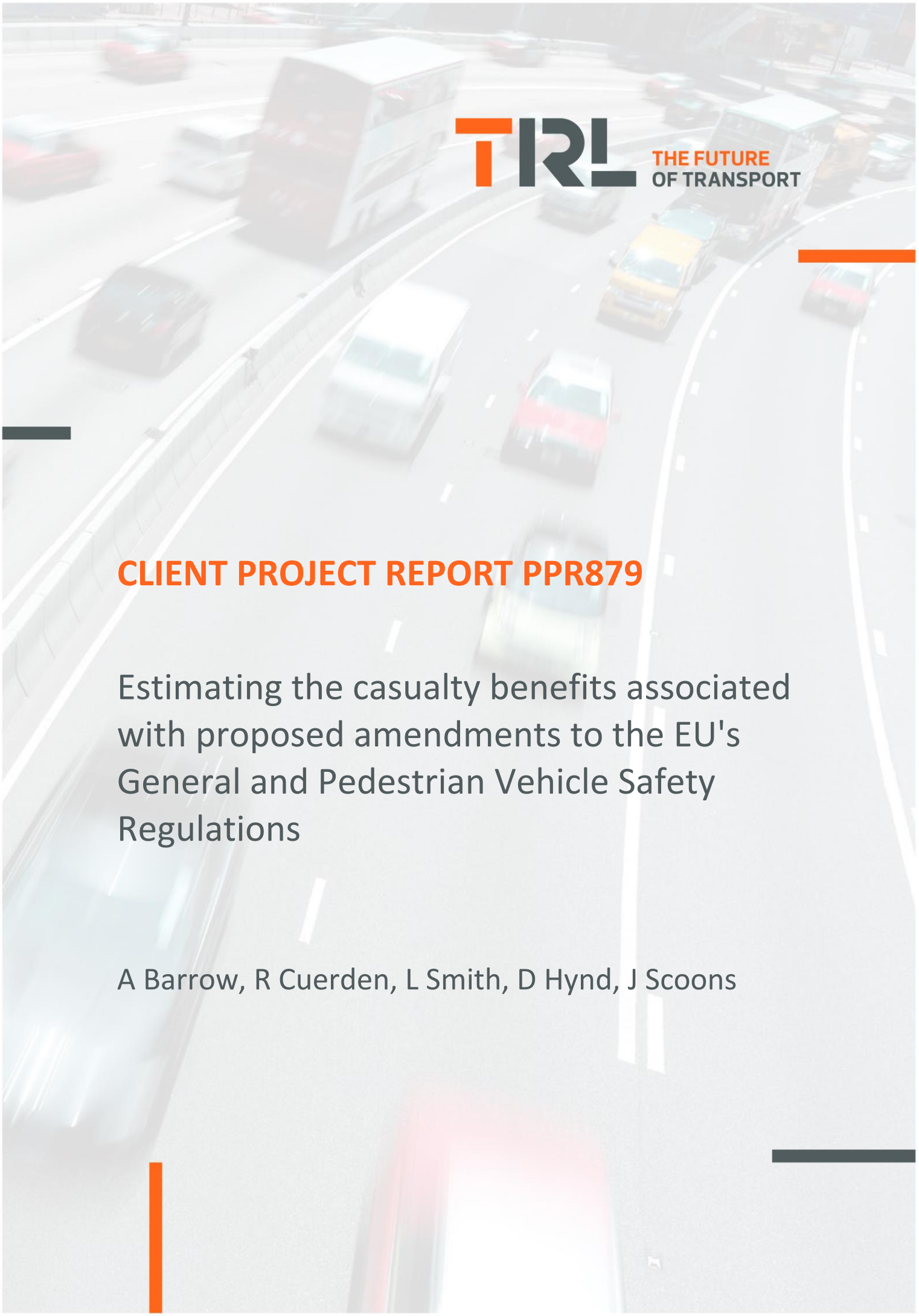

THE FUTURE OF TRANSPORT

CLIENT PROJECT REPORT PPR879

Estimating the casualty benefits associated with proposed amendments to the EU's General and Pedestrian Vehicle Safety Regulations

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Version	Date	Description	Editor	Technical Reviewer
Draft	27/01/17	Draft report to highlight the results	RWC	
1.0	02/02/17	Draft report	RWC	
2.0	03/03/17	Second draft report	AB	RWC
3.0	22/05/17	Third draft report	AB, LS, DH, RWC	RWC
4.0	06/06/17	Final Version	AB	RWC
5.0	13/12/17	Final Version – updated FSO, F94, S95, HED	AB	ME
5.1	16/01/17	Final Version – updated SFS and REV	AB	ME

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Executive Summary

The General Safety Regulation (GSR), Regulation (EC) 661/2009, and the Pedestrian Safety Regulation (PSR), Regulation (EC) 78/2009, are the main regulations, which control the safety of M and N category vehicles in the European Union. Regulation (EC) 661/2009, amended by Commission Regulations (EU) number 407/2011, 523/2012 and 2015/166 governs the type approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units. The Regulation lists the UN Regulations that apply on a compulsory basis and the vehicle types to which each regulation applies. Regulation (EC) 78/2009 on the type approval of motor vehicles with regard to the protection of pedestrians and other Vulnerable Road Users (VRU) (PSR)) updated Directive 2003/102/EC with modified and more advanced provisions, adapted to the technical progress. This includes passive safety requirements to mitigate the risk of critical injury in case of a collision between a vehicle and a person.

As required by the General and Pedestrian Safety Regulations, the European Commission has been conducting a review of the regulations to develop proposals for amendments to include new safety features. A first stage of the review was completed and reported by TRL in 2015[1]. This initial review considered over 50 candidate measures that could be considered for implementation in the GSR or PSR. The outputs were indicative cost-benefits provided in order to differentiate those measures that are very likely, moderately likely or very unlikely to provide a benefit consistent with the cost of implementation.

A second stage of the review is currently being conducted, based on candidate measures identified in the first stage review. To investigate further the real world safety benefits that could be afforded if certain measures were adopted, ACEA has commissioned TRL to perform a first-step analysis to identify the target populations for eight of the measures:

- **VIS** – improved front end design for direct **vis**ion and VRU detection
- **ISA** – **I**ntelligent **S**peed **A**ssistance
- **FSO** – **F**rontal impact **S**mall **O**verlap crash test
- **SFS** – **S**ide impact **F**ar **S**ide occupant crash test
- **F94** – **F**rontal Impact Crash Test (removal of exemptions from Regulation **94**)
- **S95** – **S**ide Impact Crash Test (removal of exemptions from Regulation **95**)
- **HED** – Adult **Hea**d to Windscreen Area
- **REV** – **Re**versing **D**etection

The aim of this study was to undertake new accident analysis, using data from Great Britain (GB), to identify and quantify the road user casualty target populations (TP) that are likely to benefit from the introduction of each of the eight potential measures listed above.

[1] Hynd *et al.* (2015). Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users. doi: 10.2769/497485

It should be noted that at this stage:

- The effectiveness of each measure was not evaluated, so the casualty TP estimates represent a maximum potential benefit for Great Britain.
- No analysis of the costs to implement these measures has been performed.

Findings

The results are derived from analysis of Great Britain's police-reported road traffic injury database (Stats19) and the UK's Road Accident In-Depth Studies (RAIDS) database. The reference population used for this analysis is Stats19 reported injury road casualties from 2011-2015. Table 1 details the 964,009 injured casualties by vehicle and road user type.

Table 1: Casualties in reported collisions in Great Britain 2011-2015 by vehicle type, casualty class and severity

Vehicle type	Rider/Occupant			Pedestrians struck by...			Total
	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	
Pedal cycle	547	16,090	81,238	17	469	1,760	100,121
PTW	1,725	25,450	71,330	59	1,000	3,720	103,284
M1	3,989	39,721	531,977	1,400	20,786	77,564	675,437
M2	14	197	2,474	10	108	338	3,141
M3	40	1,546	24,605	148	1,126	4,211	31,676
N1	191	1,966	24,470	175	1,656	6,107	34,565
N2	16	187	1,967	37	178	612	2,997
N3	102	592	3,539	239	397	693	5,562
N unknown	2	6	73	1	8	44	134
Other*	122	1,000	4,575	39	286	1,070	7,092
Total	**6,748**	**86,755**	**746,248**	**2,125**	**26,014**	**96,119**	**964,009**

Note*: Other vehicle type includes ridden horse, agricultural vehicles and tram/light rail

Table 2 identifies the casualty Target Populations (TP) for Great Britain for each of the eight measures. The table provides estimates of the number of killed, seriously and slightly injured casualties, injured in accidents which occurred in the five years from 2011 to 2015, who could benefit from each of the eight measures. The target populations identified for each of the measures are not completely mutually exclusive and therefore cannot be summed. For example, some measures would benefit the vehicle occupants only. For example FSO would reduce the number of M1 user casualties, whereas ISA would prevent casualties both for users of the vehicles fitted with the technology and for their collision partners, including other vehicle users and VRUs.

It was only possible to estimate a TP for the number of killed pedestrians and pedal cyclists for VIS (improved front end design for direct and indirect driver vision) because of a lack of representative in-depth data for serious and slight casualties at the time of writing.

Table 2: Potential Casualty Target Populations (TP) for each measure (Great Britain 2011-2015)

Measure	Vehicle type	Casualty type	TP casualties who benefit from measure			
			Killed	Seriously injured	Slightly injured	Total
VIS – improved front end design for direct and indirect driver vision	N2	Pedestrians & pedal cyclists	**36**	**232**	**825**	**1,093**
	N3		**275**	**564**	**1,015**	**1,854**
	N Unk		**1**	**14**	**56**	**71**
ISA – Intelligent Speed Assistance	M1	All vehicle users & VRUs	**1,469**	**7,680**	**43,916**	**53,065**
	M2		**0**	**27**	**109**	**136**
	M3		**9**	**18**	**86**	**113**
	N1		**18**	**217**	**1,790**	**2,025**
	N2		**0**	**18**	**90**	**108**
	N3		**54**	**68**	**321**	**443**
FSO – Frontal impact Small Overlap crash test *	M1	M1 occupants	**69**	**793**	**12,376**	**13,238**
SFS – Side impact Far Side occupant crash test *†	M1	M1 Occupants	**132**	**857**	**10,352**	**11,341**
F94 – Frontal Impact Crash Test (removal of exemptions from Regulation 94) *	M1 N1	M1 & N1 occupants that are currently exempt	**123**	**1,203**	**11,963**	**13,289**
S95 – Side Impact Crash Test (removal of exemptions from Regulation 95) *	M1 N1	M1 & N1 occupants that are currently exempt	**26**	**267**	**4,018**	**4,311**
HED – Adult Head to Windscreen Area †	M1	Pedestrians	**299**	**3,673**	-	**3,972**
	M1	Cyclists	**18**	**534**	-	**552**
REV – Reversing Detection ***Note: Stats19 only includes collisions on the public highway and excludes those occurring in car parks, service yards and private workplace sites.***	N2 N3 O3 O4	Pedestrians & pedal cyclists	**7**	**41**	**136**	**184**

Notes: * **FSO** and **SFS** only consider injury to occupants in cars registered from 2004-2015. Therefore, they cannot be compared with the other measures because they represent a sub-sample of real world collisions.

† Target populations are expressed as a range (Minimum – Maximum)

'-' Means no estimate could be made

‡ Totals are for killed and seriously injured casualties only

1 Introduction

The General Safety Regulation (GSR), Regulation (EC) 661/2009, and the Pedestrian Safety Regulation (PSR), Regulation (EC) 78/2009, are the main regulations, which control the safety of M and N category vehicles in the European Union. Regulation (EC) 661/2009 of the European Parliament and Council, amended by Commission Regulations (EU) number 407/2011, 523/2012 and 2015/166 governs the type approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units. The Regulation lists the UN Regulations that apply on a compulsory basis and the vehicle types to which each regulation applies. To date, a number of amendments have been made to the General Safety Regulation including mandating:

- Electronic Stability Control (ESC) systems on cars, vans, trucks and buses
- Fitment of tyre pressure monitoring systems on cars
- Lane Departure Warning Systems (LDWS) and Advanced Emergency Braking Systems (AEBS) for trucks and buses
- ISOFIX child restraint anchorages on cars
- Cab strength crash protection of vans and trucks
- A large number of UN Regulations replacing repealed Directives

Regulation (EC) 78/2009 on the type approval of motor vehicles with regard to the protection of pedestrians and other vulnerable road users updated Directive 2003/102/EC with modified and more advanced provisions, adapted to the technical progress. This includes passive safety requirements to mitigate the risk of critical injury in case of a collision between a vehicle and a person.

As required by the General and Pedestrian Safety Regulations, the European Commission has been conducting a review of the regulations to develop proposals for amendments to include new safety features. Based on the CARS 2020 communication and the Policy Orientations on Road Safety 2011-2020, a proposed amendment should meet the following criteria:

- Road safety should follow an integrated approach regarding the driver, infrastructure and vehicles
- New measures for improved vehicle safety should be enforceable, compatible with infrastructure, and encourage the development of and progress on innovative active and passive safety measures and promote new technologies
- Specific attention should be given to vulnerable road users as well as vehicle occupants presenting an intrinsic fragility due to their age (i.e. young children and the elderly)
- Particular attention should be given to the assessment of technologies that exploit the interactions between the driver, the vehicle and the driving environment, such as Intelligent Transport Systems (ITS)

A first stage of the review was completed and reported by TRL in 2015[2]. This initial review considered over 50 candidate measures that could be considered for implementation in the GSR or PSR. The outputs were indicative cost-benefits provided in order to differentiate those measures that are very likely, moderately likely or very unlikely to provide a benefit consistent with the cost of implementation.

A second stage of the review is currently being conducted, based on candidate measures identified in the first stage review. To investigate further the real world safety benefits that could be afforded if certain measures were adopted, ACEA has commissioned TRL to perform a first-step analysis to identify the target populations for eight of the measures:

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- **REV** – **Re**versing **D**etection

The aim of this study was to undertake new accident analysis, using data from Great Britain (GB), to identify and quantify the road user casualty target populations (TP) that are likely to benefit from the introduction of each of the eight potential measures listed above.

It should be noted that at this stage:

- The effectiveness of each measure was not evaluated, so the casualty TP estimates represent a maximum potential benefit for Great Britain.
- No analysis of the costs to implement these measures was performed.

[2] Hynd *et al.* (2015). Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users. doi: 10.2769/497485

2 Method

2.1 Objectives: Research Questions

The specific research questions for each measure and the vehicle categories to which they apply are listed below:

1: Front End Design (VIS)

Detail:	Compare active safety with direct driver vision benefits
Category:	N2/ N3
Research Q1:	Find the potential casualty target population for extended direct vision and VRU detection systems and the proportion and the gravity (i.e. casualty characteristics in terms of, for example, distribution of injury severity) of relevant accidents for “blind spot” in the truck driver vision and to driver distraction

2: Intelligent Speed Assistance (ISA)

Detail:	Benefits of ISA on Passenger Vehicles and Commercial Vehicles (CV), compared with speed limiters already regulated.
Category:	M1/N1; M2/N2; M3/N3
Research Q1:	Find the potential casualty target population for ISA (i.e. accidents with speed limit infringement) and the proportion and gravity (i.e. casualty characteristics in terms of, for example, distribution of injury severity) of accidents by vehicle type (limited to STATS19 vehicle types)

3: Frontal Small Overlap (FSO)

Detail:	Benefit of passive vs active measures
Category:	M1
Research Q1:	Find the potential casualty target population and the proportion and gravity (i.e. casualty characteristics in terms of, for example, distribution of injury severity) of small overlap car accidents

4: Side Impact Far Side Occupant (SFS)

Detail:	Benefits of measures to protect front seat occupants seated on the non-struck side of a car in a side impact
Category:	M1

Research Q1:	Find the potential casualty target population and the proportion and gravity (i.e. casualty characteristics in terms of, for example, distribution of injury severity) of far side car accidents

5: Frontal Impact Crash Test (F94)

Detail:	Benefits of extension to all M1/N1
Category:	M1/N1 now excluded
Research Q1:	Find the potential casualty target population and the proportion and gravity (i.e. casualty characteristics in terms of, for example, distribution of injury severity) of excluded M1/N1 front accidents

6: Side Impact Crash Test (S95)

Detail:	Benefits of extension to all M1/N1
Category:	M1/N1 now excluded
Research Q1:	Find the potential casualty target population and the proportion and gravity (i.e. casualty characteristics in terms of, for example, distribution of injury severity) of excluded M1/N1 side impact accidents

7: Adult Head to Windscreen Area (HED)

Detail	Benefits of secondary safety measures to reduce the risk of head injury due to pedestrian and cyclist head impacts to the edges of the windscreen, the A-pillars, the scuttle and the windscreen header
Category:	M1
Research Q1:	Find the potential casualty target population and the proportion and gravity (i.e. casualty characteristics in terms of, for example, distribution of injury severity) of pedestrian accident with head to windscreen impact

8: Reversing Detection (REV)

Detail:	Benefit of reversing detection systems for N2/N3/O3/O4
Category:	N2/N3/O3/O4
Research Q1:	Find the target population for reversing detection systems for N2/N3 vehicles and O3/O4 trailers and the gravity (i.e. casualty characteristics in terms of, for example, distribution of injury

severity) of reversing accidents

2.2 Overview of method for each measure

The overall method for estimating the target population for each measure is outlined below. Where in-depth data is available and pertinent, all three steps are followed. For some measures, only the Stats19 data is used.

1. **Characteristics of gross target casualty population for GB (Stats19)**

   Quantify gross target casualty populations for GB: Precise target populations cannot always be defined at this level, because the information available is at a relatively high level. For example, the number of injurious car occupant collisions with a first point of contact at the front of the vehicle can be determined, but it is not possible to differentiate between full-width, moderate overlap (F94 measure) and small overlap (FSO measure) frontal collisions. However, collisions can be grouped by e.g. injury severity (killed, serious, slight) and road type (motorway, main road, minor road, urban road) to facilitate more precise scaling.

2. **In-depth assessment of collision typology (RAIDS)**

   Analyse in-depth collision data to identify collisions and casualties that could be addressed by each measure: Quantify the collisions (and casualty characteristics) that are directly relevant to each measure as a proportion of the larger group identified in Step 1. For example, for the FSO measure this would be the proportion of the car (M1) frontal impacts in the in-depth data that have a small overlap. The data is grouped, for example by injury severity and road type, for comparison with the Stats19 data.

3. **Estimate of specific GB target population based on scaling in-depth data**

   Estimate specific GB target populations based on scaling in-depth collision data (2) with gross target population (1): The in-depth data is appropriately weighted to represent the GB road casualty population. The groups of collisions or casualties identified in step (2) are used to estimate the equivalent number of injured road users that are recorded by the police at a national level. The in-depth data is collected using stratified sampling procedures, typically favouring more injurious collisions, and therefore the proportions and size of the respective casualty groups needs to be adjusted to be representative.

2.3 Data Sources

The following datasets are used in the study:

Stats19 is Great Britain's database that records police reported traffic accidents that result in injury to at least one person. The database primarily records information on where the accident took place, when the accident occurred, the conditions at the time and location of the accident, details of the vehicles involved, and information about the casualties. Approximately 50 pieces of information are collected for each accident (Department for Transport 2007). More information on the Stats19 data used in this study is given in Section 2.3.1.

The **Road Accident In-Depth Studies (RAIDS)** brings together different types of investigation from earlier studies into a single programme combining existing legacy data with new data in a common and comprehensive database. The study began in 2012 and uses on-scene and retrospective investigation techniques to capture data to understand the causes of road collisions and the causes and mechanism of the resulting injuries.

More information on the RAIDS data used in this study is given in Section 2.3.2.

2.3.1 Stats19

Stats19 data for the five years between 2011 and 2015 were used for this analysis.

Stats19 is the database of reported injury collisions on the public road reported to and by the police. Whilst, most, if not all fatalities are reported, DfT acknowledges that there may be lower levels of reporting for serious injuries, and to a greater extent, slight injuries. Therefore the potential number of casualties that could be alleviated due to the measures here is likely to be an underestimate.

The total number of casualties reported in Stats19 between 2011 and 2015 by severity is shown below.

Killed casualties are defined human casualties who sustained injuries which caused death less than or equal to 30 days after the collision. Confirmed suicides are excluded. An injured casualty is recorded by the police as seriously injured or slightly injured based on information at the time of the collision and will not generally reflect the results of a medical examination. A serious injury is defined as an injury for which a person is detained in hospital as in 'in-patient', or any of the following injuries whether or not they are detained in or confirmed by a hospital: fractures, concussion, internal injuries, crushings, burns (excluding friction burns), severe cuts, and severe general shock requiring medical treatment and injuries causing death 30 or more days after the collision.

Table 3: Casualties reported in Stats19 by year and severity GB, 2011-2015)

Casualty severity	2011	2012	2013	2014	2015	2011-15 Total
Killed	1,901	1,754	1,713	1,775	1,730	**8,873**
Seriously injured	23,122	23,039	21,657	22,807	22,144	**112,769**
Slightly injured	178,927	170,930	160,300	169,895	162,315	**842,367**
Total casualties	**203,950**	**195,723**	**183,670**	**194,477**	**186,189**	**964,009**

Stats19 includes data relating to the circumstances of the collisions, the vehicles involved, the resultant casualties and the contributory factors (based on the opinion of the reporting officer at the time of the collision; may not be the result of a detailed collision investigation).

The severity as recorded in Stats19 is the opinion of the reporting officer at the time of the collision based on available information and does not always get followed up with hospital data, and hence some severities may be incorrectly reported.

Deaths in Stats19 are defined as those that occurred within 30 days of the collision, due to the collision (i.e. not suicide or natural causes) and on the public road in Great Britain. Northern Ireland and the Isle of Man are not included.

Collisions occurring on private land, for example, car parks are not included.

The following *vehicles types* are recorded:

- 01: Pedal cycle
- 02: Motorcycle 50 cc and under
- 03: Motorcycle over 50 cc and up to 125 cc
- 04: Motorcycle over 125 cc and up to 500 cc
- 05: Motorcycle over 500 cc
- 97: Motorcycle - Unknown cc
- 23: Electric motorcycle
- 08: Taxi/private hire car
- 09: Car
- 10: Minibus (8-16 passenger seats)
- 11: Bus or coach (17 or more passenger seats)
- 19: Van/goods vehicle under 3.5 tonnes maximum gross weight
- 20: Goods vehicle between 3.5 and 7.5 tonnes maximum gross weight
- 21: Goods vehicle over 7.5 tonnes maximum gross weight
- 98: Goods vehicle unknown weight
- 17: Agricultural vehicles (includes diggers etc.)

- 16: Ridden horse
- 22: Mobility scooter
- 18: Tram/light rail
- 90: Other vehicle

Pedestrians are not recorded as a vehicle; instead they are recorded as casualties of the vehicle that hit them.

Articulated vehicles are not split into separate tractors and trailers; they are recorded in the appropriate weight category and there is a separate field to record towing and articulation (see Section 2.3.1.1 for a discussion on matching Stats19 vehicle classifications to the vehicle categories used the General Safety and Pedestrian Safety Regulations).

The Vehicle Registration Mark (VRM) of the involved vehicles is also recorded, and these data are linked to Stats19 by DfT based on vehicle registration data held by DVLA to provide 'vehicle enhanced data'. The enhanced data includes the number of passenger seats, the body type, the year of manufacture and registration, the gross vehicle weight (GVW), and the make and model. The enhanced data are not available for all vehicles in Stats19, and in some cases the data are flagged by DfT as not matching the vehicle type recorded, and in some cases not all of the enhanced data are available. The availability of enhanced vehicle data is shown in Table 4.

Table 4: Availability of enhanced vehicle data in Stats19 (GB, 2011-2015)

Vehicle type	Stats19 categories	% of vehicles (2011-2015) with good[‡] vehicle enhanced data	% of vehicles with enhanced data with non-zero registration year	% of vehicles with enhanced data with non-zero manufacture year	% of vehicles with enhanced data with non-zero GVW
M1	Car and taxi	84%	86%	86%	16%
M2 & M3	Minibus and bus/coach	80%	84%	84%	55%
N1, N2 & N3	Goods vehicles	78%	83%	83%	66%

[‡] marker = 1, i.e. vehicle types match

2.3.1.1 Vehicle types

The vehicle types as described in Stats19 were used in combination with the gross vehicle weights in the enhanced data to classify vehicles into the EU vehicle Categories as shown in Table 5. This provides the closest match between the Stats19 vehicle classifications and the EU vehicle Categories, although it should be noted that it is not an exact match, especially for heavy goods vehicles. The resultant number of vehicles in collisions in each Category is shown in Table 8.

