THE UNIVERSITY of ADELAIDE

CASR136 - February 2016

JRR Mackenzie, JE Woolley, CS Stokes, CN Kloeden, SJ Raftery

Centre for Automotive Safety Research

Analysis and modelling of crashes in Tasmania

CENTRE FOR AUTOMOTIVE SAFETY RESEARCH

THE UNIVERSITY of ADELAIDE

Analysis and modelling of crashes in Tasmania

JRR Mackenzie, JE Woolley, CS Stokes, CN Kloeden, SJ Raftery

CASR REPORT SERIES

CASR136

February 2016

Report documentation

REPORT NO.	DATE	PAGES	ISBN	ISSN
CASR136	February 2016	55	978-1-921645-74-7	1449-2237

TITLE

Analysis and modelling of crashes in Tasmania

AUTHORS

JRR Mackenzie, JE Woolley, CS Stokes, CN Kloeden, SJ Raftery

PERFORMING ORGANISATION

Centre for Automotive Safety Research
The University of Adelaide
South Australia 5005
AUSTRALIA

SPONSORED BY

Department of State Growth
GPO Box 536
Hobart TAS 7001
AUSTRALIA

AVAILABLE FROM

Centre for Automotive Safety Research
http://casr.adelaide.edu.au/publications/researchreports

ABSTRACT

This report provides advice on the focus and components of the next Tasmanian Road Safety Strategy. The progress of the Tasmanian Road Safety Strategy 2007-2016, and the associated action plans, was reviewed through an analysis of crash data. It was found that the overall number of crashes per year in Tasmanian has remained fairly constant. However, the percentage of crashes that resulted in fatal or serious injuries has decreased by around five percent in the last decade. Several crash problem areas that had been identified and targeted with various road safety actions were investigated. The majority were found to have experienced a decrease in average crash rate from the period 2006-2010 to the period 2011-2014. Crashes involving older drivers, pedestrians, and cyclists were found to have an increased crash rate and may warrant further attention in the future. The number of fatal and serious casualties over the 2001-2014 period was reviewed and, based on the current trend, it was considered unlikely that the 2010-2015 casualty reduction target of 20 percent would be achieved. A model was then developed to predict the casualty trends into future years and determine the likelihood that future targets will be achieved. Modelling was performed to explore the effect of several potential road safety countermeasures and suggest what combination of these countermeasures might be used to improve the chances of reaching future targets under the current best practice approach of the Safe System.

KEYWORDS

Road safety, strategy, safe system, crashes, injuries

Summary

The progress of the Tasmanian Road Safety Strategy 2007-2016, and the associated action plans, was reviewed through an analysis of crash data. It was found that the overall number of crashes per year in Tasmanian has remained fairly constant. However, the percentage of crashes that resulted in fatal or serious injuries has decreased by around five percent in the last decade. Several crash problem areas that had been identified and targeted with various road safety actions were investigated. The majority were found to have experienced a decrease in average crash rate from the period 2006-2010 to the period 2011-2014. Crashes involving older drivers, pedestrians, and cyclists were found to have an increased crash rate and so may warrant further attention in the future. In addition, only small progress towards reducing crashes involving motorcycles was achieved. The number of fatal and serious casualties over the 2001-2014 period was reviewed and, based on the current trend, it was considered unlikely that the 2010-2015 casualty reduction target of 20 percent would be achieved.

A review of potential road safety countermeasures under the four areas of the Safe System (safer speeds, safer road users, safer vehicles, and safer roads) was conducted. Then, a model was developed to predict the number of fatal and serious casualties into future years and determine the likelihood that future targets will be achieved. Additionally, the model was used to explore the effect of several of the suggested road safety countermeasures and explore what combination of these countermeasures might be used to improve the chances of reaching future targets. The predicted number of fatal and serious casualties that would be prevented through the implementation of each of the modelled countermeasures is presented. Lowering speed limits showed the greatest potential for reducing casualties, followed by implementing measures to reduce the average age of Tasmania's vehicle fleet and introducing further limitations to novice drivers. The effect of infrastructure treatments was also explored along with the considerable associated costs.

Strategic directions, roll-out strategies, and appropriate casualty reduction targets for the 2017-2026 road safety strategy are then suggested based on the earlier exploration of crash trends and the predicted effectiveness of various countermeasures. Potential strategic directions that focus on speed reductions or efforts that reduce the average age of the vehicle fleet are detailed, along with a third direction that utilises a mixture of measures. An exploration of the optimal infrastructure countermeasures to implement is also presented.

A suitable method of setting (and tracking) a target for the desired reduction in fatal and serious casualties over the 2017-2026 road safety is presented. Based on the predicted effectiveness of the potential strategic directions, a range of reduction targets are then suggested with some commentary of how easily they could be achieved.

Some commentary on the value of the road safety levy and alignment with the National Road Safety Strategy is also provided.

Contents

1 Introduction ... 1

2 Progress and achievements of the 2007-2016 strategy ... 2

2.1 Casualty reduction targets and identified risk areas ... 5

2.2 Casualty reduction targets for 2010-2015 and 2015-2020 periods ... 5

2.3 Crash trends in target areas ... 6

3 Potential effectiveness of road safety countermeasures ... 9

3.1 Safer speeds ... 10

3.2 Safer road users ... 11

3.3 Safer vehicles ... 13

3.4 Safer roads ... 15

3.5 Safe System countermeasures ability to address target areas ... 18

3.6 Modelling future fatal and serious casualties in Tasmania ... 19

3.7 Background effects ... 20

3.8 Predicted countermeasure effects ... 21

4 Suggestions for the 2017-2026 strategy ... 25

4.1 Potential strategic directions ... 25

4.2 Roll-out strategy ... 31

4.3 Suggested casualty reduction targets ... 32

4.4 The road safety levy ... 34

4.5 Alignment with the National Road Safety Strategy (NRSS) ... 36

Acknowledgements ... 38

References ... 39

Appendix A – Modelling Tasmania's road transport system ... 43

Appendix B – National road safety priority areas ... 50

1 Introduction

Road trauma presents a significant burden that encompasses the psychological impacts of death and injury borne by the victims and their families, as well as the direct financial costs associated with property repair, casualty rescue, medical treatment, and rehabilitation. The Tasmanian Road Safety Strategy 2007-2016 reports that the yearly burden of road trauma in Tasmania includes more than 470 people admitted to hospital, around 48 lives lost, and an estimated cost of nearly $500 million.

In response to this, the Tasmanian Government and the Tasmanian Road Safety Council have adopted the philosophy of European countries such as Sweden and The Netherlands (who are considered world leaders in road safety) and committed to the long term vision of the elimination of all road related fatalities and serious injuries.

The path to achieving this vision of zero fatalities and serious injuries relies on an approach called the Safe System, which acknowledges that mistakes within the road system will occur. The road system should thus be designed such that the consequences of mistakes do not result in fatal or serious injuries for any road user.

The Tasmanian Road Safety Strategy 2007-2016 highlighted areas where safety may be lacking and proposed to address them with actions under four areas of the Safe System: safer travel speeds, best practice infrastructure, increased safety for young road users, and enhanced vehicle safety. Targets for a reduction in fatal and serious casualties were also set. Subsequent action plans then outlined practical actions that would be implemented to pursue these desired casualty reductions and address the areas highlighted for urgent attention.

The current road safety strategy is due to expire in 2016 and the new Tasmanian Road Safety Strategy 2017-2026 is under development. This 2017-2026 strategy will call for a new set of targets that consolidate on the gains already made and provide strategies for how future targets will be met under the Safe System framework.

This report provides analyses to assist with informing the development of the 2017-2026 road safety strategy and is presented in four main Sections. In Section 2 the progress and achievements of the 2007-2016 strategy are investigated. The casualty reduction targets specified in the 2007-2016 strategy are outlined and crash data is then analysed to explore the success, and future likelihood, in meeting these targets. The crash data is also further analysed to explore the progress in reducing casualties in several identified target areas.

Section 3 introduces a wide range of potential countermeasures and discusses their relative effectiveness. A methodology for modelling fatal and serious injury casualties in Tasmania is then presented. The effects of background changes to the road transport system are modelled to predict the number of casualties in future years. The effects of several potential countermeasures, such as speed limit reductions or alterations to the GLS system, are also modelled to assess their potential impact on the number of casualties.

In Section 4, a number of strategic directions for the 2017-2026 strategy are suggested based on the findings of the previous Sections. Advice on the intelligent roll out of countermeasures is provided with comments on the ramifications of delaying implementation. Achievable new targets for the reduction of fatal and serious casualties are then proposed.

2 Progress and achievements of the 2007-2016 strategy

This Section investigates the progress and achievements of the Tasmanian Road Safety Strategy 2007-2016 (henceforth referred to as the "2007-2016 strategy"). Section 2.1 outlines the fatal and serious casualty reduction targets stated in the 2007-2016 strategy. In addition to the general casualty reduction targets, the 2007-2016 strategy highlights several target areas as warranting specific attention for casualty reductions. In Section 2.2 an analysis of Tasmanian crash data is performed to determine the progress in achieving the fatal and serious casualty reduction targets. Further crash analyses are then performed in Section 2.3 to determine whether there have been casualty reductions in the identified target areas and whether there are other areas where attention may be required.

In order to provide some perspective and background to the crash data analyses presented below, a brief investigation of Tasmania's public road system is presented here. The road system, and particularly the safety of the road system, can be affected by many factors. The most significant effect on the system is likely to be driving exposure – that is, the amount of driving that is occurring. In Figure 2.1, the changes in several factors that may be indicative of driving exposure are shown for the period of 2001-2014. Tasmanian population, vehicle kilometres travelled, and number of registered vehicles were obtained from the Australian Bureau of Statistics (ABS, 2001 – 2015a; ABS, 2001 – 2015b). The number of licences was obtained from the Tasmanian Department for State Growth. Also shown in Figure 2.1 is the annual number of casualty crashes in Tasmania.

Over the period shown in Figure 2.1 there have been gradual increases in population, number of registered vehicles, and number of licences. However, apart from an increase between 2001 and 2005, the number of vehicle kilometres travelled has remained relatively constant. In regards to the current 2007-2016 strategy these changes indicate that, while the number of vehicles and drivers has increased, it is unlikely that there has been a substantial increase in the amount of driving occurring in Tasmania. In addition, it can be seen that there has been little change in the total number of casualties.

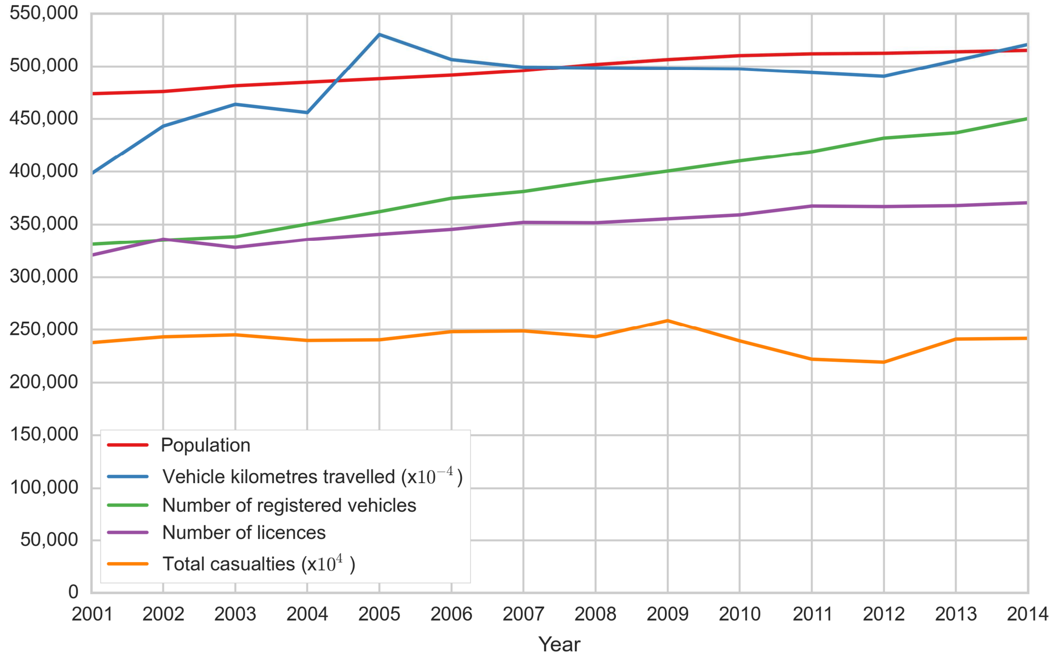

Figure 2.1
Changes relevant to Tasmania's public road system over the period 2001-2014

The focus of the 2007-2016 strategy (and indeed the upcoming 2017-2026 strategy) is on reducing fatal and serious casualties. Figure 2.2 shows the percentage of casualties that were fatal or serious over the 2001-2014 period. It can be seen that the percentage of fatal and serious casualties has decreased from more than 20 percent to less than 15 percent over the last decade. This is indicative of a positive general improvement in road safety across Tasmania.

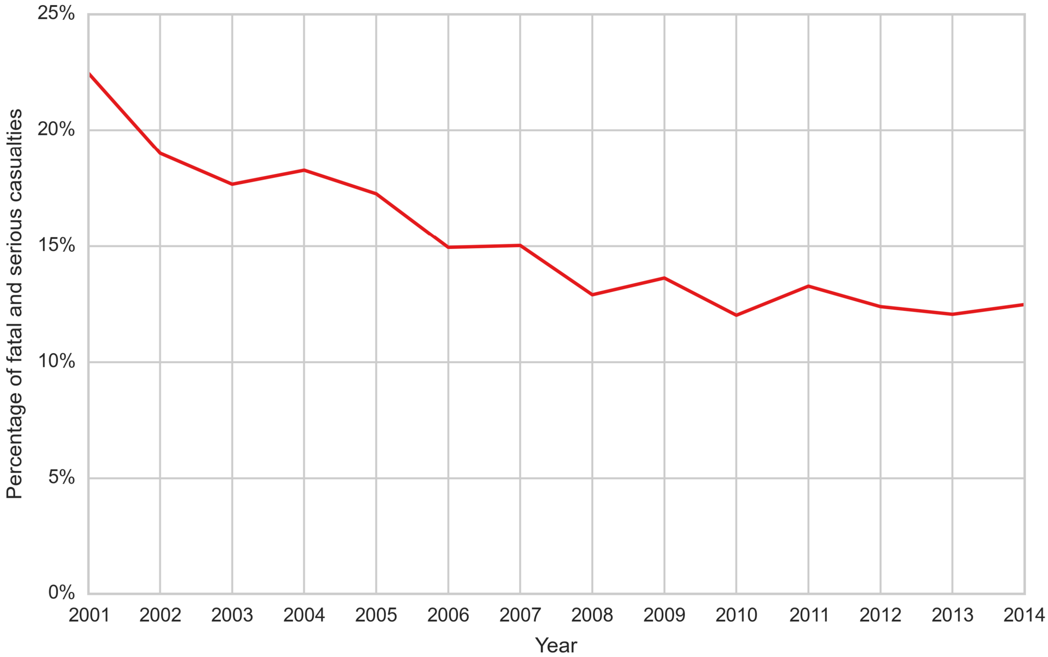

Figure 2.2
Percentage of casualties that were fatal or serious over the period 2001-2014

In Figure 2.3 the location of the fatal and serious casualties that occurred during the period of 2001-2014 is shown. The majority of casualties occurred near the main metropolitan centres of Hobart, Launceston, and along the northern coast around Devonport. There are also a considerable number of casualties that occurred along the main highways that connect these metropolitan centres.

Tasmania’s roads are separated into several functional categories as shown in Table 2.1. The number of kilometres within each category and the number of fatal and serious casualties that occurred on each category and the rate of casualties per kilometre over the 2001-2014 period is also shown. It can be seen that the Trunk roads had the highest rate of casualties, followed by the Regional Freight and Access roads. This is also likely to be a reflection of where traffic volumes are highest on the road network.

Table 2.2 shows the number of fatal and serious casualties by vehicle type (including pedestrians). Unsurprisingly, light vehicles account for the majority of the casualties over the 2001-2014 period. Motorcycles were the second most common vehicle from which a casualty occurred, followed by pedestrians.

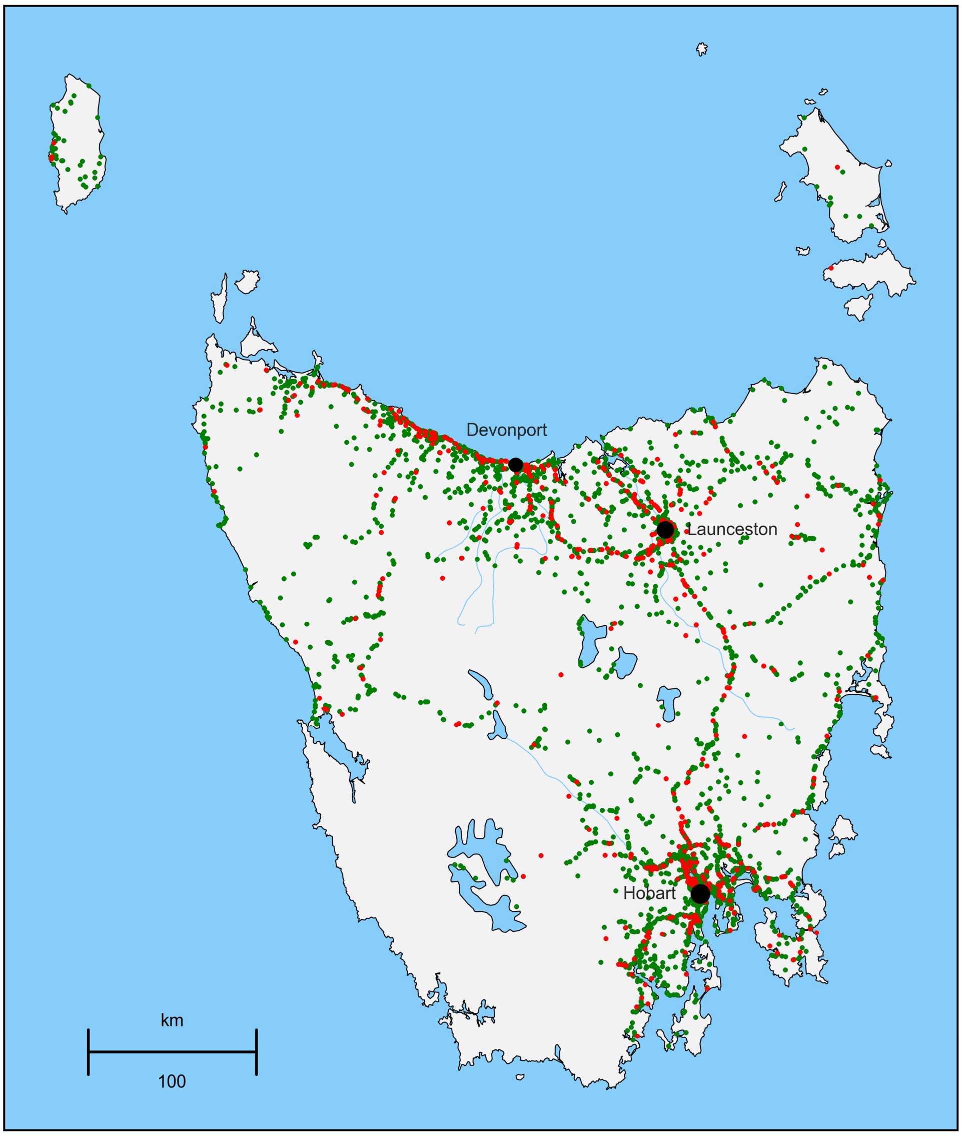

Figure 2.3
Location of fatal (red dot) and serious (green dot) casualties in Tasmania over the 2001-2014 period

Table 2.1
Number of kilometres, number of fatal and serious casualties, and casualties per kilometre by road category (2001-2014)

Road category	Total km	Fatal and serious casualties	Casualties per km
Trunk roads	489	725	1.48
Regional freight roads	425	374	0.88
Regional access roads	726	634	0.87
Feeder roads	841	432	0.51
Other state roads	1,214	357	0.29
Local council roads	-	2,620	-

Table 2.2
Number of fatal and serious casualties by vehicle type (2001-2014)

Vehicle type	Fatal and serious casualties
Light vehicle	3,231
Motorcycle	1,053
Pedestrian	508
Bicycle	163
Heavy vehicle	115
All-terrain vehicle	67
Wheeled toy	5

2.1 Casualty reduction targets and identified risk areas

The Tasmanian Road Safety Strategy 2007-2016 set the following casualty reduction targets:

- By 2010, a 20% reduction in the number of serious injuries and fatalities from 2005.
- By 2015, a 20% reduction in the number of serious injuries and fatalities from 2010.
- By 2020, a 20% reduction in the number of serious injuries and fatalities from 2015.

