



# **Safer journeys for motorcycling on New Zealand roads**

DRAFT for consultation  
December 2011

## Foreword



The disproportionate number of crashes involving motorcycles is one of the reasons why the government's road safety strategy, Safer Journeys, has prioritised motorcycling safety on our roads.

The statistics tell a sobering story about the safety risks associated with motorcycling. Crashes involving motorcycles are highly disproportionate to the number of kilometres driven on our roads by motorcyclists. For example, the risk of a motorcyclist being killed or seriously injured in New Zealand is 18–20 times higher than that of a car driver. Clearly there is much more that we can do to improve safety for motorcyclists no matter if they are commuting to work or enjoying a weekend ride.

Safer Journeys guides us to make a shift in how we address safety. This strategy introduced the Safe System approach toward road safety – a fundamental shift in how we think about, and act on, road safety. This approach shifts the mindset around crashes from one in which blame is often placed on the road user to one in which we recognise that human error is inevitable and that the road system needs to protect the road user from death or serious injury.

The intent of *Safer journeys for motorcycling* is to help reduce serious injuries and fatalities involving motorcycles on New Zealand roads. This safety guide has been written for use by a variety of audiences, including road controlling authorities, road designers, maintenance crews, motorcyclists and others in the motorcycling sector. It represents the holistic approach to safety called for in Safer Journeys, but it emphasises the safe roads and roadsides pillar of the Safe System approach. This new approach is being tested 'on the ground' in the Coromandel region, with some great work emerging on a high-risk motorcycling route in that area.

The safety guide has been developed with tremendous support and input from many others in the sector, including road controlling authorities, ACC, and MOTO NZ (Motorcyclists Own The Options). The collaboration among all parties has been instrumental in delivering a safety guide that represents the wide range of perspectives needed in order to result in significant safety gains. We value our relationships with the motorcycling sector and are grateful that the active participation from these groups ensures that all points of view are not only considered, but are fundamental in the development of the guide's key recommendations.

We trust this safety guide will be well used and will help to facilitate a shift over time in how motorcycling safety is approached. Importantly, we intend for the guide to be a dynamic document that is updated over time. Making our roads safer for motorcycling will be an ongoing focus for all of us, and we expect that our relationship with the motorcycling sector will continue on this journey. We continue to welcome suggestions and comments, including about what's been working well and what hasn't.

In the meantime, I am encouraged by the results of this shared work thus far and look forward to a continued dialogue and further collaboration in making New Zealand's roads safer for motorcycling.

A handwritten signature in black ink, which appears to read 'Geoff Dangerfield'. The signature is fluid and cursive, written on a white background.

Geoff Dangerfield  
Chief Executive  
NZ Transport Agency

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## Glossary of terms

Term	Definition
3 Es	Engineering, education and enforcement
ATP markings	Audio-tactile profiled markings
Austrroads	National Association of Australian Road Authorities
HRIG	<i>High-risk intersections guide</i>
High-severity crashes	Fatal and serious crashes
Fatal injury	Where death occurs within 30 days as a result of a crash
Harm minimisation speed	Posted speed limit targets that are based on impact speeds at which the chance of a fatal outcome increase rapidly
Harm reduction speed	A posted speed limit based on using a balance between the current speed limit and a harm minimisation speed
HRRRG	<i>High-risk rural roads guide</i>
KAT	KiwiRAP assessment tool
KiwiRAP	The New Zealand joint agency road assessment programme
Minor injuries	Injuries sustained as a result of a crash that is not likely to need a visit to the hospital, eg cuts, sprains, bruises
Moped	Two or three wheeled vehicles and either: <ul style="list-style-type: none"> <li>• has an engine cylinder capacity not exceeding 50cc and a maximum speed not exceeding 50km/h, or</li> <li>• has a power source other than a piston engine and a maximum speed not exceeding 50km/h</li> </ul> <p>Note: additional information of vehicle equipment standards and classifications can be sourced at <a href="http://www.nzta.govt.nz">www.nzta.govt.nz</a></p>
Motorcycle	Two or three wheeled vehicles ( with side car) and either: <ul style="list-style-type: none"> <li>• has an engine cylinder capacity exceeding 50cc, or</li> <li>• has a maximum speed exceeding 50km/h</li> </ul> <p>Note: additional information of vehicle equipment standards and classifications can be sourced at <a href="http://www.nzta.govt.nz">www.nzta.govt.nz</a>.</p>
MoT	Ministry of Transport
NZTA	NZ Transport Agency
OECD	Organisation for Economic Cooperation and Development
Open road	A road which has a derestricted speed limit or where the posted speed limit is 100km/h
PTW	Powered two wheelers
RCA	Road controlling authority
RoNS	Road of national significance

Rural road	In relation to a road, is one having a posted speed limit of > 70km/h. <sup>1</sup> It can be a motorway, state highway, expressway, local road or private road  A rural road can have many forms, eg high volume four lane median divided expressway, two lane undivided and a low volume one lane unsealed road (see section 1.3)
Serious injury	Includes injuries that are likely to involve a visit to the hospital such as broken bones
Speed zone	a posted speed limit based on the driver's 85th percentile operating speed
TA	Territorial authority
Urban road	A road with a speed limit equal to or less than 70km/h <sup>1</sup>

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<sup>1</sup> Note that, for the purposes of the guide and any relevant crash analysis, the definition of a rural road is a road with a posted speed limit of greater than 70km/h. However, in some documents, such as the New Zealand Traffic control devices manual, this has been defined as being 70km/h or more.

# 1 Introduction and objectives

## 1.1 Purpose

*Safer journeys for motorcycling* has been prepared by the NZ Transport Agency (NZTA) to provide guidance on the government's Safer Journeys 2020 strategy initiative to focus efforts on increasing the safety of motorcycling. The key objective of this document is to provide practitioners and policy makers with best practice guidance to identify, target and address key road safety issues on high-risk motorcycle routes. It provides links to a number of road safety resources and guidance for planning, funding and evaluating safety projects and programmes. Specifically, it is intended to provide:

- details of a Safe System approach for motorcycling, including safe roads and roadsides, safe speeds, safe road use and safe vehicles in New Zealand
- identification of key crash issues for motorcyclists
- tools to help identify and analyse high-risk motorcycle routes and motorcycling road safety issues
- a range of countermeasures for key crash types occurring in rural and urban environments, to help develop best-value remedial treatments
- guidance for developing, prioritising and funding road safety infrastructure and speed management programmes
- references to further tools and resources to evaluate implemented countermeasures
- national consistency regarding the identification of motorcycle routes and the application of proven countermeasures.

In addition to this document, the *High-risk rural roads guide* (HRRRG published September 2011) and the *High-risk intersection guide* (HRIG currently under development) could be referenced for more detailed information and recommendations on both high-risk rural routes and urban and high-risk rural intersections.

## 1.2 Scope

This document refers and directly links to the Austroads guides and to a number of appropriate policies, standards and guidelines applicable to New Zealand practice.

This document will support and reference:

- the New Zealand Ministry of Transport's (MoT) *Safer Journeys: New Zealand's road safety strategy 2010-2020* (March 2010)
- the MoT's cross-agency *Safer Journeys action plan 2011-12* (March 2011)
- the NZTA's Road Safety Strategy Plan (December 2010)
- New Zealand legislation and, in particular, the Land Transport Act 1998 and rules made pursuant to that act, including the Land Transport (Road User) Rule, the Land Transport Rule: Traffic Control Devices, and the Land Transport Rule: Setting of Speed Limits
- general policies contained in Austroads guides (guides to traffic management, road design, road safety) and other Austroads technical guides
- New Zealand and, as appropriate, Australian standards codes of practice and guidelines
- published standards of various organisations and authorities.

This document provides rules, standards and guidance on measures to improve safety on high-risk motorcycling routes. However, practitioners must always apply sound judgement when identifying and installing any countermeasures to ensure the best possible safety outcomes. Any departures from recommended practice must be supported by documentation of the principles behind the departures.

## 1.3 Definitions

For the purposes of using this document:

- a rural road is a road with a speed limit of 70km/h<sup>2</sup> or more. It can be a motorway, state highway, expressway, local road or private road
- a rural road can have many forms ranging from a high volume four-lane median divided expressway, a two-lane undivided and a low volume one-lane unsealed road as shown in the photos below



- an urban road is a road with a speed limit of 70km/h or less
- a high-risk motorcycle route<sup>3</sup> is either a
  - a rural road where the injury crash density (collective risk) is high or medium-high compared with other roads as defined in section 4 or
  - an urban road where the injury crash density (collective risk) is high or medium-high compared with other roads. Note that it has been recognised that further analysis and consistency between the high-risk intersection guide is needed prior to confirming and then describing a high-risk urban intersection or site. (See comment box in section 4.4.1.)

For rural areas, collective crash risk, medium-high and high define the route as a high-risk motorcycle route, subject to having at least two or more motorcycle injury crashes over a five-year period or four or more motorcycle injury crashes over a 10-year period.

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<sup>2</sup> Note that, for the purposes of this document and any relevant crash analysis, the definition of a rural road is a road with a posted speed limit of 80km/h or more. However, in some documents, such as the NZ Transport Agency's *Traffic control devices manual*, this has been defined as being 70km/h or more.

<sup>3</sup> A high-risk motorcycle route identified as high-risk through this document may not necessarily meet the requirements for a high strategic fit in the Investment and Revenue Strategy for funding purposes. Refer section 4.4.1.

## 1.4 Target audience

The principles presented here are relevant to both state highway and territorial local authorities (TLA) for both urban and rural road networks. This document is intended to provide guidance to:

- RCAs
- state highway and local roads engineers
- planners
- funders
- policy makers.
- motorcyclists
- road system designers.

It may also be useful to other industry practitioners, developers and private landowners when they would like to identify road safety risks and develop appropriate risk-reducing measures.

## 1.5 Risk management, communication and engagement

The objective of this document is to reduce motorcycle crashes on NZ roads as defined by the Safer Journeys strategy. The term 'high-risk motorcycle route' takes into account both consequence and likelihood of crashes occurring.

In defining a high-risk or favoured motorcycling route, this document provides a mixture of information (section 4) ranging from providing sources where favoured motorcycle routes can be found and the methodology to assist RCAs in risk identification (such as those calculations and charts provided for local roads to determine high-risk routes etc).

Communication, consultation and engagement are some of the most important components of risk management and should be considered at all stages of the process. For example, in using the high-risk motorcycle route definitions further, risk identification may be through local and national motorcycling groups/organisations, public feedback, RTA, high volume road users, AA and emergency services. Further information on effective engagement with key stakeholders can be found in section 7.3. In using this feedback we should therefore also determine whether that level of perceived risk matches the actual or potential risk through the use of crash and road data. Once routes or sites have been determined, further consultation can be undertaken with the community and road user groups on better understanding the risks and the best methods of addressing these. This is explained further in sections 6 and 7.

The user of this document should document the identification, analysis, treatment and monitoring process for high-risk motorcycle routes. This record provides the right level of information for the decision maker and the person responsible for taking action.

Further information on risk management, communication and consultation and recording the risk management process can be sourced from AS/NZA ISO31000: 2009 *Risk management: Principles and guidelines* and chapters 3 and 9 of SAA/SNZ HB 436:2004 *Risk management guidelines*.

## 2 Strategic context

### 2.1 Safer Journeys: Road safety strategy 2010

The New Zealand government released its Safer Journeys strategy in March 2010. Safer Journeys is a national strategy to guide improvements in road safety over the period 2010 to 2020. The strategy sets out a long-term vision for New Zealand of 'a safe road system increasingly free of death and serious injury'.<sup>4</sup>

To support the vision, Safer Journeys introduces, for the first time in New Zealand, a Safe System approach to road safety (section 2.2).

Safer Journeys also lists a number of key initiatives that have been identified as having the greatest impact on road trauma. These initiatives will be implemented through a series of action plans relating to safe roads and roadsides, safe speeds, safe road use and safe vehicles.

### 2.2 Safe System

The Safe System approach under Safer Journeys represents a fundamental shift in the way New Zealanders think about road safety. It works on the principle that it is not acceptable for a road user to be killed or seriously injured if they are involved in a crash. The Safe System approach also acknowledges that road users are fallible and will continue to make mistakes.

The four key goals of the Safe System are to ultimately achieve:

- safe roads and roadsides that are predictable and forgiving of mistakes - their design should encourage appropriate road user behaviour and speeds
- safe speeds that suit the function and level of safety of the road - road users understand and comply with speed limits and drive to the conditions
- safe vehicles that help prevent crashes and protect road users from crash forces that cause death and serious injury
- safe road use that ensures road users are skilled, competent, alert and unimpaired and people comply with road rules, choose safer vehicles, take steps to improve safety and demand safety improvements.

#### 2.2.1 Safe System principles

A Safe System approach to road safety represents a fundamental shift in the way New Zealanders think about road safety. It works on the principle that it is not acceptable for a road user to be killed or seriously injured if they are involved in a crash. The Safe System approach also acknowledges that road users are fallible and will continue to make mistakes.

Scandinavian research<sup>4</sup> indicates that, even if all road users complied with all road rules, fatalities would only fall by around 50% and serious crashes by 30%. Putting this in a New Zealand context, if everybody obeyed all the road rules, there would still be around 200 road deaths each year (based on present fatalities).

The traditional 3 Es approach to road safety (engineering, education and enforcement) has helped achieve our current levels of road safety and these elements remain important. However, the 3 Es approach tends to blame and try to correct the road user. Continuing with this approach will not achieve the desired gains in road safety in New Zealand. A Safe System approach recognises the need for system designers and road users to share responsibility, with the ultimate aim of protecting road users from death and serious injury.

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<sup>4</sup> Safer Journeys: New Zealand's road safety strategy 2010–2020. Ministry of Transport, 2010.

The Safe System approach is about acknowledging that:

1. Human beings make mistakes and crashes are inevitable	However, the current consequences of those mistakes and crashes should not be regarded as acceptable. A Safe System aims to reduce the likelihood of crashes with a focus on removing the potential for death or serious injury.
2. The human body has a limited ability to withstand crash forces	The human body has a limited tolerance to crash forces. A Safe System aims to manage the magnitude of crash forces on the human body to remove the potential for death or serious injury. (Refer to figure 2-1.)
3. System designers and road users must all share responsibility for managing crash forces to a level that does not result in death or serious injury	The aim of the system designer is to deliver a predictable (self-explaining) road environment to the road user that is also forgiving of mistakes. The Safe System relies on the principle of shared responsibility between system designers and road users. System designers include planners, engineers, policy makers, educators, enforcement officers, vehicle importers, suppliers, utility providers, insurers, etc.
4. It will take a whole-of-system approach to implement the Safe System in New Zealand	Everyone plays a part in providing a safe transport system. Road designers will design safe roads and roadsides that will encourage safe behaviour and be forgiving of human error. Vehicle technology (safe vehicles) will vastly improve communication with the road environment to ensure appropriate speeds that respond to real-time conditions (safe speeds). Road users need to understand and play their part in the system, including an acceptance of the skills required to get a driver licence as well as maintaining their vehicles to appropriate standards.

