeds, with the free flow average HGV speed on single carriageway trunk roads being 45.8 mph in an analysis of speeds from 2015 onwards. In order to quantify the benefits of the speed limit change it was necessary to define a Do Minimum (scenario 1) with more realistic maximum HGV speeds, above the 40 mph speed limit. This was set to 45.8mph.

4.3.2 From this base it was therefore possible to test four further scenarios (the 'Do Something') that reflected the four options for possible HGV speed limit changes on Scottish roads set out in the introduction. For clarity, the four do-something scenarios tested were:

- Scenario 2: An increase in HGV speed limits on all non-urban single carriageways;
- Scenario 3: An increase in HGV speed limits on trunk non-urban single carriageways;
- Scenario 4: An increase in HGV speed limits on all non-urban single and dual carriageways; and
- Scenario 5: An increase in HGV speed limits on trunk non-urban single and dual carriageways.

[15] STAG Technical Database, section 12.6 (https://www.transport.gov.scot/publication/stag-technical-database/section-12/#s126)

4.3.3 To reflect these scenarios within the model, the maximum speed permitted for HGVs was adjusted. It is important to note that this does not mean that the maximum speed for HGVs was increased to 50mph on single carriageways. The TMfS14 does not include speed/flow relationships specific to HGVs and therefore the modelling may not fully reflect this limit increase in average HGV speeds. It was therefore necessary to set the maximum speed for HGVs at the level of the forecast average HGV speed following a change in speed limit i.e. adding a forecast increase in speeds to the revised do-minimum (scenario 1). To achieve this, the observed change in average HGV speeds in free flow conditions from the England & Wales initial evaluation (discussed in paragraph 2.3.5) have been applied, as shown in Table 7. *It should be recognised that, as detailed in Chapter 3, the baseline conditions in England & Wales and Scotland were different and therefore the use of the observed increase from the former, following an HGV speed limit increase, is for indicative purposes only.*

Table 7. TMfS14 HGV Scenario Speeds Increases by Road Type, compared with Do Minimum ('Scenario 1') (mph)

	Non-Urban Single Carriageway		Non-Urban Dual Carriageway	
Scenario	Non-Trunk	Trunk	Non-Trunk	Trunk
2	+1.5	+1.5	-	-
3	-	+1.5	-	-
4	+1.5	+1.5	+0.7	+0.7
5	-	+1.5	-	+0.7

4.3.4 Figure 1 shows the links for which HGV speeds have been changed by scenario, wherein orange links are unchanged and blue links have received a speed uplift.