Table 5: Vehicle category definitions

Category	Definition	Stats19 definition	Notes
M1	Passenger car not more than 8 passenger seats	Vehicle type = 8 or 9 (car or taxi)	Vehicles with 8 passenger seats will be missed
M2	Passenger vehicle with more than 8 passenger seats and maximum mass not exceeding 5 tonnes	Vehicle type = 10 (minibus) or 11 (bus/coach) with max weight up to 5 tonnes. If no vehicle weight data then Stats19 vehicle type = 10	Stats19 minibus defined as 8-16 passenger seats, so vehicles with 8 passenger seats will be added
M3	Passenger vehicle with more than 8 passenger seats and maximum mass exceeding 5 tonnes	Vehicle type = 10 (minibus) or 11 (bus/coach) with max weight > 5 tonnes. If no vehicle weight data then Stats19 vehicle type = 11	Stats19 bus or coach defined as 17 or more passenger seats
N1	Goods vehicles not exceeding 3.5 tonnes	Vehicle type = 19, 20, 21 or 98 with max weight up to 3.5 tonnes. If no vehicle weight data then vehicle type = 19 (Goods vehicles 3.5 tonnes MGW and under)	
N2	Goods vehicles between 3.5 and 12 tonnes	Vehicle type = 19, 20, 21 or 98 with max weight >3.5t and ≤12t. If no vehicle weight data then Vehicle type = 20 (Goods vehicles 3.5-7.5t)	
N3	Goods vehicles having a maximum mass exceeding 12 tonnes	Vehicle type = 19, 20, 21 or 98 with max weight >12 tonnes. If no vehicle weight data then Vehicle type = 21 (Goods vehicles 7.5 tonnes and over	
N unknown		Vehicle type = 98 (goods vehicle unknown weight) and no vehicle weight data	

Note 1: Gross vehicle weight field only used if marker = 1 (that is, the Stats19 vehicle type matches the enhanced vehicle type)

Note 2: vehicle type 20 and 21 are included in the N categories with a check of the MGW because the MGW in the enhanced Stats19 data is more accurate than the Police-reported classification in the base Stats19 data.

2.3.1.2 Notes on M-Category vehicle matching

Table 6 shows the number of passenger seats, where known, for collision involved M category vehicles.

Table 6: Vehicle category by number of passenger seats (where vehicle types match in the enhanced data)

Category	1-7	8	9-16	17-98	Total	Total 2011-2015	% with known no. of seats
M1	493,322	1,291	14	6	494,633	969,174	51.0%
M2	263	504	959	80	1,806	3,067	58.9%
M3	6	12	87	25,120	25,225	31,005	81.4%
Total	***493,591***	***1,807***	***1,060***	***25,206***	***521,664***	***1,003,246***	***52.0%***

According to the EU vehicle categories, vehicles with up to and including 8 passenger seats are classed as M1; however, in Stats19 vehicles with 8 or more passenger seats are defined as minibuses. Where the enhanced data were available with a good match and the number of passenger seats was known (494,633 vehicles), 99.7% of these vehicles had between 1 and 7 passenger seats and 0.3% had 8 seats, and very few had 9 or more seats. Therefore, the differences in classifications will have minimal effect on analyses regarding M1 vehicles.

However, there will be a larger effect on M2 vehicles: where the enhanced data were available with a good match and the number of passenger seats was known (1,806 vehicles), 57.5% had more than 9 passenger seats and 28% had 8 passenger seats. That is, 28% of the M2 Category vehicles (263 vehicles) should have been classified as M1; again, this makes negligible difference to the M1 analyses but should be borne in mind for conclusions regarding M2 vehicles.

99.9% of M3 vehicles with good enhanced data (25,225) had 9 or more passenger seats and therefore are correctly classified.

2.3.1.3 Notes on N-Category vehicle matching

Table 7 shows the GVW, where known, for N category vehicles involved in collisions. The relevant Stats19 classifications are:

- **19**: Van/goods vehicle under 3.5 tonnes maximum gross weight
- **20**: Goods vehicle between 3.5 and 7.5 tonnes maximum gross weight
- **21**: Goods vehicle over 7.5 tonnes maximum gross weight
- **98**: Goods vehicle unknown weight

Table 7: Vehicle category by gross vehicle weight (where vehicle types match in the enhanced data)

Category	GVW	Stats19 vehicle type 19 (<3.5t))	Stats19 vehicle type 20 (3.5-7.5t)	Stats19 vehicle type 21 (>7.5t)	Stats19 vehicle type 98 (unknown GVM)	Total	Total 2011-2015	% with known GVM
N1	<=3.5t	37,831	1,818	214	151	40,014	66,403	60.3%
N2	>3.5t-<7.5t	636	518	193	8	1,355	7,872	65.9%
N2	>=7.5t-<=12t	643	1,838	1,318	36	3,835		
N3	>12t	567	2,240	15,868	243	18,918	25,942	72.9%
Total		***39,677***	***6,414***	***17,593***	***438***	***64,122***	***100,217***	***64.0%***

It can be seen that 'Stats19 classification 19 vehicles' should match exactly with Category N1 vehicles. In practice 95% of Stats19 class 19 vehicles with a known mass had a GVW ≤ 3.5 tonnes and were therefore correctly classified. A further 4.5% had a mass between 3.5 and 7.5 tonnes, and 0.5% had a mass > 7.5 tonnes.

Category N2 and N3, which are separated at 12 tonnes, do not match so well with Stats19 classifications, which are separated at 7.5 tonnes. For N2, 8% of the class 20 vehicles had a GVM between 3.5 and 7.5 tonnes (i.e. correctly classified in Stats19 and attributable to Category N2), 29% had a GVM between 7.5 and 12 tonnes (incorrectly classified, but still correctly attributable to Category N2. A further 1818 (28%) of class 20 vehicles had a GVM of <3.5 tonnes and were moved to the N1 category, and 2240 (35%) had a GVM of >12 tonnes and were moved to the N3 category. Approximately one-third of goods vehicles did not have a known GVM and the largest error resulting from this will apply to the N2 category; caution should therefore be exercised when interpreting N2 data.

Of the vehicles in Stats class 21, 98% had a gross vehicle weight of 7.5 tonnes and over (i.e. were correctly classified) and 90% had a gross vehicle weight of more than 12t and therefore placed in the N3 Category.

Table 8: Number of vehicles in collisions (all severities, 2011-2015) included in analysis

Category	Number of vehicles in collisions 2011-2015	% with gross vehicle weight in enhanced data (and marker)	% with year of manufacture (and marker)
M1	969,174	14%	83%
M2	3,067	33%	64%
M3	31,005	56%	81%
N1	66,403	60%	80%
N2	7,872	66%	73%
N3	25,942	73%	73%

2.3.1.4 Vehicle weights and R-point heights

The availability of gross weight data in the enhanced Stats19 collision data for the M1 classification is low (only 14% – see Table 8); this means that the F94 measure (involving M1 passenger cars with a maximum permissible mass greater than 2.5 tonnes) requires additional data in order to be able to identify the correct subset of M1 vehicles. Similarly, additional data is required to define the subset of M1 vehicles with an R-point height > 700 mm for the S95 measure. These data were provided by ACEA and supplemented by some additional gross vehicle weight data obtained via searching for vehicle specifications on-line.

In total there were 75 vehicles included in the list. See Appendix A.

The 75 makes and models were matched with the makes and models in the enhanced Stats19 data. A 'like' operator was used, so all variant were found that started with the model given; for example, 'Audi Q7' selects the following vehicles in the Stats19 data:

- Q7 LE TDI QUATTRO A
- Q7 LE TDI QUATTRO AUTO
- Q7 QUATTRO TDI
- Q7 S LINE + TDI QUATTRO AUTO
- Q7 S LINE + TFSI QUATTRO AUTO
- Q7 S LINE FSI QUATTRO A
- Q7 S LINE QUATTRO FSI
- Q7 S LINE QUATTRO TDI
- Q7 S LINE TDI 245 QUATTRO AUTO
- Q7 S LINE TDI QUATTRO A
- Q7 S LINE TDI QUATTRO AUTO
- Q7 SE FSI QUATTRO A
- Q7 SE QUATTRO TDI
- Q7 SE TDI 245 QUATTRO AUTO

- Q7 SE TDI QUATTRO A
- Q7 SE TDI QUATTRO AUTO
- Q7 TDI QUATTRO A
- Q7 TFSI QUATTRO AUTO

For Mercedes, both Mercedes and Mercedes-Benz were matched with makes, and an operator was used to select models that had a number following the letter of the class, so that, for example V-class or 'V' selected 'V220 CDI AMBIENTE' but not 'Vaneo…'. A similar process was undertaken for each make and model.

Notes:

- We have used 'like model*' in queries. This means that there may be some vehicles with a model name which doesn't start with the model name are excluded (We needed to use this criteria this as otherwise Ford Edge included Ford Fiesta Edge).
- Since we only have a list of larger vehicles, and not a list of all vehicles with their weights it is difficult to assess the completeness of matching. We checked any vehicles in the list of large vehicles which did not have any collision involved vehicles.
- There are likely to be other vehicles which meet the criteria which we have not included in the list.

2.3.2 RAIDS

The RAIDS database contains new data from the RAIDS Phase 1 and Phase 2 data collection periods, plus data from legacy studies between 1995 and 2010:

- The **On The Spot (OTS)** study, which collected crash data at the scene enabling data to be collected as soon as possible after the crash occurs, before vital evidence had been removed. Data was collected for all vehicle types and accident severities (2000 to 2010).
- The **Co-operative Crash Injury Study (CCIS)**, which commenced in 1983 and finished in 2010. This study investigated car collisions, including retrospective vehicle examinations, to understand car occupant injury causation.
- The **Heavy Vehicle Crash Injury Study (HVCIS)**, collected detailed information on collisions involving heavy goods vehicles, light commercial vehicles, large passenger vehicles, minibuses, agricultural vehicles and 'other motor vehicles' (OMVs). The project consisted of two main elements:
    - Retrospective analysis of police fatal files (HVCIS fatal files) for collisions involving vehicles of interest. The researchers used the detailed information collected by the police to determine potential countermeasures which could have avoided or reduced the severity of the collision.
    - The Truck Crash Injury Study (TCIS) which collected detailed information from investigations undertaken by the Vehicle and Operator Services Agency (VOSA) for both injury and non-injury accidents in 15 areas covering England, Scotland and Wales.

The **Road Accident In-Depth Studies (RAIDS)** programme brings together different types of investigation from legacy studies into a single programme combining existing data with new, in a common and comprehensive database.

Currently there are two types of RAIDS investigations:

- *On scene*: A crash scene investigation done at the time of the collision while the emergency services are still present. These investigations focus on the vehicle, the road user and the highway issues and can include all injury severities, including non-injury crashes and those with relatively minor vehicle damage. All vehicle types and road users are included.
- *Retrospective*: An investigation that is typically performed the day after a collision, which examines vehicles that have had to be recovered from the crash site having suffered more serious damage and where an occupant has attended hospital due to their injuries. The sampling procedure for Phase 1 (2012-2015) included retrospective vehicle investigations divided into two categories:
  - 'Retrospective passenger car examinations', and
  - 'Retrospective large vehicle examinations'.

  In Phase 2 (2015-2018), the retrospective investigations focus on gathering data on collisions that involve new cars or pedal cycles or motorcycles, but all other vehicles involved in the collisions are investigated too.

For all case types, follow-up activities involve the collection and coding of anonymous injury and questionnaire data. Each collision type has targets for the number of cases collected, and the distribution of injury levels within those cases, with a bias towards killed and serious injury (KSI) collisions. The approach and protocol for these case types is described further in the following sections.

The following describes sample sizes for each study in the RAIDS database:

- OTS cases n = 4,744 Phases 1, 2 and 3 (2000-2010)
- CCIS cases n = 10,611 Phases 6, 7 and 8 (1998-2010)
- TCIS cases n = 1,476 All cases (1995-2010)
- HVCIS fatal cases n = 3,980 All cases (1995-2010)
- RAIDS programme has collected information on 1,255 collisions (cases) in Phase 1 (2012-2015).

3 Results

Table 9 summarises the Stats19 road user casualties used for the analysis undertaken for this project. The largest group is car users (M1), with over 4,000 killed occupants and over half a million injured casualties. The next largest casualty group is pedestrians, many of whom were injured following an impact with a car.

Table 9: Stats19 road user casualties 2011-2015

Road user group	Killed	Seriously injured	Slightly injured	Total
Pedestrians	2,125	26,014	96,119	124,258
Pedal cyclists	547	16,090	81,238	97,875
PTW users	1,725	25,450	71,330	98,505
M1 occupants	3,989	39,721	531,977	575,687
M2 occupants	14	197	2,474	2,685
M3 occupants	40	1,546	24,605	26,191
N1 occupants	191	1,966	24,470	26,627
N2 occupants	16	187	1,967	2,170
N3 occupants	102	592	3,539	4,233
N unknown occupants	2	6	73	81
Other vehicle occupants	122	1,000	4,575	5,697
Total	**8,873**	**112,769**	**842,367**	**964,009**

The analysis uses in-depth RAIDS data for some of the measures where this can help provide a better estimate of the target casualty population.

3.1 Front End Design (VIS)

3.1.1 Characteristics of gross target casualty populations for GB (Stats19, 2011-2015)

Table 10 quantifies the number of pedal cyclists and pedestrians (Vulnerable Road Users, VRU), who experienced an impact with the front or side of an N2 or N3 (Vehicle Of Interest, VOI). In total, 3,018 VRUs were injured between 2011-2015 in GB associated with collisions with N2 or N3 vehicles at the front or side of the vehicle. There were 71 VRU casualties struck by an N vehicle; it was not known if they were N2 or N3 and are referred to as "N n/k" in the Tables.

Table 10: VRU casualties by VRU type, VOI category and injury severity

Vehicle type	VRU type	VRU hit by front of vehicle				VRU hit by side of vehicle				Grand Total
		Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
N2	Pedal cycle	6	28	107	141	4	72	282	358	**499**
	Pedestrian	14	63	145	222	12	69	291	372	**594**
N2 Total		**20**	**91**	**252**	**363**	**16**	**141**	**573**	**730**	**1093**
N3	Pedal cycle	24	78	152	254	54	176	414	644	**898**
	Pedestrian	145	155	186	486	52	155	263	470	**956**
N3 Total		**169**	**233**	**338**	**740**	**106**	**331**	**677**	**1114**	**1854**
N n/k	Pedal cycle	0	2	11	13	0	6	16	22	**35**
	Pedestrian	1	2	4	7	0	4	25	29	**36**
N n/k Total		**1**	**4**	**15**	**20**	**0**	**10**	**41**	**51**	**71**
N all	Pedal cycle	30	108	270	408	58	254	712	1024	**1432**
	Pedestrian	160	220	335	715	64	228	579	871	**1586**
N all Total		**190**	**328**	**605**	**1123**	**122**	**482**	**1291**	**1895**	**3018**

Table 11 and Table 12 describe the 1,432 pedal cyclist and the 1,586 pedestrian casualties respectively by the distribution of the VOI's Gross Vehicle Weight (GVW).

The majority of pedal cyclist and pedestrian casualties were associated with N3 vehicles with a GVW of greater than 28 tonnes and less than 44 tonnes.

Table 11: Pedal cyclists struck by front or side of N vehicles, by GVW and injury severity

Vehicle type	Gross Vehicle Weight (GVW)	Cyclists hit by front of vehicle				Cyclists hit by side of vehicle				Grand Total
		Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
N2	**All (Total)**	**6**	**28**	**107**	**141**	**4**	**72**	**282**	**358**	**499**
	GVW known	6	23	59	88	3	44	169	216	**304**
	>3.5-<7.5t	1	5	23	29	0	8	55	63	**92**
	7.5t-12t	5	18	36	59	3	36	114	153	**212**
N3	**All (Total)**	**24**	**78**	**152**	**254**	**54**	**176**	**414**	**644**	**898**
	GVW known	22	62	106	190	49	145	306	500	**690**
	>12t-18t	3	17	31	51	11	46	91	148	**199**
	>18t-28t	2	10	18	30	9	28	69	106	**136**
	>28t-44t	17	35	57	109	29	71	146	246	**355**
N n/k		0	2	11	13	0	6	16	22	**35**
Total		**30**	**108**	**270**	**408**	**58**	**254**	**712**	**1024**	**1432**

Table 12: Pedestrians struck by front or side of N vehicles, by GVW and injury severity

Vehicle type	Gross Vehicle Weight (GVW)	Pedestrian hit by front of vehicle				Pedestrian hit by side of vehicle				Grand Total
		Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
N2	**All (Total)**	**14**	**63**	**145**	**222**	**12**	**69**	**291**	**372**	**594**
	GVW known	11	48	87	146	8	42	173	223	**369**
	>3.5-<7.5t	1	11	22	34	0	11	49	60	**94**
	7.5t-12t	10	37	65	112	8	31	124	163	**275**
N3	**All (Total)**	**145**	**155**	**186**	**486**	**52**	**155**	**263**	**470**	**956**
	GVW known	125	137	138	400	48	129	180	357	**757**
	>12t-18t	23	29	38	90	9	33	58	100	**190**
	>18t-28t	17	27	31	75	9	30	41	80	**155**
	>28t-44t	85	81	69	235	30	66	81	177	**412**
N n/k		1	2	4	7	0	4	25	29	**36**
Total		**160**	**220**	**335**	**715**	**64**	**228**	**579**	**871**	**1586**

Table 13 to Table 18 outline the manoeuvre of the VOI, differentiated by the urban or rural area where the collision occurred. The VRUs are classified as those struck by the front or side of the VOI and their injury severity.

Table 13, Table 14 and Table 15 consider the VOI's type of manoeuvre by pedal cyclist injury severity, by the side of the vehicle impacted and the area (urban or rural) where the collision occurred.

Table 16, Table 17 and Table 18 consider the VOI's type of manoeuvre by pedestrian injury severity, by the side of the vehicle impacted and the area (urban or rural) where the collision occurred.

Vehicle manoeuvre is based on a field collected in Stats19 which captures the movements and intended manoeuvres of each vehicle through the collision locus (Appendix B for official guidance on how this field is captured). The Stats19 manoeuvres have been grouped.

"Going ahead other" is one of the manoeuvres that is used to describe a vehicle which is not deviating from its course through the collision locus and is independent of the road structure and infrastructure. For example, where the collision locus is a junction it can be used to describe a vehicle that is travelling through the junction without turning off of the original road and onto a side road. It can also be used to describe a vehicle travelling along a road with no intersections, junctions or roundabouts. As a result "Going ahead other" naturally encompasses a wide variety of situations, which is reflected in the following tables.

The manoeuvre has been included in the analysis and generation of the estimated gross population because it will include collisions which are relevant to this measure as well as collisions that are not relevant. The purpose of this phase of the analysis is to estimate the maximum potential target population which will include some vehicles described as "Going ahead other". The proportion of these vehicles that are relevant for this measure must be determined on a case-by-case basis which will be performed in the second phase of the analysis.

Further description on manoeuvre is given in Appendix B.

Table 13: Pedal cyclist casualties struck by the front or side of N2 vehicles by the VOI manoeuvre and area

Region	Pedal cyclist	.. hit by front of vehicle				.. hit by side of vehicle				Grand Total
	N2 manoeuvre	Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
Urban	Waiting	0	1	2	3	0	0	9	9	**12**
	Slowing or stopping	0	0	3	3	0	2	2	4	**7**
	Moving off	0	1	9	10	0	0	11	11	**21**
	Turning L	0	2	16	18	1	14	45	60	**78**
	Turning R	0	4	23	27	0	8	30	38	**65**
	Changing lane	1	0	0	1	0	0	8	8	**9**
	Overtaking	0	2	5	7	0	10	48	58	**65**
	Going ahead bend	0	0	4	4	0	0	6	6	**10**
	Going ahead other	2	7	27	36	1	9	45	55	**91**
	Other	0	0	0	0	0	4	21	25	**25**
	Total	3	17	89	109	2	47	225	274	**383**
Rural	Waiting	0	0	0	0	0	2	0	2	**2**
	Slowing or stopping	0	0	1	1	0	0	0	0	**1**
	Moving off	0	0	0	0	0	0	3	3	**3**
	Turning L	0	0	2	2	0	1	4	5	**7**
	Turning R	0	0	2	2	0	0	1	1	**3**
	Changing lane	0	0	0	0	0	0	0	0	**0**
	Overtaking	0	1	1	2	0	2	19	21	**23**
	Going ahead bend	1	0	1	2	0	4	6	10	**12**
	Going ahead other	2	10	8	20	2	15	21	38	**58**
	Other	0	0	2	2	0	0	3	3	**5**
	Total	3	11	17	31	2	24	57	83	**114**
Not known		0	0	1	1	0	1	0	1	**2**
Total		**6**	**28**	**107**	**141**	**4**	**72**	**282**	**358**	**499**

Table 14: Pedal cyclist casualties struck by the front or side of N3 vehicles by the VOI manoeuvre and region

Region	Pedal cyclist	.. hit by front of vehicle				.. hit by side of vehicle				Grand Total
	N3 manoeuvre	Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
Urban	Waiting	0	0	1	1	0	0	7	7	**8**
	Slowing or stopping	1	2	5	8	1	1	1	3	**11**
	Moving off	1	3	20	24	2	10	27	39	**63**
	Turning L	4	12	17	33	24	56	87	167	**200**
	Turning R	1	5	15	21	2	3	24	29	**50**
	Changing lane	1	3	1	5	0	3	12	15	**20**
	Overtaking	0	4	8	12	2	15	63	80	**92**
	Going ahead bend	1	0	2	3	3	3	11	17	**20**
	Going ahead other	3	20	37	60	8	30	70	108	**168**
	Other	0	0	6	6	0	9	27	36	**42**
	Total	12	49	112	173	42	130	329	501	**674**
Rural	Waiting	0	0	1	1	1	2	0	3	**4**
	Slowing or stopping	0	0	1	1	0	2	0	2	**3**
	Moving off	0	1	4	5	1	3	3	7	**12**
	Turning L	1	1	3	5	1	6	9	16	**21**
	Turning R	1	4	8	13	0	0	6	6	**19**
	Changing lane	0	0	0	0	1	1	1	3	**3**
	Overtaking	2	4	6	12	3	11	40	54	**66**
	Going ahead bend	0	4	1	5	0	2	1	3	**8**
	Going ahead other	8	13	12	33	5	17	22	44	**77**
	Other	0	0	2	2	0	1	3	4	**6**
	Total	12	27	38	77	12	45	85	142	**219**
Not known		0	2	2	4	0	1	0	1	**5**
Total		**24**	**78**	**152**	**254**	**54**	**176**	**414**	**644**	**898**

Table 15: Pedal cyclist casualties struck by the front or side of N2, N3 and N n/k vehicles by the VOI manoeuvre and region

Region	Pedal cyclist	.. hit by front of vehicle				.. hit by side of vehicle				Grand Total
	N manoeuvre	Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
Urban	Waiting	0	1	3	4	0	0	16	16	**20**
	Slowing or stopping	1	2	8	11	1	3	3	7	**18**
	Moving off	1	4	33	38	2	10	38	50	**88**
	Turning L	4	14	35	53	25	71	135	231	**284**
	Turning R	1	10	39	50	2	11	58	71	**121**
	Changing lane	2	3	1	6	0	3	20	23	**29**
	Overtaking	0	6	13	19	2	26	113	141	**160**
	Going ahead bend	1	0	6	7	3	4	18	25	**32**
	Going ahead other	5	27	66	98	9	39	118	166	**264**
	Other	0	0	6	6	0	13	48	61	**67**
	Total	15	67	210	292	44	180	567	791	**1083**
Rural	Waiting	0	0	1	1	1	4	0	5	**6**
	Slowing or stopping	0	0	2	2	0	2	0	2	**4**
	Moving off	0	1	4	5	1	3	6	10	**15**
	Turning L	1	1	6	8	1	7	14	22	**30**
	Turning R	1	4	10	15	0	0	7	7	**22**
	Changing lane	0	0	0	0	1	1	1	3	**3**
	Overtaking	2	5	7	14	3	14	60	77	**91**
	Going ahead bend	1	4	2	7	0	6	7	13	**20**
	Going ahead other	10	24	20	54	7	34	44	85	**139**
	Other	0	0	4	4	0	1	6	7	**11**
	Total	15	39	56	110	14	72	145	231	**341**
Not known		0	2	4	6	0	2	0	2	**8**
Total		**30**	**108**	**270**	**408**	**58**	**254**	**712**	**1024**	**1432**

Table 16: Pedestrians casualties struck by the front or side of N2 vehicles by the VOI manoeuvre and area

Region	Pedestrians	.. hit by front of vehicle				.. hit by side of vehicle				Grand Total
	N2 manoeuvre	Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
Urban	Waiting	0	0	1	1	0	0	3	3	**4**
	Slowing or stopping	0	1	5	6	0	0	7	7	**13**
	Moving off	2	4	15	21	1	9	12	22	**43**
	Turning L	1	3	11	15	4	7	27	38	**53**
	Turning R	0	4	14	18	1	2	12	15	**33**
	Changing lane	0	0	1	1	0	0	0	0	**1**
	Overtaking	0	0	4	4	0	1	8	9	**13**
	Going ahead bend	1	2	3	6	0	3	10	13	**19**
	Going ahead other	7	30	74	111	5	28	146	179	**290**
	Other	0	2	3	5	0	2	6	8	**13**
	Total	11	46	131	188	11	52	231	294	**482**
Rural	Waiting	0	0	0	0	0	0	0	0	**0**
	Slowing or stopping	0	1	1	2	0	0	1	1	**3**
	Moving off	1	0	0	1	0	1	4	5	**6**
	Turning L	0	1	0	1	0	2	1	3	**4**
	Turning R	0	1	1	2	0	0	0	0	**2**
	Changing lane	0	0	0	0	0	0	0	0	**0**
	Overtaking	0	0	0	0	0	0	1	1	**1**
	Going ahead bend	0	0	0	0	0	0	3	3	**3**
	Going ahead other	2	13	10	25	1	13	50	64	**89**
	Other	0	0	1	1	0	1	0	1	**2**
	Total	3	16	13	32	1	17	60	78	**110**
Not known		0	1	1	2	0	0	0	0	**2**
Total		**14**	**63**	**145**	**222**	**12**	**69**	**291**	**372**	**594**