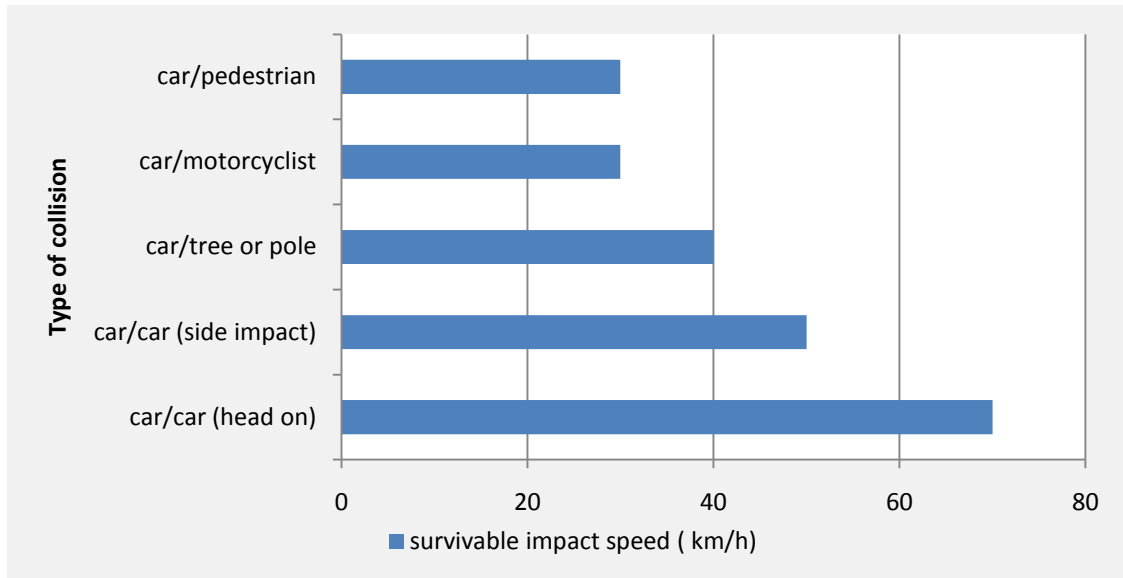
## 2.2.2 Human tolerance to physical force

The fundamental principle of a Safe System is the relationship between road users, vehicles, speeds and road infrastructure, and how much force the human body can withstand when each of these four elements interacts in the event of a crash. The OECD<sup>5</sup> states that ‘the human body’s tolerance to physical force is at the centre of the Safe System approach’. In addition, the Australian *National road safety strategy 2011–2020* states that ‘the chances of surviving a crash decrease rapidly above certain impact speeds, depending on the nature of the collision’. This is illustrated in figure 2-1, which presents the risk of a fatality occurring as a result of five key crash types. A collision for a motorcyclist with a car has a survivable impact speed of 30km/h which is significantly lower than the current operating speed for motorcycles or vehicles on rural roads.

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<sup>5</sup> *Towards Zero: Ambitious Targets and Safe System Approach*, OECD, 2008

Figure 2-1: Survivable impact speeds for different scenarios



Note: The range of impact speeds for each crash type is considered to be survivable in most cases.

The OECD<sup>5</sup> recognises that safe speeds are paramount in achieving a Safe System. However, achieving operating speeds that are safe speeds (figure 2-1), particularly on rural roads throughout New Zealand, will in some cases adversely affect transport efficiency. Other measures, such as reducing roadside obstacles and protecting all road users from collisions would be needed to reduce crash severity where safe speed thresholds cannot be appropriately provided. The need to balance efficiency desires and safety often leads to a harm reduction philosophy as opposed to more rigid harm minimisation philosophies.



Figure 2-2: The Safe System

## HOW IS THE SAFE SYSTEM APPROACH DIFFERENT?

Source: www.motorcycle-usa.com

When a motorcyclist travelling on a rural road in wet weather loses control on a bend, a crash into a solid roadside object such as a power pole is likely to result in death.

### UNDER A SAFE SYSTEM

The road user has a much lower risk of death or suffering serious injury because:



- motorcycles will increasingly have advanced safety features, including anti lock braking and electronic stability control (ESC)
- road surfaces will be improved and roadside objects removed or barriers installed
- speed is managed to safe levels through more appropriate speed limits, self-explaining roads that encourage safe speeds and devices such as intelligent speed assist
- road users are alert and aware of the risks and drive to the conditions.

## 2.2.3 Safe System components

Under a Safe System, designers create and operate a transport system where road users who are alert and compliant are protected from death and serious injury. The four key components of a Safe System are illustrated in Figure 2-2 and include:

- safe roads and roadsides that are predictable and forgiving of mistakes – their design should encourage appropriate road user behaviour and speeds
- safe speeds that suit the function and level of safety of the road – road users understand and comply with speed limits and drive to the conditions
- safe vehicles that help prevent crashes and protect road users from crash forces that cause death and serious injury
- safe road use that ensures road users are skilled, competent, alert and unimpaired and people comply with road rules, choose safer vehicles, take steps to improve safety and demand safety improvements.



Figure 2-2 Safe System Components:

## 2.2.4 Safe System in a motorcycling context

There are some differences when considering applying a Safe System approach in regards to motorcyclists, high-risk and favoured routes.

F. E. Holgate<sup>6</sup> states that 'In the case of motorcycles, a safe system could be achieved in three ways:

<sup>6</sup> Holgate F. E. Motorcycling and the safer system – an international perspective. Vicroads, 2011.

- Limiting travel to roads where there is segregation from heavier vehicles or where the travel speeds of these vehicles, and motorcyclists is below a survivable limit – probably or the order of 40-50km/h with current protective technologies.
- Improving vehicle, protective equipment and roadside performance to increase the speed at which collisions are survivable.
- Improving technology so that rider errors do not result in a crash occurring.

For all three of these, the gaps between current performance (constrained by technology and community acceptance) are significant, such that for many years, motorcycle safety will need to be focused on risk reduction. The Safe System model provides a means to understand the problem and derive tools to facilitate this risk reduction.'

While all these factors could achieve a Safe System, a level of practicality or achievability should be considered. Given the road infrastructure in New Zealand it will be difficult to achieve segregation of other vehicles on motorcycle routes and lowering speed limits to survivable limits (harm minimisation speeds) may not be acceptable to the community, a balance of less extreme options (such as harm reduction speeds) could be sought.

Holgate states further that:

- 'in the short to medium term , motorcycling will remain an inherently risky activity, and
- that measures should be taken to reduce risk wherever they will be most effective rather than following the pure Safe System approach, and
- that the most significant gains may derive from attention ...to error and crash avoidance, rather than mitigating their effects, and
- that strategies should not ignore the opportunities...to (promote) improved protective clothing and equipment.'

## 2.3 Key Safer Journeys initiatives

### 2.3.1 Introduction

The recent rise in popularity of motorcycle and moped use is likely to continue. Without a focus on the safety of motorcyclists, this could mean motorcycle injuries continue to increase. 'The risk of a motorcyclist being killed or seriously injured is about 18 times higher than for a car driver'<sup>4</sup>. This is why the Safer Journeys strategy contains a number of actions listed under the four pillars, including:

- safe road use initiatives outlined in section 2.3.2
- safer roads and roadsides which through their outcomes are likely to reduce motorcycle crashes and injury severity. These are discussed in section 2.3.3
- some guidance and reference provided on a number of speed management initiatives presented under the safe speeds plan, which through their outcomes are likely to reduce motorcycle crashes and injury severity. Speed management is an important tool for improving the safety of motorcyclists on high-risk roads (both urban and rural) and is therefore included in this document, alongside typical improvement measures for common issues. This is discussed further in section 2.3.4
- safe vehicle use actions outlined in section 2.3.5.

The aim of the Safer Journeys strategy is that by 2020 'to increase the safety of motorcycling by reducing the road fatality rate of motorcycle and moped riders from 12 per 100,000 population to a rate similar to that of the best performing Australian state, Victoria, which is 8 per 100,000'.

## 2.3.2 Safe road use

Responsible road use is a key component of the Safe System and particularly relates to motorcyclists. Motorcycle riding requires quite different vehicle control and cognitive driving to car driving. The potential outcomes of any crash, whether caused by the rider, other road users, the road environment or the vehicle itself, are more severe for motorcyclists<sup>4</sup>.

This document provides guidance on the safe road use plan with a particular focus on:

- implementing regulatory changes and improving motorcycle training
- engaging motorcyclists
- implementing safety treatments on high risk motorcycle routes
- motorcycle focused enforcement.

## 2.3.3 Safe roads and roadsides

We know how to make our roads safer. Engineering solutions such as median barriers, skid-resistant surfaces, forgiving roadsides, separate cycle lanes and intersections have a proven track record.<sup>4</sup> Although these types of measures are not solely related to reducing both the number and severity of motorcycle crashes, they will still provide an enormous overall benefit. Some of the roads and roadsides actions that will assist in this are:

- targeting high-risk motorcycle routes and high-risk urban intersections
- progress Safe System demonstration projects, and
- Design, build and maintain roads of national significance (RoNs).

The greatest safety gains on high-risk motorcycle routes are expected to be achieved by focusing on reducing injury outcomes and providing forgiving roadsides. This approach is also consistent with the Safer Journeys long-term vision of:

**'A safe road system increasingly free of death and serious injury.'**

A fatal and serious motorcycle crash is equally likely to occur in an urban area as it is in a rural area. However, the types of crashes are somewhat different. For example, in rural areas 42% of high severity crashes are loss of control type movements and in urban areas, 41 % of high severity crashes are made up of the three specific intersection movements. They are right turn off main road, right turn from a side road and at an X junction when both vehicles are travelling straight through.

Detailed information on these crash types, for both urban and rural roads, is included in section 3.

The NZTA and local government need to ensure that road safety efforts focus on these key areas to help achieve safe roads and roadsides.

Although motorcyclists travel at higher speeds than 'typical' vulnerable road users, they are still at high risk of severity of injury. On some routes, this may be higher and any treatments proposed should recognise their vulnerability.

## 2.3.4 Safe speeds

The focus detailed in the *Safer Journeys action plan 2011-2012* is on helping people to drive to the conditions and encouraging them to comply with safe speed limits. Road users need to understand how their decisions about travel speeds affect them and others.<sup>4</sup>

This document provides guidance on the following Safer Journeys safe speed actions 2011-2012 could assist with reducing motorcycle crashes and severity. These are:

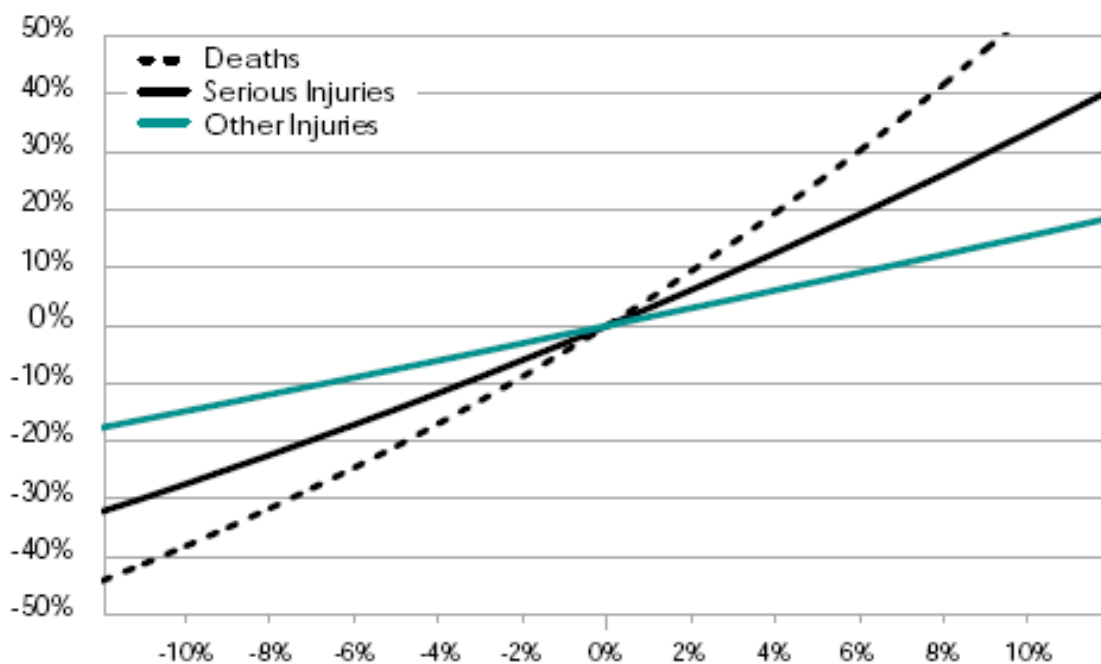
- creating more speed zones on high-risk motorcycle routes to help make roads more self explaining, and to establish criteria for what roads with different speed limits should look like
- public campaigns to achieve acceptance of safe speeds

- creating speed limits that reflect a Safe System approach
- increasing the use of speed cameras.

Safe speeds are closely linked to safe roads and roadsides – especially for rural road and highway networks. This document describes how safe speeds can be achieved to complement safe roads and roadsides in order to improve safety for all road users. Appropriate speed management related countermeasures are proposed that relate to all aspects of the Safe System, ie safe roads and roadsides, safe road use, safe speeds and safe vehicles.

‘The likelihood of being involved in a serious casualty crash rises significantly with even minor changes in travelling speed (figure 2-3). For example; Australian research has shown that the risk of a serious casualty crash doubles with just a 5km/h speed increase on 60km/h urban roads or with a 10km/h increase on rural highways.’ Australian Transport Council. *National road safety strategy 2011-2020*.

**Figure 2-3: Relationship between change of mean speed and crashes**



The default speed limit on New Zealand open/rural roads is 100km/h and it is generally applied to all rural roads with only limited exceptions. A more suitable speed limit for these roads might in future be one that more closely matches the use and function of roads and their present safety features. The NZTA is encouraging the implementation of demonstration safer speed areas<sup>7</sup> for roads on which the default speed limit is inappropriate. Harm minimisation and harm reduction speeds used within Safe System approach to reduce high-severity crashes are further described within the NZTA high-risk rural roads guide.

