Appendix B – Summary of Literature Review

The review team has undertaken an extensive literature review to inform the approach taken to the assessment of the Options. The literature review reviewed was specific to speed limits changes and a summary of the pertinent points are below. The documents considered within this literature review were:

- Norway – Elvik et al. (2019), “Updated estimates of the relationship between speed and road safety at the aggregate and individual levels";
- Norway – Elvik (2005), “Speed and Road Safety. Synthesis of Evidence from Evaluation Studies”;
- Sweden – Vadeby (2018), “Traffic safety effects of new speed limits in Sweden”;
- Belgium - Pauw et al. (2013), “Safety effects of reducing the speed limit from 90 km/h to 70 km/h”;
- United Kingdom – Kinnear et al. (2015), “An experimental study of factors associated with driver frustration and overtaking intentions”;
- Ireland – Transport Infrastructure Ireland. (2022), “Impact of National Road Speed Limit Reductions on Greenhouse Gas Emissions”;
- France – Buttignol. (2020), “French policy of reducing the speed limit from 90 to 80 km/h: how to assess social effects?”;
- France - Cohen et al. (2014), “Assessing The Impact of Speed Limit Changes On Urban Motorways: A Simulation Study In Lille, France”;
- United Kingdom - Calculation of Road Traffic Noise, Department of Transport, 1988; and
- United Kingdom - LA111, Noise and Vibration, Revision 2, May 2020.

The literature review has identified several key themes which are discussed below. A detailed review of the Irish Speed Limit review which published in September 2023 has been undertaken and is reviewed separately in Appendix K.

Road Safety

Elvik et al. (2019) – Norway and Elvik (2005) – Norway

International evidence collated within Elvik 2019 (sampled in Table B-1 below) has identified impacts of changes in speed limits and the impacts of speed camera enforcement. This report has identified these key impacts as:

- Reducing speed limits will reduce mean traffic speeds. A 10mph reduction in speed limits will achieve a 4kph reduction in mean traffic speeds; and
- Enforcement via speed cameras will significantly improve compliance with speed limits.

Table B-1 – Mean Speed Following Intervention Collated from Elvik et al. (2019)

Study	Country	Intervention	Extent of Intervention	Speed Limit Before (km/h)	Speed Limit After (km/h)	Mean Speed Before (km/h)	Mean Speed After (km/h)
Mountain et al., 2004	Great Britain	Speed cameras	62 sites	Not Applicable	Not Applicable	52.8	45.7
Bobevski et al., 2007	Australia	Speed cameras	Statewide	Not Applicable	Not Applicable	71.7	68.7
ITF, 2018	France	Speed cameras	Nationwide	Not Applicable	Not Applicable	126.0	119.0
ITF, 2018	France	Speed cameras	1661 fixed	Not Applicable	Not Applicable	88.0	81.0
ITF, 2018	France	Speed cameras	932 mobile	Not Applicable	Not Applicable	93.0	86.0
Long et al., 2006	Australia	Speed limit change	1060 km	110	100	99.4	97.5
Christensen and Ragnøy, 2007	Norway	Speed limit change	393 km	90	80	85.1	82.2

Study	Country	Intervention	Extent of Intervention	Speed Limit Before (km/h)	Speed Limit After (km/h)	Mean Speed Before (km/h)	Mean Speed After (km/h)
Elvik, 2013	Norway	Speed limit change	15.6 km	80	60	76.3	69.9
Vadeby, Forsman 2018	Sweden	Speed limit change	2831 km	110	100	100.5	98.4

The papers evaluates the Nilsson Power Model, which describes the relationship between traffic speed and road safety. The power model suggests that a given relative change in the mean speed of traffic is associated with a corresponding relative change in the number of accidents or accident victims by means of a power function. The document summarises the results of a meta-analysis of studies that have evaluated the relationship between traffic speed and road safety. It is important to note that this analysis is not based on actual speed limit reduction measures.

Vadeby (2018) – Sweden

The study was primarily aimed to describe and analyse the long-term traffic safety effects of introducing increased and reduced speed limits and to assess changes in driving speeds due to the changed speed limits. The review of speed limits was conducted in two phases. The study has used before and after method with a control group to compare the changes in accident and injury outcomes on roads where speed limits were changed against the corresponding changes in the control group.

The results from the sample survey showed that introducing a speed limit reduction of 10 km/h led to a decrease in mean speeds of around 2–3 km/h for all vehicles and that having an increase of 10km/h in the speed limit resulted in an increase in mean speeds by 3 km/h.