Table 17: Pedestrians casualties struck by the front or side of N3 vehicles by the VOI manoeuvre and area

Region	Pedestrians	.. hit by front of vehicle				.. hit by side of vehicle				Grand Total
	N3 manoeuvre	Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
Urban	Waiting	1	2	7	10	1	1	1	3	**13**
	Slowing or stopping	3	1	5	9	1	2	3	6	**15**
	Moving off	36	20	29	85	7	11	22	40	**125**
	Turning L	2	6	15	23	7	19	43	69	**92**
	Turning R	1	4	12	17	2	12	29	43	**60**
	Changing lane	0	0	0	0	0	0	0	0	**0**
	Overtaking	3	1	2	6	0	3	3	6	**12**
	Going ahead bend	1	2	6	9	1	3	4	8	**17**
	Going ahead other	45	67	69	181	13	47	85	145	**326**
	Other	0	2	2	4	2	8	9	19	**23**
	Total	92	105	147	344	34	106	199	339	**683**
Rural	Waiting	0	0	1	1	0	1	1	2	**3**
	Slowing or stopping	0	3	4	7	0	0	1	1	**8**
	Moving off	5	3	4	12	1	9	5	15	**27**
	Turning L	1	3	3	7	1	2	4	7	**14**
	Turning R	0	0	0	0	1	1	6	8	**8**
	Changing lane	1	0	0	1	1	0	0	1	**2**
	Overtaking	0	0	0	0	0	1	2	3	**3**
	Going ahead bend	1	1	3	5	1	2	3	6	**11**
	Going ahead other	43	40	22	105	13	31	39	83	**188**
	Other	0	0	0	0	0	1	3	4	**4**
	Total	51	50	37	138	18	48	64	130	**268**
Not known		2	0	2	4	0	1	0	1	**5**
Total		**145**	**155**	**186**	**486**	**52**	**155**	**263**	**470**	**956**

Table 18: Pedestrians casualties struck by the front or side of N2, N3 and N n/k vehicles by the VOI manoeuvre and area

Region	Pedestrians	.. hit by front of vehicle				.. hit by side of vehicle				Grand Total
	N manoeuvre	Killed	Seriously injured	Slightly injured	Total	Killed	Seriously injured	Slightly injured	Total	
Urban	Waiting	1	2	8	11	1	1	4	6	**17**
	Slowing or stopping	3	2	10	15	1	2	10	13	**28**
	Moving off	38	24	44	106	8	20	34	62	**168**
	Turning L	3	9	27	39	11	27	70	108	**147**
	Turning R	1	8	26	35	3	14	43	60	**95**
	Changing lane	0	0	1	1	0	0	0	0	**1**
	Overtaking	3	1	6	10	0	4	11	15	**25**
	Going ahead bend	2	4	9	15	1	6	14	21	**36**
	Going ahead other	52	98	146	296	18	76	244	338	**634**
	Other	0	4	5	9	2	10	17	29	**38**
	Total	103	152	282	537	45	160	447	652	**1189**
Rural	Waiting	0	0	1	1	0	1	1	2	**3**
	Slowing or stopping	0	4	5	9	0	0	2	2	**11**
	Moving off	6	4	4	14	1	10	9	20	**34**
	Turning L	1	4	3	8	1	4	5	10	**18**
	Turning R	1	1	1	3	1	1	6	8	**11**
	Changing lane	1	0	0	1	1	0	0	1	**2**
	Overtaking	0	0	0	0	0	1	3	4	**4**
	Going ahead bend	1	1	3	5	1	2	6	9	**14**
	Going ahead other	45	53	32	130	14	46	97	157	**287**
	Other	0	0	1	1	0	2	3	5	**6**
	Total	55	67	50	172	19	67	132	218	**390**
Not known		2	1	3	6	0	1	0	1	**7**
Total		**160**	**220**	**335**	**715**	**64**	**228**	**579**	**871**	**1586**

Table 19 summarises the Target Population for VIS.

Table 19: Gross target population for VIS

Region	VRU	Injury severity			
		Killed	Seriously injured	Slightly injured	Total
N2	Pedal cyclist	10	100	389	**499**
	Pedestrian	26	132	436	**594**
	Total	36	232	825	**1093**
N3	Pedal cyclist	78	254	566	**898**
	Pedestrian	197	310	449	**956**
	Total	275	564	1015	**1854**
N n/k	Pedal cyclist	0	8	27	**35**
	Pedestrian	1	6	29	**36**
	Total	1	14	56	**71**
N all	Pedal cyclist	88	362	982	**1432**
	Pedestrian	224	448	914	**1586**
Total		**312**	**810**	**1896**	**3018**

3.1.2 In-depth assessment of collision typology (RAIDS)

The target population summarised in Table 20 estimates the maximum pedal cyclist and pedestrian casualties in GB over a 5 year period that could be influenced by this measure. The target population is limited by the resolution of the Stats19 dataset used to determine the figures. However, by using a more detailed dataset (RAIDS) it is possible to infer a more accurate target population by accounting for more factors that will influence the effectiveness of the measure (e.g. travelling speed of the heavy vehicle).

The subset of RAIDS used in this measure (HVCIS) only captures fatal collisions that occurred from 1995 to 2010. Therefore, only the estimated target population of fatalities will be considered and the raw RAIDS figures must be weighted to the Stats19 sample of fatalities from 2011 to 2015. As the datasets are from different time periods, the RAIDS dataset will not perfectly weight up to the Stats19 figures because some collisions will have occurred in the RAIDS sample that have not occurred in the Stats19. These collisions are effectively given a weighting factor of 0 and as a result the RAIDS totals will not always match the Stats19 totals.

Table 20 and Table 21 show the RAIDS data for pedal cyclists and pedestrians killed by heavy vehicles respectively. Both tables show the distribution of fatalities hit by the front or side of

the heavy vehicle, the manoeuvre the vehicle was performing and the region (urban or rural) of the collision locus for N2, N3 and all heavy vehicles (N2, N3 and N2 or N3 with unknown gross vehicle masses).

Table 20: RAIDS pedal cycle fatalities by type of heavy vehicle, manoeuvre and area

RAIDS pedal cycle fatalities		N2 Pedal cycle Fatalities			N3 Pedal cycle Fatalities			All Pedal cycle Fatalities		
		Frontal	Side	Total	Frontal	Side	Total	Frontal	Side	Total
Urban	Waiting	0	0	**0**	0	0	**0**	0	0	**0**
	Stopping	0	0	**0**	0	0	**0**	0	0	**0**
	Moving off	1	1	**2**	4	6	**10**	6	7	**13**
	Turning Left	2	2	**4**	16	25	**41**	22	38	**60**
	Turning Right	0	2	**2**	0	3	**3**	2	7	**9**
	Changing lane	0	0	**0**	0	0	**0**	0	0	**0**
	Overtaking	0	0	**0**	1	1	**2**	2	4	**6**
	Going ahead bend	0	0	**0**	0	0	**0**	0	1	**1**
	Going ahead other	8	1	**9**	8	10	**18**	18	14	**32**
	Other	0	0	**0**	0	0	**0**	0	0	**0**
	Total	11	6	**17**	29	45	**74**	50	71	**121**
Rural	Waiting	0	0	**0**	0	0	**0**	0	0	**0**
	Stopping	0	0	**0**	0	0	**0**	0	0	**0**
	Moving off	0	0	**0**	0	0	**0**	0	0	**0**
	Turning Left	0	0	**0**	0	0	**0**	0	0	**0**
	Turning Right	0	0	**0**	0	0	**0**	0	0	**0**
	Changing lane	0	0	**0**	0	0	**0**	1	0	**1**
	Overtaking	1	3	**4**	3	1	**4**	4	5	**9**
	Going ahead bend	0	0	**0**	0	0	**0**	0	0	**0**
	Going ahead other	6	2	**8**	9	1	**10**	16	3	**19**
	Other	0	0	**0**	0	0	**0**	0	0	**0**
	Total	7	5	**12**	12	2	**14**	21	8	**29**
Unknown		0	0	**0**	2	1	**3**	4	4	**8**
Total		**18**	**11**	**29**	**43**	**48**	**91**	**75**	**83**	**158**

Table 21: RAIDS pedestrian fatalities by type of heavy vehicle, manoeuvre and area

RAIDS pedestrian fatalities		N2 Pedestrian Fatalities			N3 Pedestrian Fatalities			All Pedestrian Fatalities		
		Frontal	Side	Total	Frontal	Side	Total	Frontal	Side	Total
Urban	Waiting	0	0	**0**	0	0	**0**	0	0	**0**
	Stopping	0	0	**0**	1	0	**1**	1	0	**1**
	Moving off	3	0	**3**	58	3	**61**	85	3	**88**
	Turning Left	1	0	**1**	6	14	**20**	8	19	**27**
	Turning Right	1	0	**1**	3	0	**3**	5	3	**8**
	Changing lane	0	0	**0**	0	0	**0**	0	0	**0**
	Overtaking	1	1	**2**	0	1	**1**	1	3	**4**
	Going ahead bend	4	1	**5**	2	2	**4**	6	3	**9**
	Going ahead other	22	4	**26**	27	11	**38**	68	23	**91**
	Other	2	0	**2**	5	2	**7**	8	3	**11**
	Total	34	6	**40**	102	33	**135**	182	57	**239**
Rural	Waiting	0	0	**0**	0	0	**0**	0	0	**0**
	Stopping	0	0	**0**	0	0	**0**	0	0	**0**
	Moving off	1	0	**1**	0	0	**0**	1	0	**1**
	Turning Left	0	0	**0**	0	0	**0**	0	0	**0**
	Turning Right	0	0	**0**	0	0	**0**	0	0	**0**
	Changing lane	0	0	**0**	1	0	**1**	1	0	**1**
	Overtaking	0	0	**0**	2	0	**2**	2	0	**2**
	Going ahead bend	3	1	**4**	5	0	**5**	8	1	**9**
	Going ahead other	11	4	**15**	36	4	**40**	56	13	**69**
	Other	0	0	**0**	0	0	**0**	0	0	**0**
	Total	15	5	**20**	44	4	**48**	68	14	**82**
Unknown		1	0	**1**	6	2	**8**	8	3	**11**
Total		**50**	**11**	**61**	**152**	**39**	**191**	**258**	**74**	**332**

3.1.2.1 *Weighting RAIDS data*

The RAIDS data was weighted to the equivalent Stats19 data for pedal cyclists and pedestrian killed by N2 (Table 13 and Table 16), N3 (Table 14 and Table 17) and all heavy vehicles (Table 15 and Table 18) respectively.

The following tables detail the factors used to weight the RAIDS data to the estimated gross target population at a national level for pedal cyclist (Table 22) and pedestrian (Table 23) fatalities respectively. These factors correct the RAIDS data based on vehicle type, vehicle manoeuvre, VRU type, and collision location.

Table 22: Weighting factors for pedal cyclist fatalities

		N2 Pedal cycle Fatalities		N3 Pedal cycle Fatalities		All Pedal cycle Fatalities	
		Frontal	Side	Frontal	Side	Frontal	Side
Urban	Waiting	0.00	0.00	0.00	0.00	0.00	0.00
	Stopping	0.00	0.00	0.00	0.00	0.00	0.00
	Moving off	0.00	0.00	0.25	0.33	0.17	0.29
	Turning Left	0.00	0.50	0.25	0.96	0.18	0.66
	Turning Right	0.00	0.00	0.00	0.67	0.50	0.29
	Changing lane	0.00	0.00	0.00	0.00	0.00	0.00
	Overtaking	0.00	0.00	0.00	2.00	0.00	0.50
	Going ahead bend	0.00	0.00	0.00	0.00	0.00	3.00
	Going ahead other	0.25	1.00	0.38	0.80	0.28	0.64
	Other	0.00	0.00	0.00	0.00	0.00	0.00
Rural	Waiting	0.00	0.00	0.00	0.00	0.00	0.00
	Stopping	0.00	0.00	0.00	0.00	0.00	0.00
	Moving off	0.00	0.00	0.00	0.00	0.00	0.00
	Turning Left	0.00	0.00	0.00	0.00	0.00	0.00
	Turning Right	0.00	0.00	0.00	0.00	0.00	0.00
	Changing lane	0.00	0.00	0.00	0.00	0.00	0.00
	Overtaking	0.00	0.00	0.67	3.00	0.50	0.60
	Going ahead bend	0.00	0.00	0.00	0.00	0.00	0.00
	Going ahead other	0.33	1.00	0.89	5.00	0.63	2.33
	Other	0.00	0.00	0.00	0.00	0.00	0.00
Unknown		0.00	0.00	0.00	0.00	0.00	0.00

Table 23: Weighting factors for pedestrian fatalities

		N2 Pedestrian Fatalities		N3 Pedestrian Fatalities		All Pedestrian Fatalities	
		Frontal	Side	Frontal	Side	Frontal	Side
Urban	Waiting	0.00	0.00	0.00	0.00	0.00	0.00
	Stopping	0.00	0.00	3.00	0.00	3.00	0.00
	Moving off	0.67	0.00	0.62	2.33	0.45	2.67
	Turning Left	1.00	0.00	0.33	0.50	0.38	0.58
	Turning Right	0.00	0.00	0.33	0.00	0.20	1.00
	Changing lane	0.00	0.00	0.00	0.00	0.00	0.00
	Overtaking	0.00	0.00	0.00	0.00	3.00	0.00
	Going ahead bend	0.25	0.00	0.50	0.50	0.33	0.33
	Going ahead other	0.32	1.25	1.67	1.18	0.76	0.78
	Other	0.00	0.00	0.00	1.00	0.00	0.67
Rural	Waiting	0.00	0.00	0.00	0.00	0.00	0.00
	Stopping	0.00	0.00	0.00	0.00	0.00	0.00
	Moving off	1.00	0.00	0.00	0.00	6.00	0.00
	Turning Left	0.00	0.00	0.00	0.00	0.00	0.00
	Turning Right	0.00	0.00	0.00	0.00	0.00	0.00
	Changing lane	0.00	0.00	1.00	0.00	1.00	0.00
	Overtaking	0.00	0.00	0.00	0.00	0.00	0.00
	Going ahead bend	0.00	0.00	0.20	0.00	0.13	1.00
	Going ahead other	0.18	0.25	1.19	3.25	0.80	1.08
	Other	0.00	0.00	0.00	0.00	0.00	0.00
Unknown		0.00	0.00	0.33	0.00	0.25	0.00

The weighted RAIDS data are detailed in the following 6 tables and show the distribution of pedal cyclists and pedestrians killed by collisions with N2, N3 and all heavy vehicles respectively, accounting for the speed and manoeuvre of the vehicle.

The estimate of the Target Population for VIS for cyclist and pedestrian fatalities, is based on the following assumptions:

- The heavy vehicle was travelling under or equal to 20 mph (32 km/h), and
- The heavy vehicle was performing a relevant manoeuvre.

This analysis is based on RAIDS HVCIS (fatal) data analysis only and does not include case-by-case investigation. The findings provide a useful guide, but there are limitations with this approach, including the assumptions listed above, the HVCIS cases cover an older timescale (from 1990s) than Stats19 and other collision causation factors and circumstances are not accounted for. Therefore at this stage the weighted results have not been used to quantify the Target Population. Instead, the findings from the Stats19 analysis are used. Research Question 2 will follow a case-by-case analysis method and through the deeper investigation

of more recent RAIDS collisions it will be possible to identify the importance of driver vision and weight the cases more accurately

The subsequent tables show pedal cyclists and pedestrians killed by collisions with heavy vehicles where the speed was calculated reliably. An adjustment has been made at the bottom of each table to weight the collisions to include vehicles with unknown travel speeds (Weighted Total).

These casualties and the target population in each table are highlighted in red.

Table 26 estimates a Target Population for improved visibility of 42 pedal cyclists killed in collisions with heavy vehicles (N2, N3 and N n/k) from a total of 88 fatalities.

Table 29 estimates a Target Population for improved visibility of 78 pedestrians killed in collisions with heavy vehicles (N2, N3 and N n/k) from a total of 224 fatalities.

Table 24: Weighted pedal cyclists killed by N2 vehicles by the speed (mph) and manoeuvre

Heavy Vehicle Manoeuvre	0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-60	61-70	Total
Changing lane to left	0	0	0	0	0	0	0	0	0	0	0
Changing lane to right	0	0	0	0	0	0	0	0	0	0	0
Going ahead left hand bend	0	0	0	0	0	0	0	0	0	0	0
Going ahead other	0	0	0	0	1	0	2	1	0	1	5
Going ahead right hand bend	0	0	0	0	0	0	0	0	0	0	0
Held-up	0	0	0	0	0	0	0	0	0	0	0
Overtaking moving vehicle	0	0	0	0	0	0	0	0	0	0	0
Overtaking stationary vehicle	0	0	0	0	0	0	0	0	0	0	0
Parked	0	0	0	0	0	0	0	0	0	0	0
Reversing	0	0	0	0	0	0	0	0	0	0	0
Starting	0	0	0	0	0	0	0	0	0	0	0
Stopping	0	0	0	0	0	0	0	0	0	0	0
Turning left	0	1	0	0	0	0	0	0	0	0	1
Turning right	0	0	0	0	0	0	0	0	0	0	0
U turn	0	0	0	0	0	0	0	0	0	0	0
Undertaking (on nearside)	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn left	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn right	0	0	0	0	0	0	0	0	0	0	0
Total (speed known)	0	1	0	0	1	0	2	1	0	1	6
Weighted Total	0	2	0	0	2	0	3	2	0	2	10
Target Population	2										

Table 25: Weighted pedal cyclists killed by N3 vehicles by the speed (mph) and manoeuvre

Heavy Vehicle Manoeuvre	0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-60	61-70	Total
Changing lane to left	0	0	0	0	0	0	0	0	0	0	0
Changing lane to right	0	0	0	0	0	0	0	0	0	0	0
Going ahead left hand bend	0	0	0	0	0	0	0	0	0	0	0
Going ahead other	1	1	0	2	1	2	3	9	4	0	23
Going ahead right hand bend	0	0	0	0	0	0	0	0	0	0	0
Held-up	0	0	0	0	0	0	0	0	0	0	0
Overtaking moving vehicle	0	0	0	0	0	0	0	1	4	0	4
Overtaking stationary vehicle	0	0	0	0	0	0	0	0	0	0	0
Parked	0	0	0	0	0	0	0	0	0	0	0
Reversing	0	0	0	0	0	0	0	0	0	0	0
Starting	1	0	0	0	0	0	0	0	0	0	1
Stopping	0	0	0	0	0	0	0	0	0	0	0
Turning left	5	8	7	0	0	0	0	0	0	0	20
Turning right	0	0	1	0	0	0	0	0	0	0	1
U turn	0	0	0	0	0	0	0	0	0	0	0
Undertaking (on nearside)	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn left	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn right	0	0	0	0	0	0	0	0	0	0	0
Total (speed known)	7	9	8	2	1	2	3	9	8	0	49
Weighted Total	11	14	13	3	2	3	5	14	13	0	78
Target Population	41										

Table 26: Weighted pedal cyclists killed by all heavy vehicles by the speed (mph) and manoeuvre

Heavy Vehicle Manoeuvre	0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-60	61-70	Total
Changing lane to left	0	0	0	0	0	0	0	0	0	0	0
Changing lane to right	0	0	0	0	0	0	0	0	0	0	0
Going ahead left hand bend	0	0	0	0	0	0	0	0	0	0	0
Going ahead other	1	1	0	2	1	2	5	10	4	1	28
Going ahead right hand bend	0	0	0	0	0	0	0	0	0	0	0
Held-up	0	0	0	0	0	0	0	0	0	0	0
Overtaking moving vehicle	0	0	0	0	0	0	0	1	4	0	4
Overtaking stationary vehicle	0	0	0	0	0	0	0	0	0	0	0
Parked	0	0	0	0	0	0	0	0	0	0	0
Reversing	0	0	0	0	0	0	0	0	0	0	0
Starting	1	0	0	0	0	0	0	0	0	0	1
Stopping	0	0	0	0	0	0	0	0	0	0	0
Turning left	5	9	7	0	0	0	0	0	0	0	20
Turning right	0	0	1	0	0	0	0	0	0	0	1
U turn	0	0	0	0	0	0	0	0	0	0	0
Undertaking (on nearside)	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn left	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn right	0	0	0	0	0	0	0	0	0	0	0
Total (speed known)	7	10	8	2	1	2	5	11	8	1	55
Weighted Total	11	15	13	3	2	3	8	18	13	2	88
Target Population	42										

In summary, 42 of 88 (48%) pedal cyclists were killed in collisions where improved visibility could have influenced the outcome. The most common collision type involved N3 vehicles “turning left” at low speed (20 pedal cyclists).

Table 27: Weighted pedestrians killed by N2 vehicles by the speed (mph) and manoeuvre

Heavy Vehicle Manoeuvre	0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-60	61-70	Total
Changing lane to left	0	0	0	0	0	0	0	0	0	0	0
Changing lane to right	0	0	0	0	0	0	0	0	0	0	0
Going ahead left hand bend	0	0	0	0	0	1	0	0	0	0	1
Going ahead other	0	0	0	0	2	3	5	1	2	1	14
Going ahead right hand bend	0	0	0	0	0	0	0	0	0	0	0
Held-up	0	0	0	0	0	0	0	0	0	0	0
Overtaking moving vehicle	0	0	0	0	0	0	0	0	0	0	0
Overtaking stationary vehicle	0	0	0	0	0	0	0	0	0	0	0
Parked	0	0	0	0	0	0	0	0	0	0	0
Reversing	0	0	0	0	0	0	0	0	0	0	0
Starting	0	0	0	0	0	0	0	0	0	0	0
Stopping	0	0	0	0	0	0	0	0	0	0	0
Turning left	0	0	0	0	0	0	0	0	0	0	0
Turning right	0	0	0	0	0	0	0	0	0	0	0
U turn	0	0	0	0	0	0	0	0	0	0	0
Undertaking (on nearside)	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn left	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn right	0	0	0	0	0	0	0	0	0	0	0
Total (speed known)	0	0	0	0	2	4	5	1	2	1	15
Weighted Total	0	0	0	0	3	7	9	2	3	2	26
Target Population	0										

Table 28: Weighted pedestrians killed by N3 vehicles by the speed (mph) and manoeuvre

Heavy Vehicle Manoeuvre	0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-60	61-70	Total
Changing lane to left	0	0	0	0	0	0	0	0	0	0	0
Changing lane to right	0	0	0	0	1	0	0	0	0	0	1
Going ahead left hand bend	1	1	0	0	0	0	0	0	1	0	2
Going ahead other	3	5	2	3	5	14	19	28	25	0	104
Going ahead right hand bend	0	0	0	1	0	0	0	0	0	0	1
Held-up	0	0	0	0	0	0	0	0	0	0	0
Overtaking moving vehicle	0	0	0	0	0	0	0	0	0	0	0
Overtaking stationary vehicle	0	0	0	0	0	0	0	0	0	0	0
Parked	0	0	0	1	0	0	0	0	0	0	1
Reversing	0	0	0	0	0	0	0	0	0	0	0
Starting	20	7	3	0	0	0	0	0	0	0	31
Stopping	3	0	0	0	0	0	0	0	0	0	3
Turning left	2	3	2	1	0	0	0	0	0	0	8
Turning right	0	0	0	0	0	0	0	0	0	0	1
U turn	0	0	0	0	0	0	0	0	0	0	0
Undertaking (on nearside)	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn left	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn right	0	0	0	0	0	0	0	0	0	0	0
Total (speed known)	29	16	8	5	6	14	19	28	26	0	151
Weighted Total	38	21	10	7	8	18	25	37	34	0	197
Target Population	76										

Table 29: Weighted pedestrians killed by all heavy vehicles by the speed (mph) and manoeuvre

Heavy Vehicle Manoeuvre	0-5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-60	61-70	Total
Changing lane to left	0	0	0	0	0	0	0	0	0	0	0
Changing lane to right	0	0	0	0	1	0	0	0	0	0	1
Going ahead left hand bend	0	0	0	0	0	1	0	0	2	0	3
Going ahead other	2	2	4	3	10	18	28	20	26	3	116
Going ahead right hand bend	0	0	0	0	0	0	0	0	0	0	1
Held-up	0	0	0	0	0	0	0	0	0	0	0
Overtaking moving vehicle	0	0	0	0	0	3	0	0	0	0	3
Overtaking stationary vehicle	0	0	0	0	0	0	0	0	0	0	0
Parked	0	0	0	1	0	0	0	0	0	0	1
Reversing	0	0	0	0	0	0	0	0	0	0	0
Starting	22	7	2	0	0	0	0	0	0	0	31
Stopping	3	0	0	0	0	0	0	0	0	0	3
Turning left	2	4	4	2	0	0	0	0	0	0	11
Turning right	1	0	0	1	0	0	0	0	0	0	3
U turn	0	0	0	0	0	0	0	0	0	0	0
Undertaking (on nearside)	0	0	0	0	0	0	0	0	0	0	0
Unknown	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn left	0	0	0	0	0	0	0	0	0	0	0
Waiting to turn right	0	0	0	0	0	0	0	0	0	0	0
Total (speed known)	30	13	10	7	11	22	28	21	27	4	173
Weighted Total	39	17	13	9	14	28	36	27	35	5	224
Target Population	78										

For pedestrians killed by collisions with heavy vehicles, it is estimated that 35% (78 of 224) could have been prevented with improved visibility. The majority of the pedestrians (76) were killed by collisions with N3 vehicles, but more work (Research Question 2) is required before the nature of N2 vehicle pedestrian conclusions can be quantified.