<sup>7</sup> Under the *Safer Journeys action plan 2011-2012*, the NZTA and local government are responsible for delivering the following: ‘Ensure the uptake of effective safe speed limits in high-risk ... rural areas, including implementation of demonstration areas as part of Safe System demonstration projects’. ‘Demonstration’ rural safer speed areas will help inform how implementing effective safer speed limits can best be accomplished, what problems may occur and how to effectively communicate with road users. Safer speed area demonstration projects will be appropriate to the many areas in New Zealand where it is not possible to economically justify improved infrastructure to enable safe ‘high’ travel speeds.

### 2.3.5 Safe vehicles

The action plan for safe vehicles includes a plan to increase public awareness and demand for safer light vehicles and promote advanced features such as collision avoidance technology. While not a direct improvement to motorcyclists, this would assist in overall crash reduction. The safe road user action plan outlines the importance of promoting existing and new technologies such as anti-lock brakes, airbags and advanced protected clothing for motorcyclists.

Note for comment: More information on emerging technology in the Safe Vehicle space is forthcoming.

## 2.4 No surprises environment

Austrroads part 15; *Guide to traffic engineering practice - Motorcycle safety* (now superseded by a number of other Austrroads guides) described what a safe road environment is and what it should provide to all road users. In summary:

A safe road environment should:

- WARN the road user of any substandard or unusual features
- INFORM the road users of conditions to be encountered
- GUIDE the road user through unusual road sections
- CONTROL the road user's passage through conflict points or conflict sections
- FORGIVE the road user's errant or inappropriate behaviour (providing forgiving roads and roadsides for them under a Safe System - section 0).

And therefore a safe road environment should provide:

- no surprises in road design or traffic control
- a controlled release of relevant information (the design matches information processing abilities)
- repeated information where necessary to emphasise risk.

## 2.5 Investment framework

The *Government policy statement on land transport funding 2012* (GPS), covering the period 2012/13 to 2021/22, has a stronger safety focus than the previous GPS, with its priorities being road safety, value for money and economic growth and productivity improvement. While no specific safety funding activity class has been created, there is an expectation that the level of safety investment funding is to be made transparent and the NZTA will be required to report on how it has been used to improve road safety. Safety expenditure includes the safety proportions of RoNS, safety improvements such as barriers and realignments, minor safety works, efforts on high-risk motorcycle routes, high-risk rural roads, high-risk intersections, demonstration projects, road safety education and a safety component of maintenance and renewals.

The NZTA's Investment and Revenue Strategy (IRS) has been altered to account for the GPS 2012. There is an increased focus on reductions in deaths and serious injuries and the adoption of a Safe Systems approach in line with Safer Journeys. For a 'high strategic fit' the IRS has a requirement to address actual crash records only.

This investment focus combined with this document is aimed at strongly encouraging RCAs to focus their efforts on the Safer Journeys priorities and actions.

## 2.6 Source material

This document recognises that there are several other motorcycle guidance documents that apply relevant treatments. These are described in section 8.

In addition, the NZTA has recently developed the *High-risk rural roads guide* and the *High-risk intersection guide*.

## 3 Data

There are several types of data available for use when determining what the overall reported issues are for motorcyclists. This information can be sourced from the government's crash analysis system (CAS), ACC statistics, motor vehicle registrations and other national and international research reports.

This section describes the CAS reported crash data in detail and further information on understanding the issues can be found in section 6.

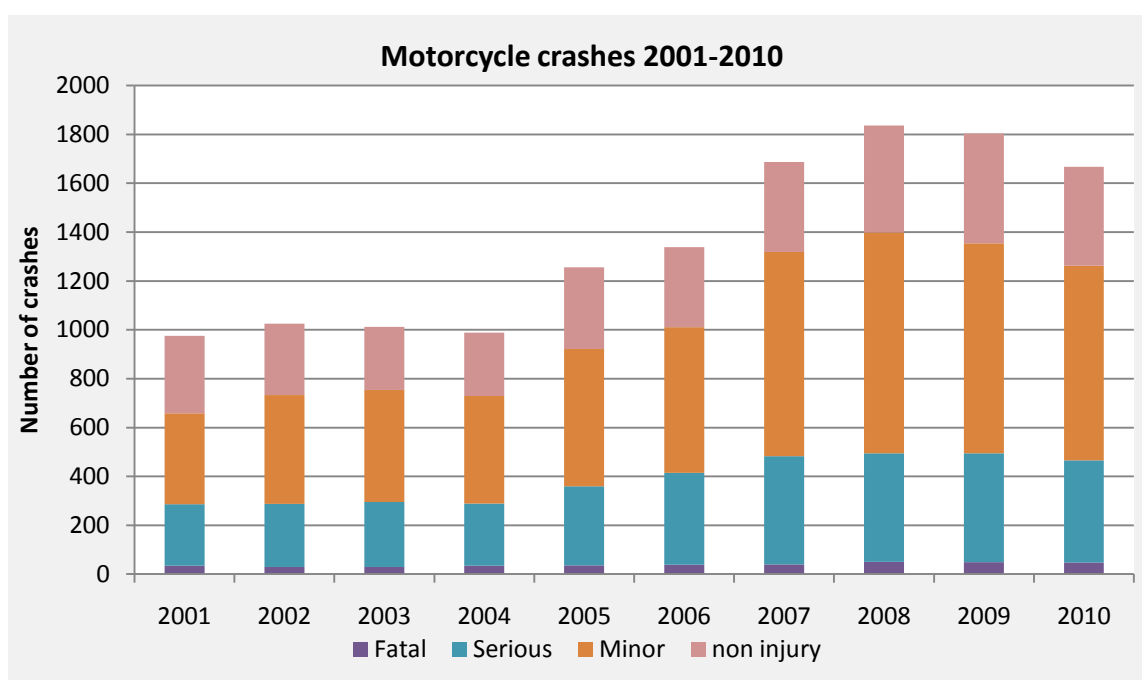
### 3.1 Reported crash data

The crash analysis system (CAS) shows a total of 13,591 crashes involving motorcycles or mopeds from 2001-2010, including 391 fatal, 3489 serious, 6281 minor and 3454 non-injury crashes. Those crashes involved 394 motorcycle and moped deaths and 3634 serious injuries. Motorcycle and moped crashes have increased from the previous five-year period (2001-2005) to the next (2006-2010) by almost 60% (figure 3-1). Sixty-seven percent of those crashes occurred in urban<sup>8</sup> areas. However, only 47.5 % of the social cost indicating, not surprisingly, a slightly higher severity of crash injuries occur in rural areas.

Motorcycle and moped injuries attributed to 7% of the total injuries in NZ, 16% of the high severity (fatal and serious) injuries from 2001-2010 as shown in figure 3-2.

When comparing this by travel mode, (figure 3-3) it shows that the proportion of motorcyclist's 100 million vehicle kilometres travelled is small compared to driver and passengers. However, the number of motorcyclists killed or injured is significantly higher than other modes.

Figure 3-1: Motorcycle crashes by severity (2001-2010). Source: CAS



<sup>8</sup> Urban = the posted speed limits is equal to or less than 70km/h

Figure 3-2: Road user injury and high severity crash percentage by road user type 2001-2010. Source: CAS

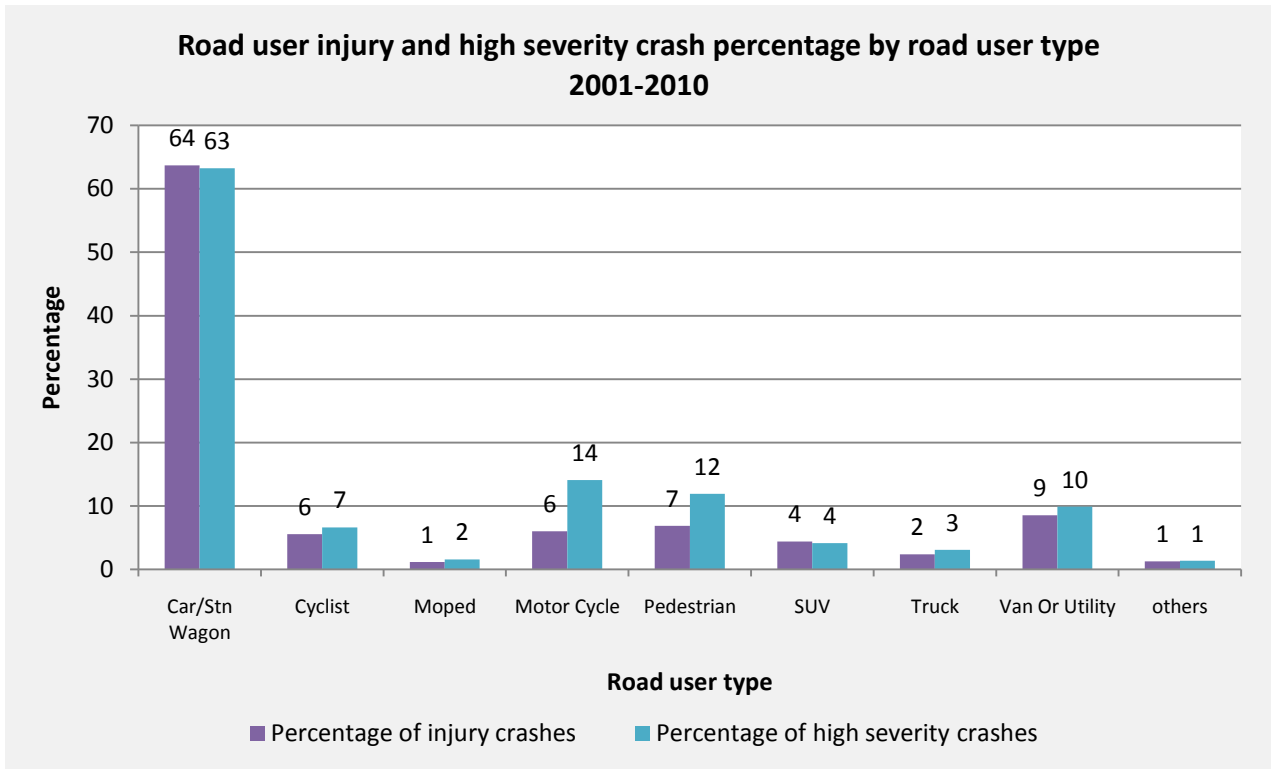


Figure 3-3: 100 million km travelled per year by mode (road based modes only, ages 5 & over). Source: NZTA