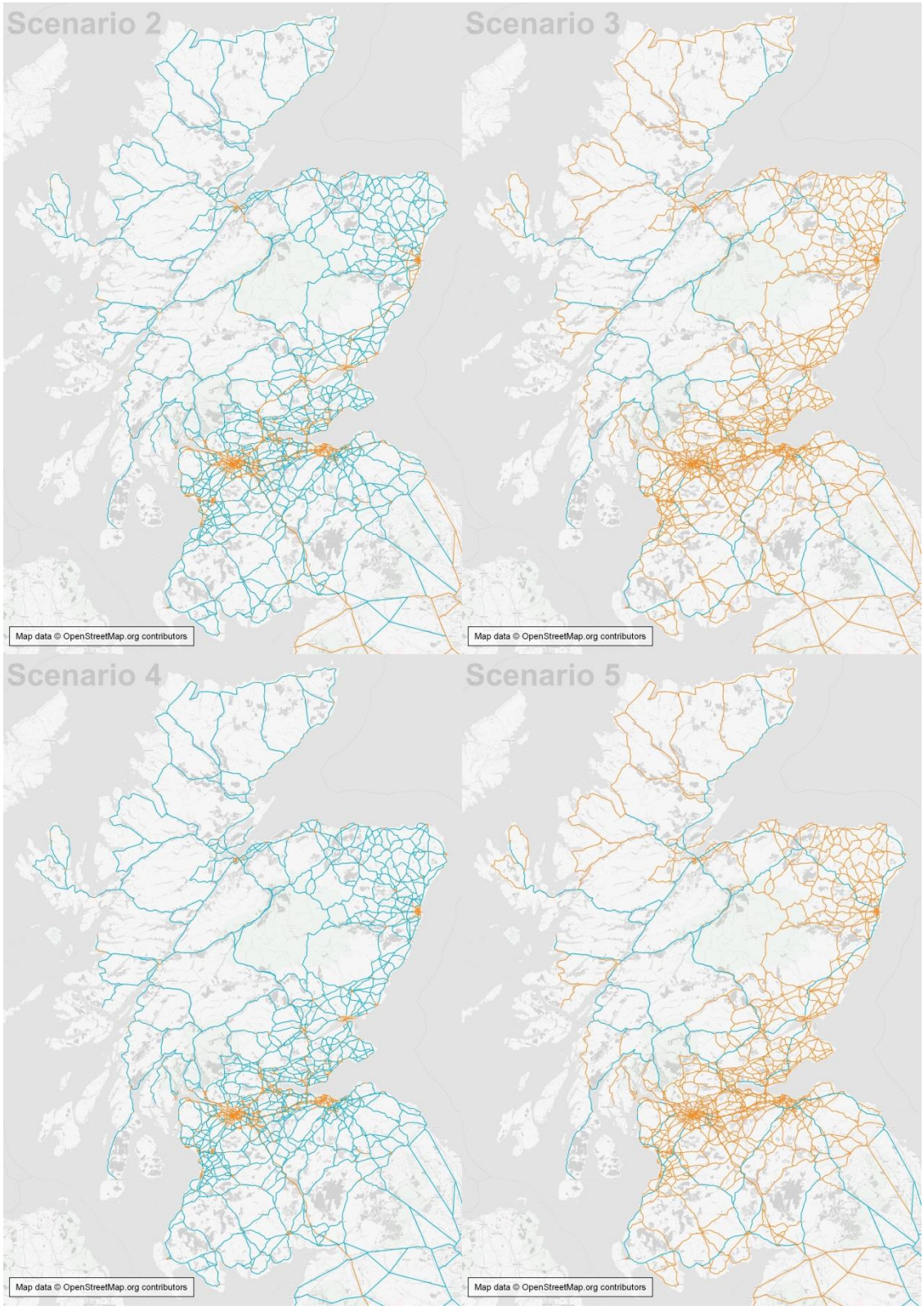

Figure 1. Roads with amended speed, by scenario

4.3.5 The scenarios were run for 2017, 2027, and 2032 forecast years, and the results run through the DfT appraisal software TUBA, with standard WebTAG economic parameters[16] over a 17 year appraisal period[17]. This gave the standard TEE outputs, including:

- Present Value of Benefit (PVB) of the first order impact of the time savings;
- PVB of the impact of the average speed change on vehicle operating costs;
- PVB of the change in CO_2 equivalent emissions, as well as the untraded CO_2 equivalent emissions, in tonnes, for the modelled years; and
- PVB of the impact of the change in fuel purchasing on the indirect tax take.

4.3.6 These model scenario outputs were also analysed in order to calculate the safety benefits.

4.3.7 As discussed in paragraph 4.2.8, where tested interventions are small in relation to overall model size, great care must be made to ensure that the transport model is well converged, in order to ensure that the differences between the with and without intervention scenarios are predominantly due to the scheme being tested. The scenario described above are small in two ways:

- The size of the increase in HGV speed (as shown in Table 7); and
- For Scenarios 3 and 5 in particular, the number of road sections that are affected (as shown in Figure 1).