3.1.3 Summary

Figure 1 shows a diagrammatic representation of the analysis performed using Stats19 and weighted RAIDS (HVCIS) data to generate the estimated gross target population.

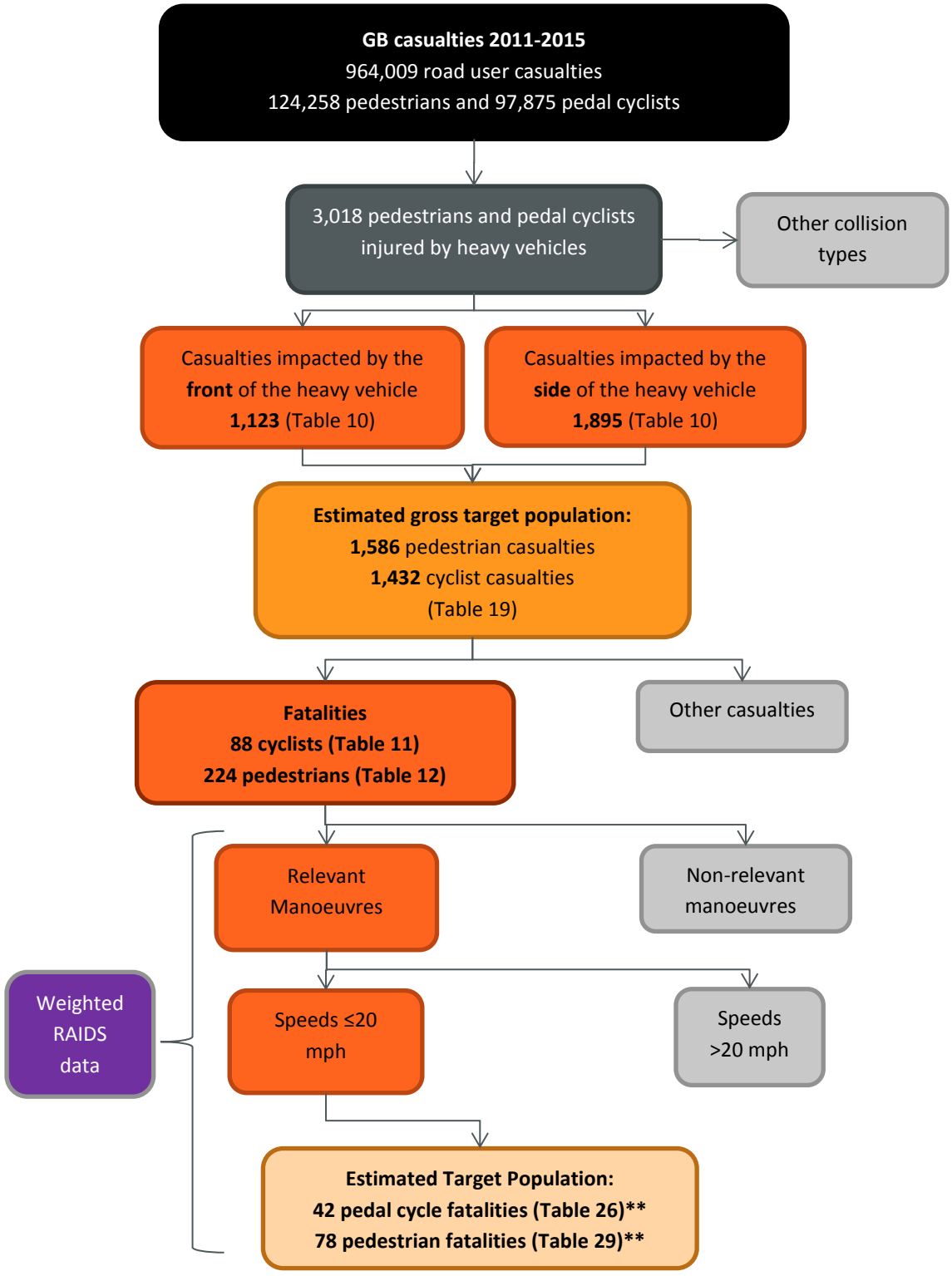


Figure 1: Tree diagram of the analysis generating the estimated gross target population for pedestrians and cyclists killed by N2 and N3 vehicles

** A breakdown of fatalities killed by N2 vehicles is shown in Table 24 and Table 27.

** A breakdown of fatalities killed by N3 vehicles is shown in Table 25 and Table 28.

3.2 Intelligent Speed Assistance (ISA)

- Benefits of ISA on Passenger Vehicles and Commercial Vehicles (CV), compared with speed limiters already regulated
- Vehicle Type: (M1/N1); M2/N2; M3/N3
- Find the potential casualty target population for ISA (i.e. accidents with speed limit infringement) and the proportion and gravity of accidents by vehicle type (limited to STATS19 vehicle types)

3.2.1 Characteristics of gross target casualty population for GB (Stats19)

In Stats19, the police assign up to six Contributory Factors (CF) with regard to the collision that describes, in their opinion, the factors that contributed the occurrence of the collision. Each CF is assigned with a confidence level of either 'Very likely' or 'Possible' depending on the evidence available to the police officer at the time of the collision and their opinion. CF 306 is the factor which identifies if a specific vehicle was exceeding the speed limit and this action contributed to the cause of the collision.

Table 30 summarises the total number of casualties by injury severity and road user type in collisions involving M1, M2, M3, N1, N2 and N3 vehicles. Some of these casualties are occupants of these vehicles, but there are other vehicle users and pedestrians also in these collisions.

From Table 30, there were 6,885 total fatalities in accidents with M1 vehicles involved, of which 3,989 were M1 occupants, 3 were M2 occupants and 1,457 were pedestrians.

Table 31 shows only those collisions where the Vehicle of Interest (VOI) was reported by the police to be 'exceeding the speed limit' and classified as 'very 'likely'. There were 527 total fatalities associated with M1 speeding vehicles, 356 of these were occupants of the speeding M1 vehicle and 70 were pedestrians struck by the vehicle.

Table 32 provides a summary of the results, with 7.7% of M1 fatal collisions being associated with the M1 vehicle 'exceeding the speed limit'.

Table 30: All casualties in collisions involving VOI by VOI type, road user group and severity. Includes drivers with causation factors indicating poor compliance with law, who would be unlikely to abide by speed warning.

Road user group	M1			M2			M3			N1			N2			N3		
	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured
M1	3,989	39,721	531,977	20	105	1,541	88	513	6,382	322	2,843	41,110	68	425	4,922	534	1,927	19,464
M2	3	77	1,614	14	197	2,474	0	2	32	0	22	232	0	9	57	5	13	137
M3	13	413	9,456	0	3	71	40	1,546	24,605	0	44	1,370	0	7	154	4	84	793
N1	56	965	16,941	2	9	104	3	26	421	191	1,966	24,470	7	52	484	64	234	1,729
N2	6	62	1,129	0	1	11	0	5	45	1	22	282	16	187	1,967	10	47	277
N3	29	169	1,377	0	2	15	6	13	62	13	35	381	1	10	108	102	592	3,539
N unknown	0	1	44	0	0	0	0	0	0	0	0	8	0	0	1	2	0	7
Pedal cycle	289	12,071	67,645	2	47	186	21	307	1,560	40	1,276	5,936	12	134	503	90	342	787
PTW	990	16,121	50,685	8	51	149	31	214	644	176	1,631	4,901	26	158	393	91	427	709
Other	53	529	2,881	0	0	6	5	19	132	9	69	363	2	8	59	14	65	223
Pedestrian	1,457	21,037	78,355	11	126	354	160	1,335	4,635	192	1,834	6,551	45	207	697	261	460	843
Total	**6,885**	**91,166**	**762,104**	**57**	**541**	**4,911**	**354**	**3,980**	**38,518**	**944**	**9,742**	**85,604**	**177**	**1,197**	**9,345**	**1,177**	**4,191**	**28,508**
% VOI occupants	*57.94%*	*43.57%*	*69.80%*	*24.56%*	*36.41%*	*50.38%*	*11.30%*	*38.84%*	*63.88%*	*20.23%*	*20.18%*	*28.59%*	*9.04%*	*15.62%*	*21.05%*	*8.67%*	*14.13%*	*12.41%*

Table 31: All casualties in collisions involving VOI with 'exceeding speed limit' recorded a CF as 'very likely' by VOI type, road user group and injury severity. Includes drivers with causation factors indicating poor compliance with law, who would be unlikely to abide by speed warning.

Road user group		M1			M2			M3			N1			N2			N3		
		Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured
VOI occupant casualties		**356**	**2,034**	**7,846**	**0**	**7**	**21**	**0**	**1**	**20**	**4**	**37**	**222**	**0**	**0**	**10**	**2**	**9**	**26**
Other casualties in collision	86	536	5,155	0	1	4	0	2	6	1	18	289	0	3	8	9	6	43	43
	0	3	16	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	7	95	0	0	0	0	0	1	0	0	2	0	0	2	0	0	0	0
	0	25	249	0	0	0	0	0	0	0	4	15	0	0	1	1	2	8	8
	0	2	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	0	2	18	0	0	0	0	0	0	0	0	3	0	0	0	0	0	2	2
	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	5	36	100	0	0	0	0	0	0	0	4	7	0	0	1	2	0	0	0
	10	46	91	0	0	0	0	1	0	0	1	8	0	0	0	1	0	2	2
	0	6	31	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
	70	204	330	0	1	2	2	2	0	3	11	12	0	1	0	0	0	0	0
Total		**527**	**2,901**	**13,944**	**0**	**9**	**29**	**2**	**6**	**27**	**8**	**75**	**560**	**0**	**4**	**23**	**15**	**17**	**82**

Table 32: Summary of all casualties in VOI collisions and all casualties in VOI exceeding speed limit very likely CF collisions. Includes drivers with causation factors indicating poor compliance with law, who would be unlikely to abide by speed warning.

		M1	M2	M3	N1	N2	N3
All casualties in VOI collisions	Killed	6,885	57	354	944	177	1,177
	Seriously injured	91,166	541	3,980	9,742	1,197	4,191
	Slightly injured	762,104	4,911	38,518	85,604	9,345	28,508
All casualties in VOI collisions exceeding speed limit very likely collisions	Killed	527	0	2	8	0	15
	Seriously injured	2,901	9	6	75	4	17
	Slightly injured	13,944	29	27	560	23	82
% of casualties in VOI collisions exceeding speed limit very likely collisions	*Killed*	*7.7%*	*0.0%*	*0.6%*	*0.8%*	*0.0%*	*1.3%*
	Seriously injured	*3.2%*	*1.7%*	*0.2%*	*0.8%*	*0.3%*	*0.4%*
	Slightly injured	*1.8%*	*0.6%*	*0.1%*	*0.7%*	*0.2%*	*0.3%*

3.2.2 Removing other CFs indicating poor compliance with laws?

A number of contributory factors record driver violations that may be associated with risky behaviour (Richards *et al.*, 2010). A set of contributory factors was defined that were used to remove cases from the Stats19 target population for voluntary or advisory ISA on the basis that a driver choosing to engage in these behaviours would be unlikely to take notice of a speed warning. The contributory factors to exclude were:

- CF206: Overloaded or poorly loaded vehicle or trailer
- CF301: Disobeyed automatic traffic signal
- CF302: Disobeyed Give Way or Stop sign or markings
- CF303: Disobeyed double white lines
- CF304: Disobeyed pedestrian crossing facility
- CF305: Illegal turn or direction of travel
- CF501: Impaired by alcohol
- CF502: Impaired by drugs (illicit or medicinal)
- CF504: Uncorrected, defective eyesight
- CF506: Not displaying lights at night or in poor visibility
- CF508:Driver using mobile phone
- CF901: Stolen vehicle
- CF902: Vehicle in course of crime

Table 33 summarises the casualties by injury severity and road user type in collisions involving M1, M2, M3, N1, N2 and N3 vehicles that did not include driver 'risky behaviours' described as the contributory factors listed above. This additional selection reduced the overall population of casualties compared with Table 30.

From Table 33, there were 6,229 total fatalities in accidents with M1 vehicles, of which 3,527 were M1 occupants, 52 were N1 occupants and 1,340 were pedestrians.

Table 34 shows only those collisions where the Vehicle of Interest (VOI) was 'exceeding the speed limit' 'very 'likely'. There were 325 total fatalities associated with M1 speeding vehicles, 224 of these were occupants of the speeding M1 vehicle and 49 were pedestrians struck by the vehicle.

Table 35 provides a summary of the results, with 5.2% of the M1 pertinent collisions being associated with the M1 vehicle 'exceeding the speed limit'.

Table 33: All casualties in collisions involving VOI by VOI type, road user group and severity. Excludes drivers with causation factors indicating poor compliance with law, who would be unlikely to abide by speed warning.

Road user group	M1			M2			M3			N1			N2			N3		
	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured
M1	3,209	33,113	428,598	20	89	1,281	75	470	5,232	282	2,442	31,581	63	388	3,868	467	1,744	16,405
M2	1	55	1,227	9	158	1,946	0	1	25	0	21	198	0	9	40	1	11	113
M3	6	265	5,796	0	2	49	22	973	15,323	0	28	987	0	5	106	2	71	631
N1	48	831	13,333	2	8	80	3	21	341	154	1,560	19,525	7	45	407	59	211	1,520
N2	6	53	948	0	1	11	0	2	36	1	20	236	12	162	1,696	10	45	232
N3	24	147	1,161	0	2	13	3	11	57	10	26	316	1	10	85	87	503	3,024
N unknown	0	1	27	0	0	0	0	0	0	0	0	8	0	0	1	2	0	6
Pedal cycle	243	8,422	40,453	2	36	118	21	237	1,001	34	887	3,496	11	101	301	80	287	529
PTW	877	13,831	39,957	7	49	127	29	193	519	155	1,406	3,833	22	135	319	79	379	592
-Other	43	414	2,053	0	0	6	5	15	84	9	59	253	2	5	44	12	57	173
Pedestrian	1,241	16,874	52,600	11	107	212	145	1,154	3,170	156	1,494	4,156	38	176	428	227	390	560
Total	**5,698**	**74,006**	**586,153**	**51**	**452**	**3,843**	**303**	**3,077**	**25,788**	**801**	**7,943**	**64,589**	**156**	**1,036**	**7,295**	**1,026**	**3,698**	**23,785**
% VOI occupants	*56.32%*	*44.74%*	*73.12%*	*39.22%*	*19.69%*	*33.33%*	*24.75%*	*15.27%*	*20.29%*	*35.21%*	*30.74%*	*48.90%*	*40.38%*	*37.45%*	*53.02%*	*45.52%*	*47.16%*	*68.97%*

Table 34: All casualties in collisions involving VOI with 'exceeding speed limit' recorded a CF as 'very likely' by VOI type, road user group and injury severity. Excludes drivers with causation factors indicating poor compliance with law, who would be unlikely to abide by speed warning.

Road user group		M1			M2			M3			N1			N2			N3		
		Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured
VOI occupant casualties		224	1,159	5,542	0	4	16	0	0	12	2	24	145	0	0	8	2	8	20
Other casualties in collision	M1	301	3,494	0	1	4	0	1	6	0	10	214	0	3	7	8	6	39	40
	M2	2	6	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
	M3	5	62	0	0	0	0	0	1	0	0	2	0	0	2	0	0	0	0
	N1	14	179	0	0	0	0	0	0	0	1	13	0	0	1	1	1	7	7
	N2	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	N3	2	11	0	0	0	0	0	0	0	0	3	0	0	0	0	0	2	1
	N unknown	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Pedal cycle	31	77	0	0	0	0	0	0	0	2	4	0	0	1	0	0	0	0
	PTW	34	78	0	0	0	0	1	0	0	1	6	0	0	0	1	0	2	2
	Other	5	22	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
	Pedestrian	144	241	0	1	2	2	2	0	2	10	7	0	1	0	0	0	0	0
Total		**325**	**1,699**	**9,716**	**0**	**6**	**24**	**2**	**4**	**19**	**4**	**48**	**396**	**0**	**4**	**20**	**12**	**15**	**71**

Table 35: Summary of all casualties in VOI collisions and all casualties in VOI exceeding speed limit very likely CF collisions. Excludes drivers with causation factors indicating poor compliance with law, who would be unlikely to abide by speed warning.

		M1	M2	M3	N1	N2	N3
All casualties in VOI collisions	Killed	5,698	51	303	801	156	1,026
	Seriously injured	74,006	452	3,077	7,943	1,036	3,698
	Slightly injured	586,153	3,843	25,788	64,589	7,295	23,785
All casualties in VOI collisions exceeding speed limit very likely collisions	Killed	325	0	2	4	0	12
	Seriously injured	1,699	6	4	48	4	15
	Slightly injured	9,716	24	19	396	20	71
% of casualties in VOI collisions exceeding speed limit very likely collisions	*Killed*	5.70%	0.00%	0.66%	0.50%	0.00%	1.17%
	Seriously injured	2.30%	1.33%	0.13%	0.60%	0.39%	0.41%
	Slightly injured	1.66%	0.62%	0.07%	0.61%	0.27%	0.30%

3.2.3 In-depth assessment of collision typology (RAIDS)

3.2.3.1 RAIDS measure of excessive speed

Table 36 to Table 40 outline the number of collisions by vehicle involvement (M1, M2, M3, N1, N2 and N3) and differentiate between those with vehicles at or under the posted speed limit and those which involved a vehicle above the limit. The speed is not necessarily the causation of all these collisions, but it is reasonable to assume that the greater speed contributed adversely to the injury outcome.

Table 36: M1 vehicles by speed relative to the posted speed limit and the maximum injury severity of the collision

Speed relative to limit (mph)	Fatal	Serious	Slight	Uninjured	Unknown	Total
Under	40	357	1516	910	44	2867
0	21	83	353	274	26	757
1-5	1	13	57	52	10	133
6-10	2	25	53	37	9	126
11-15	3	8	16	28	5	60
16-20	2	9	14	16	2	43
21-25	2	4	10	10	2	28
26-30	4	1	5	10	0	20
31+	1	4	5	6	3	19
Total	**76**	**504**	**2029**	**1343**	**101**	**4053**
%age > 0mph	**19.74%**	**12.70%**	**7.89%**	**11.84%**	**30.69%**	**10.58%**

Table 37: M2 vehicles by speed relative to the posted speed limit and the maximum injury severity of the collision

Speed relative to limit (mph)	Fatal	Serious	Slight	Uninjured	Unknown	Total
Under	0	0	8	1	0	9
0	0	0	0	0	0	0
1-5	0	0	0	0	0	0
6-10	0	0	0	0	0	0
11-15	0	0	0	0	0	0
16-20	0	0	0	1	0	1
21-25	0	0	0	0	0	0
26-30	0	0	0	0	0	0
31+	0	0	0	0	0	0
Total	**0**	**0**	**8**	**2**	**0**	**10**
%age > 0mph	**0.00%**	**0.00%**	**0.00%**	**50.00%**	**0.00%**	**10.00%**

Table 38: M3 vehicles by speed relative to the posted speed limit and the maximum injury severity of the collision

Speed relative to limit (mph)	Fatal	Serious	Slight	Uninjured	Unknown	Total
Under	3	13	27	24	0	67
0	1	2	5	2	0	10
1-5	1	1	1	0	0	3
6-10	0	0	0	1	0	1
11-15	0	0	0	0	0	0
16-20	0	0	0	0	0	0
21-25	0	0	0	0	0	0
26-30	0	0	0	0	0	0
31+	0	0	0	0	0	0
Total	**5**	**16**	**33**	**27**	**0**	**81**
%age > 0mph	**20.00%**	**6.25%**	**3.03%**	**3.70%**	**0.00%**	**4.94%**

Table 39: N1 vehicles by speed relative to the posted speed limit and the maximum injury severity of the collision

Speed relative to limit (mph)	Fatal	Serious	Slight	Uninjured	Unknown	Total
Under	3	33	125	69	4	234
0	2	12	33	24	0	71
1-5	0	6	4	2	0	12
6-10	1	1	5	1	0	8
11-15	0	1	1	4	0	6
16-20	0	0	3	0	0	3
21-25	0	0	0	0	0	0
26-30	0	0	0	1	0	1
31+	0	0	0	1	0	1
Total	**6**	**53**	**171**	**102**	**4**	**336**
%age > 0mph	**16.67%**	**15.09%**	**7.60%**	**8.82%**	**0.00%**	**9.23%**

Table 40: N2 & N3 vehicles by speed relative to the posted speed limit and the maximum injury severity of the collision

Speed relative to limit (mph)	Fatal	Serious	Slight	Uninjured	Unknown	Total
Under	8	24	111	104	3	250
0	0	2	6	12	0	20
1-5	0	0	0	2	0	2
6-10	0	0	4	5	0	9
11-15	0	0	0	0	1	1
16-20	0	1	0	0	0	1
21-25	0	0	1	0	0	1
26-30	0	0	0	0	0	0
31+	0	0	0	0	0	0
Total	**8**	**27**	**122**	**123**	**4**	**284**
%age > 0mph	**0.00%**	**3.70%**	**4.10%**	**5.69%**	**25.00%**	**4.93%**

3.2.4 Estimate of specific GB target population

For this measure, the target population was not derived from the RAIDS data because enough information is available within Stats19. The RAIDS data presented above gives more context and begins to describe more about the nature of collisions, where traveling above the posted speed limit was a factor.

Future research will undertake a case-by-case review approach to measure the likely effectiveness of an ISA system.

3.2.4.1 Under-reporting of Contributory Factor 306 – 'Excessive speed'

It is known that 'exceeding the speed limit' is under-reported by police in Stats19 contributory factor data – see for example DfT road safety research report No. 117 (Richards et al., 2010). Table A6.2 in Richards et al. is reproduced in Table 41 below and compares excess speed recorded using the contributory factors in linked OTS and STATS19 cases. The analysis was based on 1,551 linked Stats19 and OTS cases and showed that there were 23 Stats19 cases with excessive speed recorded as very likely, and a further 5 recorded as possible, compared with 120 very likely cases in the same collisions investigated as part of OTS.

Table 41: Comparing excess speed as CFs in linked OTS and Stats19 cases very likely (Richards *et al.*, 2010)

		Excess speed (OTS) very likely		
		Yes	No	Total
Excess speed (STATS19) very likely	Yes	16	7	**23**
	No	104	1,424	**1,528**
	Total	**120**	**1,431**	**1,551**
Excess speed (STATS19) very likely or possible	Yes	16	12	**28**
	No	104	1,419	**1,523**
	Total	**120**	**1,431**	**1,551**

The majority of the difference was cases which were recorded with excessive speed as very likely in OTS, but not recorded in Stats19 as either very likely or possible. Note that there were also cases where the Stats19 data included excessive speed (as very likely or possible) which did not have this factor recorded in OTS. Overall, this analysis suggested that excessive speed factors are 4 or 5 times more likely than Stats19 suggests.

Therefore, Table 42 provides an overview of the findings from Stats19 review and scales the data from Table 34 by the underreporting factor quantified in Table 41. This increases the number of fatalities associated with M1 speeding vehicles from 325 to 1,470.

Table 42: Summary of excessive speed related injury collisions in GB 2011-2015

		M1	M2	M3	N1	N2	N3
All casualties in VOI collisions	Killed	6,885	57	354	944	177	1,177
	Seriously injured	91,166	541	3,980	9,742	1,197	4,191
	Slightly injured	762,104	4,911	38,518	85,604	9,345	28,508
Casualties with CF 306 (exceeding speed)	Killed	527	0	2	8	0	15
	Seriously injured	2,901	9	6	75	4	17
	Slightly injured	13,944	29	27	560	23	82
Remove 'Risky behaviour'							
All casualties in VOI collisions that had no non complaint CFs (exceeding speed limit not excluded)	Killed	5,698	51	303	801	156	1,026
	Seriously injured	74,006	452	3,077	7,943	1,036	3,698
	Slightly injured	586,153	3,843	25,788	64,589	7,295	23,785
Casualties with CF 306 (exceeding speed)	Killed	325	0	2	4	0	12
	Seriously injured	1,699	6	4	48	4	15
	Slightly injured	9,716	24	19	396	20	71
Scale data							
All casualties in VOI collisions exceeding speed limit very likely collisions	**Killed**	**1,469**	**0**	**9**	**18**	**0**	**54**
	Seriously injured	**7,680**	**27**	**18**	**217**	**18**	**68**
	Slightly injured	**43,916**	**109**	**86**	**1,790**	**90**	**321**
	Total	**53,065**	**136**	**113**	**2,025**	**108**	**443**

3.2.5 Summary

A summary of the analysis steps are presented in diagrammatic form in Figure 2.