In addition, a number of crash problem areas were identified: run-off road crashes; intersection crashes; head-on crashes; speed; inattention; non-use of seatbelt; drink driving; young road users; motorcyclists; and pedestrians.

There was a focus on four strategic directions to achieve the casualty reduction targets and improve safety in the identified problem areas: safer travel speeds, best practice infrastructure, increased safety for young road users, and enhanced vehicle safety.

2.2 Casualty reduction targets for 2010-2015 and 2015-2020 periods

The 2007-2016 strategy calls for specific reductions in the number of fatal and serious casualties over three periods. Figure 2.4 shows the number of fatal and serious casualties over the period 2001-2014, along with the specified 20 percent reduction targets over the two periods of 2005-2010 and 2010-2015.

As was highlighted in the 2014-2016 Action Plan, the 2005-2010 target was successfully achieved with a reduction of approximately 30 percent in fatal and serious casualties from 2005 to 2010. In fact the number of fatal and serious casualties in 2010 was unusually low when compared to the trend over the previous five year period. This natural fluctuation is to be expected, particularly in the state of Tasmania where the annual number of fatal and serious casualties is relatively low.

However, while this low number in 2010 ensured that the 2005-2010 target was met, it also produced an unrealistic goal for the 2010-2015 target. It is clear from Figure 2.4 that this target is unlikely to be met, despite a continuing downward trend in casualties and the promising reductions in various target areas highlighted in Section 2.3 below. The modelling presented in Section 3 also predicts that the 2010-2015 target in unlikely to be met.

As suggested, the use of a single year of casualty data for setting goals can result in unrealistic targets due to the natural fluctuation in casualty numbers. For future target setting a more appropriate method may be to base goals on the average of, or trend over, several years of baseline data. It is worth noting, however, that the modelling in Section 3 predicted only an 11.2 percent reduction over the 2010-2015 period, indicating that the goal of a 20 percent reduction was unlikely to have been met even if the target was more appropriately set.

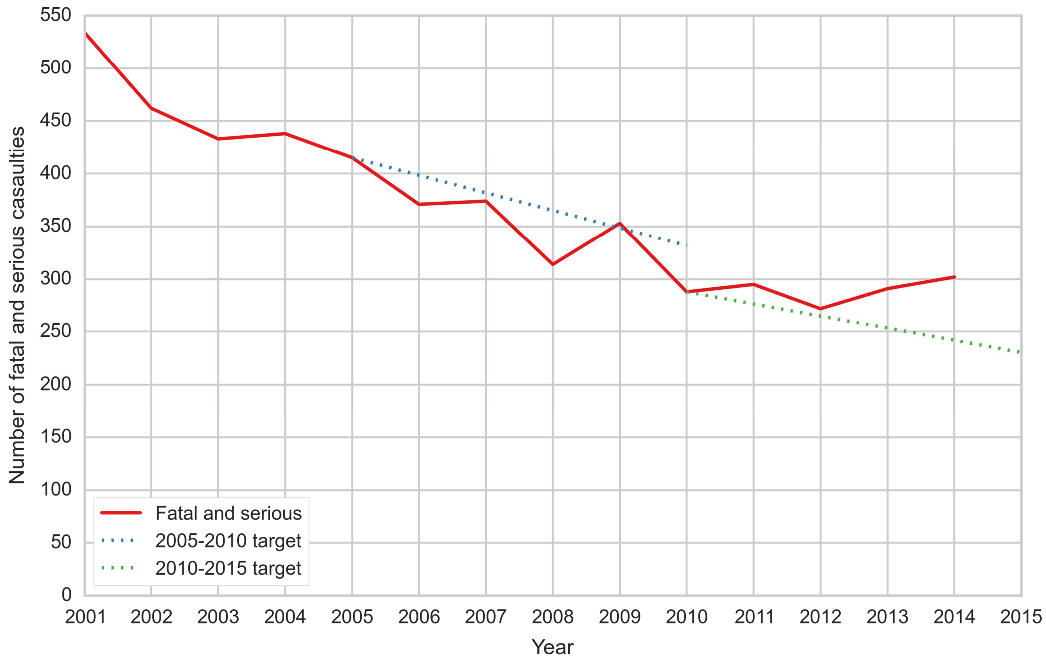

Figure 2.4
Number of fatal and serious injury casualties in Tasmania over the 2001-2014 period, with casualty reduction targets from the 2007-2016 strategy

2.3 Crash trends in target areas

The 2014-2016 Action Plan noted a decrease in the number of crashes in each of the target areas highlighted in the 2007-2016 strategy. The progress in addressing these target areas is further investigated here. Table 2.3 shows the annual average number of fatal and serious casualties during three different periods in various target areas. The three periods were selected to facilitate the analysis of progress over various stages of the 2007-2016 strategy; period A (2001-2006) is prior to the current strategy, period B (2007-2010) is early in the current strategy, and period C (2011-2014) is later in the current strategy. Also shown in Table 2.3 is the percentage of fatal and serious casualties attributed to each target area in the most recent period (2011-2014) and the percentage change in casualties between periods.

As noted above, the overall number of fatal and serious casualties had trended downwards over time. The annual average number of casualties has reduced from 442 in period A, to 332 in period B and then to 290 in period C. Many of the target areas considered below were addressed specifically by various countermeasures as part of the 2007-2016 strategy and associated action plans. As such, it would be expected that these target areas should experience a decrease in casualties that is greater than the general reduction.

The target areas that had the most prevalent number of fatal and serious casualties were crashes in rural locations, crashes on high speed roads, run off road crashes (on curves), crashes involving motorcycles, hit fixed object crashes, and crashes involving young drivers.

The change in the average number of casualties between period A and period B may represent the early effects of the 2007-2016 strategy. There was a general reduction of 25 percent between periods A and B. Crashes at intersections and crashes involving young drivers had notably higher reductions between the same periods. Run off road crashes (on straight alignment) showed a limited reduction of 12 percent, while crashes involving motorcycles showed a particularly limited reduction of only 6 percent.

There was a general reduction in casualties of 34 percent between periods A and C, which may represent the effects of the 2007-2016 strategy as more actions are implemented. Notably high reductions in the average number of casualties was observed for crashes involving young drivers, crashes involving trucks, crashes at night time, and crashes involving novice drivers. More limited reductions were found for crashes involving motorcycles, crashes involving older drivers, and crashes involving pedal cycles.

Progress over the course of the 2007-2016 strategy may be represented by the change in the average number of casualties between periods B and C. The general reduction in fatal and serious casualties between these periods was 13 percent. Crashes involving novice drivers, crashes involving trucks, crashes involving young drivers, hit fixed object crashes, and crashes at night time had notably greater reductions in casualties. On the other hand, crashes involving motorcycles displayed a notably lower reduction. Additionally, crashes involving pedal cycles, crashes involving older drivers, and crashes involving pedestrians showed an increase in the average number of casualties between periods B and C.

Taken as a whole, the results in Table 2.3 are indicative of a positive improvement in road safety since the implementation of the 2007-2016 strategy. Compared to the six year period prior to the implementation of the 2007-2016 strategy, all of the target areas that were considered have experienced a reduction in the average number of casualties.

Specifically attributing certain actions brought about by the 2007-2016 strategy to these reductions is beyond the scope of this report. However, it is clear that the 2007-2016 strategy and the associated action plans have brought about an accelerated reduction in fatal and serious casualties that would otherwise not have occurred.

There were several target areas in which there was particularly notable progress. Casualties resulting from crashes at night time decreased by almost a third over the course of the 2007-2016 strategy and by more than half compared to the pre-strategy period. Casualties resulting from hit fixed object crashes (which account for a quarter of all casualties) showed a similar reduction. Crashes involving young or novice drivers were a focus of the 2007-2016 strategy. Casualties associated with these crashes reduced by over a third over the course of the strategy and by half compared to the pre-strategy period. Crashes involving trucks were not specifically mentioned in the 2007-2016 strategy. Nonetheless, fatal and serious casualties associated with truck crashes also showed considerable reductions.

There were four target areas in which progress was noted to be lacking. Casualties resulting from crashes involving older drivers, crashes involving pedestrians, and crashes involving pedal cycles were all found to have increased over the course of the 2007-2016 strategy. Each of these target areas also displayed limited casualty reductions relative to the pre-strategy period. Casualties resulting from crashes involving motorcycles account for over a quarter of all fatal and serious casualties. Alarmingly, however, casualties associated with motorcycle crashes showed only limited reductions between all of the considered periods. Attention on these four target areas will need to be maintained in the 2017-2026 strategy.

Table 2.3
Annual average number of fatal and serious casualties for various target areas during the three periods 2001-2006 (A), 2007-2010 (B), and 2011-2014 (C), along with the percentage change in average casualties between periods

Target area	Annual average in period (rounded to nearest integer)			Percentage of all fatal and serious casualties in period C	Percentage change between periods		
	A	B	C		A to B	A to C	B to C
All crashes	442	332	290	100.0%	-24.9%	-34.4%	-12.7%
Rural crashes	260	216	181	62.4%	-19.2%	-30.4%	-16.2%
High speed crashes (80 km/h and above)	267	210	173	59.7%	-21.3%	-35.2%	-17.6%
Night time crashes (8pm-6am)	94	68	46	15.9%	-27.7%	-51.1%	-32.4%
Run off road crashes (straight alignment)	73	64	50	17.2%	-12.3%	-31.5%	-21.9%
Run off road crashes (curved alignment)	128	94	83	28.6%	-26.6%	-35.2%	-11.7%
Crashes at intersections	68	43	39	13.4%	-36.8%	-42.6%	-9.3%
Hit fixed object crashes	128	109	73	25.2%	-14.8%	-43.0%	-33.0%
Head on crashes	79	61	49	16.9%	-22.8%	-38.0%	-19.7%
Crashes involving young drivers (<25 years old)	132	86	57	19.7%	-34.8%	-56.8%	-33.7%
Crashes involving novice drivers (L or P licence)	79	65	41	14.1%	-17.7%	-48.1%	-36.9%
Crashes involving older drivers (>65 years old)	49	38	43	14.8%	-22.5%	-12.2%	+13.2%
Crashes involving pedestrians	44	30	33	11.4%	-31.8%	-25.0%	+10.0%
Crashes involving pedal cycles	14	10	12	4.1%	-28.6%	-14.3%	+20.0%
Crashes involving motorcycles	86	81	76	26.2%	-5.8%	-11.6%	-6.2%
Crashes involving trucks	39	29	19	6.6%	-25.6%	-51.3%	-34.5%

3 Potential effectiveness of road safety countermeasures

The aim of the upcoming 2017-2026 Road Safety Strategy for Tasmania will be to build upon the progress and achievements of the 2007-2016 strategy (highlighted in the previous Section), and to address target areas in which progress was found to be lacking. These aims will be accomplished through the implementation of road safety countermeasures under the Safe System approach.

The Safe System approach represents what is regarded as best practice in addressing road safety and underpinned the previous 2007-2016 strategy. The approach represents a major shift in the way road safety is perceived and managed. It forms the basis of the National Road Safety Strategy (NRSS) as well as the strategies of the various States and Territories throughout Australia.

What is different under the Safe System is that we acknowledge that the road system is inherently unsafe and that errors are to be expected. It therefore follows that we need to transform our road system into one that is forgiving of error. In other words, people should not be killed or seriously injured as a result of errors that occur on the road system. This means keeping crash forces to survivable levels and in many cases "designing crashes out of the system". Transforming the road system in this way means that solutions should be sought and coordinated across four key areas: speed, vehicles, roads and road users.

Evidence is emerging that better quantifies the nature of the road safety problem. In a study by Wundersitz and Baldock (2011) it was found that extreme behaviours only explained a limited amount of the circumstances behind death and injury on the road. For fatality crashes, approximately 40% of cases involved extreme behaviour. In the case of injury crashes, only 10% of crashes involved extreme behaviour. This indicates two important things. Firstly, the community perception that road safety is a problem of all the "bad" drivers out there is unfounded. Secondly, fatal crashes do not constitute a good basis for making judgements on injury crashes in general. Therefore we need to regard the road safety problem as one of system failures, where people in everyday driving situations make errors. Extreme behaviours also need to be managed but they should not govern countermeasure solutions for all road users.

It is also important to note that under the Safe System there is also a shift away from a black spot mindset as the reality is that crashes will become increasingly random in location into the future. Instead, systemic changes that address the core issue of energy transfer and human tolerance to injury will increasingly receive more attention. Solutions will need to have more of a focus on mitigating consequences should a crash occur rather than just considering likelihood.

There are numerous Safe System countermeasures that could be adopted in a road safety strategy. A number of countermeasures are introduced in Section 3.1 to 3.4 under the four headings of safer speeds, safer road users, safer vehicles, and safer roads. An indication of the potential effectiveness of these countermeasures is given. However, for some countermeasures it is difficult to determine the effectiveness as evaluations have not been conducted, the research evidence is contradictory, or it is difficult to translate results from a specific study to more general circumstances. It should be noted that the effectiveness of many potential countermeasures have been considered for the sake of completeness, even though some may not necessarily be practicable in Tasmania. The ability of the countermeasures discussed in each of the Safe System areas to address the target areas highlighted in Section 2 is then presented in Section 3.5.

In order to assess the potential effectiveness of several of these countermeasures in Tasmania, a model of fatal and serious casualties was developed. This model is described in Section 3.6, with further details provided in Appendix A.

Section 3.7 utilises the model to predict how the number of fatal and serious casualties in Tasmania would change over time due to background effects, such as changes to the number of registered vehicles or the advancement of vehicle safety technologies, without the implementation of any countermeasures. Then, in Section 3.8, the additional effects of various modelled countermeasures are explored.

3.1 Safer speeds

Speed is one of the main determinants of death and injury from use of the road system. Simply put, speed in combination with mass determines the energy in the road system and therefore the extent of injury when inevitable errors and consequent crashes occur.

The issue of speed is not just related to compliance with the speed limit. The appropriateness of the speed limit in the first place also needs to be questioned. It is quite evident that at current travelling speeds, vehicles are unable to protect occupants, motorcyclists, pedestrians and cyclists when collisions occur. It is not well known that the speeds at which vehicles can prevent injury are generally much lower than the posted speed limits on the road network. Table 3.1 below highlights aspirational speeds that minimise harm and injury when a collision occurs.

Table 3.1
Safer speeds initiatives and their effectiveness

Crash configuration	Speed above which likelihood of death increases dramatically
Head on collision between passenger cars	70 km/h
Right angle impact between passenger cars	50 km/h
Side impact of a passenger car into a tree or pole	30 km/h
Collision between a pedestrian and a passenger car	30 km/h

Although the actual values of these numbers may be debated as car fleets change, the most important point to note is that there is a significant mismatch between current operating speeds and the speeds that minimise harm. Add to this the complexity of children, the elderly, motorcycles and heavy vehicles and it becomes apparent that the road system is inherently unsafe.

Our understanding of the role of speed in injury outcomes has increased significantly over the past decade and it would be fair to say that current speed limits would not have been set as high if this knowledge existed over 60 years ago. In the same way that the community respects changes to practices in relation to smoking and asbestos, speed should also be reviewed on the basis of increased knowledge.

The good news is that speed is a “silver bullet” in road safety terms. There is overwhelming evidence that whenever speed limits are lowered, road trauma reduces. Even small changes in travelling speed across the network can lead to large reductions in road trauma. This is supported internationally but much of the research evidence has actually originated in studies on Australian roads. For example, in South Australia the move from 60 to 50km/h (Kloeden et al., 2007) and 110 to 100km/h (Makenzie et al., 2015) is associated with a 25% drop in casualties on those roads where the change occurred.

For this reason, establishing appropriate travelling speeds that are safe remains one of the most effective ways that injury and death can be reduced on the road network and must remain a key consideration of any road safety strategy. To achieve the equivalent reductions using any other countermeasure would be very difficult, and certainly would not be possible at the same low cost or in a rapid timeframe.

The safer speed countermeasures mentioned above, and their effectiveness, are summarised in Table 3.2.

Table 3.2
Safer speeds countermeasures and their effectiveness

Countermeasure	Effectiveness
* 110 km/h limits to 100 km/h	~ 25% reduction in all casualties (Mackenzie et al., 2015)
* 100 km/h limits to 90 km/h	Estimated 20% reduction, based on other studies of speed effects
* 60 km/h limits to 50 km/h	~ 25% reduction in all casualties (Kloeden et al., 2007)

* Modelled

3.2 Safer road users

The road user has received the bulk of attention when considering road safety management over past decades. It seems logical that people make mistakes and therefore we need to ensure we educate and enforce so that road users do not make mistakes. While Australia has been one of the most successful countries in achieving crash reductions from behavioural initiatives, it is also unrealistic to think that errors when using the road can ever be totally eliminated. No matter how well trained or skilled people are, mistakes will still continue to occur. We therefore need to focus on solutions that encourage appropriate road user behaviour but be open to the idea that more effective solutions could lie within other areas of the Safe System. For example, a barrier in the middle of the road will eliminate risky overtaking manoeuvres and an alcohol interlock in a vehicle will eliminate drink driving in that vehicle.

This is not to say that current attempts to enforce or educate should cease and quite the opposite, they should continue. However, we should have more realistic expectations about what can be achieved through the behavioural approaches when compared to other options and the effort required to achieve equivalent outcomes.

Traditional approaches that have been highly successful include the adoption of Graduated Licencing Systems (GLS) for novice drivers, speed enforcement, and random breath testing.

A well designed GLS will protect novice drivers from the potential cognitive overload of the more complex tasks associated with driving, such as night time driving or maintaining concentration while there are other occupants in the vehicle. This protection allows novice drivers to develop crucial experience in a safer driving environment. Healy et al. (2012) found that the introduction of a GLS in Victoria, which included passenger restrictions and vehicle power restrictions, resulted in a 31 percent reduction in fatal and serious injury crashes for novice drivers. Since GLS initiatives are always introduced as a package of restrictions, the individual effects of the various elements are difficult to quantify. Another initiative targeted towards novice drivers is the raising of the age at which a provisional licence can be obtained. By delaying the provisional licensing age, young drivers are able to gain more experience while on their learner's licence, where they are supervised by a fully licenced driver, and will also be more mature by the time they are ready to obtain their provisional licence.