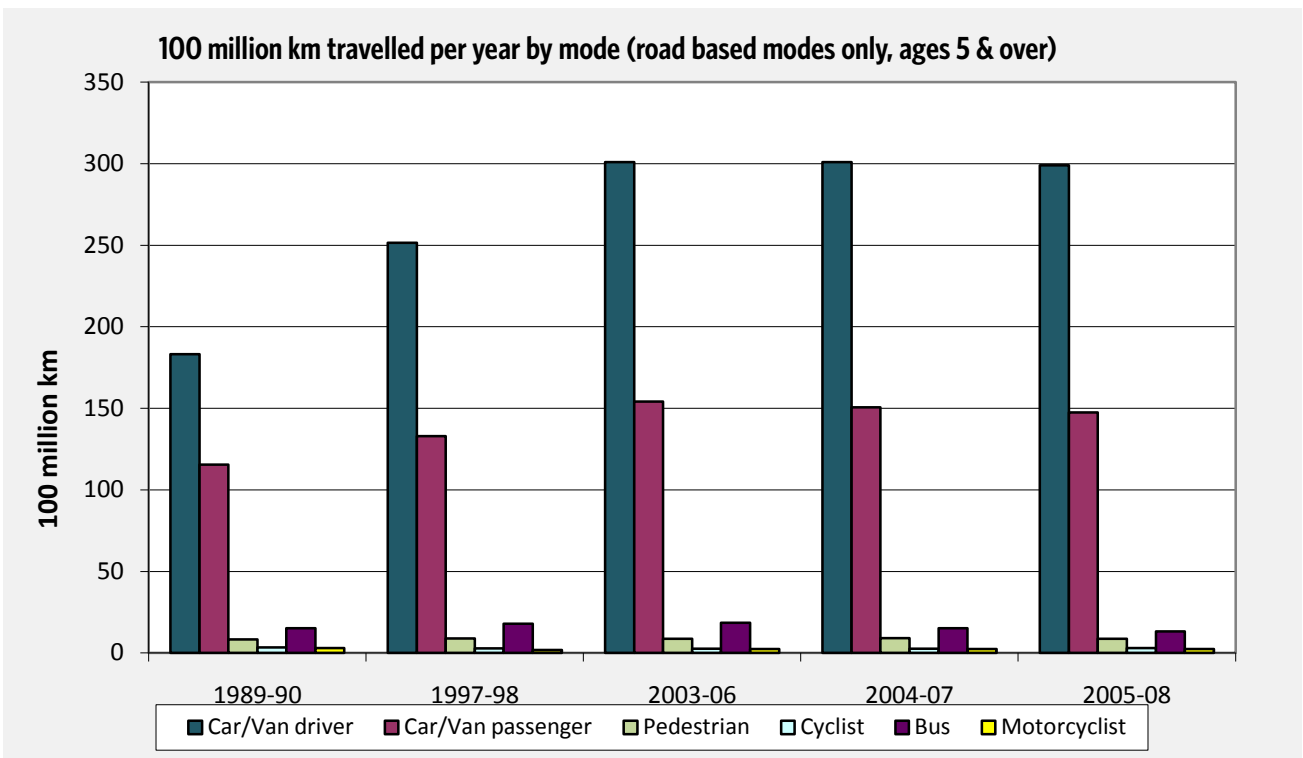
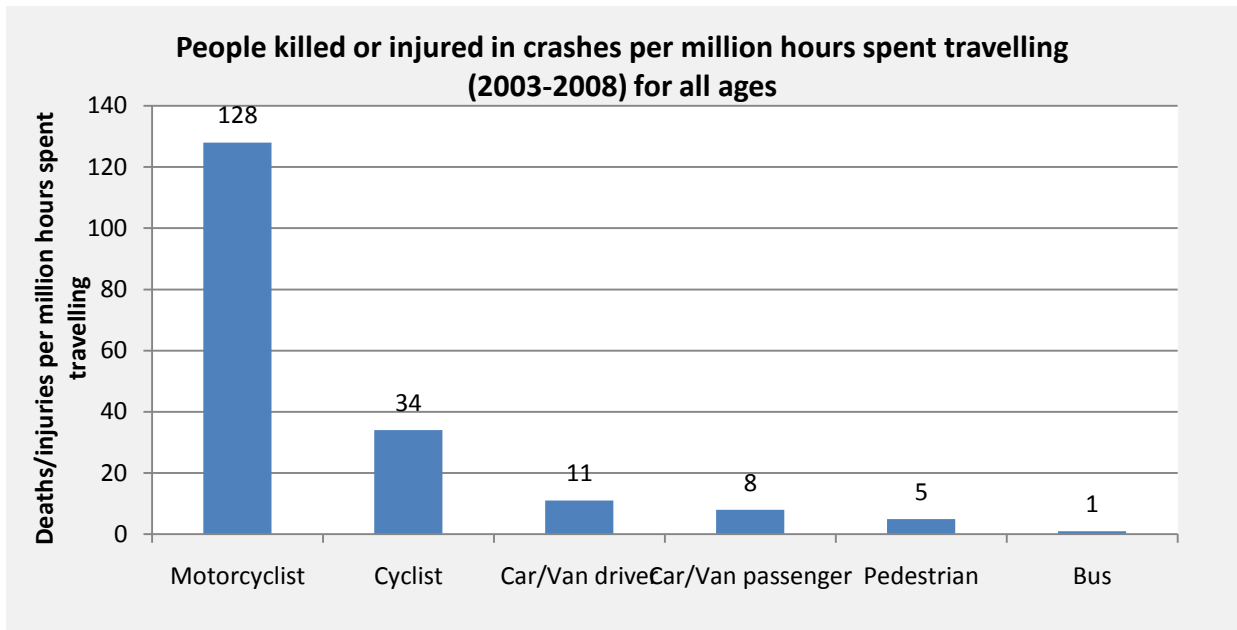
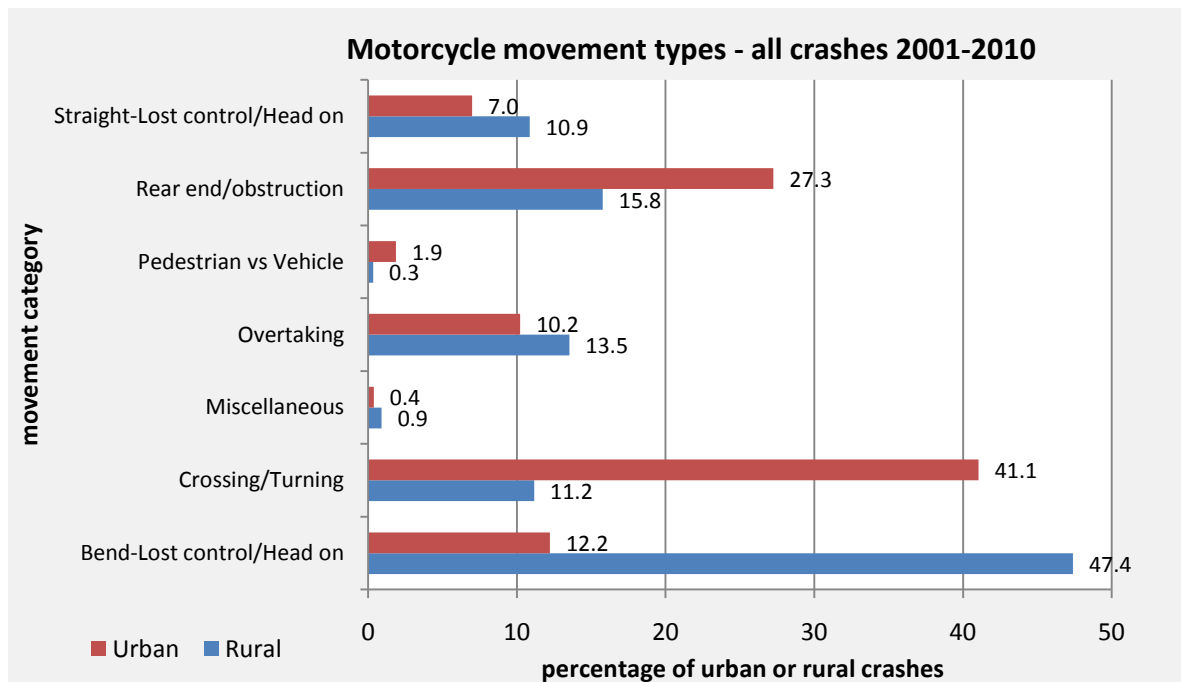


Figure 3-4: People killed or injured in crashes per million hours spent travelling (2003-2008) for all ages Source; NZTA presentation



The most common movement types for crashes involving motorcyclists/mopeds is shown in figure 3-5 and shows the most common movement is crossing/turning in urban areas and bend-lost control/head on in rural areas. Table 3-1 illustrates that crossing/turning type crashes are overrepresented for motorcycle crashes compared with all road user crashes in both all injury/non-injury and high severity crashes. In rural areas, loss of control on bends are slightly overrepresented in all injury/non-injury crashes compared to all road user crashes. However crashes with high severity outcomes are relatively similar.

Figure 3-5: Movement types - all motorcycle crashes 2001-2010. Source: CAS



**Table 3-1: Main movement types of motorcycles/mopeds compared to all crashes. Source: CAS**

		Main movement	Motorcycle/moped crashes only	All road user crashes
<b>Urban</b>	All crashes	Crossing/turning	41% <sup>1</sup>	27%
	High severity	Crossing/turning	44%	28%
<b>Rural</b>	All crashes	Bend (loss of control)	47% <sup>2</sup>	40%
	High severity	Bend (loss of control)	56%	52%

Note 1: of which 15% vehicles making right turn in front of straight through traffic.

Note 2: of which 23% were loss of control turning right.

A look at driver fault causes shows that motorcyclists were at either prime or part fault for 49% of urban crashes and 79% of rural crashes. However, it is recognised that there are a lot more single vehicle crashes in rural areas (approximately 2.6 times more) and operating speeds are significantly higher and therefore the at-fault value will generally be higher in rural areas than urban areas.

The most common contributing factor for at-fault motorcyclists is poor handling of which it is 50% of all crashes in urban areas and 33% in rural areas. A further breakdown of at-fault motorcycle/moped contributing factors in order of frequency is shown in table 3-2.

**Table 3-2: Factors for crashes where motorcyclists/mopeds drivers were at fault**

Urban (number of factors)	Rural (number of factors)
Poor handling (801)	Poor handling (1090)
Poor observation ( 708)	Too fast for the conditions (691)
Poor judgement (615)	Poor observation (531)
Too fast for the conditions (530)	Poor judgement (461)
Alcohol (479)	Road factors ( 457)

Road factors for motorcycle crashes were identified as a factor in 23% of rural crashes and 9% of urban crashes. The main road factors are identified in table 3-3.

**Table 3-3: Road factors for motorcycle crashes in New Zealand (2001-2010)**

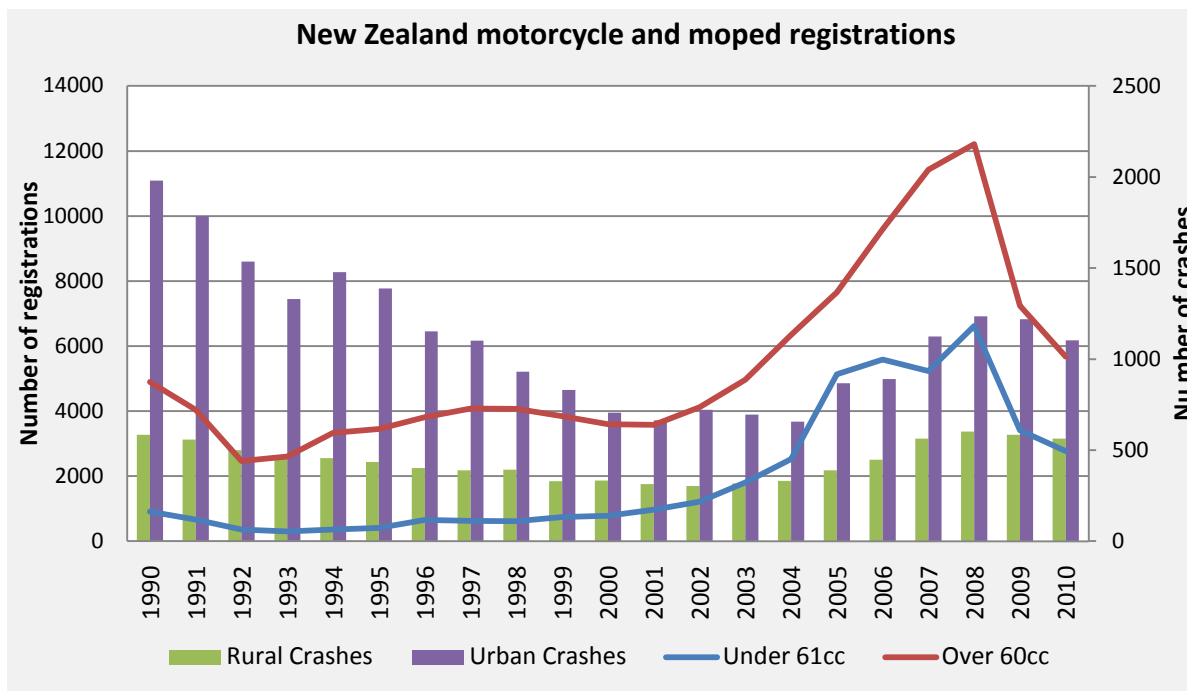
Urban ( number of factors)	Rural ( number of factors)
Road slippery (including general and rain) (246)	Road slippery (including general and rain) (234)
Road slippery (loose material on seal) ( 70)	Road slippery (loose material on seal) (206)
Road slippery (oil/diesel/fuel) ( 52)	Road slippery (oil/diesel/fuel) (72)

## 3.2 Motorcycle registrations

The NZ Transport Agency's motor vehicle registration numbers for motorcyclists and mopeds (figure 3-6) shows an increase from 2001 to 2008 and then a drop off in 2009 and 2010. This drop off could be due to the increase in the costs to register a motorcycle (December 2009) which ranged from increases of 29% to 48%.

Comparing registration numbers against crash numbers for both urban and rural areas, there is some correlation from about 2004 onwards. From 1990 there is a decrease in crashes, while motorcycle registrations showed a slight trend upwards with the trend increasing at a greater rate from 2001<sup>9</sup>.

Figure 3-6: New motorcycle/moped registrations numbers vs. crash numbers <sup>10</sup>



### 3.3 Mopeds versus motorcycles

The crash data in this section generally talks about issues that used combined crash lists for motorcycles and mopeds. However, they do have different rider types including those that only hold car licences are generally used in urban conditions and therefore have some different key at-fault contributing factors. They are involved in 26% of urban crashes, in 2.6% of rural crashes and crashes in both urban and rural areas (excluding rural moped crashes) have shown an increase over the past 10 years (figure 3-7).

Further analysis of the data shows some of the key differences in moped crashes compared to motorcycle crashes are shown in table 3-4.

<sup>9</sup> Note that a moped is defined as a vehicle less than 50cc and low power.

<sup>10</sup> Source: New Zealand motor vehicle registration statistics 2010, NZTA.

Figure 3-7: Moped versus motorcycle crashes 2001-2010 (Source: CAS)

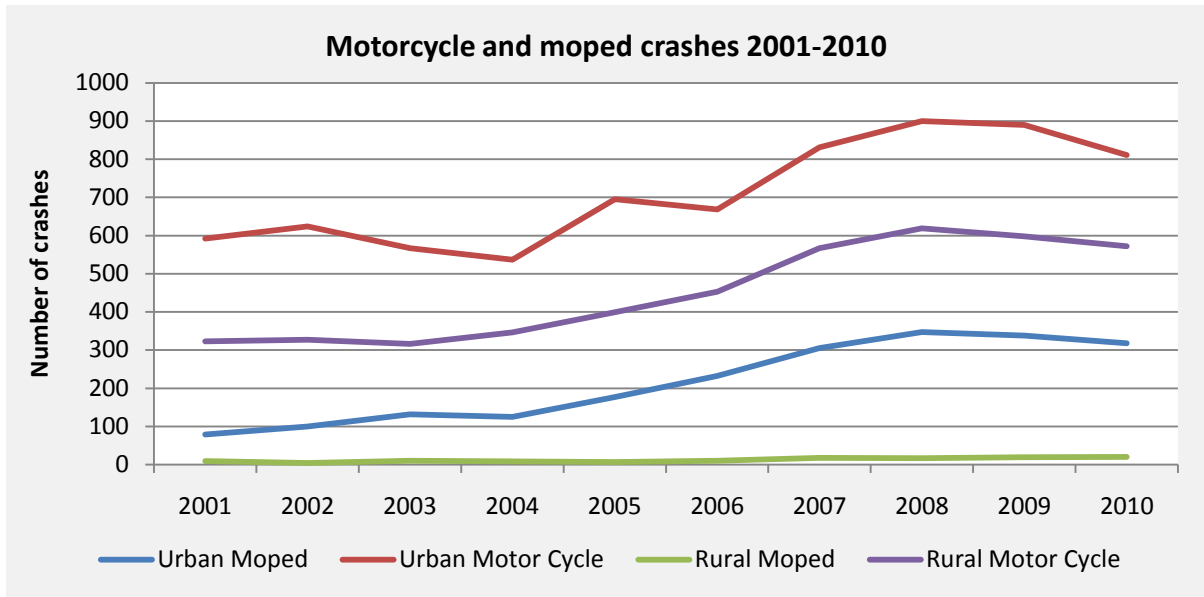


Table 3-4: Key at-fault contributing factors for mopeds versus motorcycles

Mopeds	Motorcycles
Poor observation	Poor handling
Poor judgement	Too fast for the conditions
Poor handling	Poor observation
Failed to give way/stop	Poor judgement



Source: [www.scootling.co.nz](http://www.scootling.co.nz)



Source: [www.cibusih.comyr.com](http://www.cibusih.comyr.com)

## 4 Identifying routes

The safety performance of a road is a function of:

- the likelihood of each user travelling on the road being involved in a crash
- the exposure or frequency, ie the number of vehicles using the route (traffic volume).

There are two types of routes that can be determined:

1. Favoured routes - are those routes that have been identified by either motorcycling agencies, eg MOTO, rider groups, communities, RCAs or any other key stakeholder as being a preferred route for motorcycling.
2. High-risk routes - which are essentially lengths of road with a higher than average crash risk, and by implication are roads where targeted safety improvements are most likely to reduce trauma.

The identification of favoured routes is relatively subjective and therefore how we determine those is difficult within the context of this document. Further information can be obtained from motorcycling industry and community groups (section 7.3). This section focuses on how we identify high-risk routes.