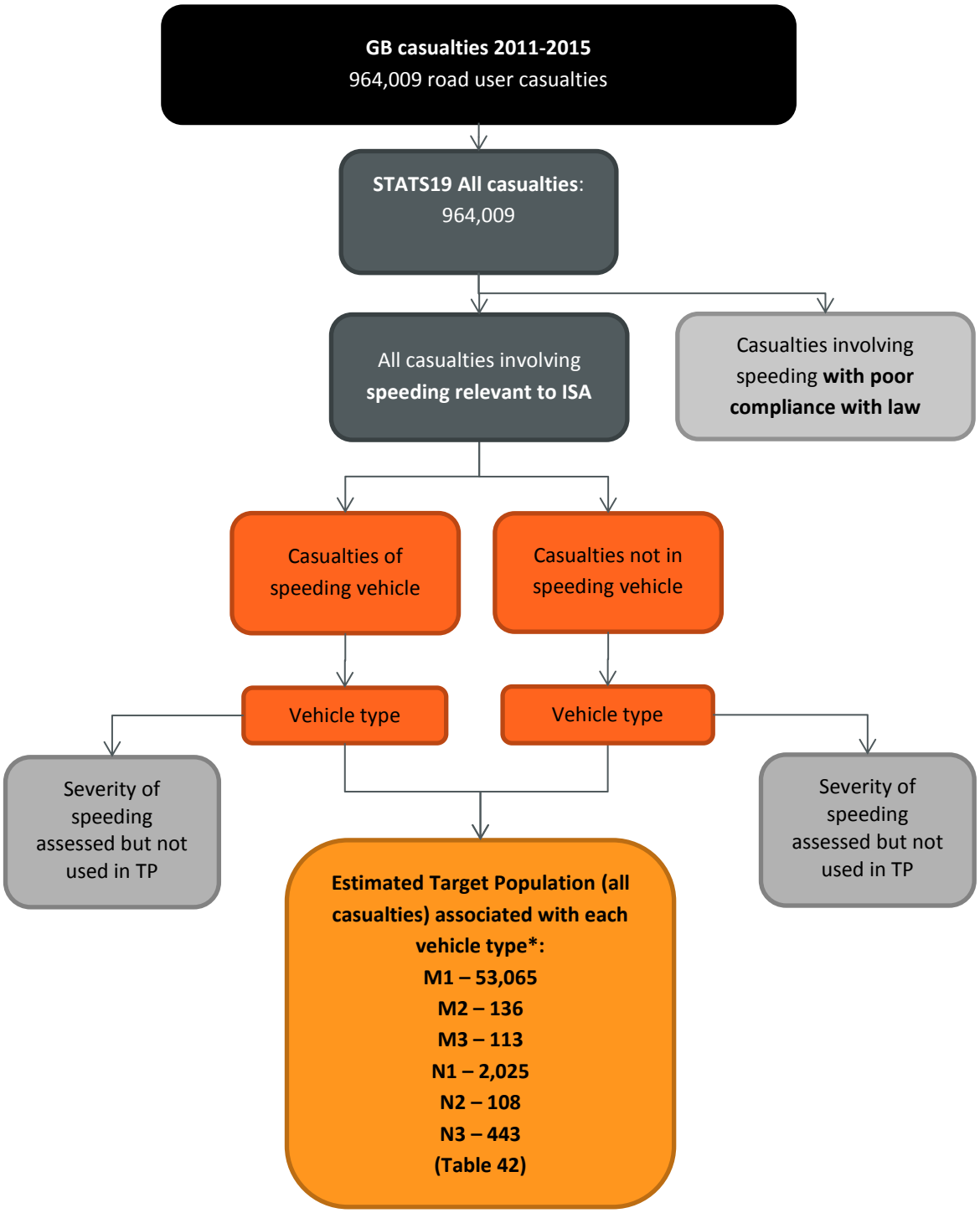


Figure 2: Tree diagram of the analysis generating the estimated gross target population for vehicles fitted with ISA

Note * : The casualties are not mutually exclusive, because some collisions will involve more than one speeding vehicle

3.3 Small Overlap

Benefit of passive vs active measures

- Vehicle Type: M1
- Find the proportion and gravity of small overlap car accident

3.3.1 Characteristics of gross target casualty population for GB (Stats19)

Table 43 shows the number of casualties in collisions involving an M1 vehicle with a first point of impact as front by the number of vehicles involved and pedestrian involvement.

Table 43 - Number of casualties involving M1 vehicles with first point of impact = front by number of vehicles, pedestrian involvement and collision severity

Pedestrian involvement	Number of vehicles	Killed	Seriously injured	Slightly injured	Total
Non Pedestrian	1	815	8,370	51,096	60,281
	2	1,099	13,423	149,052	163,574
	>=3	465	4,568	42,322	47,355
Pedestrian	1	2	63	824	889
	2	2	46	391	439
	>=3	6	34	201	241
Total		**2,389**	**26,504**	**243,886**	**272,779**

Considering only non-pedestrian M1 frontal impact casualties, 22% involved a single M1 vehicle, 60% involved 2 vehicles and 18% involved three or more vehicles.

The first two groups are considered in the next sections. The third group (those involving three or more vehicles) are not considered further since it is not recorded in Stats19 which vehicles impacted with which other vehicle(s).

Stats19 does not include which part of front was hit or amount of overlap – this information must be derived from the in-depth data and scaled up to the Stats19 level.

3.3.1.1 Single vehicle collisions

Stats19 records the first object hit on and off the carriageway. For single vehicle (non-pedestrian) collisions, collisions were excluded if the objects were considered not to cause a significant impact as shown in Table 44.

Table 44 – Objects hit exclusions and inclusions

	Include	Exclude
On carriageway	Previous accident	None
	Roadworks	Bridge - roof
	Parked vehicle	Open door of vehicle
	Bridge - side	Central island of roundabout
	Bollard/Refuge	Kerb
	Other object	Any animal (except ridden horse)
Off carriageway	Road sign/Traffic signal	(none)
	Lamp post	Bus stop/shelter
	Telegraph pole/Electricity pole	Submerged in water (completely)
	Tree	
	Central crash barrier	
	Nearside or offside crash barrier	
	Entered ditch	
	Wall or fence	
	Other permanent object	

Table 45 shows the number of casualties in single vehicle (non-pedestrian) M1 front impact collisions by objects hit exclusions and inclusions.

Table 45 – Number of casualties in M1 vehicles single vehicle front impact by objects hit exclusions and inclusions

Year of manufacture	Objects hit	Killed	Seriously injured	Slightly injured	Total
2004+	No objects hit on or off carriageway	21	436	3,660	4,117
	Included objects off or on carriageway	330	3,108	19,036	22,474
	excluded object on or off carriageway	9	58	679	746
	Total	360	3,602	23,375	27,337
pre 2004	No objects hit on or off carriageway	22	463	3,386	3,871
	Included objects off or on carriageway	362	3,212	17,717	21,291
	excluded object on or off carriageway	11	77	619	707
	Total	395	3,752	21,722	25,869
unknown	No objects hit on or off carriageway	8	153	1,161	1,322
	Included objects off or on carriageway	51	851	4,712	5,614
	excluded object on or off carriageway	1	12	126	139
	Total	60	1,016	5,999	7,075
TOTAL	No objects hit on or off carriageway	51	1,052	8,207	9,310
	Included objects off or on carriageway	743	7,171	41,465	49,379
	excluded object on or off carriageway	21	147	1,424	1,592
	Total	815	8,370	51,096	60,281

Note: An object can be recorded as hit both on and off carriageway. Where a vehicle hit an excluded object on the carriageway and an included object off the carriageway and vice versa these have been included.

The most commonly hit objects were off the carriageway: 'other permanent object (25% of casualties), tree (21%) and lamp post (9%).

3.3.1.2 Two vehicle collisions

Casualties in two vehicle non-pedestrian M1 front impact collisions, by other vehicle type and casualty severity (M1 frontal impact casualties only).

The majority of M1 casualties in the two-vehicle collisions were in collisions involving two M1 vehicles (86%). Whilst the proportion of M1 casualties in two vehicle collisions with N3 vehicles was low; these were high severity, accounting for 22% of M1 fatalities.

Table 46 – Number of casualties in M1 vehicles 2 vehicle front impact collisions by M1 vehicle year of manufacture, occupant severity and other vehicle type

	2004+			<2004			unknown			Total
Other vehicle type	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	
M1	295	5,393	66,968	311	4,221	47,357	57	1,374	14,238	**140,214**
M2	0	20	231	2	19	186	0	7	53	**518**
M3	20	100	786	16	99	589	0	28	195	**1,833**
N1	38	461	4,893	38	391	3,643	11	119	1,047	**10,641**
N2	12	76	550	12	60	463	1	21	116	**1,311**
N3	126	304	1,885	94	280	1,337	21	91	425	**4,563**
N unknown	0	6	38	0	2	17	0	2	23	**88**
Pedal cycle	2	14	312	0	17	210	0	9	97	**661**
PTW	1	41	894	0	24	502	0	20	213	**1,695**
Other	16	107	796	21	80	765	5	37	223	**2,050**
Total	**510**	**6,522**	**77,353**	**494**	**5,193**	**55,069**	**95**	**1,708**	**16,630**	**163,574**

Table 47 shows the first point of impacts for the other vehicle in M1 collisions. 46% of total M1 casualties and 74% of M1 fatalities were head on collisions (i.e. M1 was front and other vehicle was front) and 23% of total M1 casualties and 11% of M1 fatalities were in shunt type collisions (i.e. M1 front, other vehicle rear).

Table 47 – Number of casualties in M1 vehicles two vehicle front impact collisions, by M1 vehicle year of manufacture, occupant severity and other vehicle first point of impact

Other vehicle first point of impact	2004+			<2004			unknown			
	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	Total
Did not impact	19	226	2,213	29	243	1,874	4	62	501	5,171
Front	392	4,113	34,861	379	3,269	23,856	73	1,060	7,579	75,582
Rear	59	923	18,001	50	735	13,979	8	255	4,046	38,056
Offside	24	716	12,268	25	565	9,050	4	210	2,534	25,396
Nearside	16	544	10,008	11	381	6,310	6	121	1,970	19,367
(blank)	0	0	2	0	0	0	0	0	0	2
Total	**510**	**6,522**	**77,353**	**494**	**5,193**	**55,069**	**95**	**1,708**	**16,630**	**163,574**

Over half of M1 casualties (52%) were occupants of M1 vehicles manufactured 2004 or more recent.

Table 48: Year of manufacture of M1 vehicles involved in two vehicle collisions

M1 year of manufacture	Killed	Seriously injured	Slightly injured	Total
2004+	510	6,522	77,353	84,385
<2004	494	5,193	55,069	60,756
unknown	95	1,708	16,630	18,433
Total	**1,099**	**13,423**	**149,052**	**163,574**

3.3.2 In-depth assessment of collision typology (RAIDS)

Vehicle occupants from CCIS and RAIDS were selected on the following criteria:

- Vehicle type = M1 passenger cars;
- Year of Manufacture ≥ 2004;
- A single impact to the front of the vehicle with no rollover events;
- Occupants were belted;
- Occupants were in the first row of seats.

3.3.2.1 Casualty distribution for all frontal impacts

Table 49 and Table 50 show the distribution of all casualties (seat belted and unrestrained) in all relevant cars that met the selection criteria by gender and age respectively. Table 51 and Table 52 show the same data for seat belted occupants only but are not used in estimating the gross target population. The sample of 1,118 casualties includes small overlap frontal collisions and all other types of frontal collisions.

Table 49: Fatal, serious and slight casualty distribution by gender for all M1 frontal impacts

Injury Severity	Female	Pregnant Female	Male	Not Known	Total
Fatal	19	0	42	0	61
Serious	169	1	194	0	364
Slight	328	5	358	2	693
Total	**516**	**6**	**594**	**2**	**1,118**

Table 50: Fatal, serious and slight casualty distribution by age group for all M1 frontal impacts

Injury Severity	Child (≤13)	Adult	Senior (>60)	Not Known	Total
Fatal	0	36	25	0	61
Serious	4	254	103	3	364
Slight	12	552	107	22	693
Total	**16**	**842**	**235**	**25**	**1,118**

Table 51: Fatal, serious and slight seat belted casualty distribution by gender for all M1 frontal impacts

Injury Severity	Female	Pregnant Female	Male	Not Known	Total
Fatal	17	0	27	0	44
Serious	152	0	153	0	305
Slight	270	5	294	2	571
Total	**439**	**5**	**474**	**2**	**920**

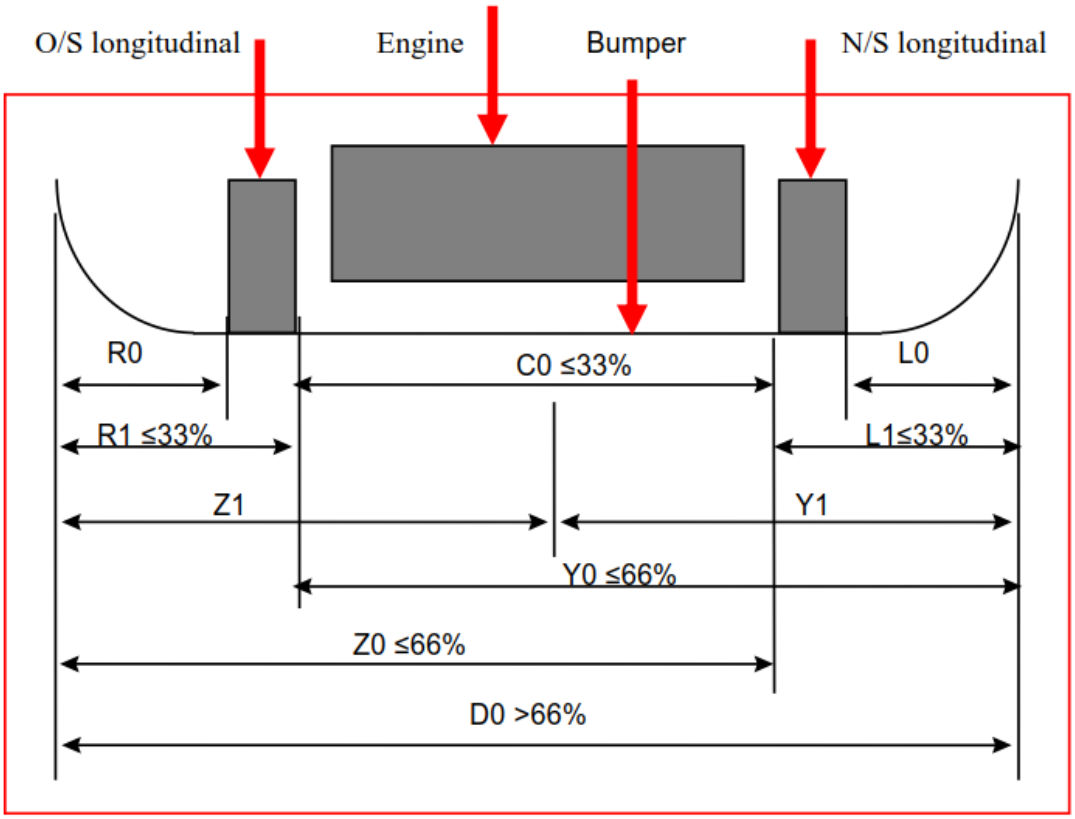
Table 52: Fatal, serious and slight seat belted casualty distribution by age group for all M1 frontal impacts

Injury Severity	Child (≤13)	Adult	Senior (>60)	Not Known	Total
Fatal	0	24	20	0	44
Serious	4	204	96	1	305
Slight	11	457	88	15	571
Total	**15**	**685**	**204**	**16**	**920**

3.3.2.2 Small overlap frontals vs all other frontal impacts

Vehicles that had small overlap frontal collisions were defined using the horizontal deformation part of the Collision Deformation Classification (CDC) code (Figure 3). Vehicles coded as R0 or L0 are categorised as small overlap frontal impacts and all other codes are categorised into other frontal impacts. R0 and L0 by definition do not include engagement of the main longitudinal rails. The following tables show the casualty distribution and collision characteristics between passenger cars in small overlap and other frontal impacts.

Table 53 and table 54 present the proportion of the car occupants in frontal collisions that experienced a small overlap frontal configuration and all other collisions for all casualties and only seat-belted casualties, respectively. The type of objects hit by cars in small overlap and all other frontal collisions is shown in Table 55 and Table 56 by the casualty injury severity for all casualties and only seat-belted casualties, respectively.



Options:

R0 = ≤ ⅓ from right side - not including longitudinal
L0 = ≤ ⅓ from left side - not including longitudinal
R1 = ≤ ⅓ from right side - including longitudinal
L1 = ≤ ⅓ from left side - including longitudinal
C0 = Centre (to inside of longitudinals) must be less than ⅓ of total width
Z1 = ½ from right side
Y1 = ½ from left side
Z0 = ≤ ⅔ from right side (independent from position of longitudinals)
Y0 = ≤ ⅔ from left side (independent from position of longitudinals)
D0 = distributed direct damage over ⅔ width of vehicle

Figure 3 – Horizontal deformation location codes for frontal collisions, small overlap defined as R0 or L0 (Source: RAIDS data collection notes; based on Collision Deformation Classification Code; SAE J224b)

Table 53: Distribution of front seat car occupants by their injury severity and frontal collision type

Injury Severity	Small Overlap	% distribution	Other Frontal	% distribution	Total
Fatal	5	8.20%	56	91.80%	61
Serious	30	8.24%	334	91.76%	364
Slight	89	12.84%	604	87.16%	693
Total	**124**	**11.09%**	**994**	**88.91%**	**1,118**

Table 54: Distribution of front seat car seat belted occupants by their injury severity and frontal collision type

Injury Severity	Small Overlap	% distribution	Other Frontal	% distribution	Total
Fatal	2	4.55%	42	95.45%	44
Serious	24	7.87%	281	92.13%	305
Slight	66	11.56%	505	88.44%	571
Total	**92**	**10.00%**	**828**	**90.00%**	**920**

Table 55: Distribution of front seat car occupants by their injury severity and frontal collision type

Object impacted	Fatal		Serious		Slight		Total
	n	%	n	%	n	%	
Small overlap							
M1	1	20.0	16	53.3	56	62.9	73
M2/3	0	0.0	0	0.0	0	0.0	0
N1	0	0.0	0	0.0	0	0.0	0
N2/3	3	60.0	5	16.7	20	22.5	28
PTW	0	0.0	0	0.0	0	0.0	0
Other vehicle	0	0.0	0	0.0	0	0.0	0
Narrow object	0	0.0	1	3.3	6	6.7	7
Wide object	1	20.0	8	26.7	5	5.6	14
Other	0	0.0	0	0.0	2	2.2	2
Not known	0	0.0	0	0.0	0	0.0	0
Total	5	100.0	30	100.0	89	100.0	124
Other fontal							
M1	22	39.3	204	61.1	454	75.2	680
M2/3	0	0.0	2	0.6	2	0.3	4
N1	0	0.0	0	0.0	0	0.0	0
N2/3	28	50.0	65	19.5	80	13.2	173
PTW	0	0.0	0	0.0	0	0.0	0
Other vehicle	0	0.0	1	0.3	0	0.0	1
Narrow object	2	3.6	23	6.9	30	5.0	55
Wide object	4	7.1	36	10.8	36	6.0	76
Other	0	0.0	3	0.9	2	0.3	5
Not known	0	0.0	0	0.0	0	0.0	0
Total	56	100.0	334	100.0	604	100.0	994
Total	**61**		**364**		**693**		**1,118**

Table 56: Distribution of front seat car occupants seat belted by their injury severity and frontal collision type

Object impacted	Fatal		Serious		Slight		Total
	n	%	n	%	n	%	
Small overlap							
M1	0	0.0	13	54.2	43	65.2	56
M2/3	0	0.0	0	0.0	0	0.0	0
N1	0	0.0	0	0.0	0	0.0	0
N2/3	2	100.0	4	16.7	14	21.2	20
PTW	0	0.0	0	0.0	0	0.0	0
Other vehicle	0	0.0	0	0.0	0	0.0	0
Narrow object	0	0.0	1	4.2	6	9.1	7
Wide object	0	0.0	6	25.0	3	4.5	9
Other	0	0.0	0	0.0	0	0.0	0
Not known	0	0.0	0	0.0	0	0.0	0
Total	2	100.0	24	100.0	66	100.0	92
Other fontal							
M1	21	50.0	180	64.1	392	77.6	593
M2/3	0	0.0	2	0.7	2	0.4	4
N1	0	0.0	0	0.0	0	0.0	0
N2/3	19	45.2	57	20.3	62	12.3	138
PTW	0	0.0	0	0.0	0	0.0	0
Other vehicle	0	0.0	1	0.4	0	0.0	1
Narrow object	0	0.0	13	4.6	22	4.4	35
Wide object	2	4.8	26	9.3	26	5.1	54
Other	0	0.0	2	0.7	1	0.2	3
Not known	0	0.0	0	0.0	0	0.0	0
Total	42	100.0	281	100.0	505	100.0	828
Total	**44**		**305**		**571**		**920**

3.3.3 Estimate of specific GB target population based on scaling in-depth data

The proportions of all car occupants in the first row in a small frontal overlap impact by injury severity were identified from the RAIDS data (Table 53) and used to estimate the number of M1 casualties in GB below. Figure 4 diagrammatically shows how the proportion of car occupants in small overlap frontal collisions was derived from RAIDS and then projected to the equivalent car occupants in the national STATS19 data to generate the estimated gross target population for this measure.

Table 57 summarises the number of casualties whom could benefit in GB from the FSO measure, with 863 killed or seriously injured car users forming the Target Population over a five year period.

Table 57: Estimated Target Population for FSO (GB 2011-2015; cars 2004+)

Stats19 injury severity	Stats19 all small overlap casualties (2004+)			Estimated % cars with small overlap	Estimated Target Population
	1-Vehicle	2-Vehicle	Total		
Killed	330	510	840	8.20%	69
Serious	3,108	6,522	9630	8.24%	793
Slight	19,036	77,353	96,389	12.84%	12,376
Total	**22,474**	**84,385**	**106,859**		**13,238**

The assumptions and controls used in this analysis are:

- 2004+ M1 cars only – these vehicles would comply with the current F94 regulation and there is a significant bias to more severe injury outcomes when the analysis includes vehicles that were manufactured before 2004 as they are associated with worse crashworthiness/collision performance.
- All (included belted) – Stats19 records if occupants were belted or unrestrained, however, there are known problems with the reporting of these data and it cannot be used reliably. As a result the estimated target population at the national level includes both seat belted (restrained) and unrestrained car occupants whom have been matched in the in-depth data. Each table presenting RAIDS data initially show all car occupants, but is duplicated immediately afterwards to show seat belted-only car occupants as well.
- For completion we have tabulated the collision type/object hit and differentiated by single and multi-vehicle collisions.

3.3.4 Summary

A summary of the analysis steps are presented in diagrammatic form in Figure 5.

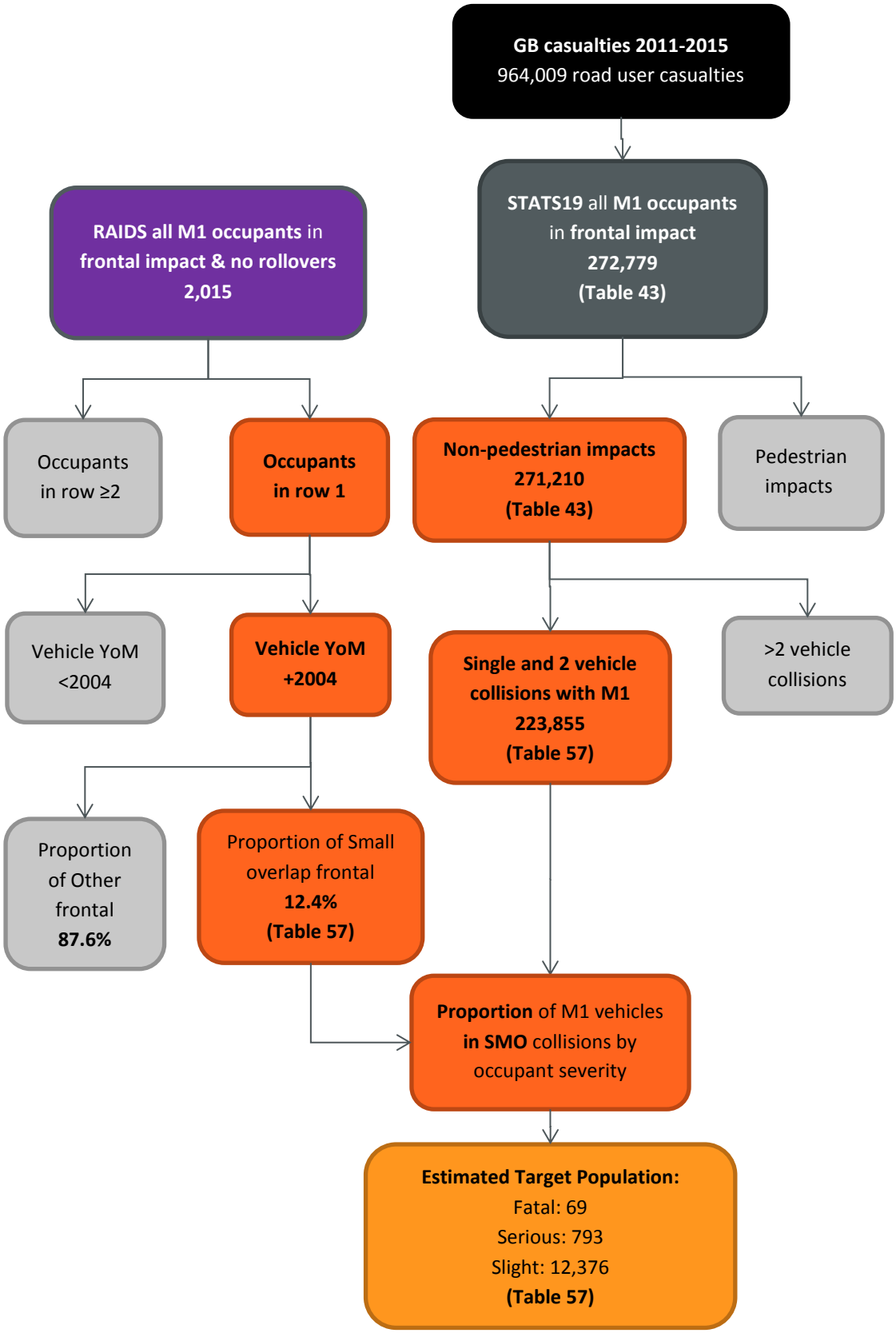


Figure 4: Tree diagram of the analysis generating the estimated gross target population for M1 occupants in small overlap frontal collisions

3.4 Side Impact Far Side Occupant (SFS)

- Benefits of measures to protect front seat occupants seated on the non-struck side of a car in a side impact
- Vehicle Type: M1
- Find the proportion and gravity of far side car accidents

3.4.1 Characteristics of gross target casualty population for GB (Stats19)

Stats19 does not include uninjured passengers and does not indicate which side of the vehicle rear passengers were seated on.