A commonly held belief among many is that deficits in road safety can be addressed by an improvement in the driving skills among the broader driving community. Driver training programs have been in operation throughout Australia and internationally for over 50 years and the effectiveness of these has been the subject of numerous evaluations and reviews (e.g., Christie, 2001; Engstrom et al., 2003; Vernick et al., 1999; Woolley, 2000). These investigations have produced little evidence that driver training programs effectively reduce either crash involvement or driving violations of those who undergo training.

The majority of drivers observe the posted speed limit (Kloeden and Woolley, 2015). However, because speed plays such a crucial role in the causation and severity of crashes, increasing the proportion of drivers who observe the posted speed limit will invariably lead to a reduced crash rate. Increasing compliance with speed limits can be achieved through enforcement. A Cochrane Collaboration meta-analysis of speed cameras concluded that they were effective at reducing speeds, and also resulted in reductions in crashes (Wilson et al., 2011). Fatal and serious injury crashes were noted to decrease by around 35 percent.

Point to point cameras are a relatively new type of speed enforcement technology that was not investigated by the Cochrane Collaboration meta-analysis. An Austroads study (Soole et al., 2012) of the effectiveness of point to point cameras in overseas countries, such as the United Kingdom and The Netherlands, found that they are associated reductions in crash rates that are similar to traditional speed cameras. Additionally, they are considered to be more acceptable and fair by drivers.

Manual police enforcement is also an option for addressing drivers that travel over the speed limit. Newstead at al. (2001) investigated the effect of manual police enforcement and concluded that an operation that was well-managed and utilised random location selection to maximise coverage could result in fatal crash reductions of approximately 30 percent.

Deterrence theory proposes that the threat of punishment can deter people from committing offending behaviours. The deterrent associated with a given punishment is influenced by three things: the certainty that the punishment will be received (e.g., likelihood of detection), the severity of the punishment, and how soon following the behaviour the punishment is received. From a traffic enforcement perspective the two main options for increasing deterrence are by increasing enforcement (certainty) or severity. Research has shown that enforcement activities that increase the likelihood of detection (e.g., speed cameras, visible police operations/presence) have been found to improve compliance with road laws (e.g., Soole et al., 2009; Wilson et al., 2011). On the other hand, examinations of penalties have found that fines alone provide little deterrence (Elvik & Christensen, 2007; Lawpoolsri et al., 2007; Moffatt & Poynton, 2007; Watson et al, 2010), and that increased or more severe fines also provide little deterrence (Moffatt & Poynton, 2007; Watson et al., 2010). While the severity of a punishment certainly contributes to deterrence, it would appear that the perceived risk of receiving the punishment may be the more important factor.

Alcohol is often highlighted as a factor in fatal or serious injury crashes. Even in legal concentrations (i.e. below 0.05), alcohol can impair a driver's decision making or reaction time. One method to overcome the effect that alcohol may have on crash causation is the lowering of the legal BAC limit. Numerous studies have found that any reduction in the legal BAC limit is associated with significant reductions in fatal and serious crashes (Norstrom and Laurell, 1997; Fell and Voas, 2006; Desapriya et al., 2007).

Some potential countermeasures could be targeted at specific groups that have been found to be more at risk of injury in the event of a crash. For example, promotion of high-visibility clothing for cyclists or protective clothing for motorcyclists. While it has been shown that high-visibility clothing assists drivers in detecting the presence of cyclists, no studies have investigated whether there is an associated crash or injury reduction (Kwan and Mapstone, 2009). On the other hand, there are clear benefits for motorcyclists in wearing protective clothing. Motorcycle jackets and motorcycle pants were found to reduce the likelihood of being admitted to hospital by 21 percent and 51 percent respectively (de Rome et al., 2011).

The safer road user countermeasures and their effectiveness are summarised in Table 3.3.

Table 3.3
Safer road users countermeasures and their effectiveness

Countermeasure	Effectiveness
GLS with all components	High (Healy et al. 2012)
* P1 at 18 years of age	GLS effective but individual effects unclear
* Night time curfew for novice drivers	GLS effective but individual effects unclear
* Passenger restrictions for novice drivers	GLS effective but individual effects unclear
Vehicle power restrictions for novice drivers	No strong evidence to support effectiveness
Greater education/training	Low
More speed cameras	~ 30% reduction in crashes (Wilson et al., 2011; Soole et al., 2012)
Increased police enforcement	~ 30 % reduction in crashes (Leggett, 1997)
Increased penalties for infringements	Low – more dependent on perception of being caught
Lowered legal BAC limit	~ 10% reduction in crashes by lowering to 0.02 (Norstrom & Laurell, 1997)
Promote high-vis clothing for cyclists	Increases cyclist detection but crash effects are unknown
Promote protective clothing for motorcyclists	~ 50% less likely to be admitted to hospital (de Rome et al., 2011)

* Modelled

3.3 Safer vehicles

Vehicle safety has been improving at a rapid rate over past decades. The ability for the vehicle structure to protect occupants in a collision (passive safety) has improved dramatically over time and attention has now turned to technologies that are capable of avoiding crashes altogether (active safety). A good indication of how vehicle safety has improved over time can be found in Newstead et al. (2013).

There is much talk of autonomous or driverless vehicles and while many technologies are currently available or soon to come to assist drivers, the world of full autonomy on all parts of the network is still some way off. It is more likely that automation is allowed on some parts of the network under certain circumstances such as specific sections of freeway for example. There is already an explosion of driver assistance technology available on the market and this will greatly enhance safety into the future. Efforts need to be made to ensure that all new vehicles sold in Tasmania and fleet purchases incorporate the safest vehicles in each class.

The research has informed us that it is important to get as many new vehicles as possible into the vehicle fleet so that maximum safety benefits can be realised. Every year a new vehicle or safety technology is delayed from entering the fleet results in a diminished safety effect in consequent years. This is because it takes many years to change over the vehicle fleet. If a new safety technology is introduced tomorrow, it will take approximately 20 years before it penetrates the entire fleet. Therefore it is important that government and private industry adopt practices that ensure the newest and safest vehicles are adopted for their fleets. This will also have a flow on effect to the community when the vehicles are resold at a later date.

While promoting new vehicle safety is an important endeavour, improving the safety of the current fleet should also be pursued. Given the strong link between the age and the crashworthiness of a vehicle, the task of improving the general safety of the fleet should be focussed on reducing the average age of the fleet. Various methods of pursuing this goal exist, including "cash for clunkers" type schemes, insurance disincentives for older vehicles, new (or newer) vehicle purchasing incentives, vehicle safety inspections, or simply mandating a maximum vehicle age.

There is also a need to get the safest vehicles to those most at risk. For example, younger drivers tend to drive older less safe vehicles while the safest vehicle in the family is at home sitting in the driveway (Anderson et al., 2013). From a risk management perspective, they should be driving the safest vehicle they have access to.

For motorcyclists, research evidence is emerging on the significant effectiveness of ABS braking systems (Teoh, 2011). At a federal level consideration is being given to making such systems mandatory on new motorcycles. Efforts to increase the numbers of ABS equipped motorcycles in Tasmania would be regarded as highly worthwhile.

Some vehicle based countermeasures are targeted at encouraging (or indeed forcing) safer behaviours from the driver and occupants. These include alcohol interlocks, seatbelt interlocks, and intelligent speed adaptation.

Alcohol interlocks are usually fitted to the vehicles of drivers who have been charged with a drink driving offence. In these situations alcohol interlocks are very effective at reducing further drink driving, though the likelihood of offending tends to increase once the device is removed (Bailey et al., 2013). Current interlock technology is perceived to be time consuming to operate, and thus there is a reluctance to voluntarily install the devices despite the potential benefits. Therefore, little is known about the effect of expanding the use of alcohol interlocks beyond drink driving offenders.

Many injuries sustained during a crash are more severe than necessary due to the non-use of seatbelts. Modelling, conducted using South Australian crash data, found that the mandatory introduction of seatbelt interlocks to all new vehicles in 2015 had the potential to prevent 2% of serious injuries and 7% of fatalities by 2030 (Searson & Anderson, 2013).

Intelligent speed adaptation (ISA) is a technology that aids the driver in observing the posted speed limit. There are three types of ISA system; advisory, supportive, and limiting. Advisory systems provide a warning (audio or visual) to the driver when they travel over the speed limit. Supportive systems operate similarly to advisory systems but additionally provide some resistance to the accelerator pedal to help the driver stay within the speed limit. Limiting systems are integrated with the vehicle's drive train and totally prevent the vehicle from travelling faster than the speed limit. The potential for the various types of ISA system to reduce crash risk was explored by Doecke and Woolley (2011). Advisory systems were found to reduce fatal and serious crashes by around 10%. Supportive and limiting systems reduced fatal and serious crashes by around 17% and 27% respectively.

The safer vehicles countermeasures mentioned above, and their effectiveness, are summarised in Table 3.4.

Table 3.4
Safer vehicles countermeasures and their effectiveness

Countermeasure	Effectiveness
Promote advanced vehicle safety systems	Large benefits would be expected but depends on level of success
* Reduce the average age of vehicle fleet	Large benefits would be expected but depends on level of success
Promote safer vehicles for novice drivers	Young driver will benefit but depends on level of success
Promote ABS for motorcycles	~ 37% reduction in fatal motorcycle crashes (Teoh, 2011)
Broader use of alcohol interlocks	Effective when fitted but broader use effects unknown (Bailey et al., 2013)
Seatbelt interlocks	~ 5% reduction in fatal and serious casualties (Searson & Anderson, 2013)
Intelligent speed adaptation	~ 10% - 27% reduction in serious crashes depending on type (Doecke & Woolley, 2011)

* Modelled

3.4 Safer roads

Under the Safe System a road environment that is forgiving of human errors is required. In the current road network, errors can easily lead to fatal outcomes and road users are often placed in situations where mistakes are to be expected. The two biggest challenges that remain from past decades are managing road departures and collisions at intersections.

Road departures are a difficult problem as they generally occur randomly in rural areas and often involve vehicle rollover or collisions with roadside hazards such as trees. Such events tend to be biased towards death or severe injury outcomes. Road departure manoeuvres are also associated with head on collisions as they often involve the same loss of control mechanisms and slewing into the path of an oncoming vehicle.

From a Safe System perspective, best practice in handling road departures and head on crashes is to make extensive use of crash barriers. There are good examples internationally and within Australia that high levels of safety can be achieved when continuous lengths of flexible safety barrier is used on the roadside and in the centre of the road (Ray et al., 2009; Washington State Department of Transport, 2009; Carlsson, 2009; Bergh et al., 2003; Candappa et al., 2011; Larsson et al., 2009). Head on crashes are virtually eliminated and departing vehicles are decelerated in a more forgiving manner. There is a growing body of evidence that such treatment can be safer and less costly than the traditional dual carriageway approach with wide medians. Thinking in relation to clear zones has been changing over time in the light of emerging evidence (Doecke and Woolley 2010). High quality rural roads can achieve safer outcomes with continuous lengths of barrier rather than a reliance on clear zones. Where barrier protection cannot be achieved, clear zones can provide some benefit for road departure crashes and the first four metres of clear zone are thought to provide the most benefit (Levett et al., 2009; Austroads, 2015b).

Despite an assumption that overtaking lanes improve safety, there are actually very few studies that prove that this is the case. This suggests that the safety effect is likely to be influenced by many other factors. Traditionally, overtaking lanes were implemented on the basis of traffic efficiency with safety as an assumed benefit. The few studies that do exist demonstrate a variation in benefits from 25% reduction in all crashes and over 50% reduction in injury crashes, to increases in certain types of crashes (Rinde 1977, Harwood and St John 1985, Harwood and Hoban 1987, Koorey et al 1999, Bui 2001, Potts and Harwood 2004, Jaehrig 2014). It is worthwhile noting that the greatest reductions in injury crashes were associated with the use of overtaking lanes with additional centreline treatments such as wide medians or centreline barriers (Koorey et al 1999, Jaehrig 2014). In the Tasmanian context the past philosophy of adopting a 2+1, or a 2+2 configuration where overtaking is provided, is still regarded as important. Consideration should also be given to mitigating crash effects upstream and downstream of the overtaking facility and at the very least the monitoring of crashes in such zones should be performed.

There has also been success with wide centreline treatments. Such treatments have been applied in in New South Wales, Queensland and South Australia and basically consist of a parallel line separated by 1 metre dividing the traffic (traditional barrier lines have a 10cm separation). Overtaking is permitted on the wide centrelines where broken lines are applied (see Figure 3.1). Evidence is emerging in some jurisdictions that installing a wide centreline can lead to significant reductions in crashes (Austroads, 2015b).

Figure 3.1
Wide centreline treatments along the Dukes Highway (South Australia) showing sections that allow overtaking (left) and no overtaking (right)

Audio tactile line marking, delineation and sealed shoulders can all contribute to a reduction in road departure crashes (DIRD, 2015 and Austroads 2015b) and there should be an aspiration to implement these on as much of the network as possible, especially where barrier protection cannot be achieved.

Collisions between vehicles at intersections are a problem because vehicles are commonly struck in their most vulnerable orientation. The risk of car occupants receiving an injury from a frontal collision is lower than a side impact because there is a “crumple zone” ahead of the windscreen that can absorb the energy in the collision. With a side impact, only the width of the door can be used to protect the occupants. In this regard, the right turn and through movement across traffic are particular problems as vehicles will tend to be struck on the side.

The provision of a forgiving road environment will mean the elimination points of conflict by closing intersections, grade separation or restricting movements such as right turns, thereby eliminating the opportunity to crash or at least avoid side impacts. Where this cannot be achieved speeds must be managed to survivable speeds (50km/h for a right angle collision between passenger cars) or the geometry of the intersection altered so that right angle collisions are not likely. One way of ensuring safe speeds is to construct plateaus on approach or within the intersection (see Figure 3.2). Similar to speed humps, this treatment guarantees that vehicles interact at safe speeds (Pratt et al., 2015) – something that speed limit signs, intersection warning signs and even traffic signals do not guarantee. This treatment also facilitates safe interactions with cyclists and pedestrians. This has been a common practice in The Netherlands for many years and the first implementations on major roads are starting to emerge in Australia.

Figure 3.2
Plateau treatment implemented at a high crash risk intersection in Kent Town, Adelaide.

Roundabouts have been an outstanding safety success as they do not allow vehicles to collide at right angles and their geometric design ensures lower interaction speeds (DIRD, 2015; Austroads, 2015a; Austroads, 2010). The gap selection task is also much simpler as traffic only circulates in one direction and fewer points of conflict exist when compared to a cross road junction (8 versus 32 for a single lane junction). Current practice means that roundabouts tend to have large footprints and cost in the $1-$5 million price range. Further research into roundabout design is needed and efforts made to see if effectiveness can still be maintained with lower cost innovative designs.

The task of retrofitting the road system to improve cyclist safety is difficult as the road system is inherently unsafe for these road users in most locations and there is community resistance to giving up car space for cyclists. From a theoretical perspective the solution is straightforward: where speeds cannot be managed to safe levels, segregation should occur. In practice and with limited funds, it may be easier to provide safe corridors as viable alternatives for cyclists to access different quadrants of the city backed up by appropriate infrastructure treatments. Such an example exists in Vancouver, Canada, amongst others, where road space was removed from motor vehicles to create a pair of safe cycling corridors (NACTO, 2014; City of Vancouver, 2015).

Pedestrian collisions are likely to be highly random in built up areas in Tasmania which makes an infrastructure response difficult. Where dedicated pedestrian crossing facilities are provided, a raised platform for the pedestrians is desirable to slow vehicle down to safe speeds. In addition, where there are concentrations of pedestrian activity, 40km/h activity zones could be implemented to provide further protection. Speed management remains key to achieving safety for pedestrians across built up areas (Retting et al., 2003; Oxley et al., 2013).

The safer roads countermeasures mentioned above, and their effectiveness, are summarised in Table 3.5.

Table 3.5
Safer roads countermeasures and their effectiveness

Countermeasure	Effectiveness
*Rumble strips (Audio tactile line marking)	Medium but issues exist with ongoing maintenance (Levett et al. 2009, DIRD 2015)
* Sealed shoulders	Medium - Austroads 2015b and DIRD 2015
Overtaking lanes	Inconclusive however best outcomes are with central median or barrier in place (Koorey et al 1999, Jaehrig 2014)
Clear zones	Medium – best practice now moving towards barriers for high standard roads (Levett et al. 2009) however clear zones still worthwhile on roads that do not receive barrier treatment
* Wide centrelines	Medium/High (Austroads 2015b)
* Roundabouts	High (DIRD 2015, Austroads 2015a, Austroads 2010)
* Right turn bans	High – potential to eliminate most right-angle crashes if executed well
* Right turn lanes	Medium/Low but still allows right angle crashes to occur
* Plateaus	High – guarantees safe speed interactions (Pratt et al. 2015)
Separation of cycle and vehicle traffic	High – eliminates interactions between vehicles and cyclists
* 2+1 Side and median barriers (wire rope, W-beam)	High – eliminates almost all off-road and cross-path crashes (Carlsson 2009)
* Wide scale improvements directed at specific crash types (e.g. run off road or head on)	High if continuous barrier options included Medium/High if wide centre lines adopted
Raised pedestrian crossings	High if speeds are effectively managed Candappa et al. 2014)

* Modelled

3.5 Safe System countermeasures ability to address target areas

The ability of countermeasures in each of the four Safe System areas to address the target areas identified in Section 2 is shown in Table 3.6 using a three star rating system. These star ratings were selected based on a synthesis of the literature on each countermeasure reviewed in the previous sections. A three star rating indicates that the countermeasures in that Safe System area directly address the specific target area. A two star rating indicates that, while the countermeasures may not directly address a particular target area, there would be some significant benefit expected nonetheless. A one star rating indicates that there would be little effect on the target area.

Safer speeds are likely to affect all the target areas, while safer roads and safer vehicles are limited in some specific areas. The effect of safer road user behavioural countermeasures is very limited and is only relevant to a few specific areas.

Table 3.6
Effectiveness of Safe System countermeasures to address specific target areas

Target area	Percentage of all fatal and serious casualties	Ability of countermeasures in the area to reduce injury			
		Speeds	Road users	Vehicles	Roads
All crashes	100.0%	+ + +	+	+ + +	+ +
Rural crashes	62.4%	+ + +	+	+ + +	+ +
High speed crashes (80 km/h and above)	59.7%	+ + +	+	+ + +	+ + +
Night time crashes (8pm-6am)	15.9%	+ + +	+ + +	+ + +	+ +
Run off road crashes (straight alignment)	17.2%	+ + +	+	+ + +	+ + +
Run off road crashes (curved alignment)	28.6%	+ + +	+	+ + +	+ + +
Crashes at intersections	13.4%	+ + +	+	+ + +	+ +
Hit fixed object crashes	25.2%	+ + +	+	+ + +	+ + +
Head on crashes	16.9%	+ + +	+	+ + +	+ + +
Crashes involving young drivers (<25 years old)	19.7%	+ + +	+ + +	+ + +	+ + +
Crashes involving novice drivers (L or P licence)	14.1%	+ + +	+ + +	+ + +	+ + +
Crashes involving older drivers (>65 years old)	14.8%	+ + +	+	+ + +	+ + +
Crashes involving pedestrians	11.4%	+ + +	+	+ +	+ +
Crashes involving pedal cycles	4.1%	+ + +	+	+ +	+ +
Crashes involving motorcycles	26.2%	+ + +	+	+ +	+ +
Crashes involving trucks	6.6%	+ + +	+	+ +	+ +

3.6 Modelling future fatal and serious casualties in Tasmania

The model described here examines road crash casualties from the past (in this case serious injuries and fatalities) and predicts the likelihood that they will occur again in the future. The prediction process takes account of various changes to the road transport system over time. The effect of each change is applied to the appropriate subset of casualties to revise the likelihood of reoccurrence in future years. For example, a change that reduced all 60 km/h speed limits to 50 km/h would be modelled by reducing the risk of reoccurrence for all casualties that occurred in a 60 km/h speed zone by an appropriate factor. Multiple changes to the road transport system can be modelled and their effects combined. By aggregating the revised risk for all the casualties in the baseline sample, a prediction for the total number of casualties in future years can be determined.