4.3.8 In an attempt to counteract this, the settings for the TMfS were adjusted such that it was required to achieve a level of convergence ten times more stringent than a standard model run. This resulted in extremely long computer run times, and is considered to be at or near the limit of what can be achieved. Even at this higher level of convergence, our best professional judgement is that the monetised values calculated for time savings, vehicle operating costs, CO_2e, and wider public finances cannot be distinguished from the margin of error of the model. In effect they can be described as 'around zero'. The safety analysis, however, is judged to be more reliable, as this is based on a more stable output of the model (link flows).

4.3.9 The monetised benefits are presented in Table 8. The table is presented on a separate page, along with the caveats that should be understood when attempting to interpret the outputs.

[16] Version 1.9.7, the current full version at the time of writing.
[17] As requested by Transport Scotland.

Table 8. Transport Economic Efficiency Results (2010 £m)

Scenario		2	3	4	5
Increase on Single by 1.5 mph		Both	Trunk	Both	Trunk
Increase on Dual by 0.7 mph		-	-	Both	Trunk
Time Savings	Business Users	*	*	*	*
	Commuters	*	*	*	*
	Other Users	*	*	*	*
	Freight	*	*	*	*
Fuel & Vehicle Operating Costs	Business Users	*	*	*	*
	Commuters	*	*	*	*
	Other Users	*	*	*	*
	Freight	*	*	*	*
Wider Public Finances (Indirect Taxation Revenue)		*	*	*	*
Environmental Impacts	Greenhouse Gases (CO_2)	*	*	*	*
Safety-		-1.15	+0.79	-0.21	+1.02
Total Present Value of Benefits (PVB)		**-1.15**	**+0.79**	**-0.21**	**+1.02**

* within the margin of error of the transport model: "around zero"

Caveats/Assumptions:

- *as detailed in Chapter 3, the baseline conditions in England & Wales and Scotland were different and therefore the use of the observed increase from the former, following an HGV speed limit increase, is for indicative purposes only.*
- The following impacts of speed limit changes are included:
  - Rerouting of HGVs between planned stops;
  - Rerouting of other road users due to changes in aggregate congestion;
  - Rerouting aspects of safety ie more or less use of inherently safer or more dangerous road classes.
- The following possible impacts are not included:
  - Local air quality impacts;
  - Noise impacts;
  - Impact of speed changes on the sequence of stops given to HGVs, or any other possible business reaction to the speed limit change[18];
  - Reduction in costs associated with speed limit offenders;
  - Reduction in platooning and lack of ability to overtake, as well as possible reduction in risk taking behaviour, with consequent safety improvements;
  - Possible impact of changes in speed limits on accident rates.

[18] For example, an HGV is directed to go from the depot (point A) to deliver to B, C, and D. The route taken between A and B, B and C etc can change in the model in response to the change in speed limit. However, the most efficient sequence of deliveries may also change in reality if the HGV speed limit changes. This effect is not modelled.

4.3.10 Scenario 2 increases the speed HGVs are able to travel on both trunk and non trunk single carriageway roads. This reports a safety disbenefit. This is intuitively reasonable, as the changes encourage HGVs to leave the dual carriageways and motorways for the now faster single carriageway network. In order to explain this interpretation, it is necessary to elaborate on how route choice in undertaken in transport models of this type.

4.3.11 Route choice in transport models is undertaken through a balance of distance and time. For example, a traveller may choose a longer but quicker route, rather than a more direct but slower one. When single, but not dual, carriageways are increased in speed, HGVs that in the Do Minimum scenario have chosen a long but fast route on dual carriageways or motorways (for example, using the M9/A9 between Perth and Grangemouth), may now find it advantageous to switch route to a shorter, now slightly faster route (in this example, single carriageway roads through Fife to the A90). In this case, safety disbenefits are likely to be seen, as single carriageway roads have higher accident rates than motorways and dual carriageways.

4.3.12 In Scenario 4, where both dual carriageways and single carriageways increase in speeds, there is less disruption to the HGV routing. As a result, the lower levels of rerouting gives safety results where the increased use of more dangerous road types almost balances the shorter trip lengths.