High-risk motorcycle routes are where the greatest reduction in severe casualties can be achieved. There are also likely to be benefits from improving roads with moderate risks or riskier spot locations (such as crash clusters/blackspots) on road lengths not formally classified as high-risk. Cost-effective solutions may be available for such sites and it is not the intention of this guide to stop blackspot studies and treatments, but rather to focus most attention on high-risk routes.

This section defines what constitutes a high-risk motorcycle route in both urban and rural areas and outlines how those can be derived. Further analysis and consistency between the high-risk intersection guide is needed prior to describing a high-risk urban intersection or site. (See comment box in section 4.4.1.)

### 4.1 High-risk rural motorcycling routes definitions

A high-risk motorcycle route for rural areas is defined as:

- a road where the injury crash density (collective risk) is classified as high or medium-high compared with other roads (section 4.4.1 and figure 4-1).

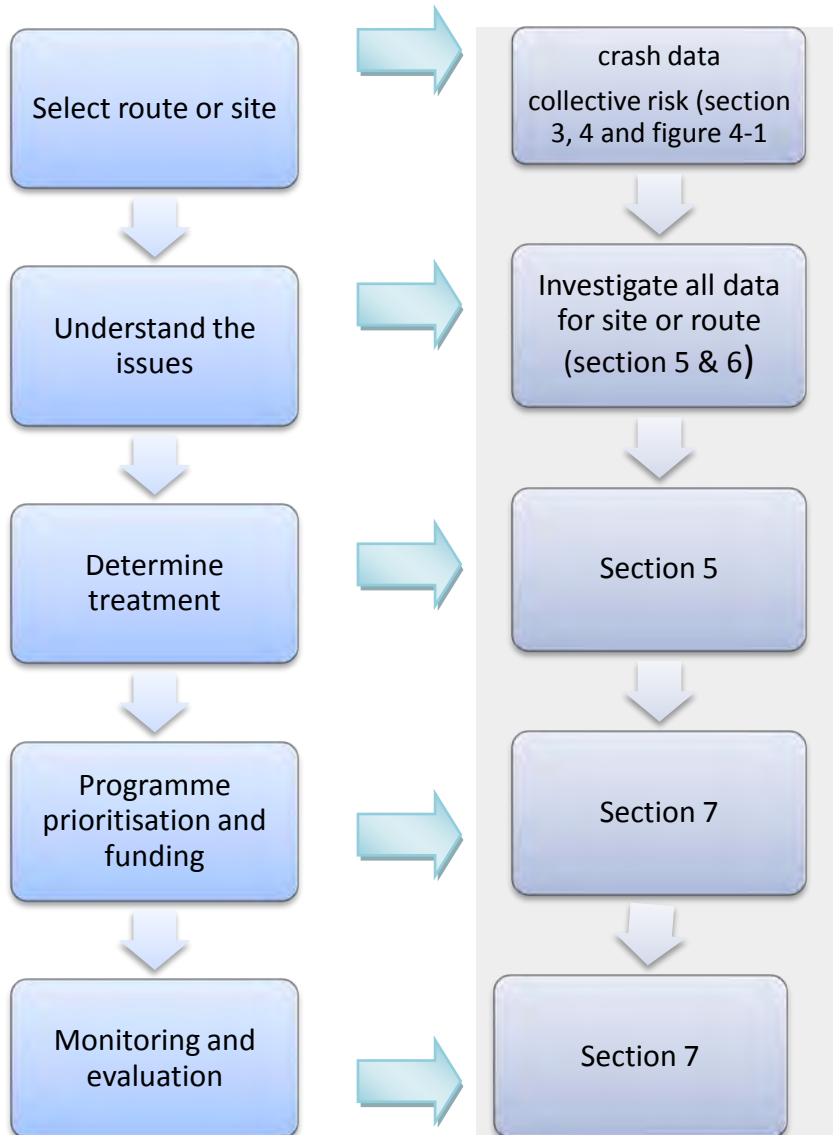
We have not defined a minimum road length. Instead, we have specified a minimum number of injuries (for rural roads) and high severity crashes (for urban roads). For rural areas, collective crash risk, medium-high and high define the route as a high-risk motorcycle route, subject to having at least two or more motorcycle injury crashes over a five-year period or four or more motorcycle injury crashes over a 10-year period.

Ideally, lengths of road being considered should be corridors (maybe 10km or longer) or adjoining road sections with similar characteristics, traffic volumes, environment and road-use purpose. However, shorter lengths can be considered. At the extremes, a very short section of road with two or more injury crashes will be a blackspot with a high crash density, while a very long section may have a low crash density (collective risk) and may only justify relatively low cost delineation improvements. In either case the process and treatments outlined in this guide are relevant.

### 4.2 Summary of process

The process of identifying high-risk motorcycle routes and sites in our networks should be completed at least every three years to provide information to support maintenance and renewal works included in the three-year National Land Transport Programme (NLTP). Table 4-1 shows the total process (from selection of the route to monitoring and evaluation).

Table 4-1: General summary process to determine, manage, implement and monitor high risk motorcycle routes



### 4.3 Using crash and RAMM data

We can use crash data to determine the crash density (collective risk). Using CAS, map the crashes on our identified section of road and then use the measurement tool to obtain the length of the road section. This approach works well when looking at predefined links, but is cumbersome when seeking to screen a network. RAMM data is better suited to network screening.

RAMM is an alternative to CAS for calculating collective risk and is more appropriate for network-wide screening. Using the traffic crash data held in the databases operated by RCAs, an annual report from CAS can be created and exported. This is linked to the RAMM road\_ID. Appendix A of the *High risk rural roads guide* describes how to perform this calculation.

One of the key issues with this approach is the proliferation of relatively short links in many RAMM databases. Once plotted in RAMM map or another GIS system, it is generally necessary to join up sequential sections of road to define a publicly known route.

## 4.4 Process to calculate collective risk

Collective risk (also known as crash density) is a measure of the number of

- injury crashes ( for rural routes) that have happened per kilometre of road per year.

Calculations to determine this risk is provided in section 4.4. Urban calculations are yet to be determined. See comment box in section 4.4.1.

### 4.4.1 Collective risk (crash density) calculations

Having identified links of interest using CAS and/or RAMM, the collective risk needs to be calculated. The following sections further discuss the definition and the calculation of collective risk.

Collective risk in this context is simply the number of either injury crashes (for rural) or high-severity crashes (for urban areas) divided by the length of road under consideration.

$$\text{Rural collective risk} = \frac{\text{injury crashes} / \text{number of years of data}}{\text{Length of road section}}$$

**Note for comment:** No definitions have yet been given for collective risk on urban routes as further work is being completed as part of this guide and it is likely that the definition of a urban site or route will be defined by number of motorcyclist injury crashes over a time period. This definition will be clarified with the publication of the draft high risk intersection guide due out December 2012.

Having calculated the collective risk, plot this value (figure 4-1). The risk scores can then be compared with a number of other rural roads risk scores (figure 4-1) to determine the relative risk of our road section, ie does it rate as a low-risk or high-risk relative to others<sup>11</sup>.

Note that to be defined as a high-risk motorcycle rural route or site in terms of collective risk it must be:

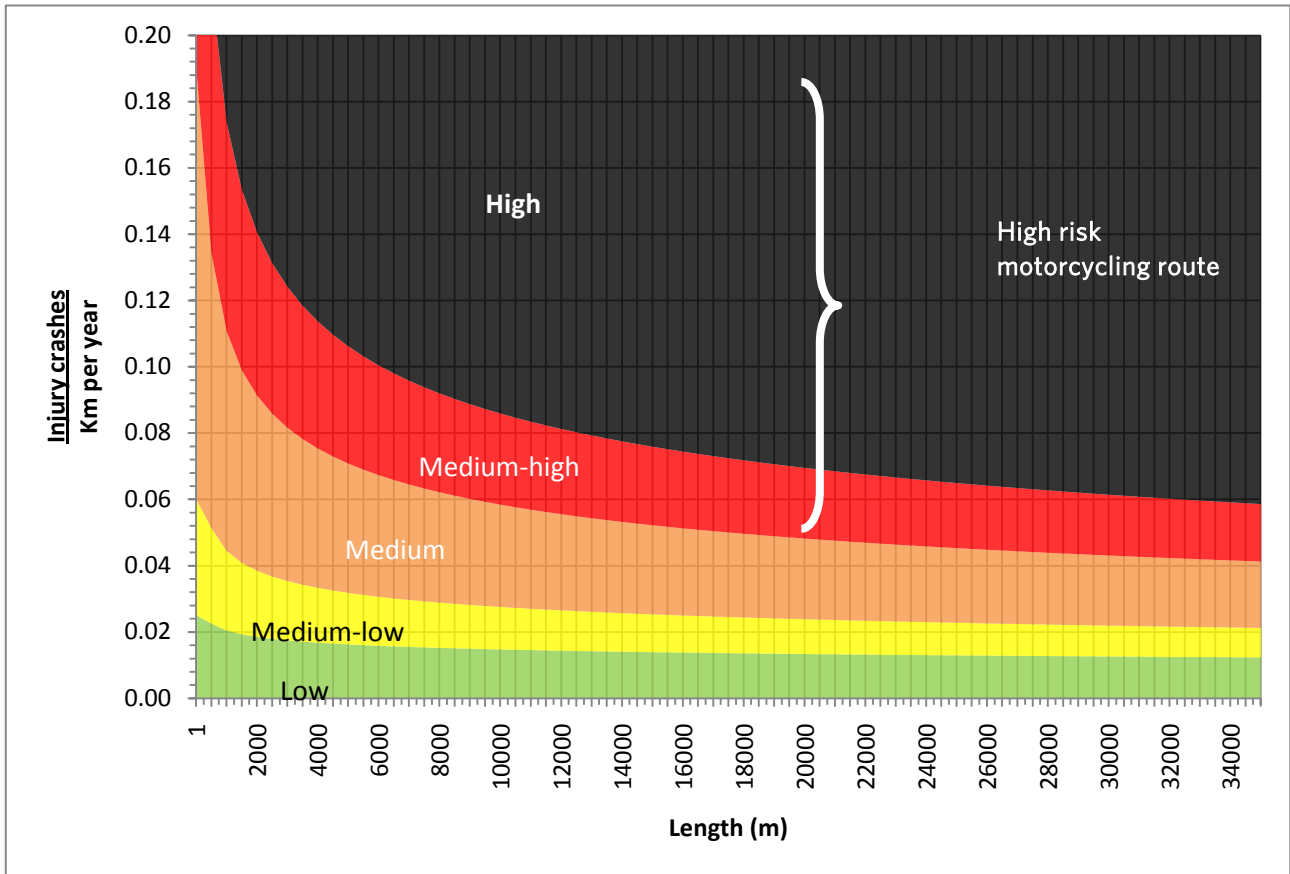
- medium-high and high as shown in figure 4-1 subject to having at least two or more motorcycle injury crashes in five years or four motorcycle injury crashes in 10 years in rural areas.

Further information on how collective risk is quantified and discussion regarding relationships between crash data and specific infrastructure figures can be referenced from the high-risk rural roads guide. The following colours have been adopted from the KiwiRAP and similar programmes for each risk description in figure 4-1.

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<sup>11</sup> Note that the risk comparison is based on the state highway rural network, as this network has relatively complete traffic volume coverage; however, the figures can be used for all roads.

Figure 4-1: Collective injury crash risk (crash density) - rural areas



## 4.5 Corridor treatment of high-risk motorcycle routes

This section provides guidance on how to use the above risk metrics to determine an appropriate treatment strategy, together with some examples of the process.

### 4.5.1 Process

The first step in such an investigation is to determine what type of safety problem we have - whether the current crash patterns have either geographical or thematic commonality, whether they are clustered (black or grey spots) or whether there is a common theme, eg lost control on curve in dark. Although there may not be specific black or grey spots, subsections of the route may appear to have more crashes than other sections.

Guidance for understanding the safety issues is given in section 5 and 6. Further analysis and treatments of crash clusters (or blackspots) can also be found in the *New Zealand guide to the treatment of crash locations*.

### 4.5.2 Interim safety treatments

It is recognised that where larger infrastructure works have been identified as the most appropriate treatment strategy, it is likely to involve a long period of incubation and implementation given the higher cost of infrastructure-type treatments. Therefore consideration should be given to providing interim safety treatments where they could still be cost effective, ie the treatment should not create difficulty or increase costs significantly when programming for larger infrastructure works in the future.

For example, if you determine that the long-term treatment for motorcyclists for a particular route was to provide roads to a high standard with median barriers and clear zoning, then the interim safety treatments could include providing wide centreline treatments, localised widening on curves and then along straights, and a prioritised clear zoning programme.

## 4.6 Treatment of non high-risk or favoured routes

If a site or route has been defined as a favoured route (section 4) it may not necessarily be high risk but has the potential to become high risk due to the numbers of motorcyclist using the route. Consideration needs to be given to treating known road safety issues like those identified in sections 5 and 6. The priorities of implementing these treatments need to be considered in conjunction with those routes or sites that have been identified as high risk (section 4.1).

# 5 Key issues and treatments

## 5.1 Key issues

Austrroads part 15; *Guide to traffic engineering practice - motorcycle safety* (now superseded by a number of other Austrroads guides) described the safety needs of motorcyclists. In summary, motorcyclists need to:

- stay in control and upright on the vehicle and stay on the carriageway
  - motorcycles are less stable than other vehicles as they only have two wheels and can easily become unstable and topple if braking, accelerating or when on a slippery or unstable pavement surface
  - motorcycles tend to have much higher power to weight ratios than cars and an increasing number of motorcycles are capable of very high speeds and acceleration
  - can be minimised through improved surface conditions, improved delineation, pavement markings, geometry and alignment, surface conditions, safer vehicles and speeds, road user experience, training and education
- avoid collisions with other road users
  - the visibility of motorcycles with other traffic - motorcyclists are often obscured from the vision of other road users, particularly in congested traffic
  - rider's visibility can be impacted (particularly peripheral vision) due to their helmet and goggles
  - can be addressed through improvements to intersections and sight visibility, safer vehicles and speeds, road user experience, training and education
- avoid collisions with roadside objects and survive (minimise injury) if fallen from a motorcycle
  - motorcyclists are extremely vulnerable to high severity injuries
  - can be addressed through protecting, removing or mitigating road and roadside hazards, safer speeds and improved rider safety gear.

A summary of the key issues is provided in table 5-1. More detailed information on these key issues and possible treatments is provided in sections 5.2 to 5.6.