Some changes to the road transport system are classified as background effects. These include changes to driving exposure and improvements to vehicle primary and secondary safety. Modelling these effects predicts how the number of casualties will change over time without any future implementation of active countermeasures.

Other changes are direct countermeasures implemented with the aim of improving road safety such as speed limit reductions, large scale infrastructure improvements, and licencing changes for novice drivers. The specifics of each countermeasure can be customised within the model, including the year of implementation and the effects of the change (which will nominally be based on literature and accepted effects). The expected reductions in the number of casualties can then be determined and the effectiveness of different combinations of countermeasures can be explored. This provides various potential options for road safety actions that can deliver greater reductions in casualties.

The accuracy of the model relies on the selection of an appropriate baseline sample of casualties from which to model forward into future years. The larger the baseline sample of past casualties, the more representative of Tasmania's road safety situation it will be. Given the relatively low number of serious injuries and fatalities on Tasmanian roads, several years of casualty data are necessary. This suggests that using data from many years into the past is desirable. However, because the road safety situation changes over time, using data from too far into the past can result in inaccurate predictions of future casualties as past effects are obscured or unaccounted for. Initial modelling indicated that casualties from the years 2007 to 2014 were the most representative baseline sample for use in the model.

There were two major changes to the road transport system implemented during this baseline period; changes to the GLS over 2008-2009 and a reduction of speed limits on unsealed roads in 2014. For both of these changes there will be some baseline casualties that occurred before the change and some that occurred after. No action needs to be taken for those baseline casualties that occurred after a particular change as they will have already experienced the effects of the change. However, modelling was required to account for the effect of the changes on those baseline casualties that occurred prior to the implementation, so that their likelihood of occurring in future years could be predicted properly. Details on how these changes during the baseline period were accounted for are presented in Appendix A.

The model utilises the baseline sample of representative casualties to investigate the effect of broad changes to the road transport system. For example, investigating the effect of reducing all 60 km/h speed zones to 50 km/h across the entire state. Relatively minor changes that affect only a small proportion of baseline casualties cannot be modelled accurately. Thus, small actions such as changing the speed limit from 60 km/h to 50 km/h on a specific road or within a small area should not be modelled.

Note that the modelling work described here involves many complex and dynamic interactions between the various background effects and active countermeasures. Every effort has been made to identify and accurately account for these interactions. Appendix A contains details on how each countermeasure was modelled.

3.7 Background effects

Changes to the road transport system that occur naturally, or slowly, and are not the direct result of the implementation of a countermeasure are modelled as background effects. The predicted change in the number of casualties in future years as a result of these background effects represent the baseline change if no further countermeasures are introduced.

Two background effects were modelled. The first was changes to driving exposure on Tasmanian roads. Over time the number of registered vehicles on the road network changes. This change has implications for how often vehicles are exposed to events in which a collision may occur. The risk of crashes occurring increases as the number of vehicles on the network increases and vice versa. The average amount that each vehicle is driven on the road network also changes over time and again has implications for how often vehicles are exposed to collision events. If vehicles are driven more then they have a greater chance of being involved in a collision and vice versa. The details on how these changes to driving exposure were modelled can be found in Appendix A.

The second background effect that was modelled was changes over time in the safety of vehicles. Over time, the general fleet will transition to newer vehicles with advanced safety technologies. The prevalence of vehicles with a great number and more advanced technologies will thus increase and the risk of serious injuries will decrease. Details on how this decrease in casualty risk, due to the turnover of the vehicle fleet, was modelled are provided in Appendix A.

The predicted number of fatal and serious casualties in each of the modelled years, as a result of background effects, are shown in Figure 3.1. This prediction provides an estimate for the number of casualties over time if no further changes to the road transport system are implemented.

In the five year period of 2010 to 2014 both the number of actual casualties and predicted casualties are shown. It can be observed that the model predictions are comparable to the number of actual recorded casualties and the downward trend over time.

The predicted casualties highlight again that meeting the 2010-2015 target is unlikely. Additionally, there was only an 11.2 percent reduction in the predicted number of casualties for the 2010 to 2015 period which indicates that the goal of 20 percent may not have been achieved even if the target was more appropriately set.

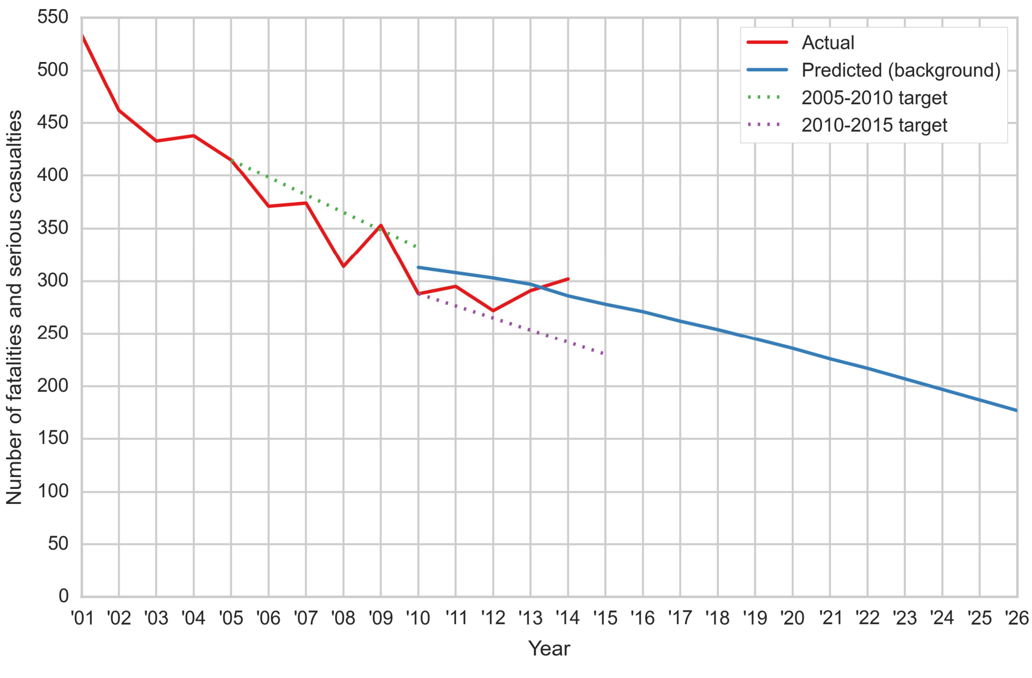

Figure 3.1
Predicted number of fatal and serious casualties based on modelled background effects, along with 2007-2016 strategy targets

3.8 Predicted countermeasure effects

Several potential countermeasures that were highlighted in the previous subsections are modelled here. They represent 'what if' scenarios that predict the effect that the countermeasures will have on the number of fatal and serious injury casualties into the future. The details on how each of the countermeasure scenarios was modelled are presented in Appendix A.

Three speed limit reduction scenarios were modelled; all 110 km/h limits reduced to 100 km/h, all 100 km/h limits reduced to 90 km/h, and all 60 km/h limits reduced to 50 km/h. These speed limit reductions were also further split into implementations on specific road categories.

For safer road users there were also three scenarios modelled, based around the expansion of the GLS. The first was a restriction that drivers must be at least 18 years old before obtaining a P1 licence. The second was that drivers on a P1 licence may only carry a maximum of one passenger in a vehicle they are driving. The last was a curfew that restricts drivers with a P1 licence from driving between midnight and 6am.

Without detailed knowledge of the Tasmanian vehicle fleet it is difficult to model specific countermeasures that target safer vehicles. Instead, the potential effect of reducing the age of the vehicle fleet was modelled. The effects of reducing the average age of the fleet by 5%, 10%, and 15% was modelled.

The model described above was used to predict the number of fatal and serious casualties for each year in the period 2010 to 2026. Each of the countermeasures was modelled individually and the annual number of casualties during the 2010-2026 period was predicted.

Table 3.7 shows the results of the modelling work. The predicted number of casualties that would be prevented over the 2017-2026 period by the implementation of each countermeasure is displayed. These predictions are based on implementing the countermeasure in the year 2017, and the number of casualties prevented would obviously be reduced if countermeasures were implemented in later years (see Section 4.2). The estimated cost of the implementation of each countermeasure is also shown.

Speed limit reductions show the best potential for reducing casualty numbers. The benefit of reducing speed limits from 100 km/h to 90 km/h appears to be a fairly evenly spread across the various road categories. On the other hand, reducing 110 km/h limits to 100 km/h will need to focus on trunk roads and reducing 60 km/h limits to 50 km/h will need to focus on non state-controlled roads.

Reducing the age of the general vehicle fleet showed the second best potential for casualty reductions. As would be expected, the greater the overall reduction in age the greater the reduction in casualties. Even the smallest modelled reduction in vehicle age of 5 percent was predicted to produce a reduction in casualties that was comparable to reducing the speed limit on large sections of road.

The most promising GLS action was the restriction that drivers must be at least 18 years old before obtaining a P1 licence, followed by a night time driving curfew, and then passenger restrictions. The predicted benefits of these GLS actions were relatively small compared with the other possible actions. This may be due to the success of a number of other GLS actions that have already been implemented, such as the increase to a mandatory 12 months on a learners licence before progressing to a provisional licence.

Note that implementing multiple countermeasures at the same time will result in some interactions and so the individual effects cannot simply be added together. Some combined effects are listed in Table 3.7 and further combinations are covered in Section 4.1.

Table 3.7
Individual effect on the number of fatal and serious casualties from various road safety countermeasures

Countermeasure	Predicted number of casualties prevented by 2026 if implemented in 2017	Estimated cost of implementation
Speed limit changes		
110 km/h to 100 km/h		
All road categories	44	$1M
Trunk roads	37	$1M
100 km/h to 90 km/h		
All road categories	162	$1M
Regional access roads	27	$1M
Regional freight roads	22	$1M
Feeder roads	27	$1M
Other state-controlled roads	22	$1M
Non state-controlled roads	55	$1M
60 km/h to 50 km/h		
All road categories	63	$1M
Non state-controlled roads	44	$1M
GLS changes		
P1 at 18 years of age	31	$1M
Passenger restrictions	10	$1M
Curfew	20	$1M
All GLS initiatives	56	$3M
Average age of vehicle fleet		
Reduction of 5%	42	^
Reduction of 10%	85	^
Reduction of 15%	126	^

^ The exact mechanism for manipulating the age of the fleet is unknown but many measures are expected to be low in cost

Accurately modelling the effects of large scale, wide spread infrastructure treatments is impossible without detailed data on the characteristics and location of currently existing infrastructure. This type of data is simply not available and so several assumptions were made for the infrastructure scenarios modelled.

The effect of implementing specific treatments along the entire length of a particular road category was modelled as outlined in Appendix A. This type of action is obviously unrealistic (and ignores the effect of existing infrastructure), but highlights the potential for casualty reductions through the implementation of infrastructure countermeasures. Furthermore, it allows comparisons to be made between different countermeasures and the investigation of which road categories are likely to benefit more than others.

The predicted effect of the infrastructure countermeasures is shown in Table 3.8. For each countermeasure (implemented in 2017), the predicted number of fatal and serious casualties that would be prevented over the 2017-2026 period is displayed. An estimated cost for the implementation of each infrastructure countermeasure along the specific road category is also given.

It is evident that achieving a Safe System compliant network using crash barriers alone is cost prohibitive. While 2+1 configurations are clearly the best option, centreline treatments also show promising casualty reductions. Sealing shoulders and installing audio-tactile line marking are less effective but still worthwhile. Roundabouts are the most effective intersection treatment, followed by installing plateaus and eliminating right turns.

Given the unrealistic nature of the infrastructure countermeasures that were modelled, caution is advised in comparing the results displayed in Table 3.8 with those in Table 3.7.

Table 3.8
Individual effect on the number of fatal and serious casualties from various road safety infrastructure countermeasures

Countermeasure	Predicted number of casualties prevented by 2026 if implemented in 2017	Estimated cost of implementation
Centreline barrier		
Trunk roads	103	$54M
Regional access roads	88	$80M
Regional freight roads	60	$47M
Wide centreline		
Trunk roads	82	$60M
Regional access roads	63	$49M
Regional freight roads	45	$35M
Two plus one		
Trunk roads	125	$730M
Regional access roads	110	$1,080M
Regional freight roads	70	$640M
Sealed shoulders		
Trunk roads	66	$200M
Regional access roads	62	$290M
Regional freight roads	38	$170M
Audio-tactile line marking		
Trunk roads	22	$8M
Regional access roads	31	$12M
Regional freight roads	19	$7M
Roundabouts		
Trunk roads	26	$280M
Regional access roads	8	$120M
Regional freight roads	6	$70M
No right turn		
Trunk roads	16	$7M
Regional access roads	8	$3M
Regional freight roads	6	$2M
Right turn lanes		
Trunk roads	8	$70M
Regional access roads	7	$30M
Regional freight roads	2	$20M
Plateaus		
Trunk roads	17	$20M
Regional access roads	8	$10M
Regional freight roads	6	$5M
Grade separation		
Trunk roads	36	$2,130M
Regional access roads	20	$930M
Regional freight roads	10	$540M

4 Suggestions for the 2017-2026 strategy

This Section utilises the analyses from Sections 2 and 3 to make suggestions for the 2017-2026 strategy. A number of potential strategic directions are suggested and a discussion of how actions should be rolled-out is presented. Suggestions for new fatal and serious casualty reduction targets are then provided. The implications of the continuation or cessation of the Road Safety Levy are discussed and finally, some details of further considerations stemming from National Road Safety Strategy are provided.

4.1 Potential strategic directions

It is evident that Tasmania has limited resources with which to invest in road safety. The transformation of the road network that is required to Safe System standards will not be achievable on all roads nor within the life of the next strategy. This situation is not unique to Tasmania and all of the states in Australia with many times the resources still struggle to transform their road networks into safe ones.

Although many countermeasures are available it is important to consider their cost, likely effectiveness and the timeframe in which they can achieve benefits. Table 3.7, in the previous Section provided an indication of likely effectiveness of countermeasures and their related costs, from different areas of the Safe System.

It is quite apparent that speed management remains the most viable option for reducing death and injury on Tasmania's roads. Safer infrastructure is capable of providing more forgiving environments; however this would take immense investment and considerable time to achieve. Safer vehicles also hold much potential benefit for the future however it will take time for the vehicle fleet to turnover sufficiently with newer and safer vehicles. Some programs supporting safer road users can be effective but are generally not as efficient as other countermeasure approaches. Notable exceptions are traffic enforcement backed up by mass media and the graduated licencing system.

As an example, it is likely that the implementation of a lower speed limit will cost under a million dollars to implement. In contrast, the creation of a safe road environment using barriers in the centre of the road and on the roadsides in a “2+1” configuration will cost something in the order of $730 million on trunk roads alone. The upgrading of intersections where people have been injured to roundabouts on the same road type will cost in the order of $280 million. It would also take several years to construct the upgrades whereas the benefits from the lower speed limit would accrue immediately.

Safer vehicles should be promoted and fleet purchases should involve the safest vehicles in each category. However with an average fleet age of over 10 years in Tasmania, it would be many years before even half the fleet had a new safety feature that was made available tomorrow.

Enforcement activity backed up by mass media is expensive to maintain and finding additional resources to increase upon current levels is always a challenge. However this activity needs to continue to prevent regression in road safety performance. Regulation and licencing are other avenues that have proven to be effective and GLS schemes have proved to be highly effective internationally. Other intervention programs may be beneficial provided resources are available and they are operated at a very low cost. Researchers have generally been struggling for decades to demonstrate the effectiveness of behavioural programs in road safety. This is not to say that such programs do not work, however demonstrating that they work has been difficult. This indicates that if they do work, there are many factors that are likely to also influence the chances of successful outcomes.

The following sections highlight various combinations of countermeasures and their likely effect on casualty numbers by 2026. The potential strategic directions that are suggested below detail a set of major actions that could be implemented. However, these actions can, and should, be complemented by the continuation of current activities and the introduction of further small scale activities where appropriate.

4.1.1 A focus on lower speed limits

One strategic direction for reducing fatal and serious casualties is to focus the majority of efforts into reducing speed limits. The reduction of speed limits has been shown by the modelling to be the most effective countermeasure. The expected reduction in casualties would be significant and immediate. In addition, the implementation of speed limit reductions would be relatively low in cost.

These suggested actions are based on the Safe System approach that the speed limit should be set based on the available safety infrastructure. Under this approach, most roads have a posted speed limit that is too high. Tasmania could adopt a position that no road has a speed limit above 100 km/h. In addition, there are many roads with a currently posted speed limit of 100 km/h that are poorly maintained of have insufficient infrastructure and should be reduced to 90 km/h. On this basis, one set of suggested actions for a focus on lower speed limits are as follows:

- Reducing all 110 km/h speed limits to 100 km/h
- Reducing 100 km/h speed limits on minor road categories to 90 km/h (i.e. feeder roads, other state-controlled roads, and non state-controlled roads).

The modelling predicts that the implementation of these countermeasures in 2017 would prevent 165 casualties by 2026.

In addition to these speed reductions, some effort could be expended on actions that reduce the average age of the vehicle fleet. This would complement the speed limit reductions and result in further safety benefits. Thus, a second set of suggested actions for a focus on lower speed limits are as follows:

- Reducing all 110 km/h speed limits to 100 km/h
- Reducing 100 km/h speed limits on minor road categories to 90 km/h (i.e. feeder roads, other state-controlled roads, and non state-controlled roads)
- Reducing the average age of the fleet age by 5%.

The modelling predicts that the implementation of these countermeasures in 2017 would prevent 185 casualties by 2026.

Speed limit reductions could also be utilised in urban areas with the reduction of 60 km/h zones to 50 km/h. The third set of actions that focus on lower speed limits would then be as follows:

- Reducing all 110 km/h speed limits to 100 km/h
- Reducing 100 km/h speed limits on minor road categories to 90 km/h (i.e. feeder roads, other state-controlled roads, and non state-controlled roads)
- Reducing all 60 km/h speed limits to 50 km/h.

The modelling predicts that the implementation of these countermeasures in 2017 would prevent 205 casualties by 2026.

The implementation of lower speed limits however remains a contentious issue in the community both in Tasmania and nationally. Despite the overwhelming research evidence there is still resistance to change. From the community risk management perspective, any reductions in travelling speed that can be achieved are considered worthwhile. This may therefore mean that implementation occurs on specific road corridors or in certain geographical areas rather than over the whole state at any one point in time.