4.3.13 Scenarios 3 and 5 only apply speed changes to a small subset of the road network, which are often in rural areas with low levels of route choice. In these areas the trunk roads will tend to be the highest standard option available, and hence the safest. The limited route switching that occurs will, therefore, tend to provide safety benefits.

4.4 Summary

4.4.1 In relation to the research question set out in paragraph 4.2.1 the following conclusions can be drawn:

- The lack of comparability between the Scottish and England & Wales road networks mean that emerging findings from the post HGV speed limit increase evaluation are not transferrable to the Scottish context. Model results in this chapter are provided for indicative purposes only;
- Testing of the small changes in HGV speeds observed in England & Wales results in travel time savings, vehicle operating costs, CO2e, and wider public finances for each tested scenario that cannot be distinguished from the margin of error of the transport model;
- Safety benefits, excluding any possible effect of the HGV speed limits on accident rates, could be assessed by the model, as this is based on a more stable output of the model (link flows). Small negative benefits were found for scenarios that applied the HGV speed limit change to all rural roads, whereas small positive benefits were seen for scenarios that restricted speed increases to the trunk road network only. This was explained by the general increase scenarios encouraging small levels of rerouting to less suitable, more dangerous roads.
- Other possible impacts could not be assessed using the available modelling tool:
    - Local air quality impacts;

- Noise impacts;
- Impact of speed changes on planned HGV routes, or any other possible business reaction to the speed limit change;
- Reduction in costs associated with speed limit offenders;
- Reduction in platooning and lack of ability to overtake, as well as possible reduction in risk taking behaviour, with consequent safety improvements;
- Possible impact of changes in speed limits on accident rates.

5. Summary of Evidence

5.1 Introduction

5.1.1 Sections 2-4 of this report have reviewed a range of available evidence relating to speeds and the factors that influence these. This section provides a short synthesis of evidence for each of the main road types on which speed limit changes could be applied.

5.2 Single Carriageway Trunk Roads

5.2.1 Single carriageway trunk roads make up approximately 4% of the Scottish rural road network and carry an estimated 14% of the HGV miles operated. The evidence presented in Section 3 has highlighted that the baseline (2016) average free flow speeds of HGVs on single carriageway trunk roads in Scotland was 48.2 mph. This is well in excess of the 40 mph speed limit that exists. In comparison, the baseline for England & Wales was 46.4 mph, which increased by approximately 1 mph following the speed limit change to 50 mph.

5.2.2 It is noteworthy that the 2016 baseline for Scottish single carriageway trunk roads was higher than both the England & Wales baseline and the 2016 ex-post results. Furthermore, the speed differential between HGVs and light vehicles in the 2014 baseline in Scotland was 5 mph, so lower than the 7 mph reported in England and Wales. It could therefore be questioned how much higher HGV average speeds could increase on Scottish single carriageway trunk roads.

5.3 Single Carriageway Non-Trunk Roads

5.3.1 Single carriageway non-trunk roads make up approximately 40% of the Scottish road network, and carry an estimated 30% of freight mileage. The baseline 2014 average HGV speed was lower (44.6 mph) for non-trunk than trunk, as would be expected. The speed differential to light vehicles was also lower (4 mph) reflecting the slower average speeds on such roads. The latter again raises the question as to the extent to which HGV average speeds could increase given their similarity to light vehicles (48.9mph average speed in 2014) which had a limit of 60mph. These free flow speeds suggest that the characteristics and topography of these roads is likely to be contributing to constraining average speeds for both light and heavy vehicles.

5.3.2 However, these findings do not preclude individual HGVs increasing their speed should a 50mph limit be introduced. It is also considered likely that the impacts of a speed limit change will be specific to individual routes, reflective of the baseline and topographical characteristics e.g. routes such as the A9 where platoons behind slower moving HGVs were common causes of driver frustration.