Stats19 only records first point of impact. This may have been with another vehicle, pedestrian or object.

Left Hand Drive (LHD) vehicles, casualty class and car passenger fields were used in combination with the first point of impact to extract the number of front seat car passengers with a far-side impact.

Table 58 shows the number of M1 occupant casualties by whether they were located on the crash side or far side of the vehicle. There were 53,857 far-side car/taxi occupant casualties in collisions for the five years from 2011 to 2015 (only those far-side casualties counted, not other casualties in these collisions).

16,500 (12% of all car occupant casualties) that were not classifiable:

- Rear seat passenger or no car passenger data (0 or blank)
- No LHD data (blank)

Table 58: Number of M1 vehicle occupants by side of impact and year of manufacture

Year of manufacture	Far Side or Crash Side	Killed	Seriously injured	Slightly injured	Total
2004 onwards	Crash Side	343	2,391	36,926	39,660
	Far Side	179	1,639	27,680	29,498
	unknown	62	561	8,626	9,249
	TOTAL	584	4,591	73,232	78,407
	% Far side	31%	36%	38%	38%
before 2004	Crash Side	369	2,082	22,559	25,010
	Far Side	249	1,458	17,814	19,521
	unknown	57	527	5,272	5,856
	TOTAL	675	4,067	45,645	50,387
	% Far side	37%	36%	39%	39%
unknown	Crash Side	52	449	5,271	5,772
	Far Side	37	361	4,440	4,838
	unknown	14	119	1,262	1,395
	TOTAL	103	929	10,973	12,005
	% Far side	36%	39%	40%	40%
TOTAL	Crash Side	764	4,922	64,756	70,442
	Far Side	465	3,458	49,934	53,857
	unknown	133	1,207	15,160	16,500
	TOTAL	1,362	9,587	129,850	140,799
	% Far side	34%	36%	38%	38%

3.4.1.1 Far-side car collision population for GB (Stats19)

55% of the casualties that were far side from the first impact were in vehicles manufactured in 2004 or later.

Table 59: Far-side car and taxi casualties by year of manufacture

Vehicle year of manufacture	Killed	Seriously injured	Slightly injured	Total	% KSI
unknown	37	361	4,440	4,838	8.2%
before 2004	249	1,458	17,814	19,521	8.7%
2004 onwards	179	1,639	27,680	29,498	6.2%
Total	**467**	**3,532**	**50,925**	**54,924**	**7.3%**

3.4.2 In-depth assessment of collision typology (RAIDS)

Vehicle occupants from CCIS and RAIDS were selected on the following criteria:

- Vehicle type = M1 passenger cars;
- Year of Manufacture ≥ 2004;
- A single impact to the right or left of the vehicle with no rollover events;
- Occupants were belted;

Table 60 and Table 61 show the distribution of all casualties (seat belted and unrestrained) in all relevant cars that met the selection criteria by gender and age respectively (n = 186). Table 62 and Table 63 show the same data for seat belted occupants (n = 139) only but are not used in estimating the gross target population.

Table 60: Fatal, serious and slight casualty distribution by sex for all M1 Far-side impacts

Injury Severity	Female	Pregnant Female	Male	Not Known	Total
Fatal	3	0	16	0	19
Serious	17	0	26	1	44
Slight	57	2	64	0	123
Total	**77**	**2**	**106**	**1**	**186**

Table 61: Fatal, serious and slight casualty distribution by age group for all M1 Far-side impacts

Injury Severity	Child (≤13)	Adult	Senior (>60)	Not Known	Total
Fatal	0	15	4	0	**19**
Serious	1	30	12	1	**44**
Slight	1	96	23	3	**123**
Total	2	140	40	4	**186**

Table 62: Fatal, serious and slight seat belted casualty distribution by gender for all M1 Far-side impacts

Injury Severity	Female	Pregnant Female	Male	Not Known	Total
Fatal	2	0	11	0	13
Serious	14	0	22	1	37
Slight	41	2	46	0	89
Total	**57**	**2**	**79**	**1**	**139**

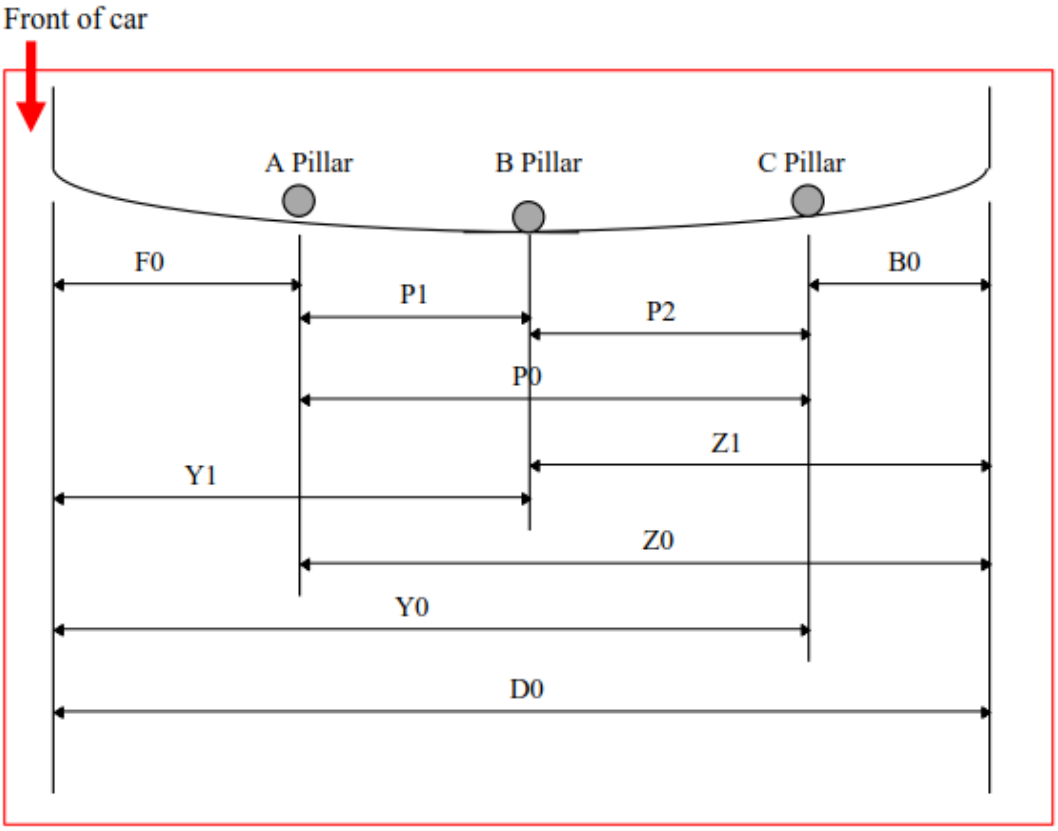
Table 63: Fatal, serious and slight seat belted casualty distribution by age group for all M1 Far-side impacts

Injury Severity	Child (≤13)	Adult	Senior (>60)	Not Known	Total
Fatal	0	11	2	0	**13**
Serious	1	26	9	1	**37**
Slight	1	68	18	2	**89**
Total	2	104	30	3	**139**

Table 64 shows the distribution of far side occupant casualties by their severity type and the type of side impact they experienced determined by the engagement of the passenger cell. The passenger cell engagement is defined using the Collision Deformation Classification (CDC) code (Figure 5) where any collisions that did not involve direct contact with the passenger compartment (i.e. F0 and B0) were excluded from further analysis. Table 65 shows the same distribution for seat belted occupants only. This data was not used in the estimation of the gross target population.

The remaining far side casualties are shown in Table 66 by the distribution of the principal direction of force of the side impact using the CDC clock face convention (Figure 6) to describe the impact configuration. Principal forces analogous to the impact test configuration proposed for this measure are shown as 2, 3, 4, 8, 9, or 10 o'clock. Table 67 shows the same distribution for seat belted occupants only. This data was not used in the estimation of the gross target population.

Deformation location - Side impact



Options:
F0 = Front of car, forward of occupant compartment (A pillar).
P0 = The entire occupant compartment (between A and rearmost pillar).
P1 = Occupant compartment: front seats, forward of B pillar.
P2 = Occupant compartment: rear seats, rearward of B pillar.
B0 = Rear of car, rearward of occupant compartment (rearmost pillar).
Y0 = Front of car and occupant compartment.
Y1 = Front of car and occupant compartment forward of B pillar.
Z0 = Rear of car and occupant compartment.
Z1 = Rear of car and occupant compartment rearward of B pillar.
D0 = Distributed across entire side of vehicle.

Figure 5: Horizontal deformation location codes for side collisions (Source: RAIDS data collection notes; based on Collision Deformation Classification Code; SAE J224b)

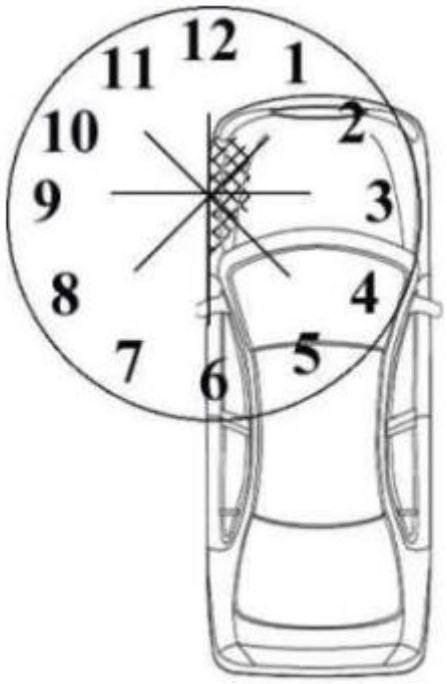


Figure 6: Principal direction of force coding (Source: RAIDS data collection notes; based on Collision Deformation Classification Code; SAE J224b)

Table 64: Far-side M1 casualties by side impact location

Side impact location	Killed	Seriously injured	Slightly injured	Total
No occupant compartment engagement (e.g. F0 or B0)	1	10	37	48
Collision Involved occupant compartment (exclude F0, B0)	**18**	**34**	**86**	**138**
Occupant compartment only Between A-C pillars (P0, P1, P2)	7	11	16	34
All far-side	19	44	123	**186**

Table 65: Far-side seat belted M1 casualties by side impact location

Side impact location	Killed	Seriously injured	Slightly injured	Total
No occupant compartment engagement (e.g. F0 or B0)	0	8	26	34
Collision Involved occupant compartment (exclude F0, B0)	**13**	**29**	**63**	**105**
Occupant compartment only Between A-C pillars (P0, P1, P2)	4	9	9	22
All far-side	13	37	89	**139**

Table 66: Far-side M1 casualties by side impact location and PDF

Principal Direction of Force	Killed	Seriously injured	Slightly injured	Total
No occupant compartment engagement (e.g. F0 or B0)	1	10	37	48
Collision Involved occupant compartment (exclude F0, B0)				
Principal direction of force 2,3,4 / 8,9,10	**14**	**23**	**46**	**83**
Principal direction of force 1,5,6,7,11,12	1	9	38	48
Unknown PDOF	3	2	2	7
Total	19	44	123	**186**

Table 67: Far-side seat belted M1 casualties by side impact location and PDF

Principal Direction of Force	Killed	Seriously injured	Slightly injured	Total
No occupant compartment engagement (e.g. F0 or B0)	0	8	26	34
Collision Involved occupant compartment (exclude F0, B0)				
Principal direction of force 2,3,4 / 8,9,10	**12**	**19**	**33**	**64**
Principal direction of force 1,5,6,7,11,12	0	8	28	36
Unknown PDOF	1	2	2	5
Total	13	37	89	**139**

Table 66 quantifies the proportion of fatal, serious and slight casualties involved in far-side collisions (74%, 52% and 37% respectively), where the nature of the impact loading to the vehicle is likely to be within scope of a potential future test requirement.

3.4.2.1 Casualty severity

The 83 far-side car occupants (seat belted and unbelted) whom experienced an impact with a PDF of 2,3,4 / 8,9,10 are grouped below by object hit.

Table 68 and Table 69 describe the injury severity of the far-side occupants in the sample by the type of object impacted. The severity of the collision is shown in Figure 8 which plots the cumulative frequency of the vehicles Equivalent Energy Speed (EES) in km/h for each casualty type. EES is a good proxy for delta-v that is calculated from the crush measurements on the vehicle.

Table 68: Injury severity of far-side occupants by type of object hit

Injury severity	Another vehicle	Pole or Narrow Object <41cm	Wide Object ≥41cm	Unknown	Total
Fatal	12	1	1	0	14
Serious	15	4	4	0	23
Slight	40	1	4	1	46
Total	**67**	**6**	**9**	**1**	**83**

Table 69: Injury severity of seat-belted far-side occupants by type of object hit

Injury severity	Another vehicle	Pole or Narrow Object <41cm	Wide Object ≥41cm	Total
Fatal	10	1	1	12
Serious	13	3	3	19
Slight	28	1	4	33
Total	**51**	**5**	**8**	**64**

Vehicles with a Valid EES are shown in Table 70 and Table 73. The cumulative frequencies of these tables are plotted in Figure 7 and Figure 8 respectively.

Table 70: Frequency of occupant severity for all casualties by EES (km/h) for far-side occupants

EES Groups	Fatal	Serious	Slight	Grand Total
0-10	0	0	5	5
11-20	2	2	25	29
21-30	0	6	6	12
31-40	1	3	3	7
41-50	2	0	1	3
51-60	0	1	0	1
61-70	2	0	0	2
71+	2	0	0	2
Grand Total	**9**	**12**	**40**	**61**

Table 71: Cumulative frequency of occupant severity for seat-belted casualties by EES (km/h) for far-side occupants

EES Groups	Fatal	Serious	Slight	Grand Total
0-10	0	0	2	2
11-20	1	0	19	20
21-30	0	5	4	9
31-40	1	2	2	5
41-50	2	0	1	3
51-60	0	1	0	1
61-70	2	0	0	2
71+	1	0	0	1
Grand Total	**7**	**8**	**28**	**43**

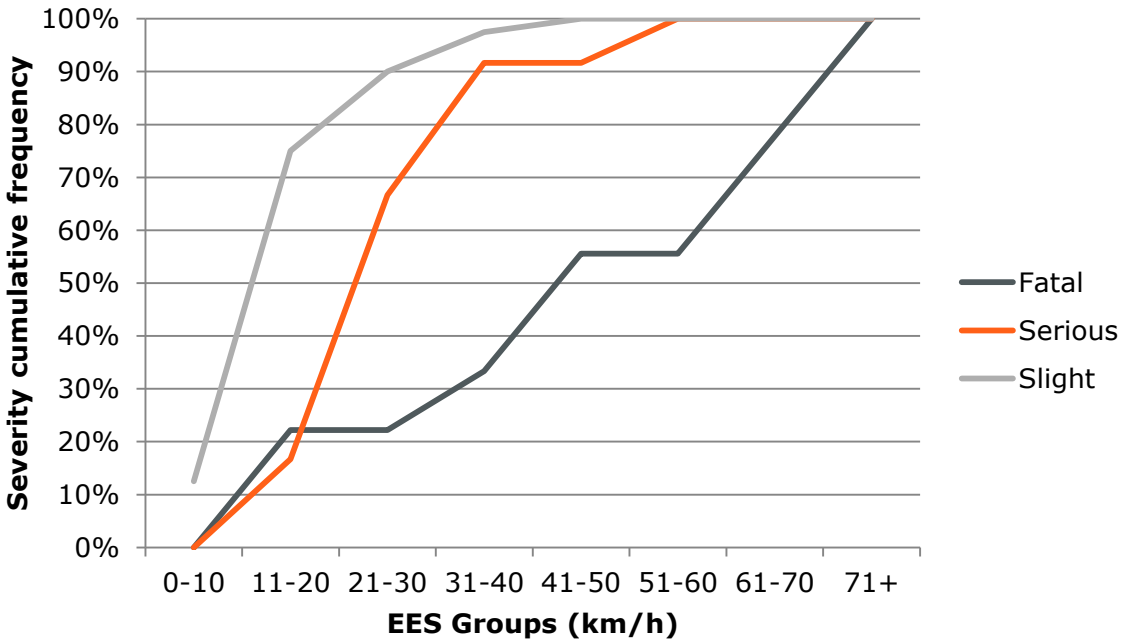


Figure 7: Cumulative frequency of occupant severity for all casualties by EES (km/h) for far-side occupants

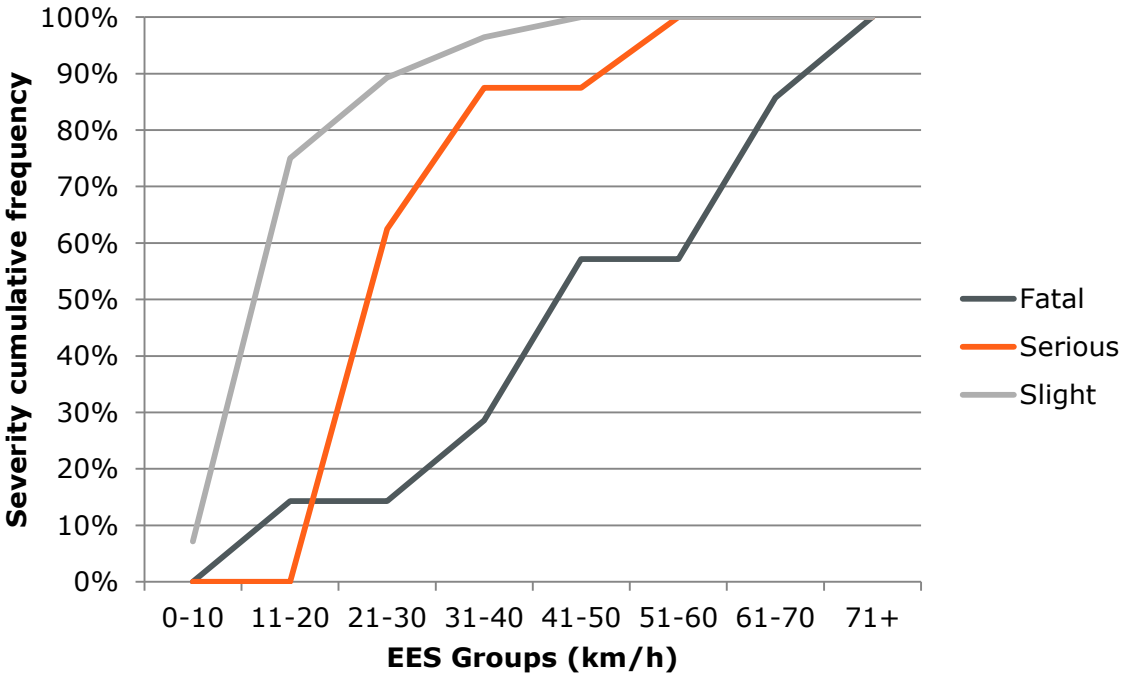


Figure 8 - Cumulative frequency of occupant severity for seat-belted casualties by EES (km/h) for far-side occupants

3.4.3 Estimate of specific GB target population based on scaling in-depth data

The proportions of car users by injury severity with a far side impact identified from the RAIDS data (Table 66) were used to estimate the number of 2004+ M1 occupant casualties in GB (Table 59). Figure 9 diagrammatically shows how the proportion of car occupants in far-side lateral collisions was derived from RAIDS and then projected to the equivalent car occupants in the national STATS19 data to generate the estimated gross target population for this measure.

Table 72 summarises the number of casualties whom could benefit in GB from the SFS measure over a 5 year period. The Gross Target Population is equivalent to all farside casualties in side impacts found in Stats19 (n = 29,498), however, by considering the proportion of farside collisions with appropriate loading of the occupant compartment the Anticipated Target Population is derived (n = 11,341).

Table 72: Estimated Target Population for SFS (GB 2011-2015; cars 2004+)

Stats19 injury severity	Stats19 all far side casualties	Estimated % cars with appropriate vehicle loading	Anticipated Target Population
Killed	179	73.7%	132
Serious	1,639	52.3%	857
Slight	27,680	37.4%	10,352
Total	**29,498**		**11,341**

The assumptions and controls used in this analysis are:

- 2004+ M1 cars only – these vehicles would comply with the current F94 and R95 regulation and there is a significant bias to more severe injury outcomes when the analysis includes vehicles that were manufactured before 2004 as they are associated with worse crashworthiness/collision performance
- All (included belted) – Stats19 records if occupants were belted or unrestrained, however, there are known problems with the reporting of these data and it cannot be used reliably. As a result the estimated target population at the national level includes both restrained and unrestrained car occupants whom have been matched in the in-depth data. Each table presenting RAIDS data initially show all car occupants, but is duplicated immediately afterwards to show seat belted only car occupants too.

3.4.4 Summary

A summary of the analysis steps are presented in diagrammatic form in Figure 9.

The target population is expressed as a proportion of all farside casualties in M1 vehicles with MY 2004+ and of all M1 casualties in Table 73.

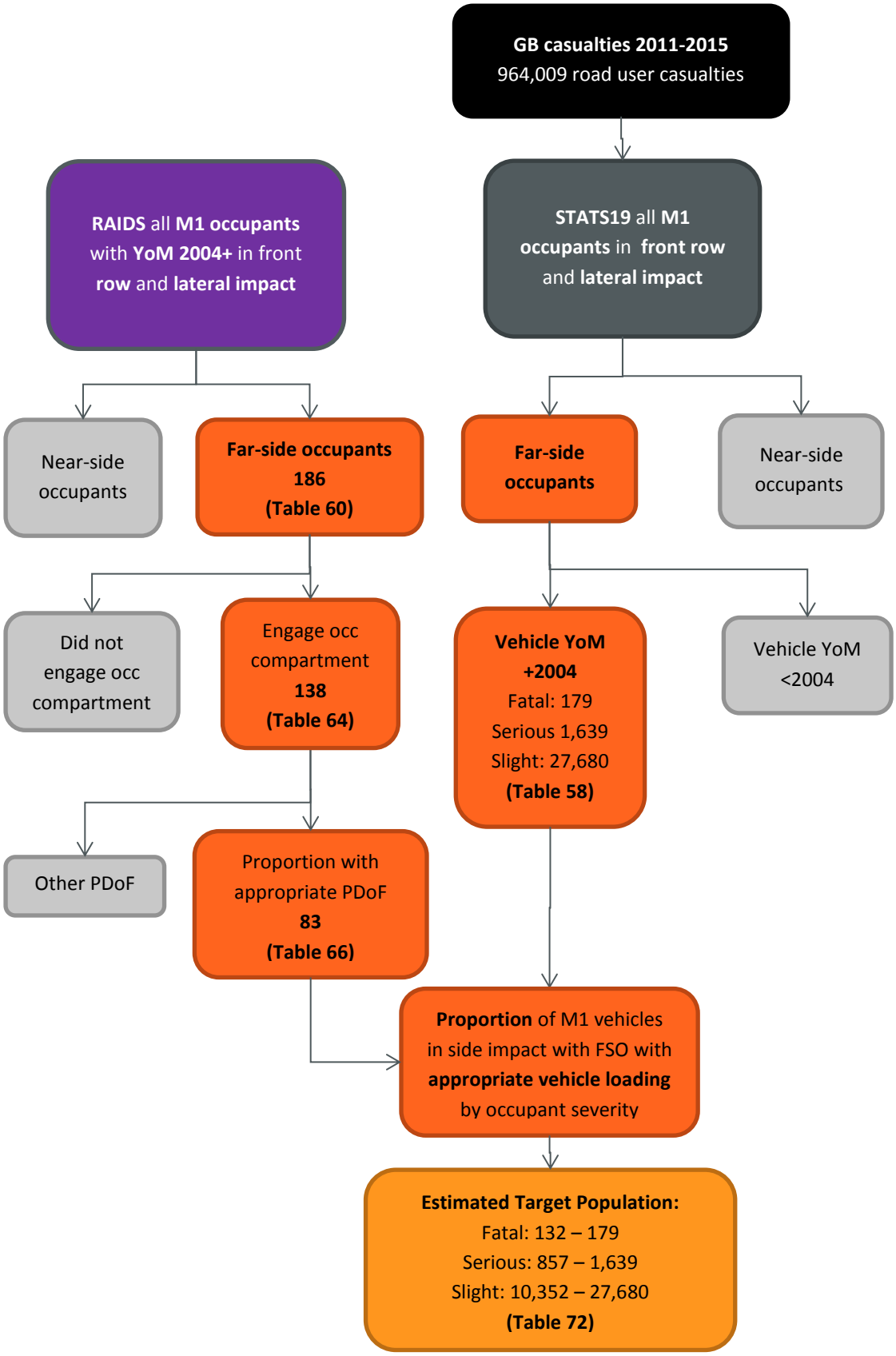


Figure 9: Tree diagram of the analysis generating the estimated gross target population for M1 occupants in far-side lateral collisions

Table 73: SFS Target Population in comparison to all M1(MY2004+) casualties in a side impact and all M1 casualties

	Target Population	All M1 casualties MY 2004+ in side impacts	% proportion of Target population	All M1 casualties	% proportion of Target population
Fatal	132	584	23%	4,006	3%
Serious	857	4,591	19%	39,925	2%
Slight	10,352	73,232	14%	534,928	2%
Total	11,341	78,407	14%	578,859	2%

3.5 Frontal Impact Crash Test (F94)

- Benefits of extension to all M1/N1, i.e. those currently excluded which are: M1 > 2.5 tonne, < 3.5 tonneGVW and all N1 < 3.5 tonne
- Find the proportion and gravity of excluded M1/N1 front accident

3.5.1 Characteristics of gross target casualty population for GB (Stats19)

Stats19 N1 and M1 vehicles with a "1st point of impact = front" were selected. The ACEA Lookup table was used to differentiate make and models with regard to weights (exceptions).