4.1.2 A focus on reducing vehicle age

Another strategic direction is to invest the majority of efforts into reducing the age of vehicles in the Tasmanian fleet. Reductions in the age of the vehicle fleet showed the second highest potential for reductions in fatal and serious casualties. However, a clear pathway to achieve a reduction in the age of the fleet is not clear due to the economic complexities of the vehicle market and limited areas where the state government can directly influence outcomes. In spite of this, it is suggested that a suitable method could be developed by economists who are familiar with vehicle taxation and trading (particularly in Tasmania). Any potential method is likely to experience political difficulties as well as technical difficulties, but the payoff from a successful age reduction program would be substantial. A potential advantage for Tasmania may be that it is an island state, where the fleet could be manipulated without significant interferences by vehicle transfers from other states. Changing the age of the vehicle fleet might invariably rely on changes to state based vehicle taxes, such as petrol excise, vehicle registration, or stamp duty on purchases and transfers. Thus, it is likely that the cost of implementation could be arranged to be relatively low or even neutral.

Reducing the average age of the vehicle fleet by 15% in 2017 is predicted to prevent 126 fatal and serious casualties as shown by the modelling in Table 3.7.

4.1.3 A combination of measures

Countermeasures in the three Safe System areas of speeds, vehicles, and road users would be implemented. This diversified approach may be more welcomed by the public if there was strong opposition to the speeds or vehicle focussed strategic directions. However, it should be noted that there is less opportunity for significant reductions in casualties when speed and vehicle measures are omitted. A set of actions using a mixture of measures might be as follows:

- Reducing all 110 km/h roads to 100 km/h
- Reducing the average age of the vehicle fleet by 5%
- Implementing further GLS countermeasures (night time and passenger curfew).

The modelling predicts that the implementation of these countermeasures in 2017 would prevent 108 casualties by 2026. Given this sub-optimal performance, a final strategic alternative is heavy investment into infrastructure.

4.1.4 Infrastructure measures

Each of the strategic directions described above could be complemented with investment in infrastructure countermeasures that further align the road environment with Safe System objectives. Due to the cost of implementing road safety infrastructure it is important to ensure the maximum benefit is achieved for the amount funding that is available.

Optimisation modelling was used to identify treatment types and combinations of treatments that best utilise a $7.5 million annual infrastructure budget sourced from the road safety levy. The details of this optimisation process are presented in Appendix A. It should be noted that this optimisation modelling was undertaken while considering the broad network costs and casualty reduction potentials of each treatment type. As such, the results should only be used to compare treatment options on a broad network basis. Application of the results to individual or small numbers of sites in not advised as the random nature of crashes at this scale is likely to become a dominant factor. Similarly, the optimization results are only likely to be accurate when each treatment is implemented on a large scale. Small scale implementation of treatments would require a highly targeted approach in order maximize their benefits.

When considering midblock treatments it is clear that extensive use of crash barriers will achieve close to Safe System performance, especially in 2+1 and 2+2 configurations, but it is unlikely that the funding required to achieve this even on a small proportion of the road network will ever become available. Other less costly measures therefore have to be considered in terms of their potential to reduce overall death and injury (see Figure 4.1). Audio-tactile line markings (ATLMs) are an effective treatment because of the higher proportion of the network that can be treated within the limitations of the infrastructure budget. It would cost approximately $18.2 million to install ATLM on the entire length of 100 km/h roads without sealed shoulders in Tasmania. This represents about 2.4 years of a $7.5 million annual budget. Due to their higher costs, widespread implementation of other midblock treatments would take considerably longer. The benefits from wire rope barrier or wide centrelines are closely aligned and both show similar safety benefits with a limited budget. However, the limited lengths of roads that could be treated under the budget mean that a more targeted approach to selecting treatment sites would be required.

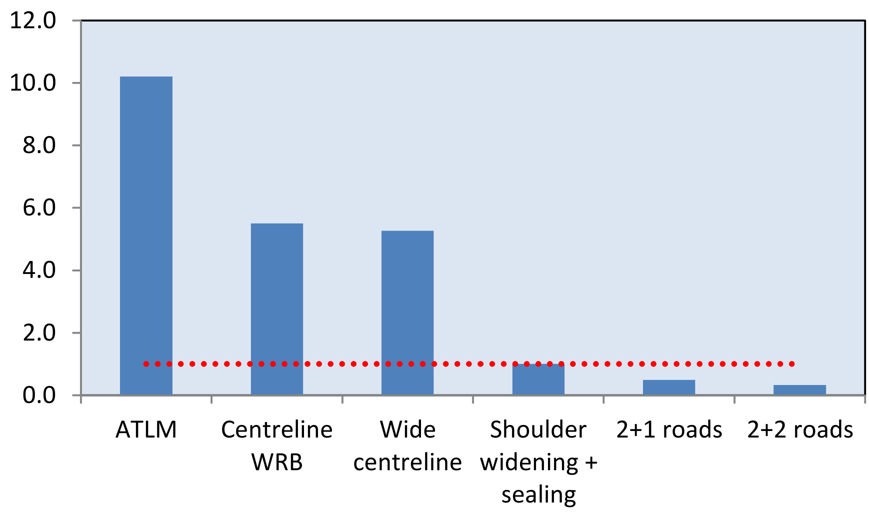

Figure 4.1

Relative comparison of the safety benefits of various intersection infrastructure treatment with an annual budgetary constraint of $7.5 million. The dotted line represents the safety benefit of shoulder widening and sealing

When considering intersection treatments, grade separation represents the most effective way to eliminate the possibility of interactions between vehicles traversing an intersection. However, the high level of funding that would be required severely limits the feasibility of widespread use. The elimination of right turns and implementation of plateaus show strong potential due to their low cost, the ability to therefore use them on a widespread basis, and their ability to reduce the incidences of high speed, right-angle interactions (see Figure 4.2). While roundabouts are also effective at reducing these interactions, their higher cost limits the number of sites that could be treated each year.

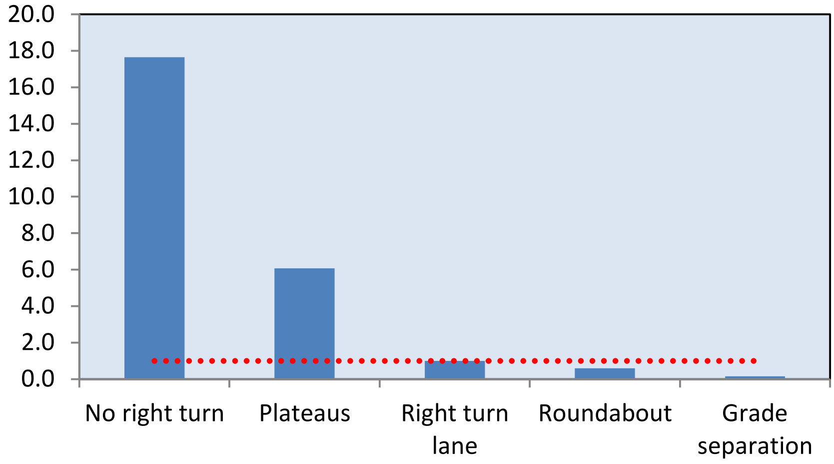

Figure 4.2
Relative comparison of the safety benefits of various intersection infrastructure treatments with an annual budgetary constraint of $7.5 million. The dotted line represents the safety benefit of implementing right turn lanes

Taking into account infrastructure funding of $7.5 million per annum sourced from the road safety levy and the costs of infrastructure treatment, the most effective combination of treatment options include ATLM and centreline treatments (wide centrelines or centreline wire rope barrier) for midblocks, and eliminating right turns and installing plateaus for intersections. Implementing a combination of different treatments may be beneficial. Such a strategy allows treatments to be selected while considering the desired outcomes and limitations of each location. The safety benefits for different combinations of midblock and intersection treatments are shown in Figures 4.3 and 4.4 respectively. The safety benefits of three suggested options that combine midblock and intersection treatments are shown in Figure 4.5.

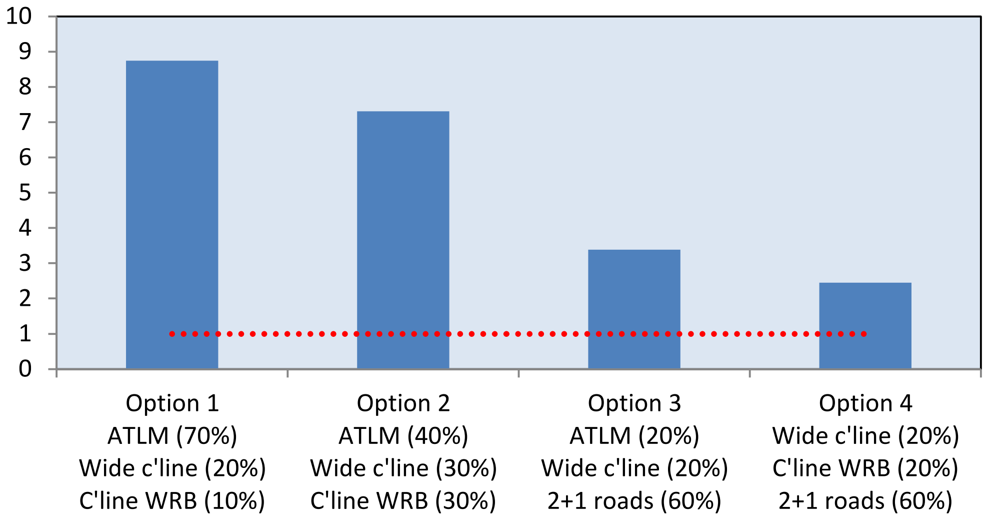

Figure 4.3
Relative comparison of the safety benefits of various midblock infrastructure treatment combinations with an annual budgetary constraint of $7.5 million. The dotted line represents the safety benefit of shoulder widening and sealing

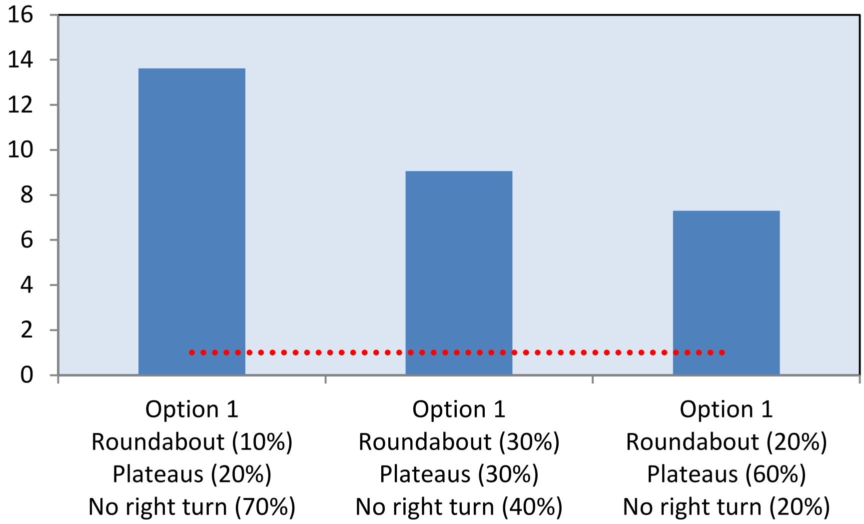

Figure 4.4
Relative comparison of the safety benefits of various intersection infrastructure treatment combinations with an annual budgetary constraint of $7.5 million. The dotted line represents the safety benefit of implementing right turn lanes

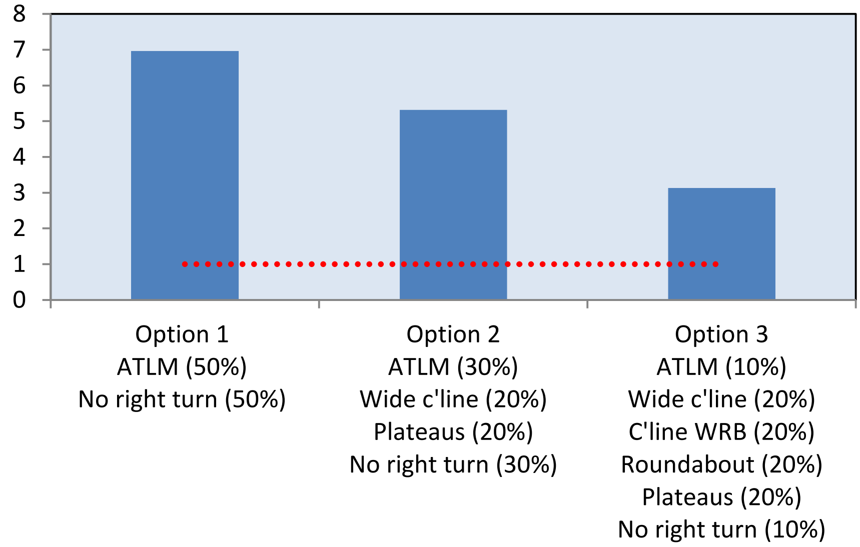

Figure 4.5
Relative comparison of the safety benefits of various mid-block and intersection treatment combinations with an annual budgetary constraint of $7.5 million. The dotted line represents the safety benefit of implementing right turn lanes and shoulder widening and sealing with equal budgetary weighting

Given that all treatments are unlikely to be applied on all parts of the network, Table 4.1 is suggested as a guide as to where the countermeasures might be applied in the road network.

Table 4.1
Proposed locations for infrastructure implementation

Treatment	Where
2+1 and 1+1 cross sections	Highest volume strategically important roads
Continuous Centreline barriers only	Highest volume trunk, freight and regional access routes
Continuous Roadside barriers	Highest volume trunk, freight and regional access routes
Wide Centrelines	Highest volume trunk, freight and regional access routes where centre line barriers not feasible
Sealed shoulders	Highest volume trunk, freight and regional access routes where above treatments not possible Commence with treatment on bends if warranted
Audio tactile line marking	Highest volume trunk, freight and regional access routes where above treatments not possible Commence with treatment on bends if warranted
Centreline barrier (discrete site)	Road lengths with identified head on collision crashes and road departures to the right
Hazard mitigation (discrete site) – barrier protection and clear zones where barriers cannot be achieved	All road types commencing with highest volume roads
Install roundabouts	Highest volume trunk, freight and regional access routes Discrete sites if warranted on lower order routes
Install speed plateaus at intersections	Largest effect will be on highest volume trunk, freight and regional access routes Any road types in a built up area if warranted
Eliminating redundant intersections and access points in the network	Entire Network
Eliminating right turns and through movements at intersections and points of access in the network	Entire Network
Modifying intersection geometry to eliminate right angle crash configurations	highest volume trunk, freight and regional access routes
Adopt full right turn control at signalised intersections	Entire Network
Adopt innovative roundabout and intersection designs	Entire Network
Create safe cycling corridors in large urban centres	North / South and East / West safe corridor for cyclists preferably with segregation
Implement calmed 40km/h pedestrian activity areas	Urban areas with high pedestrian activity
Raised pedestrian crossings	Any new crossings that are implemented

Monitoring of progress could be based on number of new sites or length of network that contains the treatment each year over the life of the strategy.

The countermeasure options presented for intersections in this report are quite novel for Australia and may not yet have strong community support. The prospect of using plateaus on busy roads and removing right turns on a widespread basis is likely to be met with considerable resistance. If these options are removed, new low cost innovative intersection designs that can be implemented on a widespread basis will need to be pursued. Low cost roundabout designs that still deliver safety benefits will also need to be explored. This highlights the need to develop innovative demonstration projects to demonstrate what Safe System infrastructure might look like into the future.

4.2 Roll-out strategy

The strategic directions suggested above specify predicted fatal and serious casualty reductions based on the modelling of countermeasures that are implemented in 2017. An implementation year of 2017 provides a 10 year period to 2026 over which the benefits of the countermeasure effect can accrue. However, it is unlikely that all the countermeasures investigated could be implemented immediately. While speed limit and GLS interventions could arguably be introduced relatively quickly, infrastructure changes and vehicle age changes would require some lead time and their full effects would build over time.

Examples of the ramifications of delaying countermeasure implementation are demonstrated in Table 4.2. It is evident that the longer the delay, the less potential there is to save lives and prevent injuries.

Table 4.2
Example of the number of fatal and serious casualties that would be prevented in the year 2026, by year of countermeasure implementation

Countermeasure	Year of implementation									
	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
110 km/h to 100 km/h	44	39	34	29	24	20	16	12	8	4
Curfew	20	18	16	14	12	10	8	6	4	2
10% age reduce	85	77	68	59	50	41	32	23	15	7

In light of this, it is prudent to introduce all intended countermeasures as soon as possible in order to maximise the safety benefit. However, if unavoidable delays between the implementation of various countermeasures are expected then some strategic planning should be applied. More immediate acting countermeasures (i.e. speed limit reductions and GLS measures) should be implemented first, while slower acting countermeasures (i.e. vehicle age manipulation or safety infrastructure construction) should be implemented later. This strategy provides an early benefit, while the later benefit has an opportunity to build.

4.3 Suggested casualty reduction targets

It was highlighted in Section 2 that the use of percentage reductions can result in unrealistic targets. A target number of fatal and serious casualties may be more appropriate and easier to understand than a target percentage reduction.

The advantage of the modelling conduced in Section 3 is the knowledge regarding the predicted number of fatal and serious casualties in Tasmania over time. Given current background trends it is estimated that, if no additional countermeasures are implemented, there will be 177 fatal and serious casualties in 2026. The effects of a number of countermeasure options were noted in Sections 3.1 to 3.2 and several of these were modelled. This modelling predicted the individual effects of each countermeasure. In addition, the combined effect of several countermeasures has been presented above.

In presenting the individual or combined effects of countermeasures, an estimate of the number of fatal and serious casualties in 2026 was provided. This enabled the following suggestions for possible casualty targets in the year 2026:

- A target of 170 is regarded as very achievable and should be considered the minimum to aim for.
- A target of 168 is regarded as very achievable with some effort and investment into the countermeasures under the mixture of measures strategic direction.
- A target of 166 is regarded as achievable under the mixture of measures strategic direction plus the addition large investment into infrastructure treatments.
- A target of 163 is regarded as possibly achievable but would require some political will along with the intelligent and careful manipulation of the vehicle fleet average age.

- A target of 160 is regarded as aspirational, but could be achieved with good political will and community acceptance of lower speeds.

These potential targets represent reductions in fatal and serious casualties trending over the period 2017 to 2026. These could be further broken down into sub-targets for each of the three expected action plan periods of 2017-2019 (1st action plan), 2020-2022 (2nd action plan), and 2023-2026 (3rd action plan).

In Figure 4.6 the minimum and maximum change in the number of fatal and serious casualties over the three action plan periods is shown. The minimum change is represented by the background effects only, without any other countermeasures. The maximum change is shown as the predicted effect form the implementation of all the modelled countermeasures.

A logical method of target setting is to use the annual average number of casualties during each action plan periods. In Table 4.3 several overall fatal and serious casualty targets are presented with an associated star rating for achievability based on the result of the modelling. For each potential target the yearly reduction in casualty is also presented, along with the required average annual number of casualties in the three action plan periods.