**Table 5-1: Summary of key issues**

Roads and roadsides	Road user	Vehicle	Speeds	Injury treatment
Surface conditions	Training & education	Maintenance	Rider behaviour (too fast for the conditions, speeding)	Proximity of helicopter landing area
Pavement markings	Rider experience, speed, route knowledge & risk taking	Power to weight ratios	Rider behaviour (following distances)	Available mobile phone coverage
Delineation	Alcohol & drug use	Features	Posted speed limits	Personal responsibility
Hazards/roadside furniture	Rider safety gear			
Geometry & alignment	Group riding			

Intersections	Rider position on the road			
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The key types of general treatments relating to safe systems, those relating to safe roads and roadside, safer vehicles, safer road users, safer speeds, targeting key crash types and others are described in the following sections.

## 5.2 Key types of treatments

### 5.2.1 General Safe System treatments

There are five key treatment philosophies (table 5-2) that have been developed for high-risk rural roads which could also be applied to high-risk motorcycling routes. Further information such as application, issues, cost, crash reduction benefits, and treatment life for each treatment type can be found within the high-risk rural roads guide.

**Table 5-2: Summary of the key treatment philosophies**<sup>12</sup>

Treatment philosophy	Description
<b>Safety maintenance</b>	Maintaining rural roads to an appropriate standard in accordance with specified standard criteria. Example measures include maintaining skid resistance levels to current specifications.
<b>Safety management</b>	Measures aimed at optimising safety levels through maintenance of the existing road network such as skid resistance. Generally, high personal risk roads with low traffic volumes will not warrant significant infrastructure investment. It will therefore be important to consider supplementing safety management on these routes with additional speed management (curve warning signs) education and enforcement measures.
<b>Safer corridors</b>	Infrastructure and speed management measures that improve safety, though to a lesser extent and generally at a lower cost compared to Safe System transformation works. Example measures include delineation, speed activated warning signs, seal widening and audio tactile profiled (ATP) markings.
<b>Safe System transformation works</b>	Measures that eliminate or significantly reduce the potential for fatal and serious injuries. These include infrastructure measures that physically separate road users and/or speed management measures that reduce impact speeds to survivable human tolerance limits. Example infrastructure measures include median barriers, roadside barriers, clear zones and roundabouts.
<b>Site-specific treatments</b>	These measures are used where you have crash clusters (blackspots) along a route or at just one site. Depending on where the crash cluster is located and to be consistent with other measures along the route, the types of treatments can be from a range of measures covering Safe System transformation works, safer corridors, safety management and safety maintenance.

As these are general treatment philosophies applied to all road users on rural roads, further consideration needs to be given to providing appropriate treatments for motorcyclists on high-risk routes or sites. This is explained further in sections 5.2.2, and 5.3 to 5.6.

<sup>12</sup> Source: NZTA *High-risk rural roads guide*

## 5.2.2 Treatments based on key crash types for motorcyclists

As discussed in section 3 of this guide, the key crash types for motorcyclists are:

- rural road - loss of control on bends (run off road/head ons)
- urban areas - crossing or turning, ie at intersections.

A description of how to address these key crash types with Safe System, safety management and safer corridor treatments is provided in this section, a summary of which is shown in table 5-3.

**Table 5-3: Summary of key crash types' best value treatments**

Key crash type	Recommended Safe System treatments <sup>1</sup>	Recommended safer corridor treatments <sup>1</sup>	Recommended safety management treatments <sup>1</sup>
<b>Run-off road</b>	Roadside barriers Clear zones Safe System speeds	Wider shoulders ATP markings Improved delineation Harm reduction speeds	Increased intervention levels Skid resistance Planting policies Hazard removal
<b>Head-on</b>	Median barriers (solid/ semi-rigid and flexible) Safe System speeds	Marked median treatments ATP markings Improved delineation (signs and markings) Active signs	Increased intervention levels Skid resistance Hazard removal
<b>Crossing or turning at intersections</b>	Grade-separated interchanges or overpasses Roundabouts Safe System speeds	Wider shoulders and separated turning facilities Improved delineation Active signs Harm reduction speeds	Intervention levels Skid resistance Improved sight visibility through various treatment

Note 1: See definition of Safe System, safer corridor and safety management treatments in Table 5-2.

## 5.3 Issues and treatments for roads and roadsides

As a result of a national and international literature search and discussions with motorcycle groups in New Zealand, the key issues for motorcyclists with regards to roads and roadside are described in sections 5.3.1 to 5.3.6.

### 5.3.1 Surface conditions

As discussed in section 3, loss of control due to road conditions was one of the most common causes of crashes for motorcycles and is mostly due to the road being slippery.

Surface conditions including changes to surface texture and skid resistance are critical due to the potential for motorcyclists to lose contact with the road surface. More specifically inadequate surface conditions on curves are hazardous as bikes only have two points of contact with the road surface and are therefore more at risk than other vehicles. Novice and inexperienced riders will also tend to place the bike into a more upright position (due to being scared of dropping the bike) and causing the bike to travel more in a straighter line. Issues and possible treatments related to surface conditions are described in table 5.4.

**Table 5-4: Issues and possible treatments for surface conditions**

Issue	Possible treatments
<p>Slippery conditions (eg rain, flooding, frost, diesel spills and bleeding) (Photo 1) can cause sudden and unexpected changes to surface texture and loss of control.</p> <p>Motorcycles also need more distance to stop in wet weather.</p>	<p>Provide standard warning signage.</p> <p>Provide adequate surface drainage to prevent water/loose material washing onto the pavement.</p> <p>Ensure minimum levels of friction on curves and straight are met and consider improvements to skid resistance investigatory levels for high risk or favoured routes particularly on approach to curves, bridges, intersections or other rural hazards that with high speed approaches.</p> <p>Improve maintenance response times.</p> <p>Consider increased frequency of routine inspections to identify any issues.</p>
<p>Surface debris (eg gravel and other debris, unsealed intersections and driveway accesses) cause sudden loss of traction. (Photo 2)</p>	<p>Provide regular sweeping of surfaces and checking after road works sites have been completed.</p> <p>Sealing of intersections where gravel side roads intersect with sealed roads.</p> <p>Repair and define of shoulders – particularly on curves.</p>
<p>Uneven surface conditions (eg corrugations, rutting, flushing, delamination, potholes) can cause motorcyclists to temporarily lose contact with the road surface.</p>	<p>Create suitable and consistent skid resistant road surfaces free of rutting and uneven surfaces.</p> <p>Ensure minimum levels of friction on curves and straight are met and consider improvements to skid resistance investigatory levels for high risk or favoured routes particularly on approach to curves, bridges, intersections or other rural hazards that with high speed approaches.</p> <p>Improve maintenance standards for prompt identification and repair of road surface (eg potholes/utility skid resistance improvements, broken road edges and consistency of surface levels).</p>
<p>Surface obstacles (manholes, steel plates, speed humps/judder bars, rail crossing, bridge expansion joints and connection to roads). (Photo 3)</p>	<p>Ensure obstacles located within the road surface (such as manhole covers and steel plates) should be flush with respect to the surrounding pavement surface. Provide skid resistant drain covers/metal road plates.</p> <p>Position manholes away from braking area or corner apex where practicable.</p> <p>Provide standard warning signs for obstacles or road features (such as speed humps) that may create loss of control for riders.</p> <p>Install skid resistant surfacing on steel bridge expansion joints.</p>
<p>Surfacing transitions, inconsistent frictional properties across road width, surface joins, multiple spray seals (Photo 4), patchwork repair (Photo 5) and treatments (potholes and edge drop offs).</p>	<p>Resurface to provide consistency.</p> <p>Ensure that when programming resurfacing the location of surface join are not placed in lean zones, approach to and middle of curves or other locations where there is possibility of a rider losing control.</p> <p>Maintain shoulder levels and provide a smooth transition.</p>
<p>Roadwork sites (eg loose aggregate, inappropriately placed signs) can create reduced levels of skid resistance and inadequate messages.</p>	<p>Provide standard temporary traffic management layout and warning signage at road worksites.</p> <p>Ensure road is back to normal conditions before temporary signs are removed.</p>

Parallel grooving is commonly used to restore surface friction. Motorcycle tyres can get trapped along parallel grooving resulting in loss of stability.

Avoid parallel grooving. Apply transverse grooving if necessary.

Removal or masking of obsolete line markings can lead to the old markings showing through. (Photo 6)

Markings can appear more noticeable in wet road conditions if they haven't been removed properly. Use techniques (such as water cutting or sand blasting) that remove road markings permanently on high-risk routes.

The *Guidelines for the management of road network skid resistance* (AP-G83/05, Jan 2005) describe issues for motorcycles which require specific consideration by maintenance practitioners and designers.



Photo 1: Flushed or slippery section located within wheel track. Source: Yvonne Forrest (MOTO).



Photo 3: Gravel migration located on a curve. Source: Yvonne Forrest (MOTO)



Photo 2: Seal join. (NZTA presentation 2011)



Photo 4: Seal change located in brake zone. Source: Yvonne Forrest (MOTO)



**Photo 5: Patchwork repair zone located on corner.**  
Source: Yvonne Forrest (MOTO)



**Photo 6: Removal of obsolete road markings.**  
Source: Yvonne Forrest (MOTO)

### 5.3.2 Pavement marking

The general issues with pavement marking relate to providing consistent, well located and skid resistant applications. Issues and possible treatments related to pavement markings are outlined in table 5-5:

**Table 5-5: Issues and possible treatments for pavement marking**

Issue	Possible treatments
Absence of road markings.	Apply road markings to current standards where required.
Slippery road markings located in the centre of the lane or on curves (eg large head directional arrows, speed control markings, other mid lane markings) can lead to low levels of skid resistance.	Apply road markings to current standards.  Restrict markings in the centre of lanes or on curves where not necessary.
The placement of audio tactile or raised markings within lane or centrelines has the potential for motorcycles to temporarily loose contact with the road surface (photo 7).	Possible restriction of audio tactile profiled (ATP) markings to edgelines only (not lane or centrelines). However a recommendation not to provide these should take into consideration the overall safety issues along a route. That is, if there is a high fatal and serious crash rate for other road users for overtaking/head-on type crashes then centreline ATP treatment may need to be installed to improve the overall safety of the route.
Transverse markings.	These types of markings are not standard and have only recently been trialled. If they have been used, the amount and location of road markings could be modified to suit motorcyclists' concerns such as providing space within the lane and stopping the markings prior to entering curves or at hazards where stopping and deceleration is likely to occur (photo 8).



Photo 7: Transverse road markings located across the lane in break zone.

Source: Yvonne Forrest (MOTO)



Photo 8: Transverse markings on approach to hazard with space left in middle of lane to accommodate motorcyclists.

Source: Martindale, A, Ulrich, C; Effectiveness of transverse markings on reducing speeds

### 5.3.3 Delineation

Delineation is particularly important for motorcycles. In particular, it is more critical at high-risk locations such as curves, approaches to hazard, and can be at night time due to the limited ability of motorcycle headlights. The following issues and possible treatments related to delineation are described in table 5-6.

Table 5-6: Issues and possible treatments for delineation

Issue	Possible treatments
<p>Inconsistencies (including absence of) route delineation and signage (eg advance warning signs, chevrons and guideposts/edge marker posts) can make it more difficult for motorcyclists to 'read' the route.</p> <p>Limited ability of motorcycle headlights.</p>	<p>Apply consistent road and edge delineation and appropriate warning signs, eg edge and centrelines, edge marker posts, curve advisory speeds should be installed (photo 9).</p> <p>Keep route layouts simple clearly defining vehicle paths.</p> <p>Consider installing appropriate and/or improved lighting standards on high risk routes and sites (photo 10).</p>



Photo 9: Delineation treatment, SH 2 Waioeka Gorge.  
Source: Opus Consultants

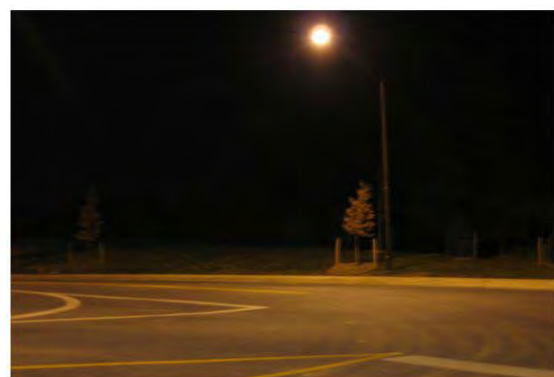
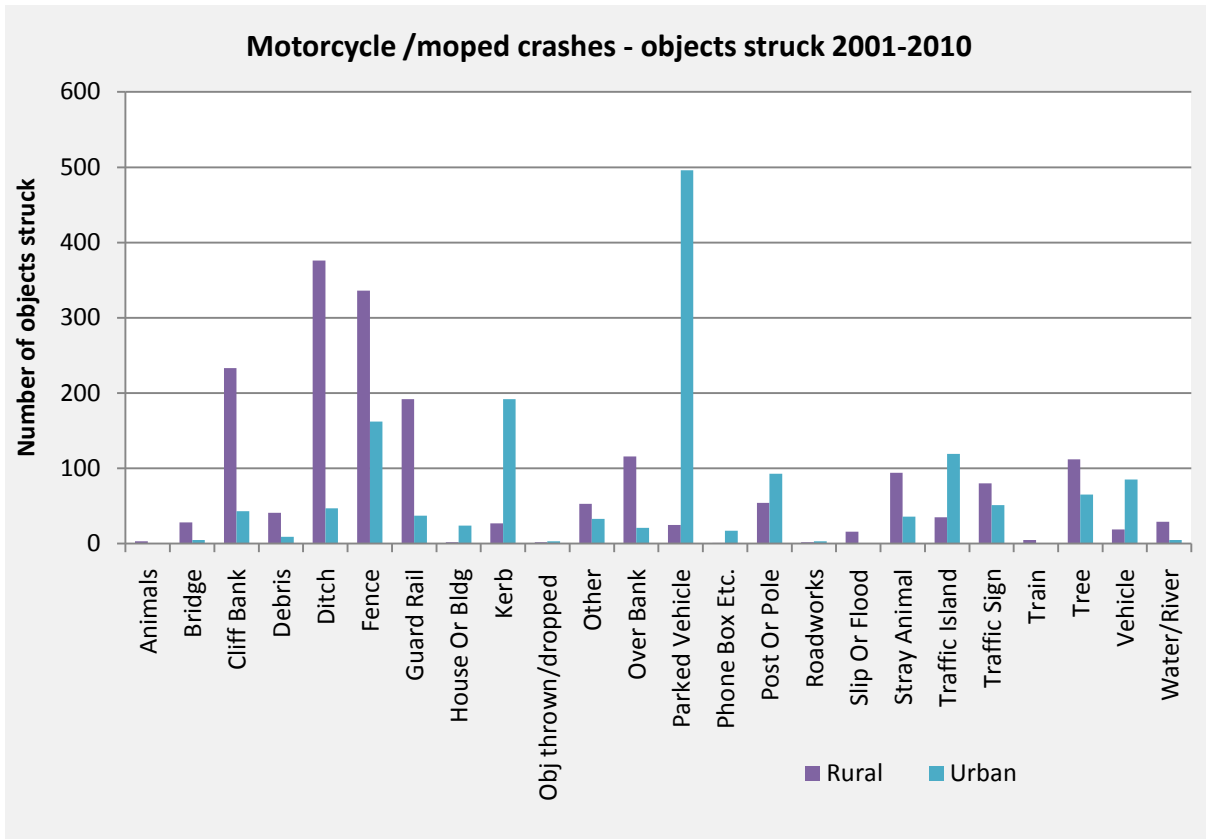


Photo 10: Standard flag lighting at intersections.  
Source: [safety.fhwa.dot.gov/](http://safety.fhwa.dot.gov/)

### 5.3.4 Hazards/roadside furniture

A search of the CAS database for objects struck for both urban and rural areas (figure 5-1) shows that the most common objects struck in urban areas for the 10-year period 2001-2010 were parked vehicles, kerbs and fences. In rural areas, ditches, fences and cliffs and banks were the most common objects struck. These were also the most common objects struck for high severity crashes (fatal and serious).

