# Appendix F – Road Safety Accident Analysis and Results

## Introduction

For Option 1 and Option 2, the accident savings and costs have been determined to inform the road safety assessment.

Further to this a sensitivity test has been undertaken which includes an uplift in fatal collisions based on post Covid-19 data within Scotland. This gives the following scenarios:

- Core – The Core scenario is outlined within this document and uses collisions data from 2021 and 2022; and
- Uplift – The Uplift scenario applies a 35% uplift to the 2022 collisions data. This represents an observed jump in fatal collisions between 2023 and early 2024.

## Economic Appraisal Approach

### Introduction

In line with Transport Appraisal Guidance (TAG), DfT's accident appraisal software, Cost and Benefits to Accidents – Light Touch (COBALT) is the default recommendation to assess the safety impacts of the scheme. However, COBALT is not sensitive to minor flow differences, and it makes use of speed banding (in increments consistent with posted speeds and a minimum speed of 30 mph) as the basis for allocations.

This implies that if the modelled change in average speed is relatively slight, there may be no allocation to an alternative speed band within COBALT, resulting in no discernible impact. This issue will be exacerbated in rural areas where alternative diversionary routes may not be available or attractive and consequently flow volumes also remain similar.

Given the scale of the network, Nilsson power law model was used to assess the change in accident savings to monetise the potential impact of the scheme.

### Nilsson Power Law

The impact of reduced speeds on the change in collisions was estimated using Elvik (2013) and the updated Nilsson (2019) power law model and disaggregated by road categories which are summarised in Table F-1. This estimates the reduction in incidents using the following formula:

$$counter\ factual\ incidents = baseline\ incidents * \left(\frac{new\ speed}{old\ speed}\right)^{\alpha}$$

Where $\alpha$ was selected as the exponent (best estimate) from Table F-1, based on the road categories and type of incident/accident to calculate the counter factual incidents with the

help of new and old speed. The difference between baseline and counter factual incidents will be a reduction incidents/savings in collisions for a particular incident type.

**Table F-1 – Summary Estimates of Exponents by Traffic Environment**

| Accident or injury severity | Rural roads/ Motorways (Best estimate) | Rural roads/Motorways (95% of confidence interval) | Urban/ residential roads (Best estimate) | Urban/residential roads (95% of confidence interval) | All roads (Best estimate) | All roads (95% of confidence interval) |
|---|---|---|---|---|---|---|
| Fatal accidents | 4.1 | (2.9, 5.3) | 2.6 | (0.3, 4.9) | 3.5 | (2.4, 4.6) |
| Fatalities | 4.6 | (4.0, 5.2) | 3.0 | (-0.5, 6.5) | 4.3 | (3.7, 4.9) |
| Serious injury accidents | 2.6 | (-2.7, 7.9) | 1.5 | (0.9, 2.1) | 2.0 | (1.4, 2.6) |
| Seriously injured road users | 3.5 | (0.5, 5.5) | 2.0 | (0.8, 3.2) | 3.0 | (2.0, 4.0) |
| Slight injury accidents | 1.1 | (0.0, 2.2) | 1.0 | (0.6, 1.4) | 1.0 | (0.7, 1.3) |
| Slightly injured road users | 1.4 | (0.5, 2.3) | 1.1 | (0.9, 1.3) | 1.3 | (1.1, 1.5) |
| Injury accidents – all | 1.6 | (0.9, 2.3) | 1.2 | (0.7, 1.7) | 1.5 | (1.2, 1.8) |
| Injury road users – all | 2.2 | (1.8, 2.6) | 1.4 | (0.4, 2.4) | 2.0 | (1.6, 2.4) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Property-damage-only accidents | 1.5 | (0.1, 2.9) | 0.8 | (0.1, 1.5) | 1.0 | (0.5, 1.5) |

## Benefit Calculation

The reduction in incidents was then monetised using values shown in Table F-2. The value of improved road safety takes into direct costs associated with incidents such as medical and police costs. It also considers people's willingness to pay to avoid injury and death and the value of lost economic output from casualty sufferers. To calculate the incident reduction for future years, current year monetised values will be grown based on Value of Time Growth per annum (November 2023, TAG Databook, Annual Parameters) and then discounted to 2010 PV using standard discounting factors.