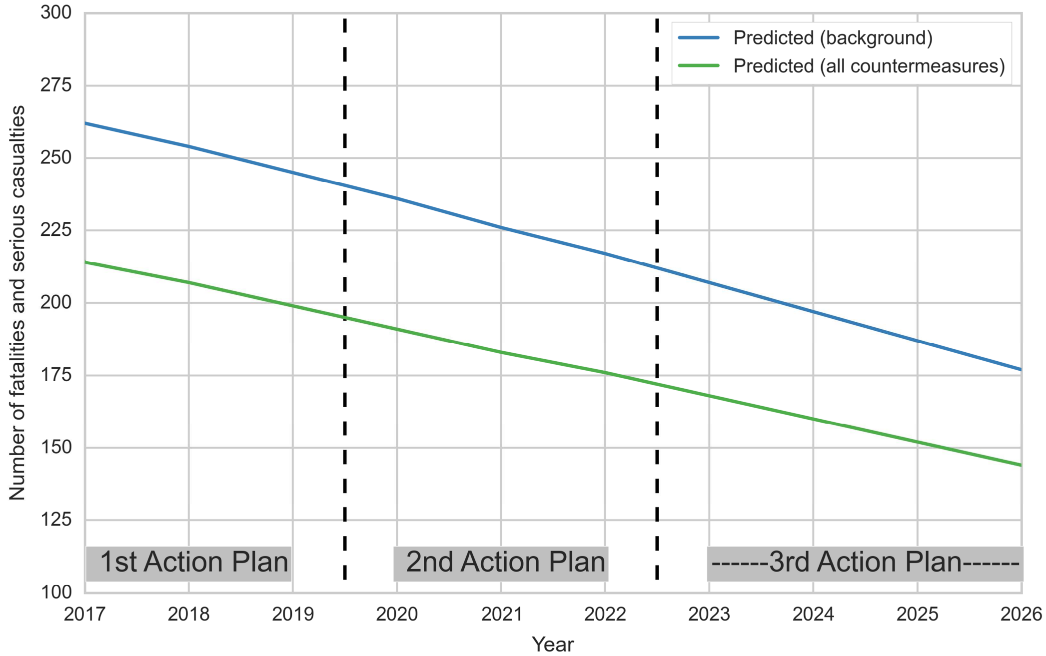

Figure 4.6
The minimum (background effects only) and maximum (implementation of all countermeasures) change in fatal and serious casualties over the three action plan periods

Table 4.3
Suggested targets for the 2017-2026 strategy and the three expected action plan periods

2026 casualty target	Achievability	Yearly reduction in casualties	Average annual number of casualties over specific periods		
			1st Action Plan period (2017-2019)	2nd Action Plan period (2020-2022)	3rd Action Plan period (2023-2026)
177 (do nothing)	-	9.4	252.2	224.0	191.1
170	✦ ✦ ✦	10.1	250.8	220.5	185.2
168	✦ ✦	10.3	250.4	219.5	183.5
166	✦ ✦	10.5	250.0	218.5	181.8
163	✦	10.8	249.4	217.0	179.2
160	✦	11.1	248.8	215.5	176.7

4.4 The road safety levy

The road safety levy generates approximately $12 million per annum for investment into road safety and is due to expire in 2017. From 2007-2015 61% of the funds raised from the levy have gone into infrastructure investment, 24% into safer speeds, 5% on young road users and 9% on complementary initiatives. With the exception of promoting safer vehicles, these proportions are broadly consistent with the commentary in this report around resources required and effectiveness of countermeasures in each area. As the levy was associated with the GLS, lower travelling speeds and best practice infrastructure it is likely that a return on investment will be obtained.

Are these proportions appropriate? There is no doubt that speed management constitutes the best option for Tasmania and any levy expenditure on achieving this is regarded as appropriate. There is scope to provide more funding to strategies that ensure the Tasmanian vehicle fleet is made up of the newest and safest cars in each category as possible. As is evident in this report, achieving safer infrastructure is prohibitively expensive and expectations about what the levy can achieve need to be realistic. Using a high proportion of the levy for infrastructure is inevitable but is unlikely to have a significant effect in any one year. The cumulative effect of infrastructure investment over several years is what needs to be considered in determining if the approach has been effective and it is therefore important that a levy is sustained over a period of several years for effectiveness to be leveraged.

Another less obvious benefit of the levy is the support for innovation and the creation of what are in effect demonstration projects. It is important that deviations from traditional practices, especially in relation to traffic management and road design, are developed in the transition towards a Safe System. Such projects can provide the community and engineers additional confidence that changes to traditional practices are warranted. Fundamentally, work is still needed to demonstrate what a Safe System actually looks and feels like to the community. The identification of innovative infrastructure approaches that are proven to be effective are likely to hold the key to Tasmania making significant progress towards a network aligned with Safe System performance. New low cost intersection designs and speed management treatments hold much potential to transform the road network in a practical and affordable way. The levy provides an ideal opportunity to pursue this type of agenda.

4.4.1 Scenarios with and without the levy

In the past few years in Australia there has been a trend towards targeted funding aimed at improving road safety. Most of these have been specifically associated with transforming road infrastructure towards Safe System outcomes. The two most notable schemes have been the Victorian Transport Accident Commission (TAC) $1 billion investment and the South Australian Motor Accident Commission (MAC) $100 million investment, both aimed at Safe System treatment and innovation. The TAC scheme (known as the *Safe System* Road Infrastructure *Program,* SSRIP) aims to accelerate the transition towards the Safe System using a highly targeted approach to safety improvements. It is notable that the third party insurers have strong business cases for their additional investment in road safety and are contributing in this way. In Tasmania, the Motor Accident Insurance Board (MAIB) has also been contributing to coordinated road safety activity since the late 1990s mainly in the area of publicity and mass media.

The removal of the levy in Tasmania without a replacement source of funding for targeted road safety expenditure would go against national trends and leave a significant gap in the ability to continually improve the road system over the long term. This gap could be covered via traditional road maintenance and investment activity (if sufficiently funded), however many of the schemes in Australia were created to be more effective in targeting safety improvements compared to the traditional approaches.

Should the levy not be available until 2026, in the order of $120 million will not be spent on the transition towards a safer road system. This is likely to have most impact on infrastructure investment which is the most costly of the countermeasures. The likely outcome of this scenario is that speed management and full GLS provisions would be the key countermeasures that would need to be pursued. Of concern would be the fact that there might not be funds to seek innovative and alternative safety countermeasures and therefore the potential to establish more cost effective ways of achieving a safe road system in Tasmania over and above speed management approaches.

4.4.2 Should the Levy be increased?

There is of course an argument that any increases in road safety funding will translate to further benefits. However this consideration is probably best made in the context of infrastructure costs. The additional benefits on combinations of infrastructure treatments by increasing the annual income from the Levy by up to three times are shown in Figure 4.7. The proportionate benefit for the increased funding is evident. As discussed earlier however, even this amount of funding would still fall short of transforming large parts of the network to 2+1 configurations for example. Therefore we suggest that considerations of increased budgets for the levy be on the basis of permitting innovative road design solutions and demonstration projects. The discovery of a low cost infrastructure treatment that is effective and can be used on a widespread basis would reap significant benefits for Tasmania in the transition towards a Safe System road network.

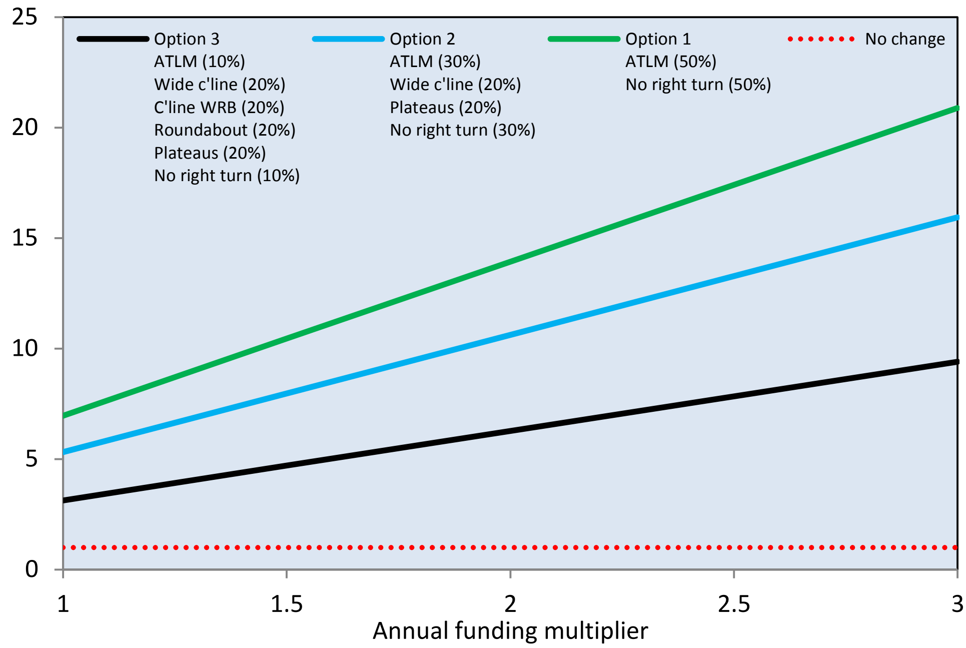

Figure 4.7
Relative comparison of the safety benefits of various infrastructure treatment combinations with an increase in annual budgetary constraint. The dotted line represents the safety benefit of implementing right turn lanes and shoulder widening and sealing with equal budgetary weighting totalling $7.5 million annually

4.5 Alignment with the National Road Safety Strategy (NRSS)

The National Road Safety Strategy (NRSS) was released in May 2011 and is based firmly on Safe System principles. At its core is the aspiration that no one should be seriously injured or killed as a result of using the road system. The strategy provides a guide for road safety directions, priorities and initiatives until 2020 and was initially supported by an action plan (the "First Steps" agenda) covering the years 2011-13.

A review of the strategy was conducted in 2014 and the following action areas were recommended as national priorities (Austroads 2014):

- Vulnerable Road Users
- Older Drivers
- Indigenous Road Users
- Speed Management
- Remote Areas
- Vehicle Technology
- Cooperative - ITS
- Monitoring Serious Injuries
- Targeted Infrastructure Investment
- Coordination with Urban Planning
- Workplace Road Safety
- National Leadership

Each of these is explained further in Appendix B. In the Tasmanian context, many of these are relevant and further exploration is warranted to establish if further activities in these areas could deliver benefits. Several of these areas have already been addressed elsewhere in this report however some further options that could be explored as part of the next strategy include:

Is there a need for a separate rural / remote component to the road safety strategy?

In the National context this suggestion was to deal with the low density remote areas common to Western Australia, South Australia, Queensland and the Northern Territory. While Tasmania does have some remote areas, it is likely that general road safety initiatives across the state would still have an influence in these areas and therefore the need to have a separate rural/remote strategy is not as high as is the case with other parts of Australia.

Are there any ITS trials that could be conducted in Tasmania?

The lower population and geographic nature of Tasmania might lend itself to trials of Intelligent Transport Systems technology. The Road Safety Levy to date has funded vehicle activated signage and further applications for innovate solutions could be considered, especially with increases in vehicle safety technologies available.

Can any enhancements be made to serious injury reporting (eg linking with hospital data) to better understand the extent of the road safety problem and prioritise treatments? This is a current national priority.

Linking health data to police crash data will provide a better understanding of injury from the road system and therefore provide better information for decision making around countermeasure selection and implementation. Linking such data is not necessarily straightforward and can be expensive. Options for linking could be explored in Tasmania to determine if there are easy pathways that are cost effective and sustainable.

Is there a linkage between urban planning and road safety and are best practice treatments adopted when the urban environment is altered (e.g. plateaus considered for any new intersections)?

Is there coordination between urban development and safety at local and state government levels and if not can this be introduced? Are best practice approaches being utilised for urban developments (e.g. raised pedestrian crossings, 40km/h pedestrian zones, non-right angle intersection designs).

Are there opportunities to engage with the private sector to adopt risk management approaches to road use? Can the Road Safety Partnerships Program be promoted more strongly in Tasmania?

The Road Safety Partnerships Program provides an excellent resource for industry to network and establish a knowledge base in relation to enhancing road safety. There are many success stories of companies achieving considerable efficiency and cost savings by pursuing a culture of safety in relation to road transport. There may be opportunities for Tasmanian industry to adopt a stronger safety culture and also see how this could be translated into the community.

Acknowledgements

This study was funded by the Tasmanian Department of State Growth. The Project Manager was Jonathan McGuffie.

The Centre for Automotive Safety Research is supported by both the South Australian Department of Planning, Transport and Infrastructure and the South Australian Motor Accident Commission.

The views expressed in this report are those of the authors and do not necessarily represent those of the University of Adelaide or the funding organisations.

References

Anderson, R. W. G., & Searson, D. J. (2014). Use of Age-Period-Cohort models to estimate effects of vehicle age, year of crash and year of vehicle manufacture on driver injury and fatality rates in single vehicle crashes in New South Wales, 2003-2010. *Accident Analysis & Prevention*, 75, 202-210.

Anderson, R. W. G., Raftery, S. J., Grigo, J. A. L., & Hutchinson, T. P. (2013). *Access to safer vehicle technologies by young drivers: factors affecting motor vehicle choice and effects on crashes* (CASR118). Adelaide: Centre for Automotive Safety Research.

Australian Bureau of Statistics [ABS] (2001 – 2015a). *Motor Vehicle Census, Australia*. (9309.0). Canberra: Australian Bureau of Statistics [ABS].

Australian Bureau of Statistics [ABS] (2001 – 2015b). *Survey of Motor Vehicle Use, Australia*. (9208.0). Canberra: Australian Bureau of Statistics [ABS].

Austroads,. (2008). *The crash and offence experience of newly licensed young drivers* (AP-R331/08). Sydney: Austroads.

Austroads,. (2010). *Road safety engineering risk assessment part 9: rural intersection crashes* (AP-T154-10). Austroads. Sydney, Australia.

Austroads,. (2015a). *Improving the performance of safe system infrastructure: final report* (AP-R498-15). Austroads. Sydney, Australia.

Austroads,. (2015b). *Road geometry study for improved rural safety* (AP-T295-15). Austroads. Sydney, Australia.

Bailey, T. J., Lindsay, V. L., & Royals, J. (2013). *Alcohol ignition interlock schemes: best practice review* (CASR119). Adelaide: Centre for Automotive Safety Research.

Bergh, T., Carlsson, A., & Larsson, M. (2003). *Swedish vision zero experience*. International Journal of Crashworthiness. 8(2). 159-167.

Bhatnagar, Y., Saffron, D., deros, M., & Graham, A. (2010). *Changes to speed limits and crash outcome – Great Western Highway case study*. Australasian Road Safety Research, Policing and Education Conference, Canberra, Australian Capital Territory, 31 August – 3 September 2010.

Bui, B. (2001). An evaluation of safety effects of overtaking lanes on rural Victorian highways. Victoria, Australia: VicRoads.

Candappa, N., D'Elia, A., Corben, B., & Newstead, S. (2009) *Evaluation of the effectiveness of flexible barriers along Victorian roads.* Monash University Accident Research Centre. Report No. 291.

Carlsson, A. (2009). *Evaluation of 2+1-roads with cable barrier: final report.* VTI Rapport 636A. Linköping, Sweden.

Christie, R. (2001). *The effectiveness of driver training as a road safety measure: An international review of the literature.* Paper presented at the Road Safety Research, Policing and Education Conference, Melbourne, Victoria, 18-20 November, 2001.

Department of Infrastructure and Regional Development (DIRD). (2015). *Treatment/crash risk matrix.* DIRD. Viewed 4 December 2015. http://investment.infrastructure.gov.au/publications/administration/pdf/Blackspot_Matrix.pdf

De Pauw, E., Daniels, S., Thierie, M., & Brijs, T. (2014). Safety effects of reducing the speed limit from 90 km/h to 70 km/h. *Accident Analysis and Prevention*, 62, 426-431.

de Rome, L., Ivers, R., Fitzharris, M., Du, W., Haworth, N., Heritier, S., & Richardson, D. (2011). Motorcycle protective clothing: Protection from injury or just the weather?. *Accident Analysis & Prevention*, *43*(6), 1893-1900.

Desapriya, E., Pike, I., Subzwari, S., Scime, G., & Shimizu, S. (2007). Impact of lowering the legal blood alcohol concentration limit to 0.03 on male, female and teenage drivers involved alcohol-related crashes in Japan. *International journal of injury control and safety promotion*, 14(3), 181-187.

Doecke, S. D., & Woolley, J. E. (2010). Effective use of clear zones and barriers in a Safe System's context. 2010 Australasian Road Safety Research, Policing and Education Conference, Canberra, 31 August - 3 September 2010.

Doecke, S. D., & Woolley, J. E. (2011). *Cost benefit analysis of Intelligent Speed Adaptation* (CASR093). Adelaide: Centre for Automotive Safety Research.

Elvik, R. (2013). A re-parameterisation of the Power Model of the relationship between the speed of traffic and the number of accidents and accident victims. *Accident Analysis & Prevention*, 50, 854-860.

Elvik, R., & Christensen, P. (2007). The deterrent effect of increasing fixed penalties for traffic offences: *The Norwegian experience. Journal of Safety Research, 38*, 689-695.

Engstrom, I., Gregersen, N. P., Hernetkoski, K., Keskinen, E., & Nyberg, A. (2003). *Young novice drivers, driver education and training: Literature review*. Swedish National Road and Transport Research Institute.

Fell, J. C., & Voas, R. B. (2006). The effectiveness of reducing illegal blood alcohol concentration (BAC) limits for driving: evidence for lowering the limit to. 05 BAC. *Journal of safety research*, 37(3), 233-243.

Harwood, D.W., & Hoban, C.J. (1987). *Low-cost methods for improving traffic operations on two-lane roads: Information guide*. Washington DC: Report Number: FHWA-IP-87-2; Federal Highway Administration.

Harwood, D.W., & St John, A.D. (1985). Passing lanes and other operational improvements on two-lane highways. Washington DC: Report Number: FHWA/RD-85/028; Federal Highway Administration.

Healy, D., Catchpole, J., & Harrison, W. (2012). *Victoria's graduated licensing system evaluation interim report*. Melbourne, VIC: VicRoads.

Jaehrig, T. (2014). *Safe passing as a measure to improve road safety on rural roads in Germany.* Paper presented at the ARRB Conference, 26th, 2014, Sydney, New South Wales, Australia.

Kloeden, C. N., Ponte, G., & McLean, A. J. (2001). *Travelling speed and the risk of crash involvement on rural roads* (CR204). Canberra: Australian Transport Safety Bureau.

Kloeden, C. N., McLean, A. J., & Glonek, G. (2002). *Reanalysis of travelling speed and the risk of crash involvement in Adelaide South Australia* (CR207). Canberra: Australian Transport Safety Bureau.

Kloeden, C. N., Woolley, J. E., & McLean, A. J. (2007). *A follow-up evaluation of the 50km/h default urban speed limit in South Australia*. Road Safety Research, Education and Policing Conference, Melbourne, Australia, 17-19 October 2007.

Kloeden, C. N., & Woolley, J. E. (2015). *Vehicle speeds in South Australia 2014* (CASR131). Adelaide: Centre for Automotive Safety Research.

Koorey, G.F., Farrelly, P.M., Mitchell, T.J., & Nicholson, C.S. (1999). Assessing passing opportunities - Stage 2. Wellington, New Zealand: Transfund New Zealand.

Kwan, I., & Mapstone, J. (2009). Interventions for increasing pedestrian and cyclist visibility for the prevention of death and injuries (review). Cochrane Database of Systematic Reviews.

Larsson, M., Candappa, N., Corben, B. (2011). *Worlds best practice in the use of flexible barrier systems along high-speed roads.* Australasian Road Safety Research, Policing and Education Conference. Sydney, Australia. 24-26 September.

Lawpoolsri, S., Li, J., & Braver, E. R. (2007). Do speeding tickets reduce the likelihood of receiving subsequent speeding tickets? A longitudinal study of speeding violators in Maryland. *Traffic injury prevention, 8*, 26-34.

Levett, S., Tang, J. & Saffron, D. (2009). Applying safety countermeasures incrementally to existing roads. Australasian Road Safety Research, Policing and Education Conference. Sydney, Australia. 10-13 November.