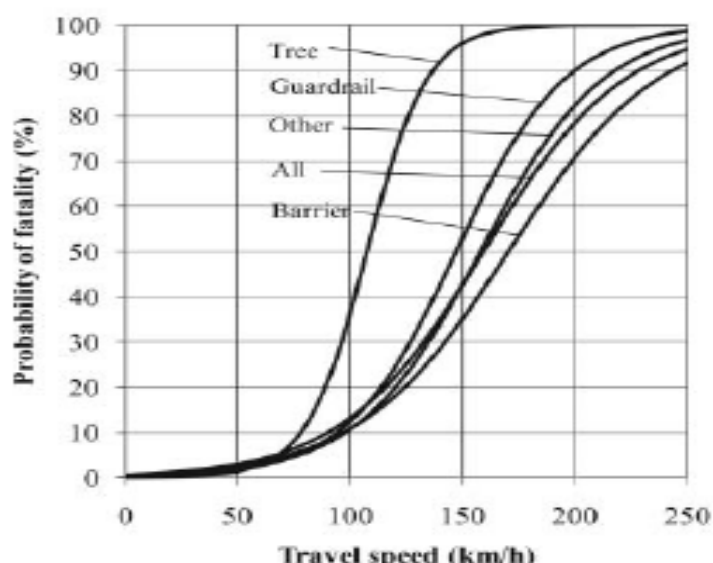
Figure 5-1: Objects struck in motorcycle crashes - 2001-2010 [source: CAS]



Current research<sup>13</sup> 'predicts that in about nine cases out of 10, a motorcyclist travelling less than about 55km/h will survive a collision with a fixed object'. The fatality risk for motorcyclists as a function of travel speed comparing the type of fixed object shows that as you reach speeds past 55km/h, the probability of a fatality significantly increases. The fatality risk for a motorcyclist hitting a tree is higher than for other objects struck (figure 5-2).

<sup>13</sup> M.R. Bambach, R.H. Grzebieta, J. Oliver & A.S. McIntosh (2011): Fatality Risk for motorcyclists in fixed object collisions, Journal of Transportation Safety & Security, 3:3, 222-235.

Figure 5-2: Probability of fatality for motorcyclists as a function of travel speed with fixed object



The following issues and possible treatments related to roadside objects are described in table 5-7.

Table 5-7: Issues and possible treatments for roadside objects

Issue	Possible treatments
<p>Roadside objects (eg culverts, culvert end walls, poles, signs, steep shoulders/deep drains, trees and vegetation) in clear zones.</p> <p>(Photo 11 and photo 12)</p>	<p>Provide a forgiving roadside environment through application of clear zone principles and removal and relocation of roadside hazards.</p> <p>Where roadside hazards cannot be removed or relocated, install appropriate barriers, flexible signage and poles.</p> <p>The frangibility of a sign support is important and consideration should be given to providing frangible sign supports where signs are located close to the road and the risk of an errant vehicle colliding with a post or pole is a factor. Information relating to impact performance, frangibility and breakaway designs can be found in the NZTA's <i>Traffic control devices manual</i> part 1, NZTA's <i>Performance based specification for traffic signs</i> and <i>State highway geometric design manual</i>, the <i>RSMA Compliance standard for traffic signs</i>, and the <i>Austrroads Guide to traffic management</i> part 10.<sup>14</sup></p> <p>Consider sealing currently unsealed shoulders to assist in recovery and/or avoidance manoeuvres.</p> <p>Consider applying more self explaining road treatments (such as transverse road markings) instead of advisory signs.</p> <p>Consider additional safety measures for barriers such as the installation of lower safety rails to reduce severity of injuries.</p>
<p>Presence of crash barriers (eg concrete, W-beam and wire ropes - see section 5.3.4.1) can be hazardous with the posts presenting the greatest potential for injury for</p>	<p>Crash barrier types should take into account vehicle types and location characteristics. A motorcyclist is usually separated from their motorcycle before they hit a crash barrier and it is usually the crash barrier post that can cause injury.</p> <p>Barrier surfaces needs to be as smooth as possible avoiding</p>

<sup>14</sup> NZTA *Traffic control devices manual* - part 1: General guidance

<p>motorcyclists.</p> <p>With wire rope barriers, there is a risk of motorcyclists getting hooked up in the wire rope barrier.</p>	<p>obstructions and indentations to reduce risk of snagging.</p> <p>Installation of rubrail ( or protection on barrier systems) if practicable.</p> <p>Addition of impact attenuator cushions on posts of wire rope safety barriers.</p> <p>Wire rope barriers should be installed well away from traffic lanes, however standards should be adhered to for maximum performance for all road users.</p> <p>Repairs to barriers must be carried out promptly to protect motorcycles and other vehicle users.</p>
<p>Collisions with animals such as wandering stock.</p>	<p>Installation of appropriate hazard warning signs.</p> <p>A programme implementation strategy could be developed for construction of stock underpasses on high volume motorcycle routes.</p>
<p>Motorcyclist sight visibility can be restricted and can be more easily hidden for other road users by parked vehicles.</p>	<p>Restrict and manage parking where it can obstruct sight distances.</p>



Photo 11: Poles located within clear zones



Photo 12: Steep slopes and open drains located within clear zones

### 5.3.4.1 Barriers

Crashes into road safety barriers (both side and central) are a significant concern to motorcyclists. Their use and type of installation has been researched and discussed on a number of different levels and it is important to put the use of these barriers into both the rider and a Safe System perspective.

Three main types of barriers are used in various locations nationally. These are:

1. Concrete barriers have no flexibility and tend to be used in central medians such a high speed motorway locations, (photo 13).
2. W-Beam barriers are considered to be semi-rigid and are used both in the central median area and road side, (photo 14).
3. Wire rope barriers are considered flexible and are also used in both central median and road side locations.(photo 15 and photo 16).

The main concern from motorcyclists relating to barrier installation is the severity of the crash when colliding with a safety barrier.

Another important focus is from a Safe System perspective. As previously discussed in section 2.2, one of the key goals of a Safe System is that 'roads and Roadsides are predictable and forgiving of mistakes'. Barriers are generally installed to protect the road user from collision with hazards (such as oncoming traffic, roadside poles, trees and gorges) that may consequently result in a fatal or serious outcome. Consideration needs to be given regarding the risks to all road users with the installation of a barrier.



Photo 13: Concrete barriers



Photo 14: W-beam or steel barriers



Photo 15: Wire rope barriers used in centre



Photo 16: Wire rope barriers used on road side

There is a significant research available on this subject – the following articles and guides provide further information.

- *Motorcycle crashes into roadside barriers stage 1 and stage 2 reports* (Monash University Study).
- Berg, F. A., Rucker, P., Gartner, M., Konig, J., Grzebieta, R., & Zou, R. (2005). *Motorcycle impact into roadside barrier- real-world accidents studies, crash tests and simulations carried out in Germany and Australia*. In: Proceedings of the 19th International Conference on the ESV, Washington, USA. pp.1-13.
- *Evaluation of the safety impact of centre-of-the-road wire rope barrier (WRB) on undivided rural roads*. (Austroads AP-T135/09).

### 5.3.5 Geometry and alignment

According to Berg et al (2005)<sup>15</sup> powered two-wheelers (PTWs) are especially vulnerable to collisions on bends and curves, where acceleration or deceleration occurs, or where the stability of the motorcycle is compromised and loss of control is more likely. A disproportionately high number of impacts happen on slip roads (ie roads with a tight radius) and on roundabouts (Williams et al., unpublished). These are precisely the areas where barriers are installed and where attention to detail is needed to ensure that adequate protection is provided. Issues and possible treatments related to geometry and alignment are described in table 5-8.

<sup>15</sup> Berg, F. A., Rucker, P., Gartner, M., Konig, J., Grzebieta, R., & Zou, R. (2005). *Motorcycle impact into roadside barriers: real-world accidents studies, crash tests and simulations carried out in Germany and Australia*. In: Proceedings of the 19th International Conference on the ESV, Washington, USA. pp. 1 - 13.

**Table 5-8: Issues and possible treatments for geometry and alignment**

Issue	Possible treatments
Changes in alignment (vertical, horizontal, double radius curves).  The vulnerability of motorcyclists on bends and curves where there is a higher risk of loss of control.	Design new roads or realignments or provide a consistent alignment on approach and through curves.  Ensure delineation is provided where there are unpredictable changes in alignment.
Lack of sightlines (eg through intersections, roundabouts, splitter islands).	Ensure clear site lines through intersections for all road users and design for route consistency and predictability.
Adverse camber (superelevation).	Provide superelevation improvements/cross section consistency with speed of road and radius of curve.

### 5.3.6 Intersections

Motorcycle crashes at intersections account for 44% of all motorcycle crashes – of that, 86% occurred in urban areas and the majority of crashes occurred at T-junctions. The main contributing factors for both urban and rural intersection crashes were ‘failing to give way or stop’ and ‘did not look or see another party until too late’. The following are also issues and possible treatments related to intersections are described in table 5-9.

**Table 5-9: Issues and possible treatments for intersections**

Issue	Possible treatments
Lack of or quality of lighting at intersections.	Install and/or improve existing lighting over at high risk or high volume intersections.
Sight visibility.	Improve sight visibility through intersections for all road users, whether through redesign or through removal or relocation of obstacles that restrict both vertical and horizontal sight lines and approach visibility (such as vegetation (photo 17 and photo 19) parking, roadside commercial activity).
Obstacles in lean zones on curves. Motorcycles overhang their wheel track by about 0.5m on each side. <sup>16</sup>	Remove or relocate hazards in lean zones; specifically close to the kerb or edge of seal. The designer should allow for angles of lean of 45 degrees (photo 20).
Form of intersection, ie roundabout/T-junction/cross roads.	Restrict some movements to reduce conflict where necessary (photo 18).

<sup>16</sup> Vicroads Motorcycle notes no. 6.



Photo 17: Sightlines obstructed at intersection  
Source: Opus International Consultants



Photo 18: Intersection with the right turn out movement restricted. Source; Google maps: pro licence



Photo 19: Sightlines through a roundabout obstructed by vegetation. Source: Austroads Part 15



Photo 20: Showing hazards located in lean zones. Source: NZTA presentation: Bullick, R. 2011

## 5.4 Issues and treatments for road users (motorcyclists)

Motorcyclists require different skills to other road users such as effective braking, cornering and swerving (crash avoidance) and also need a highly developed sense of balance.

How motorcyclists can achieve these safety needs are described in more detail in sections 5.4.1, to 5.4.6.

### 5.4.1 Training and education

In Victoria's Road Safety and Transport Strategic Action Plan for Two Wheelers, it was reported that in 10% of all fatalities the rider did not have a valid licence, while 10% were riding an unregistered motorcycle. In New Zealand (using CAS data) this is similar with 10% of fatalities and 6% of all injury crashes involving drivers who were either never licensed or had disqualified, expired, forbidden licences. Unregistered statistics cannot be easily obtained for crash data in New Zealand, however, it is interesting to note that 23% of fatal crashes in rural areas and 32% fatal crashes in urban areas involved motorcycles/mopeds with no warrant of fitness.

Training and education is a necessary component to ensuring motorcyclists have developed the necessary skills and equipment is appropriate for their level of experience. Issues and possible treatments related to training and education of motorcyclists are described in table 5-10.

**Table 5-10: Issues and possible treatments for training and education**

Issue	Possible treatments
The current motorcycle theory test only covers general road rules (NZ Safer Journeys).	The theory test should be redeveloped to place more emphasis on motorcycle specific requirements.

An increase in motorcycles use recreationally, particularly in the riders over the age of 25 years.	Motorcycle awareness campaigns targeting older recreational motorcyclists.
Currently, holders of learner and restricted motorcycle licenses are restricted to riding motorcycles of 250cc or less. However, recent advances in technology have limited the effectiveness of the restriction.	Motorcycle awareness campaigns to encourage motorcyclists to choose motorcycles appropriate for their level of experience and advanced safety features.
An increase in crashes involving mopeds. Moped riders are only required to hold a car driver licence and are not required to pass any handling skills test before they can legally ride a moped on the road (NZ Safer Journeys).	Motorcycle awareness campaigns targeting moped users.
Understanding of general road rules (all road users)	Education/motorcycle awareness campaigns targeted at all road users
Understanding of specific motorcycle issues (all road users).	Campaigns developed that outline/focus on specific motorcycle issues such as lean zones, leaning across the centreline, visibility of motorcyclists by drivers, rider fatigue, user responsibility for maintenance (tyre air pressure etc), overloading (especially for mopeds).
Buyers and importers knowledge of safety features.	Provide access to information to buyers and importers on what safety features they should be looking for such as anti lock brakes, stability control features.

Many local councils are providing motorcycle skills training and some have developed regional motorcycle strategies that focus on the motorcyclist and skills.

### 5.4.2 Rider experience, speed, route knowledge & risk taking

The following are issues and possible treatments related to rider experience, speed, route knowledge and risk taking:

**Table 5-11: Issues and possible treatments for rider experience, speed, route knowledge and risk taking**

Issue	Possible treatments
Inexperienced riders.	Rider education and licensing improvements.  Incentives to attend rider training courses.  Note: New changes in the Land Transport Amendment Rule 2011 include removing the 70km/h speed limit restriction for learner motorcycle license holders so they get more experience on the open road.
Speed choice of rider.	Install speed management and perceptual countermeasures (eg speed advisory signage, chevron indicators, edge marker posts), where there are identified high risk or favoured routes and/or sites.  Setting appropriate speed limits and consider Safe System speeds along high risk or favoured routes.  Enforcement and education.