M1 vehicles were also split by segment since the vehicle with a gross vehicle weight of at least 2,500 kg only applied to the larger vehicle segments (large family car, executive, 4x4, MPV).

Table 74 shows the number of occupants of M1 and N1 vehicles in front impact collisions. M1 vehicles are split by the segment, where known, and whether the gross vehicle weight is above 2.5t (note that 'No' includes not knowns).

There were 273,279 M1 occupant casualties in frontal impact collisions, of which 7,924 were occupants of vehicles with a GVW of more than 2.5t. These were 4x4, executive and MPV segment vehicles.

There were 12,458 N1 occupant casualties in frontal impacts, of which approximately half (49%) were occupants of vehicles with a GVW of more than 2.5t.

Table 74: M1 and N1 occupants in front impact collisions

Vehicle type	Weight>2500Kg	Killed	Seriously injured	Slightly injured	Total
M1 - Supermini	No	636	6,971	64,123	71,730
M1 - Small family car	No	556	5,198	49,888	55,642
M1 - Large family car	No	215	2,525	24,910	27,650
M1 - Roadster sports	No	37	414	2,500	2,951
M1 - 4x4	Yes	32	303	2,879	3,214
	No	39	580	4,581	5,200
M1 - Executive	Yes	3	9	72	84
	No	35	310	2,890	3,235
M1 - MPV	Yes	7	122	1,877	2,006
	No	91	1,169	12,883	14,143
M1 - Taxi	No		4	31	35
M1 - unknown	Yes	7	227	2,386	2,620
	No	733	8,708	75,328	84,769
N1	Yes	56	576	5,483	6,115
	No	81	710	5,552	6,343
Total		**2,528**	**27,826**	**255,383**	**285,737**

The majority of M1 >2.5 t casualties were drivers (66%), 20% were front passengers and 14% were rear passengers and approximately 70% were occupants of vehicles manufactured in 2004 or more recently.

Table 75: M1 >2.5t and N1 occupant casualties in frontal impacts by vehicle year of manufacture and casualty injury

	Year of manufacture	Killed	Seriously injured	Slightly injured	Total
M1 >2500	2004+	23	181	1,808	2,012
	<2004	25	308	3,392	3,725
	unknown	-	2	5	7
	Total	**48**	**491**	**5,205**	**5,744**
N1	2004+	17	160	1,190	1,367
	<2004	58	552	5,567	6,177
	unknown	-	-	1	1
	Total	**75**	**712**	**6,758**	**7,545**
Total		**123**	**1,203**	**11,963**	**13,289**

3.5.2 In-depth assessment of collision typology (RAIDS)

After an initial investigation and data tabulation, the decision was made that the data sample was currently too small for meaningful inclusion at this time.

3.5.3 Estimate of specific GB target population

Table 75 identifies the casualty target population for M1 over 2.5 t and N1 vehicles that are currently exempt from R94. In GB up to 7,545 occupants of N1 and 5,744 occupants of M1>2.5t were injured in collisions in the years 2011-2015.

3.6 Side Impact Crash Test (S95)

- Benefits of extension to all M1/N1, i.e. those currently excluded which are M1/N1 < 3.5 tonnes with an R point height > 700 mm.
- Find the proportion and gravity of excluded M1/N1 side impact accidents

3.6.1 Characteristics of gross target casualty population for GB (Stats19)

Stats19 data relating to M1 and N1 vehicles, with a "1st point of impact" of the vehicle side was used. The lookup table of make and models and R heights provided ACEA was used to identify the current exempt vehicles.

There were 4,311 casualties that were occupants of M1 and N1 vehicles with a R height >700mm. Approximately half were M1 occupants (accounting for 1% of all M1 occupant casualties) and half were N1 occupants (accounting for 44% of all N1 occupant casualties).

The vehicles with R>700mm were within 4x4, executive, MPV (and unknown) vehicle segments.

Table 76: M1 and N1 side impact vehicle occupants by vehicle segment, R height and casualty severity

		Height>700mm	Killed	Seriously injured	Slightly injured	Total
M1	Supermini	No/unk	387	2,663	33,244	36,294
	Small family car	No/unk	270	1827	27,524	29,621
	Large family car	No/unk	144	957	14,211	15,312
	4x4	Yes	11	106	1,369	1,486
		No/unk	24	205	2,791	3,020
	Executive	Yes	0	2	18	20
		No/unk	20	114	1,750	1,884
	MPV	Yes	0	9	131	140
		No/unk	45	466	8,272	8,783
	Roadster sports	No/unk	30	135	1,258	1,423
	Taxi	No/unk	0	10	197	207
	unknown	No/unk	432	3,139	39,441	43,012
	M1 Total		1,363	9,633	130,206	141,202
N1	N1	Yes	15	150	2,500	2,665
		No/unk	18	233	3,103	3,354
	N1 Total		33	383	5,603	6,019
Total			**1,396**	**10,016**	**135,809**	**147,221**

57% of M1 occupant casualties and 83% of N1 occupant casualties that were in vehicles with R>700m were in vehicles manufactured 2004 or more recently.

Table 77: M1 and N1 side impact vehicle occupants with R height >700mm by year of manufacture and casualty severity

	Year of manufacture	Killed	Seriously injured	Slightly injured	Total
M1	2004+	5	60	873	938
	<2004	6	57	645	708
M1 Total		11	117	1,518	1,646
N1	2004+	13	123	2,075	2,211
	<2004	2	27	425	454
N1 Total		15	150	2,500	2,665
Total		**26**	**267**	**4,018**	**4,311**

3.6.2 In-depth assessment of collision typology (RAIDS)

After an initial investigation and data tabulation, the decision was made that the data sample was currently too small for meaningful inclusion at this time.

3.6.3 Estimate of specific GB target population

Table 77 identifies the casualty target population for M1 and N1 vehicles that are currently exempt from R95 because the R height is greater than 700mm. In GB up to 2,665 occupants of N1 and 1,646 occupants of M1>2.5t were injured in collisions between 2011-2015.

3.7 Adult Head to Windscreen Area (HED)

- Vehicle type: M1
- Benefits of secondary safety measures to reduce the risk of head injury due to pedestrian and cyclist head impacts to the edges of the windscreen, the A-pillars, the scuttle and the windscreen header
- Find the proportion and gravity of pedestrian accident with head to windscreen impact

3.7.1 Characteristics of gross target casualty population for GB (Stats19)

Pedestrian and pedal cyclists who were involved in impacts with M1 vehicles, where the "first point of impact" on the car was described as "front" were selected in the Stats19 data.

It is recognised that other impact configurations may result in a head contact with the relevant windscreen area, but these have been excluded from this analysis.

All ages of pedestrians and cyclists were considered since the height of casualties is not recorded in Stats19 and the measure may be beneficial for some collisions involving young children.

There were 53,955 pedestrians and 35,096 pedal cyclists that were hit by the front of M1 vehicles in the 2011-2015 timeframe (Table 78).

Table 78: Casualties in collisions with front of M1 vehicles

Casualty type	Casualty age	Killed	Seriously injured	Slightly injured	Total
Pedestrians	0-15	58	3,309	13,323	16,690
	16+	903	8,358	26,944	36,205
	Unknown		158	902	1,060
	Total	**961**	**11,825**	**41,169**	**53,955**
Pedal cyclists	0-15	15	662	4,237	4,914
	16+	166	4,616	24,811	29,593
	Unknown	-	60	529	589
	Total	**181**	**5,338**	**29,577**	**35,096**

3.7.1.1 Pedestrians

Pedestrian casualties hit by M1 vehicles with first point of impact at the front of the M1 are grouped by vehicle manoeuvre (Table 79), pedestrian action (Table 80) and combined (Table 81).

Table 79: Pedestrian casualties hit by M1 vehicles with 1st point of impact = front by vehicle manoeuvre and pedestrian severity

Vehicle Manoeuvre	Killed	Seriously injured	Slightly injured	Total
Moving off	14	527	3,002	3,543
Turning left	11	405	2,073	2,489
Turning right	42	1,183	4,906	6,131
Changing lane	3	54	87	144
Overtaking	24	391	1,340	1,755
Going ahead at a bend	41	479	1,341	1,861
Going ahead other	813	8,346	25,713	34,872
Other unknown	13	440	2,707	3,160
Total	**961**	**11,825**	**41,169**	**53,955**

Other manoeuvres include: reversing, parked, waiting to go ahead, but held up, slowing or stopping, U-turn, waiting to turn left or right

Table 80: Pedestrian casualties hit by M1 vehicles with 1st point of impact = front by pedestrian action and severity

Pedestrian action	Killed	Seriously injured	Slightly injured	Total
Crossing at crossing	119	2,132	7,725	**9,976**
Crossing away from crossing	534	7,906	26,988	**35,428**
In carriageway not walking along or crossing	121	617	2,294	**3,032**
On footway or verge	53	605	2,211	**2,869**
Other/unknown	65	321	1,318	**1,704**
Walking along	69	244	633	**946**
Total	**961**	**11,825**	**41,169**	**53,955**

Table 81: Pedestrian casualties hit by M1 vehicles with 1st point of impact = front by vehicle manoeuvre and pedestrian action

Vehicle manoeuvre	Crossing at crossing	Crossing away from crossing	In carriageway not walking along or crossing	On footway or verge	Other/unk	Walking along	Total
Moving off	771	1,741	516	318	148	49	3,543
Turning left	320	1,761	81	236	70	21	2,489
Turning right	765	4,757	161	263	135	50	6,131
Changing lane	28	89	12	9	2	4	144
Overtaking	166	1,459	77	18	20	15	1,755
Going ahead at a bend	333	1,058	98	240	57	75	1,861
Going ahead other	7,008	22,686	1,807	1,534	1,149	688	34,872
Other unknown	585	1,877	280	251	123	44	3,160
Total	**9,976**	**35,428**	**3,032**	**2,869**	**1,704**	**946**	**53,955**

Other manoeuvres include: reversing, parked, waiting to go ahead, but held up, slowing or stopping, U-turn, waiting to turn left or right

3.7.1.2 Pedal cyclists

Pedal cyclist casualties hit by M1 vehicles with first point of impact at the front of the M1 are grouped by vehicle manoeuvre and pedal cyclist manoeuvre (Table 84). Collisions involving a pedal cyclist and more than one other vehicle are not included since Stats19 does not include details of which vehicles impacted with each other or in what order.

Table 82: Pedal cyclist casualties in 2 vehicle collisions with an M1 vehicles with 1st point of impact = front by cyclist manoeuvre

Cyclist manoeuvre	Killed	Seriously injured	Slightly injured	Total
Moving off	2	128	867	997
Turning left	2	97	570	669
Turning right	22	458	2,539	3,019
Changing lane	5	79	287	371
Overtaking		80	508	588
Going ahead at a bend	6	330	1,301	1,637
Going ahead other	140	4,006	22,138	26,284
Other/unk	4	160	1,367	1,531
Total	**181**	**5,338**	**29,577**	**35,096**

Table 83: Pedal cyclist casualties in 2 vehicle collisions with an M1 vehicles with 1st point of impact = front byM1 vehicle manoeuvre

M1 manoeuvre	Killed	Seriously injured	Slightly injured	Total
Moving off	2	550	3,667	4,219
Turning left	3	483	3,493	3,979
Turning right	10	1,241	7,302	8,553
Changing lane	1	35	176	212
Overtaking	11	163	836	1,010
Going ahead at a bend	9	212	805	1,026
Going ahead other	144	2,411	11,493	14,048
Other/unk	1	243	1,805	2,049
Total	**181**	**5,338**	**29,577**	**35,096**

Table 84: Pedal cyclist casualties in 2 vehicle collisions with an M1 vehicles with 1st point of impact = front by M1 vehicle manoeuvre and cyclist manoeuvre

Cyclist manoeuvre	M1 vehicle manoeuvre								
	Moving off	Turning left	Turning right	Changing lane	Overtaking	Going ahead at a bend	Going ahead other	Other/unk	Total
Moving off	332	60	68	7	20	21	427	62	997
Turning left	42	111	110	2	18	18	315	53	669
Turning right	285	170	570	6	150	71	1,671	96	3,019
Changing lane	35	15	6	17	30	11	236	21	371
Overtaking	59	36	274	7	65	1	90	56	588
Going ahead at a bend	267	150	308	9	23	545	260	75	1,637
Going ahead other	3,024	3,363	6,819	156	667	319	10,531	1,405	26,284
Other/unk	175	74	398	8	37	40	518	281	1,531
Total	**4,219**	**3,979**	**8,553**	**212**	**1,010**	**1,026**	**14,048**	**2,049**	**35,096**

3.7.2 In-depth assessment of collision typology (RAIDS)

Stats19 does not record the details of the impacts, for example, the exact location of impact between pedestrians or pedal cyclist and car. Therefore the adult's head may not have impacted with the windscreen. In-depth RAIDS data has therefore been used to estimate the proportion of pedestrian and cyclist casualties, with the first point of impact at the front of the M1, have a head impact to the windscreen area.

The dataset used for this analysis is OTS and RAIDS Phase 1 cases with a cyclist or pedestrian impacted by a Passenger car (M1) at the front.

3.7.2.1 Casualties

Pedestrian and cyclist casualties in RAIDS, split by sex and injury severity (using the fatal, serious and slight injury scale), are shown in Table 85 and Table 86 respectively.

Table 85: RAIDS pedestrian and cyclist casualties by sex

Gender	Cyclist	Pedestrian	Total
Female	11	74	85
Male	70	99	169
Not known	0	1	1
Total	**81**	**174**	**255**

Table 86: RAIDS pedestrian and cyclist casualties by injury severity

Injury severity	Cyclist	Pedestrian	Total
Fatal	3	15	18
Serious	24	83	107
Slight	44	60	104
Uninjured	3	6	9
Unknown	7	10	17
Total	**81**	**174**	**255**

There were 235 pedestrians and cyclists with known and coded AIS injuries; 103 suffered a MAIS greater or equal to 2 and 43 had an AIS of 2 or greater head injury.

The injury outcome of the pedestrians and cyclists are shown in detail in the following tables. The overall Maximum AIS (MAIS) scores for the casualties are shown in Table 87. 235 casualties had a known MAIS score with 15 (5.9%) recorded as uninjured. 117 (45.9%) casualties suffered a MAIS 1 injury score which is analogous to a slight injury and 103 (40.4%) were killed or seriously injured with MAIS ≥2.

Table 87: RAIDS pedestrian and cyclist casualties by MAIS

MAIS	Cyclist	Pedestrian	Total
0	6	9	15
1	48	69	117
2	13	38	51
3	5	24	29
4	0	10	10
5	2	11	13
6	0	0	0
Not known	7	13	20
Total	**81**	**174**	**255**

Table 88 shows the distribution of casualties by MAIS score for head injuries only. 43 (16.9%) of the casualties suffered serious or fatal head injuries and 83 (32.5%) suffered slight head injuries. 118 (46.3%) of the casualties did not sustain a head injury.

Table 88: RAIDS pedestrian and cyclist casualties by Maximum Head AIS

Max Head AIS	Cyclist	Pedestrian	Total
0	51	67	118
1	23	60	83
2	2	10	12
3	1	15	16
4	0	7	7
5	1	7	8
6	0	0	0
Not known	3	8	11
Total	**81**	**174**	**255**

Table 89 shows the distribution of helmet wearing amongst the 81 cyclists. Approximately 26% (21) of the cyclists wore helmets and none of these suffered an AIS 2 or greater head injury.

Table 89: RAIDS cyclist head MAIS grouped by helmet wearing status

MAIS	Helmet worn	No Helmet worn	Unknown	Total
0	18	25	8	51
1	3	14	6	23
2	0	2	0	2
3	0	1	0	1
4	0	0	0	0
5	0	1	0	1
6	0	0	0	0
9	0	2	1	3
Total	**21**	**45**	**15**	**81**

3.7.2.2 Head strike above the bonnet line

For the purpose of estimating the target population for this measure, the windscreen area was zoned as follows and as shown schematically in Figure 10:

- A-pillar and scuttle
- Header
- Central screen area

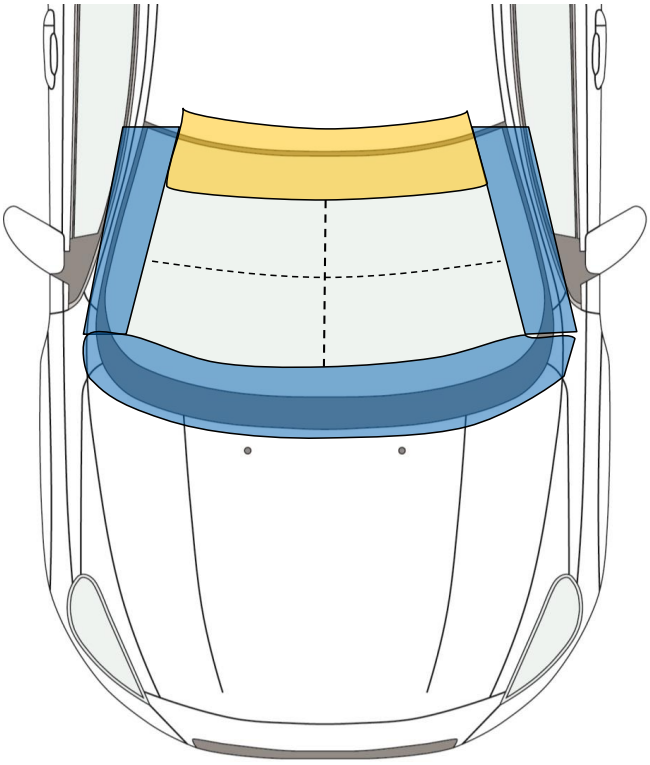


Figure 10: Windscreen zones – A-pillar and scuttle (blue); header (orange); central windscreen (green)

The A-pillar, scuttle and header groups include the 10 cm of windscreen closest to each of these regions; the photographs of all 92 cases were reviewed in detail in order to ensure that each head impact was correctly classified. The region of the windscreen close to the edge was included with the A-pillar, scuttle and header because this region is well supported by the surrounding structures and is therefore much stiffer than the central windscreen area. Therefore, the risk of injury may be expected to be higher for these parts of the windscreen and they may benefit from the same mitigation as e.g. the A-pillar.

The distribution of head strikes to the predefined areas of the windscreen and A-pillars are detailed in Table 90. The resulting casualty severity by overall injury severity, overall MAIS and maximum AIS for the head are shown in the following tables.

Table 90: Incidence of windscreen area head impacts for RAIDS pedestrian and cyclists (cells highlighted blue are in the A-pillar and scuttle area; cells highlighted orange are in the header area; cells highlighted green are in the central windscreen area)

Row Labels	OS A-pillar	OS half of W/S	NS half of W/S	NS A-pillar	None	Total
Header	1	2	3	0	0	6
Top half of W/S	1	10	10	3	0	24
Bottom half of W/S	0	16	21	4	0	41
Scuttle	0	4	16	1	0	21
None	0	0	0	0	163	163
Total	**2**	**32**	**50**	**8**	**163**	**255**

Table 91: RAIDS pedestrian and cyclist injury severity by incidence of head strike to windscreen area

Row Labels	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
Fatal	9	5	2	2	18
Serious	23	18	0	66	107
Slight	18	7	3	76	104
Uninjured	1	0	0	8	9
Unknown	6	0	0	11	17
Total	**57**	**30**	**5**	**163**	**255**

Table 92: RAIDS pedestrian injury severity by incidence of head strike to windscreen area

Row Labels	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
Fatal	8	4	1	2	15
Serious	19	15	0	49	83
Slight	12	4	0	44	60
Uninjured	1	0	0	5	6
Unknown	3	0	0	7	10
Total	**43**	**23**	**1**	**107**	**174**

Table 93: RAIDS cyclist injury severity by incidence of head strike to windscreen area

Row Labels	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
Fatal	1	1	1	0	3
Serious	4	3	0	17	24
Slight	6	3	3	32	44
Uninjured	0	0	0	3	3
Unknown	3	0	0	4	7
Total	**14**	**7**	**4**	**56**	**81**

Table 94: RAIDS pedestrian and cyclist MAIS severity by incidence of head strike to windscreen area

MAIS	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0	1	2	0	12	15
1	21	7	3	86	117
2	13	5	0	33	51
3	6	6	0	17	29
4	4	3	0	3	10
5	5	6	2	0	13
6	0	0	0	0	0
9	7	1	0	12	20
Total	**57**	**30**	**5**	**163**	**255**

Table 95: RAIDS pedestrian MAIS severity by incidence of head strike to windscreen area

MAIS	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0	1	2	0	6	9
1	14	3	0	52	69
2	10	4	0	24	38
3	6	5	0	13	24
4	4	3	0	3	10
5	5	5	1	0	11
6	0	0	0	0	0
9	3	1	0	9	13
Total	**43**	**23**	**1**	**107**	**174**

Table 96: RAIDS cyclist MAIS severity by incidence of head strike to windscreen area

MAIS	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0	0	0	0	6	6
1	7	4	3	34	48
2	3	1	0	9	13
3	0	1	0	4	5
4	0	0	0	0	0
5	0	1	1	0	2
6	0	0	0	0	0
9	4	0	0	3	7
Total	**14**	**7**	**4**	**56**	**81**

Table 97: RAIDS pedestrian and cyclist Maximum Head AIS severity by incidence of head strike to windscreen area

MAIS	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0	15	10	2	91	118
1	23	5	3	52	83
2	2	3	0	7	12
3	6	5	0	5	16
4	2	2	0	3	7
5	4	4	0	0	8
6	0	0	0	0	0
9	5	1	0	5	11
Total	**57**	**30**	**5**	**163**	**255**

Table 98: RAIDS pedestrian Maximum Head AIS severity by incidence of head strike to windscreen area

MAIS	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0	11	6	0	50	67
1	15	4	1	40	60
2	2	3	0	5	10
3	6	4	0	5	15
4	2	2	0	3	7
5	4	3	0	0	7
6	0	0	0	0	0
9	3	1	0	4	8
Total	**43**	**23**	**1**	**107**	**174**

Table 99: RAIDS cyclist Maximum Head AIS severity by incidence of head strike to windscreen area

MAIS	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0	4	4	2	41	51
1	8	1	2	12	23
2	0	0	0	2	2
3	0	1	0	0	1
4	0	0	0	0	0
5	0	1	0	0	1
6	0	0	0	0	0
9	2	0	0	1	3
Total	**14**	**7**	**4**	**56**	**81**

3.7.2.3 Impact severity

The following tables detail the severity of the impact by using the speed of the vehicle at the point of impact. These speeds are calculated at the time of investigation using the evidence available at the scene to calculate the speed of the vehicle (e.g. skid marks, pedestrian throw distances, CCTV, etc.). The speeds cannot always be determined with a high degree of certainty, so a confidence system is used to separate speeds which are likely to be accurate and those with a degree of inaccuracy. The following speeds are based on high confidence calculations where the available evidence was used to calculate the vehicle's impact speed to a reasonable degree of accuracy. Low confidence speeds are categorised into "Unknown" speed.