Mackenzie, J. R. R., Kloeden, C. N., & Hutchinson, T. P. (2015). *Reduction of speed limit from 110 km/h to 100 km/h on certain roads in South Australia: a follow up evaluation* (CASR115). Adelaide: Centre for Automotive Safety Research.

Moffat, S. & Poynton, S. (2007), T*he deterrent effect of high fines on recidivism: driving offences* (Report No.: 106). Sydney, Australia: NSW Bureau of Crime Statistics and Research.

Newstead, S., Watson, L., & Cameron, M. (2013). Vehicle safety ratings estimated from police reported crash data: 2013 update Australian and New Zealand crash during 1987-2011 (Report No 318). Melbourne: Monash University Accident Research Centre.

Newstead, S. V., Cameron, M. H., & Leggett, L. M. W. (2001). The crash reduction effectiveness of a network-wide traffic police deployment system. *Accident Analysis & Prevention*, *33*(3), 393-406.

Norstrom, T., & Laurell, H. (1997). Effects of the lowering of the legal BAC limit in Sweden. *Alcohol, drugs and traffic safety*, 87-94.

Oxley, J., Yuen, J., Corben, B., Hoareau, E., & Logan, D. (2013, August). *Reducing pedestrian collisions in Melbourne's Central Business District*. Australasian Road Safety Research Policing Education Conference, 2013, Brisbane, Australia.

Pratt, K., McGarrigle, S., & Turner, B. (2015). *The hurdles of introducing innovative road safety infrastructure solutions – a case study on raised safety platforms.* Australasian Road Safety Conference. Gold Coast, Australia. 14-16 October.

Potts, IB, & Harwood, DW. (2004). Benefits and design/location criteria for passing lanes. Missouri, United States: Midwest Research Institution, Missouri Department of Transportation.

Ray, M., Silvestri, C., Conron, C., & Mongiardini, M. (2009). *Experience with cable median barriers in the United States: design standards, policies, and performance*. Journal of Transportation Engineering, 135(10), 711-720.

Retting, R. A., Ferguson, S. A., & McCartt, A. T. (2003). *A review of evidence-based traffic engineering measures designed to reduce pedestrian-motor vehicle crashes*. American Journal of Public Health, 93(9), 1456-1463

Rinde, EA. (1977). Accident rates vs. shoulder width: two-lane roads, two-lane roads with passing lanes. Sacramento, United States: Report CA-DOT-TR-3147-1-77-01. California Department of Transportation, Sacramento.

Searson, D. J., & Anderson, R. W. G. (2013). Potential effectiveness of seat belt interlocks. Road Safety Research, Policing and Education Conference 2013, Brisbane, 28-30 August 2013.

Sliogeris, J. (1992). *110 kilometre per hour speed limit – evaluation of road safety effects* (GR 92-8). Melbourne: Vic Roads.

Soole, D. W., Fleiter, J., & Watson, B. (2012). *Point-to-point speed enforcement* (No. AP-R415/12). Sydney: Austroads.

Soole, D., Watson, B., & Lennon, A. (2009). T*he impact of police speed enforcement practices on self-reported speeding: An exploration of the effects of visibility and mobility*. Paper presented at the Australasian road safety research, policing and education conference, Sydney, NSW.

Teoh, E. R. (2011). Effectiveness of antilock braking systems in reducing motorcycle fatal crash rates. *Traffic injury prevention*, *12*(2), 169-173.

Vernick, J. S., Li, G., Ogaitis, S., MacKenzie, E. J., Baker, S. P., & Gielen, A. C. (1999). Effects of high school driver education on motor vehicle crashes, violation, and licensure. *American Journal of Preventive Medicine, 16*(1S), 40-46.

Washington State Department of Transportation. (2009). *Cable median barrier report*. Olympia, United States.

Watson, B., Siskind, V., Fleiter, J. J., & Watson, A. (2010). *Different approaches to measuring specific deterrence: Some examples from speeding offender management.* Paper presented at the Australasian Road Safety Research, Policing and Education Conference, Canberra.

Wilson, C., Willis, C., Hendrikz, J. K., Le Brocque, R., & Bellamy, N. (2011). *Speed cameras for the prevention of road traffic injuries and deaths (Review)*. London: John Wiley & Sons.

Woolley, J. E. (2000). *In-car driver training at high schools: A literature review*. Adelaide: Transport SA.

Wundersitz, L. N., & Baldock, M. R. J. (2011). *The relative contribution of system failures and extreme behaviour in South Australian crashes* (CASR092). Adelaide: Centre for Automotive Safety Research.

Appendix A – Modelling Tasmania's road transport system

Changes to driving exposure

The number of registered passenger vehicles and motorcycles in Tasmania was obtained from ABS survey data for the years where it was available (ABS, 2001 – 2015a). This data is shown in Figures A1 and A2, along with fitted linear trend lines.

The number of registered vehicles and motorcycles in Tasmania was estimated for future years by extrapolating the trend lines. The risk of a casualty from the baseline period reoccurring was calculated as the ratio of the volume of registered vehicles in the year being modelled to the volume of registered vehicles in the year of the casualty.

The passenger vehicle trend line was used for all vehicles apart from motorcycles. Motorcycles experienced a higher level of growth in recent years and so utilised a separate trend line.

The average number of annual kilometres driven by passenger vehicles and motorcycles in Tasmania was obtained for the years where it was available (ABS, 2001 – 2015b). This data is shown in Figures A3 and A4, along with fitted linear trend lines.

By extrapolating the trend lines forward, the annual usage of vehicles and motorcycles in Tasmania was estimated for future years. The risk of a casualty from the baseline period reoccurring was then calculated as the ratio of the average usage of vehicles in the year being modelled to the average usage of vehicles in the year of the casualty.

The passenger vehicle trend line was used for all vehicles apart from motorcycles. Motorcycles have experienced a unique decrease in average usage over recent years and so utilised a separate trend line.

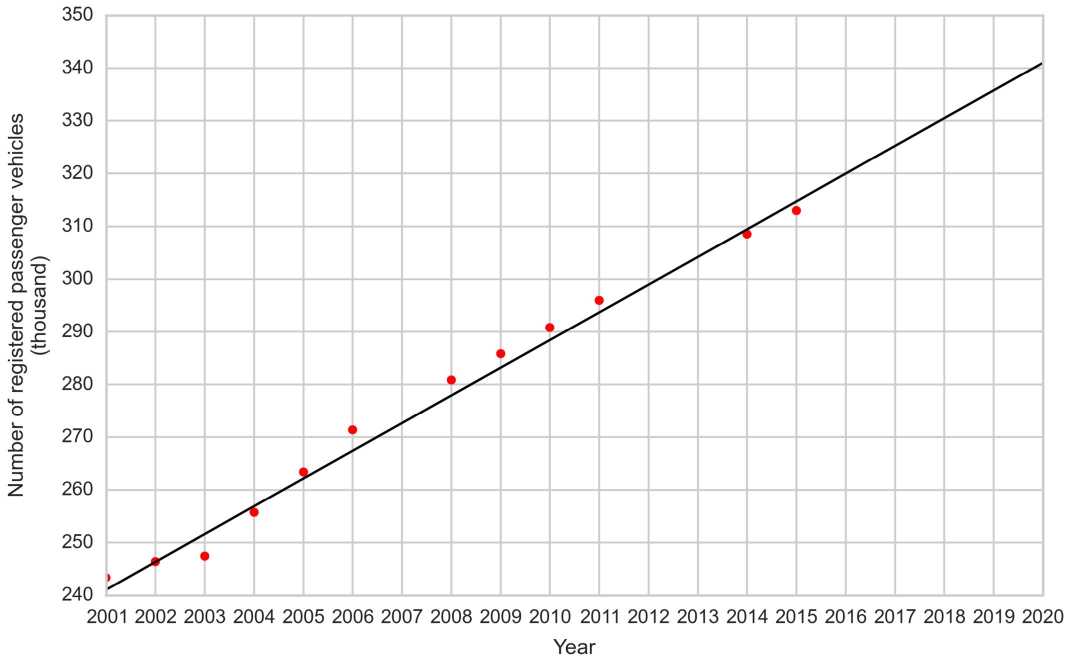

Figure A1
Number of registered passenger vehicles in Tasmania (2001-2015) based on ABS data with linear trend line

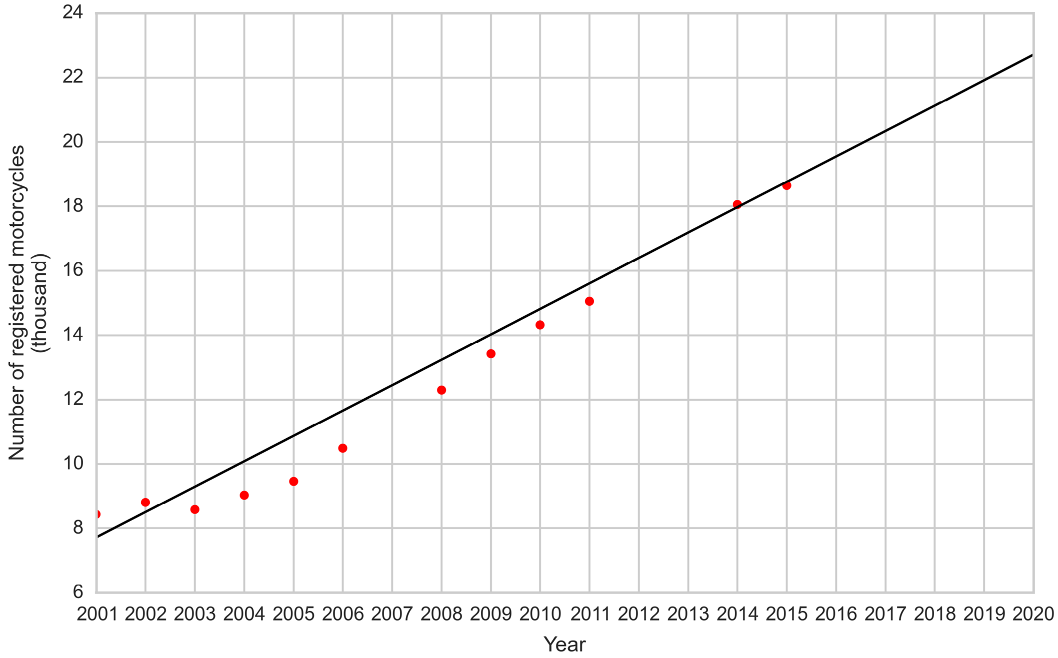

Figure A2
Number of registered motorcycles in Tasmania (2001-2015) based on ABS data
with linear trend line

Figure A3
Average number of annual kilometres travelled per registered passenger vehicle in Tasmania (2001-2015)
based on ABS data with linear trend line

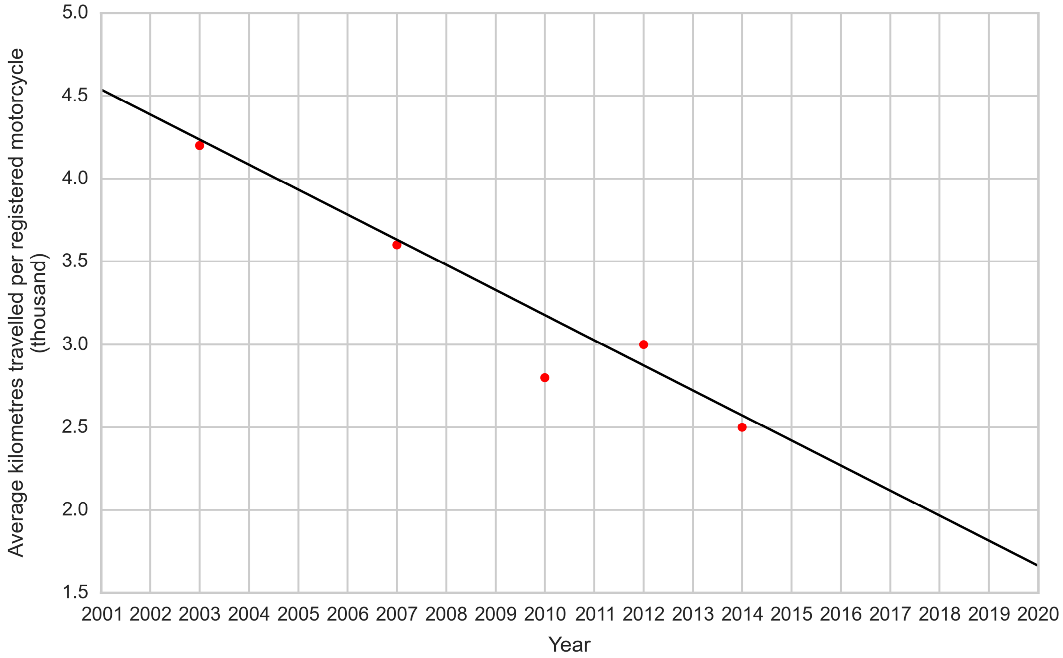

Figure A4
Average number of annual kilometres travelled per registered motorcycle in Tasmania (2001-2015) based on ABS data with linear trend line

Changes in the safety of vehicles over time

Anderson and Searson (2014) used data from NSW to disaggregate how collision year, vehicle age, and vehicle year of manufacture each affect crash risk. As a result of this research, the effect of improvements in vehicle safety over time was isolated and quantified. It was found that risk began to decline considerably for vehicles built after about 1996 and continued to increase to a maximum rate of decline for vehicles built around 2004. Anderson and Searson (2014) considered data up to the year 2010 but through extrapolation of trends were able to estimate a relative risk of being involved in a casualty crash for vehicles manufactured up to the year 2020, as shown in Figure A5 below. The curves describe the combined effects of crash involvement (primary safety) and vehicle crashworthiness (secondary safety).

The relative crash risk for each casualty in the baseline period was determined based on the year of manufacture for the vehicle of which they were an occupant. In future (modelled) years the casualty is assumed to be an occupant of a vehicle of the same age and so the year of manufacture is updated accordingly. For example, a baseline casualty who was an occupant of a vehicle manufactured in 2005 and crashed in 2010 would be modelled in 2020 as being an occupant of a vehicle manufactured in 2015. The relative crash risk in the modelled year could thus be determined.

The change in risk due to vehicle safety was then calculated as the ratio of the modelled year crash risk to the baseline year crash risk.

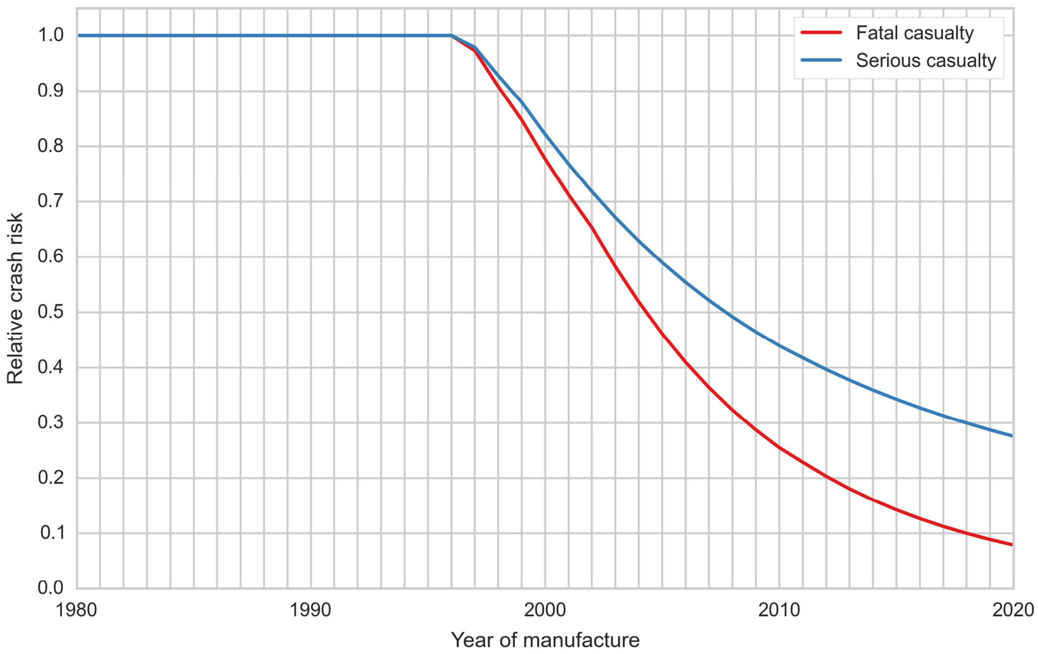

Figure A5
The dependence on vehicle year of manufacture of being killed (red line) or seriously injured (blue line) in a crash

Changes to the GLS in 2008 and 2009

In August 2008 several changes were made to the GLS including a mandatory 12 months on a P2 licence before graduating to a full licence, the introduction of a two tiered provisional system for motorcyclists, and increased penalties for offences while on provisional and learner licences. In April 2009 another set of changes were made to the GLS which included the introduction of a two tiered learner system, a mandatory 12 months on a learner licence before graduating to a provisional licence, and a further increase of penalties for offences while on provisional and learner licences.

Because changes to the GLS, such as these, are a relatively recent occurrence in Australia there has been little research so far on their effectiveness. As a result, the effects of the changes in 2008 are difficult to quantify. While it may be possible to quantify the extension of the mandatory P2 period somewhat, doing so would require detailed analysis of the number of provisional licence holders over time as well as investigation of the licence history of each of the drivers involved in crashes during the baseline period.

The effect of many of the changes that occurred in 2009 are similarly difficult to quantify. However, previous research on the crash risk of novice drivers provides an opportunity to quantify the effect that the introduction of a mandatory 12 months on a learner licence may have had.

Austroads (2008) identified South Australian drivers who obtained their first provisional car licence between July 1998 and June 2001 and who were 16 to 19 years of age at the time of provisional licensure. The crash history of these drivers during their learner period and for the five years after obtaining their provisional licence was then analysed. The risk of being involved in a casualty crash was found to be low during the learner period. However, once the driver obtained a provisional licence the risk was considerably higher and then decreased over time as experience and skill developed.

This quantification of casualty crash risk over time for novice drivers is shown by the red line in Figure A6.

The effect of extending the mandatory learners period could be estimated by shifting this curve to the right by six months and then calculating the difference in the aggregated risk over a 36 month period. However, it was found by Healy et al. (2012) that an extra six months under a learners licence reduces the crash risk upon graduating to a provisional licence. In the first year after obtaining a provisional licence the crash risk was found to be 30 percent lower, and for the second year the crash risk was 13 percent lower. If this reduced risk is accounted for (using slightly more conservative values) then the casualty crash risk over time for novice drivers can be updated as represented by the blue line in Figure A6.

By utilising the curves from Figure A6 the aggregated casualty crash risk for a novice driver post April 2009 was determined to be 0.77 times that of a novice driver prior to April 2009. Baseline casualties that involved a driver on a provisional licence and occurred prior to April 2009 can be modelled into the future by adjusting for this aggregated difference in risk.