Pauw et al. (2013) – Belgium

The study examined the effectiveness of reducing speed limits from 90 km/h to 70 km/h using a comparison group before and after study, which compared the number of crashes after the implementation of the measure with the number of crashes at the same locations before the implementation, while taking into account general road safety trend effects. The speed limits for 61 locations were restricted in 2001 and 2002, a total length of 116km. The alteration did not involve any enforcement or educational efforts; only the traffic signs were adapted. The comparison group consisted of 19 road sections with a total length of 53 km and an unchanged speed limit of 90 km/h throughout the research period.

The study found that both serious and fatal injuries showed a decrease of 33% following the speed limit reduction. However, no information on traffic volumes or speeds was given. Overall, the study suggests that the implementation of reduced speed limits will have a moderate reduction in serious and fatal injuries.

Esure Group (2024) – United Kingdom

The article produced by Esure Group, an insurance company, found that there has been a 20% drop in claims for car accidents in Wales since the 20mph speed limit was introduced in September 2023.

Kinnear et al. (2015) – United Kingdom

With respect to driver frustration, if there are slower vehicles and lack of passing opportunities drivers are likely to become frustrated. This can lead to an increase in unsafe passing manoeuvres, which in turn can lead to collisions.

In light of the lack of empirical work, the study examined the impact of various factors associated with driving on A-class roads in the United Kingdom specifically the length of platoon, proportion of Heavy Goods Vehicles (HGVs), speed and opportunities for overtaking on self-reported frustration. 183 members of the public from areas around Perth and Inverness, Scotland took part in the survey. Participants viewed simulated 'driver's viewpoint' clips representing combinations of the experimental variables.

The results showed that the analysis suggests that on single carriageway roads, speed and platoon length have a clear impact on self-reported frustration. The effect of time pressure on frustration is more nuanced and cannot be easily determined. The results showed that:

- Speed had a consistent effect on frustration. The lower speed (40 mph/64 kmph) was associated with higher self-rated frustration than the higher speed (56 mph/90 kmph);
- Drivers' intention to overtake was higher at the lower speed. The lower speed was associated with greater intention to overtake than the higher speed;
- Frustration was higher for the longer platoon. The longer platoon (10 vehicles) was associated with higher frustration than the shorter platoon (2 vehicles); and
- Drivers' intention to overtake was higher for shorter platoons than longer platoons.

Environmental

With respect to noise, vibration, global air quality and local air quality, there is published data available for air quality and noise in Scotland. However, the published data available within Scotland for rural environments is limited.

Transport Infrastructure Ireland (2022) – Ireland

The study assessed the relationship between the rate of greenhouse gases (GHGs) emitted by a vehicle and the speed that a vehicle is travelling is non-linear. Vehicle emissions are highest at low speeds while the optimum speed range for vehicles is in the range of 50kph to 90kph.

The study found that that a 10 kph reduction in speed limits on Motorways would equate to an approximate reduction in total GHG emissions of less than 0.7%, on the existing situation. Under the most extreme speed-limit change scenario tested, a 30kph reduction across all of the National Roads Network would equate to less than a 2.7% reduction in GHG emissions. However, it was noted that the assessment was based on a 2018 Irish vehicle which is expected to change and have a higher proportion of electric vehicles.

Buttignoal (2020) – France

The study assessed the impacts of reducing the maximum authorised speed limit from 90 km/h to 80 km/h on two-way rural roads without a separator. The methodology for this study included a "before and after" assessment based on a global approach, considering lost time, users killed and injured, environmental externalities.

The environmental assessment assessed the impact of speed reduction measures on air pollution, taking into account greenhouse gas emissions that affect climate change, as well as emissions of local and regional pollutants that have direct effects on the health of populations. The impact is estimated based on modelling of air pollutant emissions before and after the implementation. The modelling is carried out using the COPCETE tool for calculating pollutant emissions from road traffic according to the COPERT IV methodology. The results show a slight improvement in environmental impacts. The analyses indicated that the measure led to a slight decrease in the main air pollutants and noise pollution, although the latter is not perceptible to the human ear.

Cohen et al, (2014) – France

The paper summarises an evaluation conducted on the reduction of speed limits 110km/h to 90km/h on the Lille motorway network in France. The assessment utilised a first order macroscopic traffic simulation tool called FREQ, which was developed by the University of Berkeley. To ensure accuracy, the model was calibrated and statistically validated using traffic data from each motorway segment and direction. The volume and speed data used was provided by the traffic management system of the Lille area. The speed limit reduction measure specifically targeted the A1, A22, A25 Lille motorways, as well as the RN356 French national road.