Table 100: M1 impact speed by incidence of pedestrians and cyclist head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	1	0	33	34
6-10	2	4	0	26	32
11-15	8	2	0	20	30
16-20	2	6	0	10	18
21-25	5	2	2	6	15
26-30	2	1	2	5	10
31+	7	5	0	4	16
Unknown	31	9	1	59	100
Total	**57**	**30**	**5**	**163**	**255**

Table 101: M1 impact speed by incidence of pedestrians head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	1	0	9	10
6-10	1	2	0	21	24
11-15	5	1	0	17	23
16-20	2	4	0	5	11
21-25	4	2	0	5	11
26-30	2	1	0	5	8
31+	6	4	0	2	12
Unknown	23	8	1	43	75
Total	**43**	**23**	**1**	**107**	**174**

Table 102: M1 impact speed by incidence of cyclist head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	0	0	24	24
6-10	1	2	0	5	8
11-15	3	1	0	3	7
16-20	0	2	0	5	7
21-25	1	0	2	1	4
26-30	0	0	2	0	2
31+	1	1	0	2	4
Unknown	8	1	0	16	25
Total	**14**	**7**	**4**	**56**	**81**

Table 103: M1 impact speed by incidence of MAIS 2+ pedestrians and cyclist injury and location of head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	0	0	7	7
6-10	0	3	0	10	13
11-15	2	1	0	3	6
16-20	2	4	0	3	9
21-25	3	1	0	3	7
26-30	2	1	1	4	8
31+	5	4	0	4	13
Unknown	14	6	1	19	40
Total	**28**	**20**	**2**	**53**	**103**

Table 104: M1 impact speed by incidence of MAIS 2+ pedestrians injury and location of head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	0	0	3	3
6-10	0	2	0	9	11
11-15	1	1	0	2	4
16-20	2	3	0	1	6
21-25	3	1	0	3	7
26-30	2	1	0	4	7
31+	5	3	0	2	10
Unknown	12	6	1	16	35
Total	**25**	**17**	**1**	**40**	**83**

Table 105: M1 impact speed by incidence of MAIS 2+ cyclist injury and location of head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	0	0	4	4
6-10	0	1	0	1	2
11-15	1	0	0	1	2
16-20	0	1	0	2	3
21-25	0	0	0	0	0
26-30	0	0	1	0	1
31+	0	1	0	2	3
Unknown	2	0	0	3	5
Total	**3**	**3**	**1**	**13**	**20**

Table 106: M1 impact speed by incidence of Head AIS 2+ pedestrian and cyclist head injury and location of head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	0	0	0	0
6-10	0	0	0	4	4
11-15	0	0	0	1	1
16-20	1	3	0	1	5
21-25	1	1	0	1	3
26-30	2	1	0	2	5
31+	3	4	0	1	8
Unknown	7	5	0	5	17
Total	**14**	**14**	**0**	**15**	**43**

Table 107: M1 impact speed by incidence of Head AIS 2+ pedestrian head injury and location of head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	0	0	0	0
6-10	0	0	0	4	4
11-15	0	0	0	1	1
16-20	1	2	0	0	3
21-25	1	1	0	1	3
26-30	2	1	0	2	5
31+	3	3	0	1	7
Unknown	7	5	0	4	16
Total	**14**	**12**	**0**	**13**	**39**

Table 108: M1 impact speed by incidence of Head AIS 2+ cyclist head injury and location of head strike to windscreen area

Impact speed (mph)	Windscreen	A-pillar and Scuttle	Header Rail	None	Total
0-5	0	0	0	0	0
6-10	0	0	0	0	0
11-15	0	0	0	0	0
16-20	0	1	0	1	2
21-25	0	0	0	0	0
26-30	0	0	0	0	0
31+	0	1	0	0	1
Unknown	0	0	0	1	1
Total	**0**	**2**	**0**	**2**	**4**

3.7.3 Estimate of specific GB target population based on scaling in-depth data

The proportions of pedestrians and cyclists whom suffered a head strike to the predefined windscreen areas, which could have resulted in AIS 2+ head injuries are identified from the RAIDS data in Table 95 to Table 100:

- 83 pedestrians suffered a MAIS 2 to MAIS 6 (Table 95).
- 26 of the 83 pedestrians (31%) suffered an AIS 2 to AIS 6 head injury associated with the predefined windscreen areas (Table 98).
- 20 pedal cyclists suffered a MAIS 2 to MAIS 6 (Table 96).
- 2 of the 20 pedal cyclists (10%) suffered an AIS 2 to AIS 6 head injury associated with the predefined windscreen areas (Table 99).

The sample size for pedal cyclists is very small.

The proportions of 31% for pedestrians and 10% for pedal cyclists are used to refine the target population from Stats19 (Table 78). While the target population can be described in greater detail, these proportions allow for synergy between this study and the counterpart studies using German and French accident data.

Furthermore, the analysis considered the M1 impact speed, Table 100 to Table 108:

- 8 of the 83 pedestrians (10%) suffered an AIS 2 to AIS 6 head injury associated with the predefined windscreen areas with a known M1 impact speed less than 31 mph (Table 107)
- 6 of the 83 pedestrians (7%) suffered an AIS 2 to AIS 6 head injury associated with the predefined windscreen areas with a known M1 impact speed of 31 mph or greater (Table 107)
- 12 of the 83 pedestrians (14%) suffered an AIS 2 to AIS 6 head injury associated with the predefined windscreen areas with an unknown M1 impact speed (Table 107).

Table 109: Pedestrian and cyclist casualties with AIS 2+ head injury as a result of impact with M1 windscreens and surrounding structures (front impacts only)

Casualty type	Casualty age	Killed	Seriously injured	Slightly injured	Total
Pedestrians	0-15	18	1,028	-	1,046
	16+	281	2,596	-	2,877
	Unknown	0	49	-	49
	Total	**299**	**3,673**	**-**	**3,972**
Pedal cyclists	0-15	2	66	-	68
	16+	17	462	-	478
	Unknown	0	6	-	6
	Total	**18**	**534**	**-**	**552**

MAIS 2+ injury is assumed to be equivalent to police injury severity Killed or Seriously Injured (KSI).

It is expected that smaller pedestrians (children) will be less likely to strike the windscreen area; however, this has not been examined in this analysis. Instead a constant reduction factor is assumed for adults and children.

3.7.4 Summary

Figure 11 shows how the proportion of killed and seriously injured pedestrians and cyclists with serious head injuries induced by head strikes to the windscreen area were derived from RAIDS and then applied to the killed and seriously injured casualties at a national level in STATS19.

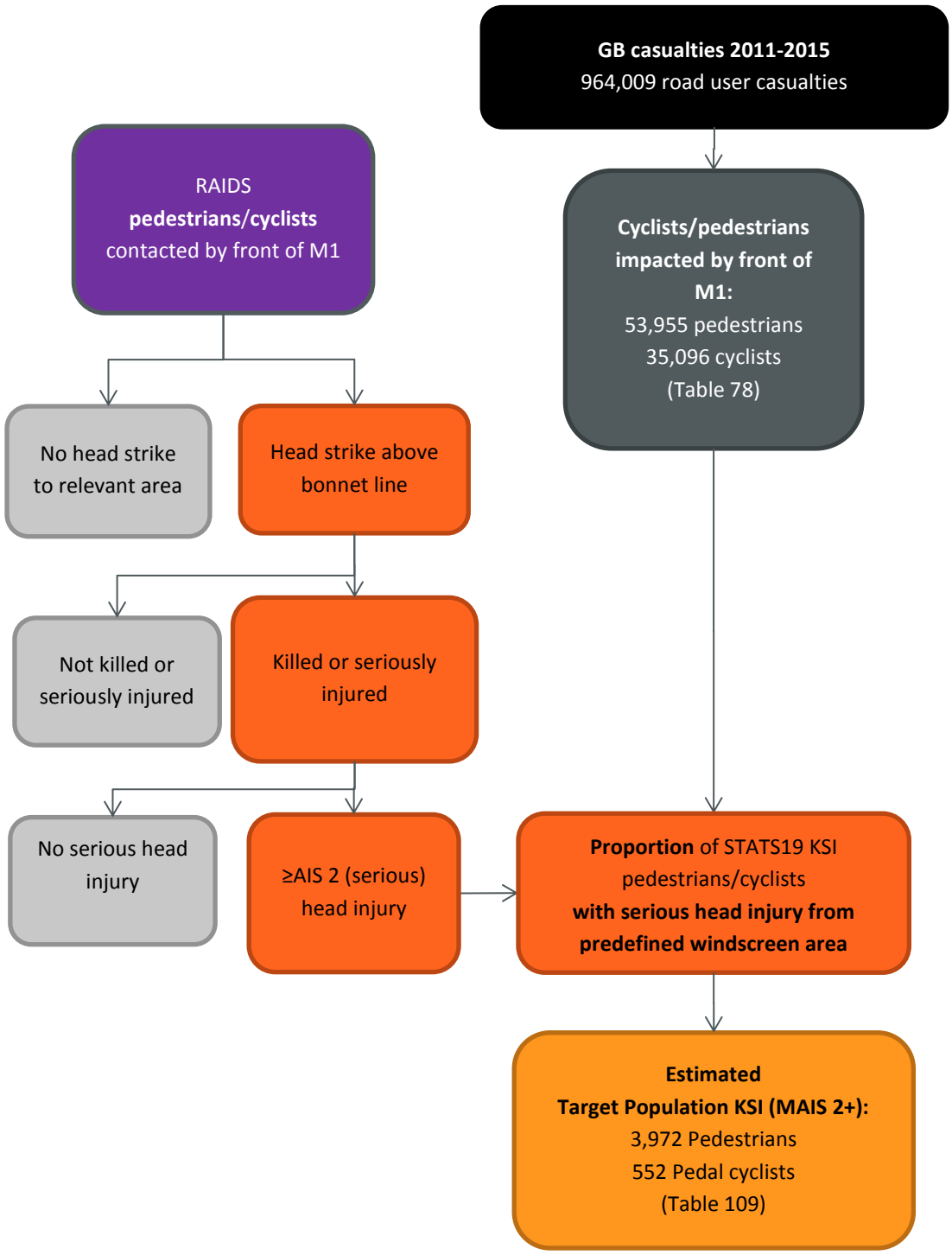


Figure 11: Tree diagram of the analysis generating the estimated gross target population for pedestrians and cyclists

3.8 Reversing Detection (REV)

- Benefit of reversing detection systems for N2/N3/O3/O4.
- Find the target population for reversing detection systems for N2/N3 vehicles and O3/O4 trailers and the gravity of reversing accidents.

3.8.1 Characteristics of gross target casualty population for GB (Stats19)

In Stats19, N2, N3 and N unknown vehicles were selected where the manoeuvre was recorded as 'reversing' and who collided with pedestrians or pedal cyclists.

There were 171 pedestrians hit by a reversing N2, N3 or N unknown vehicle and 13 cyclists in two vehicle collisions with a reversing N2, N3 or N unknown vehicle.

Table 110: Pedestrian and cyclist casualties hit by reversing N2 and N3 vehicles

VRU type	EUVehType (reversing vehicle)	Fatalities	Seriously injured	Slightly injured	Total
Pedestrians	N2	3	19	62	84
	N3	4	20	55	79
	N unknown	0	0	8	8
Pedal cyclists	N2	0	1	4	5
	N3	0	0	6	6
	N unknown	0	1	1	2
Total		**7**	**41**	**136**	**184**

3.8.1.1 Pedestrians

70 of the 171 pedestrians were crossing away from a crossing facility (none were crossing at a facility). 40 were on the footway.

Table 111: Pedestrians hit by reversing N2 and N3 vehicles by pedestrian action and severity

Pedestrian action	Fatalities	Seriously injured	Slightly injured	Total
On footway or verge	0	6	34	40
Crossing at facility	0	0	1	1
Crossing away from facility	3	16	51	70
Walking along carriageway	0	1	1	2
In carriageway not walking along or crossing	2	10	19	31
Other/unknown	2	6	19	27
Total	**7**	**39**	**125**	**171**

Approximately half of the pedestrians injured in collisions with reversing N2 and N3 vehicles were at junctions.

Table 112: Pedestrians hit by reversing N2 and N3 vehicles by pedestrian action and junction detail

Pedestrian action	Non junction	Round-about	T-junction	Slip road	Cross roads	Private drive	Other junction	Total
On footway or verge	17	0	11	0	4	7	1	40
Crossing at facility	1	0	0	0	0	0	0	1
Crossing away from facility	28	1	32	0	1	3	5	70
Walking along carriageway	0	0	1	0	1	0	0	2
In carriageway not walking along or crossing	17	1	10	0	2	1	0	31
Other/unknown	12	0	4	1	0	8	2	27
Total	**75**	**2**	**58**	**1**	**8**	**19**	**8**	**171**

3.8.1.2 Cyclists:

10 of the collisions occurred on an urban road with a speed limit of 30mph (including 6 on an A-road), the other occurred on a minor rural road with a speed limit of 60mph

Table 113: Pedal cyclist casualties in 2-vehicle collisions with reversing N2 and N3 vehicles by pedal cycle manoeuvre and junction detail

Pedal cycle manoeuvre	Non junction	T junction	Private drive	Other junction	Total
Parked	1	0	0	0	**1**
Waiting to go ahead, but held up	1	0	0	1	**2**
Slowing or stopping	0	1	0	0	**1**
Going ahead left hand bend	0	1	0	0	**1**
Going ahead other	2	3	3	0	**8**
Total	**4**	**5**	**3**	**1**	**13**

3.8.2 In-depth assessment of collision typology (RAIDS)

No in-depth data analysis was undertaken for this measure because of the limited sample size.

3.8.3 Estimate of specific GB target population

Table 110 details 184 pedestrian and pedal cyclist casualties who would be the target population for this measure.

However, Stats19 only includes collisions on the public highway. Collisions occurring in car parks, service yards, private workplace sites are therefore not included. Vehicles turning out of driveways onto the public highway (including the pavement) are included. Details of the inclusion and exclusion criteria for Stats19 collisions can be found in Appendix C.

Collisions involving a pedal cyclist and a reversing vehicle and another vehicle are not included since Stats19 does not include details of which vehicles impacted with each other or in what order.

4 Summary

The results are derived from analysis of Great Britain's police-reported road traffic injury database (Stats19) and the UK's Road Accident In-Depth Studies (RAIDS) database. The reference population used for this analysis is Stats19 reported injury road casualties from 2011-2015. Table 114 details the 964,009 injured casualties by vehicle and road user type.

Table 114: Casualties in reported collisions in Great Britain 2011-2015 by vehicle type, casualty class and severity

Vehicle type	Occupant			Pedestrians struck by..			Total
	Killed	Seriously injured	Slightly injured	Killed	Seriously injured	Slightly injured	
Pedal cycle	547	16,090	81,238	17	469	1,760	100,121
PTW	1,725	25,450	71,330	59	1,000	3,720	103,284
M1	3,989	39,721	531,977	1,400	20,786	77,564	675,437
M2	14	197	2,474	10	108	338	3,141
M3	40	1,546	24,605	148	1,126	4,211	31,676
N1	191	1,966	24,470	175	1,656	6,107	34,565
N2	16	187	1,967	37	178	612	2,997
N3	102	592	3,539	239	397	693	5,562
N unknown	2	6	73	1	8	44	134
Other*	122	1,000	4,575	39	286	1,070	7,092
Total	**6,748**	**86,755**	**746,248**	**2,125**	**26,014**	**96,119**	**964,009**

Note*: Other vehicle type includes ridden horse, agricultural vehicles and tram/light rail

Table 115 identifies the casualty Target Populations (TP) for Great Britain (2011-2015) for each of the eight measures. The table provides estimates of the number of killed, seriously and slightly injured casualties who could benefit from the measures. The measures are not mutually exclusive and cannot be summed. Further, at this stage the effectiveness of each measure has not been evaluated, so the casualty TP estimates represent a maximum benefit for Great Britain.

Some measures would benefit the vehicle occupants only. For example FSO would reduce the number of M1 user casualties, whereas ISA would prevent casualties both for users of the vehicles fitted with the technology and for their collision partners, including other vehicle users and VRUs.

It was only possible to estimate a TP for the number of killed pedestrians and pedal cyclists for VIS (improved front end design for direct and indirect driver vision) because of a lack of representative in-depth data for serious and slight casualties at the time of writing.

Table 115: Casualty Target Populations (TP) for each measure (Great Britain 2011-2015)

Measure	Vehicle type	Casualty type	TP casualties who benefit from measure			
			Killed	Seriously injured	Slightly injured	Total
VIS – improved front end design for direct and indirect driver vision	N2	Pedestrians & pedal cyclists	**36**	**232**	**825**	**1,093**
	N3		**275**	**564**	**1,015**	**1,854**
	N Unk		**1**	**14**	**56**	**71**
ISA – Intelligent Speed Assistance	M1	All vehicle users & VRUs	**1,469**	**7,680**	**43,916**	**53,065**
	M2		**0**	**27**	**109**	**136**
	M3		**9**	**18**	**86**	**113**
	N1		**18**	**217**	**1,790**	**2,025**
	N2		**0**	**18**	**90**	**108**
	N3		**54**	**68**	**321**	**443**
FSO – Frontal impact Small Overlap crash test *	M1	M1 occupants	**69**	**793**	**12,376**	**13,238**
SFS – Side impact Far Side occupant crash test *†	M1	M1 Occupants	**132**	**857**	**10,352**	**11,341**
F94 – Frontal Impact Crash Test (removal of exemptions from Regulation 94) *	M1 N1	M1 & N1 occupants that are currently exempt	**123**	**1,203**	**11,963**	**13,289**
S95 – Side Impact Crash Test (removal of exemptions from Regulation 95) *	M1 N1	M1 & N1 occupants that are currently exempt	**26**	**267**	**4,018**	**4,311**
HED – Adult Head to Windscreen Area †	M1	Pedestrians	**299**	**3,673**	-	**3,972**
	M1	Cyclists	**18**	**534**	-	**552**
REV – Reversing Detection ***Note: Stats19 only includes collisions on the public highway and excludes those occurring in car parks, service yards and private workplace sites.***	N2 N3 O3 **O4**	Pedestrians & pedal cyclists	**7**	**41**	**136**	**184**

Notes: * FSO and SFS only consider injury to occupants in cars registered from 2004-2015. Therefore, they cannot be compared with the other measures because they represent a sub-sample of real world collisions.

† Target populations are expressed as a range (Minimum – Maximum)

'-' Means no estimate could be made

‡ Totals are for killed and seriously injured casualties only

References

Hynd et al. (2015). Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users. doi: 10.2769/497485

Richards D, Cookson R, Smith S, Ganu V and Pittman M (2010). The Characteristics of Speed-related Collisions. Road Safety Research Report No. 117, Department for Transport: London. September 2010. http://webarchive.nationalarchives.gov.uk/20120606181145/http:/assets.dft.gov.uk/publications/the-characteristics-of-speed-related-collisions/rsrr117.pdf

Appendix A Vehicles with gross vehicle weight >2500 kg or R point height >700 mm

Make	Model	Variants	Weight>2500 kg	Height>700 mm
Audi	RS6		Yes	
Audi	A8		Yes	No
Audi	Q7		Yes	Yes
Audi	A6 Allroad		Yes	
Bentley	Bentayga		Yes	
Bentley	Flying Spur		Yes	
Bentley	Mulsanne		Yes	
BMW	X6		Yes	
BMW	X5		Yes	
Citroen	Jumper		yes	yes
Citroen	Jumpy		yes	yes
Citroen	SpaceTourer		yes	yes
Fiat	Freemont	7 places only	Yes	No
Fiat	Talento	All variants	yes	yes
Fiat	Fullback	All variants	yes	yes
Fiat	Freemont	All variants	No	Yes
Fiat	Ducato	All variants	yes	yes
Ford	Transit	All Transit and Transit Custom models, but not Transit Connect	Yes	Yes
Ford	Edge		Yes	Yes
Ford	S-Max	But not all models	Yes	No
Ford	Galaxy	But not all models	Yes	No
Ford	Ranger		Yes	
Hyundai	Santa Fe		Yes	
Hyundai	I800		Yes	
Infiniti	Qx70		Yes	
Jeep	Cherokee	4 wheel drive only	No	Yes
Jeep	Wrangler	All variants	No	Yes
Jeep	Wrangler	4 doors only	Yes	Yes
Jeep	Grand Cherokee	All variants	yes	yes

Make	Model	Variants	Weight>2500 kg	Height>700 mm
Land rover	Range Rover	All versions	Yes	Yes
Land rover	Range Rover Sport	All versions	Yes	Yes
Land rover	Defender	All versions	Yes	Yes
Land rover	Discovery	All versions	Yes	Yes
Land rover	Freelander		Yes	Yes
Land rover	Freelander	Except Freelander 'sport'	No	Yes
Land rover	Discovery Sport		Yes	Yes
Lexus	LS		Yes	
Lexus	RX		Yes	
Maserati	Levante	All variants	yes	yes
Mercedes	Sprinter		Yes	Yes
Mercedes	M		Yes	Yes
Mercedes	GLE		Yes	Yes
Mercedes	GL		Yes	Yes
Mercedes	GLS		Yes	Yes
Mercedes	G		Yes	Yes
Mercedes	V		Yes	Yes
Mercedes	Vito		Yes	Yes
Mercedes	Viano		Yes	Yes
Mercedes-Benz	Sprinter		Yes	Yes
Mercedes-Benz	Viano		Yes	Yes
Mercedes-Benz	Vito		Yes	Yes
Mercedes-Benz	V		Yes	Yes
Mercedes-Benz	G		Yes	Yes
Mercedes-Benz	GLS		Yes	Yes
Mercedes-Benz	GL		Yes	Yes
Mercedes-Benz	GLE		Yes	Yes
Mercedes-Benz	M		Yes	Yes
Mitsubishi	Shogun		Yes	
Mitsubishi	L200		Yes	
Nissan	NP300 Navara		Yes	
Opel	Vivaro		Yes	Yes
Opel	Movano		Yes	Yes
Peugeot	Traveller		yes	yes

Make	Model	Variants	Weight>2500 kg	Height>700 mm
Peugeot	Boxer		yes	yes
Peugeot	Expert		yes	No
Porsche	Cayenne		yes	yes
Renault	Trafic	Both M and N models	Yes	Yes
Renault	Master	Both M and N models	Yes	Yes
Rolls Royce	Phantom		Yes	
Rolls Royce	Ghost		Yes	
Rolls Royce	Wraith		Yes	
Ssangyong	Rexton		Yes	
Tesla	Model X		Yes	
Toyota	Proace		Yes	
Toyota	Hilux		Yes	
Toyota	Land Cruiser		Yes	
Vauxhall	Movano		Yes	Yes
Vauxhall	Vivaro		Yes	Yes
Volkswagen	Caravelle		Yes	
Volkswagen	Amarok		Yes	Yes
Volkswagen	Crafter		Yes	Yes
Volkswagen	Transporter		Yes	Yes
Volkswagen	Touareg		Yes	Yes
Volvo	XC90		Yes	

Appendix B STATS20 Section 2.7 Manoeuvres

The vehicle manoeuvre codes are described in:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/230596/stats20-2011.pdf

In summary the codes are:

01. Reversing
02. Parked
03. Waiting to go ahead but held up
04. Slowing or stopping
05. Moving off
06. U turn
07. Turning left
08. Waiting to turn left
09. Turning right
10. Waiting to turn right
11. Changing lane to left
12. Changing lane to right
13. Overtaking moving vehicle on its offside
14. Overtaking stationary vehicle on its offside
15. Overtaking on nearside
16. Going ahead left hand bend
17. Going ahead right hand bend
18. Going ahead other

NOTES

- This refers to actions immediately before the accident.
- A vehicle in the process of parking should be coded 01 or 04 as appropriate, not 02.
- A bus/coach stationary at a bus stop should be coded as 'Parked', code 02.
- A vehicle moving across the road to park on the offside should be coded 12, even if lanes are not marked.
- Code 12 also includes vehicles merging from a slip road.
- Code 14 should include where:

- the vehicle being overtaken on the offside is temporarily held up;
- a parked vehicle is being overtaken on the offside and a vehicle record has been produced
- for that parked vehicle (i.e. the parked vehicle is deemed to have been contributory to the accident).

- Code 15 should be used where the vehicle being overtaken is parked (see Note E(ii) above), broken down, temporarily held up or moving.
- Codes 01 - 09 should be prefixed with a zero (e.g. 'Moving off' should be coded 05).
- See also "Examples for coding the locations of accidents and vehicles" on page 23.

Appendix C STATS20 Section 2 Accidents to be reported

1. All road accidents involving human death or personal injury occurring on the Highway ('road' in Scotland) and notified to the police within 30 days of occurrence, and in which one or more vehicles are involved, are to be reported. This is a wider definition of road accidents than that used in Road Traffic Acts.
2. Examples of accidents to be reported include:
    a. accidents which commence on the highway but which involve casualties off the highway (e.g. where a vehicle runs out of control while on the highway and causes casualties elsewhere);
    b. accidents involving the boarding and alighting of buses or coaches and accidents in which passengers already aboard a bus/coach are injured, whether or not another vehicle or a pedestrian is involved;
    c. accidents to pedal cyclists or horse riders, where they injure themselves or a pedestrian;
    d. accidents resulting from deliberate acts of violence, but excluding casualties who are subsequently identified as confirmed suicides;
    e. accidents within bus stations/interchanges where they form part of the highway;
    f. accidents in Royal Parks (on roads to which the public have motor vehicle access)
3. Examples of accidents which should not be reported include:
    a. accidents which do not involve personal injury;
    b. accidents on private roads (except Royal Parks) or in car parks;
    c. accidents reported to the police 30 or more days after they occurred;
    d. accidents involving confirmed suicides only.

NOTES

The Road Traffic Act 1988 (section 170), as amended by Section 72 of the 1991 Act, stipulates that all fatal or injury accidents on public roads involving at least one mechanically propelled vehicle should be reported by the public to the police unless insurance documents, name and address, and details of vehicle ownership and registration are exchanged between drivers. This legislation defines the duty of the public to report a personal injury road accident.

In the past the interpretation of "mechanically propelled vehicle" has varied widely between local police forces, particularly about whether pedal cycle accidents, not involving a motor vehicle, should be reported. The STATS19 requirement is clear that all accidents involving non-motor vehicles such as pedal cycles and ridden horses on 'public roads' (see 2.4) should be reported, regardless of motor vehicle or pedestrian involvement. See Note L on page 44 for other examples of non-motor vehicles. Also, Note C on page 69 contains examples which should not be treated as vehicles.

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