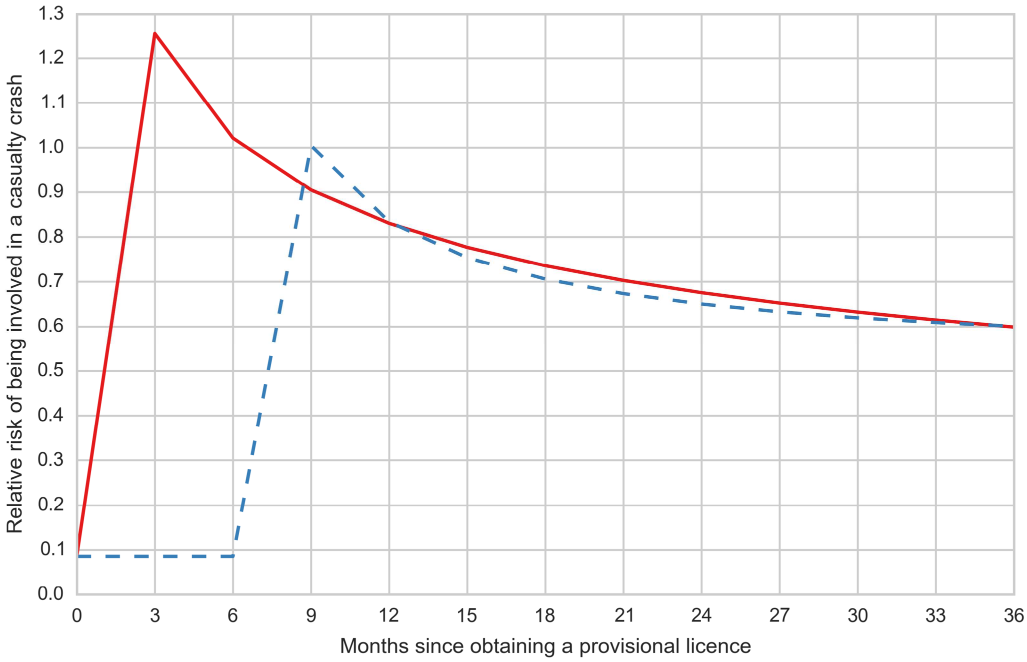

Figure A6
The relative risk of a novice driver being involved in a casualty crash based on the time since obtaining a provisional licence (red line) and the adjusted effect of spending an extra 6 months on a learner licence (blue line)

Changes to the speed limit on unsealed roads

In February 2014 the speed limit on unsealed rural roads in Tasmania was reduced from 100 km/h to 80 km/h. While it is not possible to precisely quantify the effect of this particular speed limit reduction (100 km/h to 80 km/h on unsealed roads), various studies from Australia and overseas have investigated the effects of lowering speed limits (Mackenzie et al., 2015; De Pauw et al., 2014; Elvik, 2013; Bhatngar et al., 2010; Kloeden et al., 2001, 2002, 2007; Sliogeris, 1992). Based on the findings of these studies, a conservative crash risk reduction of 30 percent was used in the model.

Changes to speed limits

As above, the effect of speed limit reductions was based on the findings of previous studies (Mackenzie et al., 2015; De Pauw et al., 2014; Elvik, 2013; Bhatngar et al., 2010; Kloeden et al., 2001, 2002, 2007; Sliogeris, 1992). Reductions from 110 km/h to 100 km/h and 60 km/h to 50 km/h were conservatively predicted to result in a 20 percent reduction in crash risk.

GLS changes

The casualties that would be avoided by implementing each of three initiatives were identified; P1 licence at 18 years of age, passenger restrictions, and a night time driving curfew. For example, casualties that resulted from a crash that occurred at 3am and involved a driver with a P1 licence would not have occurred (in most circumstances) if a curfew was implemented.

While most of these identified casualties would be avoided, there are several scenarios in which a crash (and thus the casualties) might still occur. For example a novice driver may choose not to comply with the restrictions or may have an exemption from the restrictions for work purposes. To account for these circumstances in the model a compliance rate of 80 percent was assumed, leaving a residual risk of 20 percent.

Reduction in the age of the fleet

The age of each of the vehicles in the modelled years was reduced by 5, 10, or 15 percent. A new crash risk was then calculated as described above in the section on changes in safety of vehicle over time.

Potential for improvement in infrastructure

The typical reduction in casualties resulting from the implementation of several major infrastructure countermeasures was investigated. Fatal and serious casualty reductions were identified (where possible) for the five most common types of crash, as shown in Table A.1 below (Austroads, 2010; 2015a; 2015b; Carlsson, 2009; Pratt et al., 2015; Ray et al., 2009; Washington State Department of Transport, 2009).

The large scale implementation of these infrastructure countermeasures was modelled by applying these reduction factors to the relevant baseline casualties. This provided an estimate for the effect of each infrastructure countermeasure. The effects were limited to specific road categories where these types of infrastructure treatments might be implemented. However, it should be noted that this modelling did not account for what infrastructure may already have been implemented.

Table A.1
The effect of infrastructure countermeasures on casualties resulting from various crash types

Area	Countermeasure	Reduction in fatal and serious casualties in crash type				
		Head on	Off left	Off right	Right turn	Right angle
Mid-block	Centreline barrier	80%	15%	80%	-	-
	Wide centreline	65%	-	65%	-	-
	2 + 1	90%	60%	60%	-	-
	Sealed shoulders	40%	40%	40%	-	-
	Audio-tactile line marking	-	30%	30%	-	-
Intersection	Roundabouts	70%	-	-	70%	70%
	No right turn	-	-	-	50%	-
	Right turn lanes	20%	-	-	20%	20%
	Plateaus	40%	-	-	40%	40%
	Grade separation	100%	-	-	100%	100%

Optimization infrastructure spending

A number of infrastructure treatment options were considered and the choice of which treatments to use was optimized in order to maximize safety benefit (a reduction in casualties). The safety benefit of each treatment is shown in comparison to a standard treatment type; for midblock and intersections treatments, the standard treatments used for comparison are shoulder widening and sealing and the installation of right turn lanes, respectively. For example, for the same budget the installation of plateaus has an ability to reduce casualties by about six times more than that of right turn lanes, and thus the safety benefit of plateaus is six. When calculating the safety benefit of each treatment, the following procedure was used:

- Infrastructure unit costs for each kilometre (midblock treatments) or site (intersection treatments) were used.
- Trunk (Cat I), regional freight (Cat II) and regional access (Cat III) roads were considered when calculating the total number of intersections and total length of roads.
- Casualty reduction potentials for each treatment were based on the modelling performed in Section 3.8. Unit casualty reduction potentials for each treatment were calculated as the expected reduction in casualties per treated intersection or treated kilometre of road.
- Casualty reduction potentials per dollar were calculated using unit costs and unit casualty reduction potentials.
- The safety benefit of each treatment was calculated as the casualty reduction potential per dollar multiplied by the infrastructure budget.

Appendix B – National road safety priority areas

The following is an excerpt from the Austroads (2014) review of the National Road Safety Strategy:

Thirteen priority areas were identified for which more emphasis is recommended because of changing crash patterns or a real or perceived lack of activity. The priority areas are not intended to replace the content of the 2011 strategy but are aimed at supplementing both the strategy commentary and associated action agendas.

Vulnerable Road Users

The Safe System philosophy for vulnerable road users is not as well developed as for vehicle occupants. This has been found to be true nationally and internationally, with even leading countries such as Sweden increasing their focus on vulnerable road users. The main finding of the recent review of road safety from the International Transport Forum was that vulnerable road users are receiving smaller benefits from recent road safety improvements than vehicle occupants.

The analysis of fatal crashes in Australia from 2008-13 showed the same pattern as internationally, with vehicle occupants accounting for most of the reduction in fatalities. There was almost no change in total fatalities involving vulnerable road users, with fatalities of motorcyclists and cyclists rising over the period. The analysis of hospital separations data found a much higher proportion of road-related injuries involving motorcycling and cycling than shown by the police-collected data. It also showed that injury cases among these road user types are increasing.

Motorcycling exposure has grown since 2008 with a sharp increase in vehicle kilometres travelled relative to other motorised vehicles. Cycling exposure is also thought to be increasing rapidly although there is no reliable measure. These relative increases in exposure would be expected to account for some of the difference between road user types, together with cyclists and motorcyclists not gaining the benefit from increased vehicle crashworthiness.

The “First Steps” and “Future Steps” agendas include some actions to assist vulnerable road users including improved infrastructure, lower speed limits, vehicle regulations and the development of a GLS for motorcyclists. These could be expanded and strengthened in the next action plan.

A number of infrastructure improvements have been shown to improve safety for vulnerable road users; these include improved pedestrian crossings, cyclist friendly intersection design, separation of bicycles and motor vehicles and improved road surfaces. There is also evidence that pedestrian safety would be enhanced by the rapid introduction of forward collision avoidance systems such as Autonomous Emergency Braking (AEB).

With the encouragement of active travel modes it is expected that walking and cycling will continue to increase. Both the safety and amenity provided to cyclists could be improved by better cooperation between road safety professionals and urban planners.

There is also a need for research to better understand what constitutes a Safe System for vulnerable road users. Although pedestrians, cyclists and motorcyclists are often grouped together as vulnerable road users, the three modes demonstrate different crash patterns and have different requirements of a Safe System.

Older Road Users

Fatalities of older road users are reducing at a slower rate than road user fatalities overall and particularly compared with younger road users. This is true for the total number of deaths and deaths per 100,000 people. The differences are likely to be related, in some part at least, to changing driving patterns of older people, with research showing people are driving further and into older ages and that this is increasingly applying to both males and females. It is also possible that the difference between older and younger drivers is related to road safety measures such as enhanced GLS systems that have targeted younger drivers. The vehicles driven by the different groups could also be a factor, as younger drivers, who generally drive older cars, would have only recently started to benefit from the improvements in crashworthiness that began over 15 years ago.

The current First and Future Steps agendas, which concentrate on understanding fitness to drive and alternative mobility options, need to continue and be complemented by measures to make the road system safer for older road users.

Research indicates that older drivers can benefit from receiving better information regarding vehicle choice, and a range of infrastructure changes has been recommended to assist older drivers. These changes address basic failures to provide a Safe System and so will be of benefit to all drivers.

Indigenous Road Users

While various initiatives have been undertaken to address the disproportionate risk faced by Indigenous Australians on the road, there is continued concern about inequitable outcomes. A relatively large proportion of Indigenous Australians live in remote and very remote regions, and so the overall impact of the higher rates experienced by residents of remote areas is greater for Indigenous than other Australians.

Patterns of road injury events differ between Indigenous and non-Indigenous road users including higher rates of injury as a motor vehicle passenger (not a driver) and as a pedestrian.

Institutions such as Aboriginal community-controlled health services may be appropriate avenues for road safety interventions specifically directed to Indigenous individuals and communities.

National Indigenous Road Safety Forums were held every two years from 2002 to 2010. The five forums were convened by the Commonwealth Department of Infrastructure and Regional Development. Re-establishing the Forums would provide a valuable opportunity for the limited number of people working in this area to consult and share experiences.

The 2010 Indigenous Road Safety Forum recommended a fund for Indigenous road safety projects that produce measurable change, sustainability and capacity for replication in other settings.

Speed Management

Speed management is a core component of a Safe System and remains the best opportunity for a rapid reduction in road trauma. Since 2011 some attempts at implementing safer speed limits have been made, however only limited progress has been made on major urban and rural arterial roads. The critical role of speed in the Safe System was recognised by the strategy and Safe Speeds was treated as a cornerstone area.

The stakeholder consultation suggested further exploration of technological solutions to speed management, including extending the use of Intelligent Speed Adaption (ISA). It was also suggested that national approaches to speed management and speed-related media campaigns be adopted. These items were also listed in the "First Steps" agenda.

The actions from the First and Future Steps agendas could be pursued more vigorously on rural arterial roads and also address reducing speed limits on rural local government roads.

Remote Areas

The data analysis has shown that deaths are reducing at a slower rate on rural and remote roads than in urban areas. Remote areas present a particular challenge; low volumes mean investment in infrastructure on these roads is always going to be given a low priority by traditional assessment methods and traditional enforcement is unlikely to be effective given the vast distances, extremely limited enforcement resources and infrequency of vehicles.

In time, vehicle safety technology may be the most effective countermeasure for remote areas where single vehicle road departures are a significant issue. The increasing use of Electronic Stability Control (ESC), for example, would be expected to result in a reduction in loss of control crashes in these areas. Unfortunately new technology takes considerable time to be taken up by the majority of the fleet, and those most at risk, such as young drivers in remote areas, are likely to be amongst the last to receive the benefits.

Stakeholders suggested development of a separate remote area strategy following the Western Australian model from 2009. This would need to include the potential of vehicle technologies and low cost infrastructure solutions that address core Safe System issues. As a first step, the challenges of remote area road safety need to be acknowledged in the action plan.

Vehicle Safety

Improvements to vehicles have been a major contributor to trauma reductions for over 15 years through developments in crashworthiness and occupant protection. These improvements will continue to deliver trauma reductions throughout the life of the strategy as more and more new vehicles achieve high safety standards and the older vehicles driven by the most at risk drivers improve over time.

New technologies are now being developed to assist in crash avoidance as well as occupant protection but these are likely to have most impact in trauma reductions as part of the next national road safety strategy. AEB holds the most potential and will also benefit vulnerable road users.

ISA appears to have the second highest potential to prevent crashes after AEB. The availability of accurate and reliable digital speed maps remains a challenge for the deployment of ISA in Australia, although in 2014 New South Wales made their map available via a smartphone application.

A rapid take up of technologies into the vehicle fleet will bring forward the benefits of these technologies. The Australian automotive market is characterised by low entry barriers and a high level of competition. The resultant strong competition means that regulation, plus good, easily understood consumer information is vital to ensure the safety of vehicles and to promote vehicle choice based on issues other than price.

Cooperative ITS

There have been considerable developments in Intelligent Transport Systems (ITS) since 2011. Most significant has been the imminent feasibility of connected vehicle solutions, otherwise known as Cooperative Intelligent Transport Systems (C-ITS), which have the potential to significantly improve road safety. Research and technical capacity exists within Australia but there is no clear path to implementation and a variety of approaches and operation scenarios are possible.

There is a high level of confidence that V2V and V2I technologies can deliver considerable safety benefits. While V2V has no dependence on the surrounding infrastructure, it requires both vehicles to have the technology in order to avoid the crash.

Although ITS was mentioned in the NRSS, the rapid changes since 2011 mean that the area needs to be revisited. The action plan needs to be aligned with the Austroads C-ITS Strategic Plan to ensure that a safety perspective guides major policy positions. Given the potential paradigm shift in traffic management possible with C-ITS, it would be a missed opportunity if solutions were primarily based on traffic efficiency.

Communication Strategies

Communication of road safety messages is essential in gaining support for road safety initiatives. All jurisdictions face similar challenges in communicating Safe System principles and shifting community perceptions in favour of interventions that will work. The literature review found some innovative and promising communication campaigns, reflecting a variety of approaches. The cooperative development of resources and guidelines to assist jurisdictions in communication activities could be part of the action plan.

Monitoring Serious Injuries and Crashes

Road safety has long relied upon road fatality counts as the main outcome indicator. It has been recognised that this provides an incomplete basis for planning and monitoring because initiatives directed at reducing deaths are not necessarily effective at reducing other harm, particularly persisting disability.

Measurement of serious road injury is necessary because of the large numbers of cases, the substantial burden of disability resulting from many of the cases, and the differences in trends and other aspects of the data between fatalities and serious injuries.

The measurement and monitoring of serious injuries is a complex issue, and improving the availability and reliability of data needs to be a priority of the next action plan. The Road Safety Committee of the Parliament of Victoria has recently published the report of its extensive investigation into measuring serious road injury. The findings and recommendations provide guidance on the steps needed to establish useful measures of serious road related injuries.

Infrastructure Investment

There is support for both increased infrastructure investment and modified targeting of the available funds, including increased investment to address trauma on country roads, and trauma facing vulnerable road users on urban roads. The analytical tools Australian Road Assessment Program (AusRAP) and Australian National Risk Assessment Model (ANRAM) offer considerable potential to provide a better focus for investment.

The “First Steps” agenda includes recommendations to increase safety related funding and change the priorities for infrastructure investment. The “Future Steps” agenda is focussed on more specific infrastructure treatments, such as facilities to assist cyclists and motorcyclists and low cost treatments on rural roads. These actions are still relevant to the new action plan and a study to establish best safety management practices and processes for prioritising and developing infrastructure projects may be useful in completing some of these actions. There has been support for resetting the socioeconomic value used in the appraisal of transport projects to better reflect community demand for road safety, through the Willingness to Pay (WTP) approach adopted by many countries around the world. The New South Wales WTP measure still represents the most appropriate national measure until a full national study is conducted. It is noted that the Victorian Parliamentary Road Safety Committee, in the report on its Inquiry into Serious Injury, did not support the step towards applying WTP values. The Victorian Government has yet to respond to this report.

Coordination with Urban Planning

Although fatal crashes are reducing in urban areas there is still a major problem with serious injury crashes. The planning context within which towns and cities are managed will play an important role in determining the extent to which these injuries are reduced, particularly in relation to encouraging active travel and injuries to vulnerable road users.

The recent Victorian Parliamentary Road Safety Committee Inquiry into Serious Injury highlighted the issue of bringing together urban planning and road safety. That committee noted the absence of a link to road safety in city plans and to urban planning in road safety strategies. The report considered active engagement of road safety with planning to be essential in encouraging increased use of active transport modes. The inquiry also endorsed the Organisation for Economic Co-operation and Development (OECD) recommendation that a functional road hierarchy catering for all modes is fundamental to producing a Safe System urban design.

There are clear indications of the need for engagement between safety, transport planning and urban design professionals but there has been limited success in making this happen. The Dutch Sustainable Safety approach has had some success and this is being extended, with regional governments in the Netherlands providing specific resources to make sure this engagement happens with transport policy and urban planning professionals.

Workplace Road Safety

Work-related road crashes in Australia account for about half of all occupational fatalities and a significant proportion of all road-related fatalities. Despite the road being the dominant setting for occupational fatalities, not all government agencies with occupational safety and health responsibilities identify work-related road trauma as an occupational safety priority.

Employers and fleet managers have a pivotal role in the composition of the vehicle fleet and influence the safety of very high volumes of trips each day, therefore playing an important role in the safety of the road transport system as a whole.

Workplace road safety was identified as an issue to be addressed in the way forward for the National Road Safety Strategy but was not specifically included in the First or Future Steps agendas.

Engagement with occupational safety and health agencies is important and could build on the progress of the National Road Safety Partnership Program (NRSPP). There is still an unclear picture of the scale of work-related road trauma. Incorporating purpose of trip data in crash reports could be considered to provide a more complete picture of this significant issue.

National Leadership

Internationally, road safety management is a growing focus of attention as various institutions and jurisdictions recognise that the limits to improved road safety performance are, in part, shaped by the capacity of the road safety management system operating in a country.

Many stakeholders thought that the accountability for road safety is unclear and does not assist the leadership task. Improvement in institutional structures, capacities and delivery arrangements at a national level were identified as part of the “First Steps” agenda. Governance arrangements for road safety under the Transport and Infrastructure Council have been modified in the last two years to improve national oversight and coordination of the NRSS and provision of policy advice to Commonwealth, state and territory governments.

A review of governance and management arrangements for road safety could be considered to assist subsequent decision-making. Internationally, a common tool for addressing these matters is a road safety management capacity review and this methodology (or aspects of it) would be useful.

There was also concern about a lack of engagement in the implementation of the NRSS. Many of the non-government stakeholders referred to a lack of engagement on the national road safety issue. Consideration could be given to establishing and formalising a strong stakeholder engagement process.

For further enquiries

Centre for Automotive Safety Research
The University of Adelaide
SA 5005 Australia

Telephone: +61 8 8313 5997
Facsimile: +61 8 8232 4995
Email: casr@adelaide.edu.au

casr.adelaide.edu.au