**Table F-2 – Average Value of Prevention per Casualty by Severity and Element of Cost £ (2010 Prices and 2010 Values)**

| Casualty Type | Net Output | Willingness to Pay | Medical & Ambulance | Total |
|---|---|---|---|---|
| Fatal | 107,978 | 1,537,896 | 927 | 1,646,800 |
| Serious | 20,800 | 150,550 | 12,600 | 183,950 |
| Slight | 2,199 | 11,020 | 933 | 14,152 |
| Average, all casualties | 6,562 | 52,141 | 2,910 | 61,613 |

Source: TAG Table A 4.1.1, November 2023 v1.22

## Parameters

To apply the Nilsson power law the following information is required:

- Baseline collisions;
- Road classification; and
- Average speed.

## Baseline Collisions

The number of base line collisions is required as input for the Nilsson power model, this data was extracted for the post Covid-19 years of 2021 and 2022, at the time of assessment 2023 was not available. This was done as it better captured the existing problems which the scheme is targeting.

The data was then cleaned to only include collisions that were on links present in the Transport Model for Scotland (TMfS) to ensure there was no overestimation of benefits.

The data was then geographically joined to the links extracted from TMfS so the assessment could be undertaken at a more precise link level.

For use in the Nilsson power model these collisions were then split by severity; Fatal, Serious and Slight and an average was calculated from these years for use in each of the modelled years. This approach was taken as the base model was not available at the time of assessment and therefore an uplift based on traffic growth was not possible.

### Road Classification

The Nilsson power law uses different exponents based on the road classification, the two classifications; Rural/Motorway and Urban have significantly different values and therefore can have a substantial impact on the assessment.

A desktop study was undertaken on each of the links extracted from TMfS where it was identified if the link was in an urban or residential area and classified as such.

For the Motorway classification, A roads which were functionally identical to Motorways were included within this category to create a robust assessment.

### Average Speed

The average speed was extracted from TMfS for each link in the model for each of the modelled scenarios. Average speed was used as opposed to speed limit as it was considered more accurate especially for the compliance scenario testing.

## Estimation of User Benefits

### Option 1

The accident benefits for Option 1 are presented below for the core assessment and the uplift sensitivity test which is based on the post covid trends for fatal collisions within Scotland.

**Table F-3 – Option 1 Monetised Collision Savings – 60 Years (£000's)**

| Scenario 1 | 1A - 100% | 1A- RC | 1B- 100% | 1B - RC |
|---|---|---|---|---|
| Core | £883,245 | £520,549 | £617,320 | £357,557 |
| Uplift | £991,732 | £592,649 | £659,209 | £409,675 |

Without policy with 100% compliancy offers the greatest benefits due to collision savings within option 1, this is the case for both the Core and Uplift scenarios. The uplift of 1A offers the highest PVB which is to be expected as the increase in baseline Fatal collisions leads to a higher number of savings.

The number of collisions saved in the 2025 opening year for the Option 1 without policy scenario are presented below.

**Table F-4 – 2025 Option 1 Without Policy Collisions Savings**

| Scenario | Fatal | Serious | Slight | Total |
|---|---|---|---|---|
| Core – 100% | 7 | 28 | 13 | 48 |
| Core – RC | 4 | 15 | 7 | 26 |
| Uplift – 100% | 8 | 28 | 13 | 49 |
| Uplift – RC | 5 | 15 | 7 | 27 |

**Table F-5 – 2025 Option 1 With Policy Collisions Savings**

| Scenario | Fatal | Serious | Slight | Total |
|---|---|---|---|---|
| Core – 100 | 7 | 26 | 12 | 45 |
| Core – RC | 4 | 14 | 6 | 25 |
| Uplift – 100 | 8 | 26 | 12 | 46 |
| Uplift – RC | 5 | 14 | 6 | 25 |

The number of collisions saved by each of the modelled scenarios for show that if 100% compliance is achieved double the number of collisions will be saved.

These savings are mainly found for Serious collision as this is the most common accident on the roads impacted by the speed reduction.

For the Uplift sensitivity test only the number of Fatal collisions saved changes as this is the only accident type changed within the test.

The number of collisions saved within the opening year are very similar between 1A and 1B however, this difference is more pronounced in the intermediate and design year calculations.