5.3.3 There remains no definitive link between a change in speed limits and resultant speeds in Scotland. Furthermore, any increase in average HGV speeds could have significant, if isolated, safety and local air quality impacts, which have not been quantified.

5.4 Dual Carriageway Trunk Roads

5.4.1 Dual carriageway trunk roads make up approximately 1% of the Scottish rural road network, and carry approximately 6% of freight mileage. The England & Wales evaluation identified a 0.5 mph increase in average HGV speeds following a change in speed limit to 60 mph. However, the baseline average speed of 52.2 mph was already relatively high and above the baseline limit. The comparable figure for Scottish dual carriageway trunk roads was 47.8 mph, which was the only HGV average speed that was below the baseline speed limit. These numbers could indicate the potential to increase HGV speeds in Scotland. It could equally reflect existing constraints (e.g. topography or bendiness) on these roads that keep average speeds below 50 mph.

5.4.2 Considering the level of potential increase further, the Scotland baseline HGV average speed (47.8 mph) was 10 mph below the average speed of light vehicles. Although this speed differential suggests there is potential to increase HGV speeds, it does not address the issue of why HGV average speeds in the baseline were relatively low.

5.4.3 Furthermore, the baseline average speed of light vehicles in Scotland (57.8 mph) was 7 mph below that in England & Wales (65.4 mph). The speed differential between light and heavy vehicles in Scotland was also lower at 10mph compared to 13 mph in England & Wales. It could be postulated therefore that average speeds on dual carriageway trunk roads are already constrained, even in free flow conditions, and that HGV speeds will not increase significantly following a change in speed limit.

5.4.4 An increase of between 0.5 mph and the 4 mph to match motorway average speeds (as outlined in Section 3) could be anticipated; the latter, although considered unrealistic, could have significant impacts on safety and the environment. Overall, with the relatively short length of the dual carriageway trunk road network, relative to single carriageways, there is not compelling evidence to increase the HGV speed limit form 50 mph to 60 mph across all such roads. However, consideration should be given to individual routes where slower moving HGVs is generating delays and wider journey time dis-benefits.

Appendix A - References

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Transport Scotland (2015) *A9 Data Monitoring Analysis Report*

Appendix B - Speed and Flow Data Processing

Introduction

This section contains a summary of the speed and flow traffic data processing undertaken to support the road network audit and analysis work.

Data Receipt and Processing

AECOM received automatic traffic counter data from Transport Scotland for a large number of locations (1,399 for traffic speeds and 1,476 for traffic flows). These sites are principally located on the trunk road network and cover all road types. The data covered the whole of the year 2016. A number of different vehicle classification systems are used by the sites:

- Single: no classification;
- NADICS 3: short, medium, long vehicle classification;
- Euro 6: six categories including two HGV categories;
- CA10: ten categories including six HGV categories;
- WiM18: eighteen categories including thirteen HGV categories; and
- Axle29: twenty five categories including thirteen HGV categories.

A correspondence table was established to map each of the above systems as set out in the table below so that reporting could be undertaken consistently.

	Single	**NADICS3**	**Euro 6**	**CA10**	**WiM18**	**Axle 29**
Light	Single	short, medium	Motorbike, car & small van classes	Motorbike, car & small van classes	Motorbike, car & small van classes	Motorbike, car & small van classes
Heavy	N/A	long	Other heavy	Other heavy	Other heavy	Other heavy
Rigid 2-axle HGV	N/A	N/A	N/A	N/A	Rigid 2-axle HGV	Rigid 2-axle HGV
HGV > 7.5t	N/A	N/A	Rigid & articulated HGV classes	Rigid & articulated HGV classes	Rigid & articulated HGV classes	Rigid & articulated HGV classes

The intention was to include the rigid 2-axle class in the reporting, but the above table illustrates that the categorisation does not provide sufficient detail in the majority of cases and so the final results report only HGVs as a single class (2-axle rigid speeds are included in this appendix).