The calculations were based on the formulas of the European standard COPERT III, which calculates emissions from road transport. The environmental indicators were expressed as a function of the average speeds, along with daily savings in main local pollutants such as CO, CO_2, NOx, greenhouse gases and fuel consumption expressed as percentages. It was found that the environmental impact was positive in seven out of the eight cases studied. Notably, the RN356 and A22 section experienced a reduction of 6 to 10% in CO_2 emissions.

Calculation of Road Traffic Noise, Department of Transport, 1988 - UK

Road traffic noise predictions are currently a common practice used to support planning, design and operational stages involving road traffic noise. The Calculation of Road Traffic Noise (CRTN) (HMSO, 1988) outlines the methodology for calculating and estimating noise emanating from road traffic in the UK. Section 1 of this document presents the prediction methodology.

The prediction method results in the determination of a Basic Noise Level (BNL), which is assessed at a distance of 10 m from the nearest edge of the carriageway. The BNL is determined based on various factors, including, traffic flow, the speed of the traffic, the composition of the traffic, road gradient and the road surface.

The BNL assumes a mean road traffic speed of 75 km/h with zero percentage of heavy vehicles. Corrections are applied to the BNL to determine the resultant noise level at a given receptor. The correction applicable for speed is considered as a factor of the percentage of heavy vehicles in Chart 4 of CRTN. For example, if we maintain a 5% percentage of heavy vehicles, reducing the speed from 60 mph to 50 mph has the potential to lower road traffic noise levels by approximately by 1.5 dB.

LA111, Noise and Vibration, Revision 2, May 2020 - UK

The Design Manual for Roads and Bridges (DMRB) (Highways England, 2020) provides guidance regarding noise and vibration assessments for motorways and trunk roads within the UK. The DMRB classifies the magnitude of noise change in the short term between 1 to 3 dB as ‘minor’.

Noise and Vibration

Transport Scotland’s Transportation Noise Action Plan states that transportation is the biggest source of environmental noise in Scotland. The Scottish Government produced strategic noise maps in response to the European and Council Directive for Assessment and Management of Environmental Noise 2002/49/EC (END) (The noise maps can be found on Scotland’s Noise website). Results of the noise mapping are suitable to monitor and evaluate changes in noise level exposures at a strategic level. Localised noise assessments are required to gather more detailed information related to specific areas.

One of the aims of the END is to establish action plans based on mapping results, to reduce levels where necessary, and to preserve environmental noise quality where it is good. The Scottish Government published the Environmental Noise (Scotland) Regulations 2006 to embrace the requirements on the END. The Scottish legislation describes this process in two steps. First, producing strategic noise mapping for major roads, rails, airports and industry. Secondly, preparing action plans to manage noise.

Global Air Quality

In 2019, the Scottish Government declared a climate emergency. A key component of the ongoing response to this has been to the aim to reduce carbon emissions from within Scotland.

The Climate Change Committee on the 20th March 2024, published a report on the progress made in 2023 in reducing emissions in Scotland. The report highlights that “Transport is the highest emitting sector in Scotland” and that “Progress has been limited in the past year”.

In response to the report on the 18th April 2024, the Scottish Government re-affirmed its unwavering commitment to ending Scotland's contribution to global emissions by 2045.

Local Air Quality

The main pollutants of concern in relation to human health are nitrogen dioxide (NO_2) and particulate matter (PM_{10} and $PM_{2.5}$). The air quality standards for these pollutants are outlined in Table B-2 below.

Table B-2 – Relevant Air Quality Standards

Pollutant	Concentration (µg/m^3)	Number of Exceedances Allowed in a Calendar Year
Annual mean NO_2	40	None
1-hour (hourly) NO_2	200	No more than 18
Annual mean PM_{10}	18	None
24-hour (daily mean) PM_{10}	50	No more than 7
Annual mean $PM_{2.5}$	10	None

The Scottish air quality database provides an overview of the air quality monitoring across Scotland, undertaken using both automatic monitors and NO_2 diffusion tubes. It also provides predictions of future year concentrations of oxides of nitrogen (NO_X), NO_2 and PM_{10} on a 1km x 1km basis for the whole of Scotland from a base year of 2018 up to 2030. Concentrations are predicted to reduce, i.e., improve over time, due to reductions in domestic, industrial and transport emissions. The key drivers for the precited reductions in transport emissions is the progressive introduction of ultra-low and zero emission vehicles and the phasing out of internal combustion engine vehicles by 2035.

Monitoring data and forecasts show that air quality across Scotland is generally good; however, a few pollution 'hot spots' remain for which Air Quality Management Areas (AQMAs) have been declared where local authorities anticipate that the objectives are not (or unlikely to be) met. There are currently 43 AQMAs in Scotland, these are primarily in urban areas and/or along heavily trafficked roads and have been declared for exceedances of both the short and long-term NO_2 and PM_{10} objectives.