## Option 2

The accident benefits for Option 2 are presented below for the core assessment alongside the uplift assessment which is based on the post covid trends for fatal collisions within Scotland due to the increase in traffic and the policy impacts only taking full impact in the design year.

**Table F-6 – Option 2 Monetised Collision Savings – 60 Year (£000's)**

| Scenario | 2A - 100% | 2A - RC | 2B - 100% | 2B - RC |
|---|---|---|---|---|
| Core | £1,688,208 | £866,733 | £1,211,073 | £580,313 |
| Uplift | £1,912,242 | £992,734 | £1,367,630 | £661,105 |

The Option 2 collision benefits are significantly higher than that of Option 1, which is to be expected as this option covers a wider range of roads and the associated collisions.

As with Option 1 the without policy scenario is the highest benefit as it does not contain a reduction in the number of trips across Scotland. The Uplift sensitivity test has a significantly higher benefit, with the proportionate uplift exceeding that seen within Option 1. This is due to the additional roads impacted within Option 2 having more Fatal collisions on them.

The number of collisions saved by Option 2 schemes in the opening year are presented below.

**Table F-7 – 2025 Option 2 Without Policy Collisions Savings**

| Scenario | Fatal | Serious | Slight | Total |
|---|---|---|---|---|
| Core – 100 | 14 | 52 | 33 | 99 |
| Core – RC | 7 | 25 | 15 | 47 |
| Uplift – 100 | 17 | 52 | 33 | 102 |
| Uplift – RC | 9 | 25 | 15 | 49 |

**Table F-8 – 2025 Option 2 With Policy Collisions Savings**

| Scenario | Fatal | Serious | Slight | Total |
|---|---|---|---|---|
| Core – 100 | 13 | 49 | 31 | 94 |
| Core – RC | 7 | 23 | 14 | 44 |
| Uplift – 100 | 16 | 49 | 31 | 96 |
| Uplift – RC | 8 | 23 | 14 | 45 |

The with shows a slight decrease in collision savings when compared to without policy however, it still shows a significant increase in savings compared to Option 1.

## Summary

This report covers the economic appraisal approach to collision savings and outturn results from the proposed reduction in speed limits across Scotland. This has been done using the Nilsson power Law as COBALT was not deemed suitable for this scheme.

The latest iteration of the TMfS was used alongside post Covid-19 collision data to ensure a robust assessment.

The results are presented in Table F-9 below.

**Table F-9 – Collision Result Summary – 60 Years (£000's)**

| Option | Future | 100% - Core | 100% - Uplift | RC - Core | RC - Uplift |
|---|---|---|---|---|---|
| Option 1 | Without Policy | £883,245 | £991,732 | £520,549 | £592,649 |
| Option 1 | With Policy | £617,320 | £659,209 | £357,557 | £409,675 |
| Option 2 | Without Policy | £1,688,208 | £1,912,242 | £866,733 | £992,734 |
| Option 2 | With Policy | £1,211,073 | £1,367,630 | £580,313 | £661,105 |

Option 1 shows a moderate benefit to collision savings primarily from Serious and Fatal collisions. Depending on the future growth scenario, compliance and assumptions around future collision rates this option varies between £350m and £1bn in benefits.

The realistic compliance shows a large decrease in benefits when compared to full compliance due to the assumed speed decrease being 4km/h for every 10 km/h decrease in speed limit. However, this is not a flat reduction due to the nature of the power formula.

The difference in growth in policy is reflected within the difference in benefits, the with policy is lower by around 30% when compared to the without policy as the reduction means lower traffic and increases the average speed on links due to lower congestion.

The uplift sensitivity test shows an increase of around 15% when compared to the core scenarios, this is as it only impacts the Fatal collisions as it is based off of post Covid trends.

Option 2 shows a moderate to major benefit with realistic compliance being the former and full compliance being the latter. The maximum benefit is in the uplift without policy at £1.9bn.

As with Option 1 the realistic compliance shows a decrease in benefit however, this is a much larger decrease of around 50% due to the lower changes in speed.

Option 2 shows a similar decrease in proportion to the policy impacts within Option 1 with around a 30% reduction in benefits.

The uplift sensitivity test provides the highest benefit of any scenario and shows a larger proportional increase than Option 1 due to the increased number of Fatal collisions on the additional scheme links within this option.