The raw data received was not cleaned (so could include machine errors, data from congested periods or roadworks) and additionally the calibration status of sites was not known. On this basis it was important to undertake some data cleaning prior to analysing the data, but given the large number of sites this was not possible manually and so was undertaken by removing statistical outliers from the data.

Data processing combined speeds and flows for sites where both were available and summarised the average speeds by vehicle type for each site. The summaries were then

reviewed in parallel to a review of site locations, to establish a shortlist of sites for the final analysis (where site location is not constrained by junctions, the speed limit is within scope, the number of observations across the year are sufficient etc). These summaries were then used as the basis of the analysis of the data to understand the average speeds on Scottish roads.

Summary Tables

The following tables present the results of the analysis by road type.

Non-Trunk Road Single Carriageways 60mph

		Average speed mph	Observations (number of sites)
	Free flow (0 – 100 vehicles per hour)		
Light vehicles		48.9	16
2-axle Rigid HGVs		41.9	3
HGVs > 7.5t		44.6 (39.4)	16 (3)
	All flows (0 – 1,000 vehicles per hour)		
Light vehicles		46.3	16
2-axle Rigid HGVs		41.4	3
HGVs > 7.5t		43.3 (39)	16 (3)

Note 1: The number of observations decreases for the Transport Scotland work when a greater level of categorisation is required. This is a reflection of the different classification regimes available at each site.
Note 2: brackets show results for the smaller sample, but with the increased accuracy from separating out the 2-axle rigid vehicles from the HGVs > 7.5t.

Trunk Road Single Carriageways 60mph (A9 sites removed)

		Average speed mph	Observations (number of sites)
	Free flow (0 – 100 vehicles per hour)		
Light vehicles		53.8	52
2-axle Rigid HGVs		52.5	13
HGVs > 7.5t		48.2 (48)	52 (13)
	All flows (0 – 1,000 vehicles per hour)		
Light vehicles		50.9	52
2-axle Rigid HGVs		49.5	13
HGVs > 7.5t		46.7 (47.1)	52 (13)

A9 Trunk Road Single Carriageways 60mph

		Average speed mph	Observations (number of sites)
	Free flow (0 – 100 vehicles per hour)		
Light vehicles		55.2	14
2-axle Rigid HGVs		51.2	2
HGVs > 7.5t		51.7 (49.8)	14 (2)
	All flows (0 – 1,000 vehicles per hour)		
Light vehicles		53.6	14
2-axle Rigid HGVs		50.0	2
HGVs > 7.5t		50.9 (49.2)	14 (2)

All Single Carriageways 60mph (A9 sites removed)

		Average speed mph	Observations (number of sites)
	Free flow (0 – 100 vehicles per hour)		
Light vehicles		52.7	68
2-axle Rigid HGVs		50.4	16
HGVs > 7.5t		47.4 (46.2)	68 (16)
	All flows (0 – 1,000 vehicles per hour)		
Light vehicles		49.9	68
2-axle Rigid HGVs		47.9	16
HGVs > 7.5t		46 (45.4)	68 (16)

Trunk Road Dual Carriageways 70 mph

		Average speed mph	Observations (number of sites)
	Free flow (0 – 100 vehicles per hour)		
Light vehicles		57.8	38
2-axle Rigid HGVs		N/A	N/A
HGVs > 7.5t		47.8	38
	All flows (0 – 1,600 vehicles per hour)		
Light vehicles		55.6	38
2-axle Rigid HGVs		N/A	N/A
HGVs > 7.5t		47.8	38

Motorways 70 mph

		Average speed mph	Observations (number of sites)
	Free flow (0 – 100 vehicles per hour)		
Light vehicles		61.6	24
2-axle Rigid HGVs		N/A	N/A
HGVs > 7.5t		52.4	24
	All flows (0 – 1,800 vehicles per hour)		
Light vehicles		59.9	24
2-axle Rigid HGVs		N/A	N/A
HGVs > 7.5t		52.1	24