Lack of route knowledge and new route locations.	Education on route knowledge and event based promotion. Provide a consistent environment for all road users including good delineation and identification of hazards, a no surprises and a forgiving environment.
Risk taking (seeking the thrill and riding beyond their capabilities).	Provide targeted enforcement along high risk and favoured routes and develop education campaigns.

### 5.4.3 Alcohol and drug use

The use of alcohol is a prominent factor in motorcycle crashes, particular in urban areas where it is the most common contributing factor for injury crashes from 2001-2010. Issues and possible treatments related to rider alcohol and drug use are described in table 5-12.

**Table 5-12: Issues and possible treatments for alcohol and drug use**

Issue	Possible treatments
Alcohol and drug use.	Blood alcohol/drug content testing. Random breath testing. Education.



Source: [www.police.govt.nz](http://www.police.govt.nz)

### 5.4.4 Rider safety gear

Wearing protective gear while motorcycling assists in providing safety improvements, specifically enhancing visibility of the motorcyclist to other road users and reducing injuries.

Research completed in New Zealand<sup>17</sup> identified that 'low conspicuity may increase the risk of motorcycle crash related injury. Increasing the use of reflective or fluorescent clothing, white or light coloured helmets, and daytime headlights are simple, cheap interventions that could considerably reduce motorcycle crash related injury and death. In summary:

- Drivers wearing any reflective or fluorescent clothing had a 37% lower risk than other drivers.
- Compared with wearing a black helmet, use of a white helmet was associated with a 24% lower risk.

<sup>17</sup> BMJ 2004; 328 doi: 10.1136/BMJ.37984.574757.EE (Published 8 April 2004) BMJ 2004;328:857. Motorcycle rider conspicuity and crash related injury: case-control study.

- Self reported light coloured helmet versus dark coloured helmet was associated with a 19% lower risk.
- Three quarters of motorcyclists had their headlight turned on during the day, and this was associated with a 27% lower risk’.

The following are issues and possible treatments related to rider safety gear are described in table 5-13.

**Table 5-13: Issues and possible treatments for rider safety gear**

Issue	Possible treatments
Use of protective clothing (eg hi-visibility jackets).	Promotion and education by agencies and motorcycle groups of the importance of protective clothing (figure 5-4 and figure 5-5)
Promotion of new technology (eg air bag technology, neck protection).	Promotion and education of new technology to both sellers and buyers.
Use and quality of helmet design (eg age, size, fit, and type).	Promotion and education of the importance of appropriate equipment to both sellers and buyers.

**Figure 5-3: Protective gear for motorcyclists: Source: NZTA *The official NZ road code for motorcyclists***





Figure 5-4: Education campaign to wear protective clothing; Source: [www.scootersurvival.co.nz](http://www.scootersurvival.co.nz)



Figure 5-5: Successful rider training ; [www.reducetherisk.co.nz/](http://www.reducetherisk.co.nz/)

### 5.4.5 Group riding

Many recreational motorcyclists enjoy the social opportunities from group riding. However, it can have its own set of issues as outlined in table 5-15. Additional information on group riding can be found at:

- Scooter Survival (Accident Compensation Corporation: [www.scootersurvival.co.nz](http://www.scootersurvival.co.nz)).
- Ride Forever (Accident Compensation Corporation: [www.rideforever.co.nz](http://www.rideforever.co.nz)).
- *The official New Zealand road code for motorcyclists* (NZ Transport Agency: [www.nzta.govt.nz](http://www.nzta.govt.nz)).

Table 5-14: Issues and possible treatments for group riding

Issue	Possible treatments
In group riding situations there can be peer pressure for motorcyclists to ride above their abilities to keep up with the bunch.	Education should be provided as part of training packages and other campaigns. Talk to tour group facilitators.
Lack of communication between riders	Each riding group should have a basic set of hand signals so they can communicate with each other
Keeping the group together (stopping and leaving intersections, passing vehicles etc).	Group leader takes responsibility. If you are at the front of the group leave enough room for others to join.
Inexperienced riders failing to keep up with the rest of the group may lead to them feeling pressured to ride with the group and therefore ride outside of their comfort zones and experience.	Provide designated stopping or meeting places.
Inappropriate riding formation can reduce safety for all road users.	Riders should ride in a staggered formation (photo 21 and photo 22), with less experience riders on the left outside of the lane.

Lead rider should take responsibility.

Single formation should be considered in locations where it may be safer than staggered formation; such as when the group are turning, using off-ramps, passing slower vehicles, riding in areas of narrow lane widths or areas with parked cars.<sup>18</sup>



Photo 21: Photo: Group riding  
Source: [www.rideforever.co.nz](http://www.rideforever.co.nz)



Photo 22: Staggered formation  
Source: NZTA : official road code for motorcyclists

#### 5.4.6 Rider position on the road

As vulnerable road users, motorcyclists need to position themselves where they can be seen by other road users and see the road ahead of them. Along straight sections of the road, the rider will generally position themselves in the inside wheel track so they can be seen by other road users and see the road ahead of them. At curves, for a right hand curve the rider will initially position themselves in the left hand wheel track and on a left hand curve in the right hand wheel track. Issues and possible treatments related to rider position on the road are described in table 5-16.

Table 5-15: Issues and possible treatments for rider position on the road

Issue	Possible treatments
Motorcyclists tend to position themselves in the vehicle wheel track. At curves, this can be potentially hazardous as these wheel tracks will be the higher loaded wheel track for trucks and therefore potential for more damage to the road surface and pavement.	Provide wider shoulders where needed such as on approach to out of context curves on high risk or favoured routes. Apply appropriate speed management treatments and perceptual countermeasures (photo 25). Remove head-on risk where exposure is high through appropriate treatments such as wide centrelines (and median barriers). Rider education.

<sup>18</sup> <http://www.motorcyclebasics.com/group-riding.html>



Photo 23: Shoulder widening



Photo 24: Perceptual countermeasures to slow speeds on approach to an urban area ( Dragon's teeth) Charlton and Bass, (2006)



Photo 25: Speed threshold treatment on approach to Hamilton



Photo 26: Wide centreline. Source: Yvonne Forrest MOTO

## 5.5 Issue and treatments for vehicles (the motorcycle)

### 5.5.1 Maintenance

The following are issues and possible treatments related to maintenance of motorcycles:

Table 5-16: Issues and possible treatments for maintenance of motorcycles

Issue	Possible treatments
Poor vehicle maintenance (eg inadequate tyre tread and pressure, bearings, lights, brakes).	Education and information campaigns about importance of vehicle maintenance. Vehicle inspections on popular motorcycle routes.

### 5.5.2 Power to weight ratio's

A higher proportion of crashes involving large motorcycles (500 cc or larger) result in death rather than injury – riders of large motorcycles make up 41 percent of all casualties but 60 percent of deaths. This is partly a result of riding patterns<sup>4</sup>. Issues and possible treatments related to power-to-weight ratios of motorcycles are described in table 5-18.

**Table 5-17: Issues and possible treatments for motorcycle power to weight ratios**

Issue	Possible treatments
Limited capabilities in handling more powerful vehicles than experienced or trained in.	Changes to legislation and licensing: Note: recent legislation outlined in the Land Transport (Driver Licensing) Amendment Rule 2011 will include introducing a power-to-weight restriction for novice motorcycle riders. This replaces the current cc limit for novices. Learner motorcycle licence holders will only be able to ride motorcycles which do not exceed a power-to-weight ratio of 150 kilowatts per tonne.  Training and education.

### 5.5.3 Features

Issues and possible treatments related to motorcycle features are described in table 5-19.

**Table 5-18: Issues and possible treatments for motorcycle features**

Issue	Possible treatments
Ability to be installed and availability of safety technology (eg presence of ABS, stability control, and airbags and modulating headlights).	Promotion of new safety technology.  Enhance rules regarding safety features required on imported motorcycles in New Zealand.
Lack of conspicuity associated with motorcycles.	Modulating headlights.

## 5.6 Issues and treatments for speeds

Safe speeds are a fundamental issue with regards to motorcycling and all road user safety. Travelling at safe speeds for the conditions reduces the risk of losing control of your vehicle. If a collision occurs, the speed at which you were travelling prior to that collision determines the severity of the injury.

There are a number of other treatments relating to speed management in other parts of a Safe System that control speeds and reduce injury such as vehicle technology (see section 5.5), and issues for riders in general such as risk taking, and rider safety gear (see section 5.4).

Issues and possible treatments related to speeds are described in table 5-20.

**Table 5-19: Issues and possible treatments for speeds**

Issue	Possible treatments
Travelling too fast for the conditions.	Self explaining roads: appropriate signs and markings for certain hazards, ie at curve signs and edge marker posts to highlight design of curves (particularly those that are out of context).  Visible (targeted automated and non-automated enforcement).
Speeding (ie over the speed limit).	Visible (targeted automated and non-automated enforcement).
Posted speed limits that do not match the environment or risk.	Consider harm reduction and harm minimisation speeds.
Following distances.	Enforcement and education.

## 5.7 Issue and treatments for injuries

As discussed in section 3, motorcyclists are 18-20 times more prone to being killed or seriously injured than other road users. It is important that motorcyclists (and other road users) are aware of general crash scene and first aid procedures. Further information on this can be found at the ACC website 'ride forever' [www.rideforever.co.nz](http://www.rideforever.co.nz).

A summary of the issues and possible treatments related to motorcyclist injuries are described in table 5-21.

**Table 5-20: Issues and possible treatments for injuries**

Issue	Possible treatments
Personal responsibility.	Knowledge of first aid and general crash scene procedures.
Proximity of helicopter landing area.	First responder needs (golden hour).
Available mobile phone coverage.	increased coverage in lower population areas.

## 5.8 Road safety action planning

Road safety action planning is a world best-practice process for planning and implementing road safety interventions by road safety partners. Continued and enhanced road safety action planning is one of the essential platforms for delivering the Safer Journeys road safety strategy.

Effective road safety action planning requires a collaborative approach from participating partners to provide focus, commitment and urgency in order to address and mitigate road safety risks, especially in terms of Safer Journeys high priority road safety issues (speed, alcohol and drugs, motorcycling, young drivers and roads and roadsides) for the local area.

Participating partners include regional and local authorities, the NZTA, the NZ Police and the Accident Compensation Corporation (ACC), and other road safety stakeholders according to local enthusiasm. The partners agree on regional and/or local road safety risks, identify objectives, set targets, undertake road safety actions, and monitor and review progress towards road safety targets.

It is recognised that this guide is mostly focused on engineering treatments for roads and roadsides. However, the practitioner needs to consider a range of treatments to address the safety issues and concerns of key stakeholders.

Road safety action planning is the primary way to coordinate a Safe System approach to road safety problems at sub-regional levels and could be a key opportunity for all road safety partners to identify their motorcycle improvement projects. These plans can be referenced for any additional information on agreed measures at sites or routes of interest or updated as a result of Safe System investigations.

## 5.9 General crash reduction results

While this document does not go into detail about specific crash reduction percentages, a summary of some effectiveness of treatments on motorcyclist crash reduction has been developed by the IRAP programme<sup>19</sup> and is described in table 5-22. Further information and detailed crash reduction percentages for all road users can be found in the NZTA *High-risk rural roads guide*.

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<sup>19</sup> [www.toolkit.irap.org](http://www.toolkit.irap.org)

**Table 5-21: Possible crash reduction for motorcycle crash treatments**

Treatment	Crash reduction percentage	Treatment	Crash reduction percentage
Regulate roadside commercial activity	40	Road surface upgrades	25
Motorcycle lanes	40	Shoulder sealing	25
Restrict/combine direct access points	40	Service road	25
One way network	40	Realignment - horizontal	25
Roadside safety - hazard removal	25	Parking improvements	25
Central turning lane full length	25	Traffic calming	10
Intersection - turn lanes (unsignalised)	25	Intersection - grade separation	10
Intersection - signalise	25	Intersection - turn lanes (signalised)	10
Delineation	25	Realignment - vertical	10
Intersection - delineation	25	Speed reducing treatments	10

## 6 Understand the issues

As discussed in section 4, we have determined where our high-risk motorcycle routes/sites are by determining collective risk from crash data. This process worked predominantly on the basis of using high-severity crashes (ie fatal and serious injuries in urban areas and all injury crashes in rural areas) to determine our highest-risk routes or sites. It is important to provide further analysis on all crash data and other factors to better determine the safety problem and the most appropriate countermeasures for our treatment strategy.

### 6.1 Analysing the data

Motorcyclists require different skills to other road users such as effective braking, cornering and swerving (crash avoidance) and also need a highly developed sense of balance. How motorcyclists can achieve these safety needs are described in more detail in section 5.

Crash analysis is essential before choosing countermeasures. Using all the crash data rather than just the high-severity crashes provides a larger sample size to enable us to identify the risk issues and make more informed decisions on what type of countermeasures may be appropriate for any given route/site.

Risk analysis uses the crash prediction tools that identify the factors that may be contributing to crash risk. This may help supplement any detailed crash analysis

In these investigations the road safety practitioner should look to understand:

- crash patterns for both:
  - high-severity crashes, ie those resulting in death or serious injury, as they may differ from lower-severity crashes
  - all crashes (the inclusion of minor and non-injury crashes will better highlight spatial, temporal and crash movement commonalities or factor patterns)
- the spatial location of crashes - whether they are clustered or distributed
- key risk factors such as lengths, proximity to road users and severity of hazardous roadsides
- consistency of expectation and provision of road features and roadside infrastructure.

In addition to this section, it is recommended that the NZTA's *New Zealand guide to the treatment of crash locations* and Austroads: Part 8 *Treatment of crash locations* are referenced for additional details on diagnosing crash problems.

Other data that could help develop treatments would include changes to development/residential/commercial growth in the area, traffic volumes, and key stakeholder and community concerns.

Where pedestrians, cyclists and equestrians are present, the NZTA's draft non-motorised user review procedures should be consulted to assist in defining the issues.

### 6.2 Detailed crash analysis

To help understand the safety problems, a detailed analysis of the crash data is required. Although the CAS plain English and coded reports will assist, it is strongly recommended that the original traffic crash reports are analysed and reviewed, as these provide information not available in the summary reports.

The **general factors** that need to be understood are crash movement types, midblock versus intersections, direction of travel, temporal factors (day of week, time of day, month of year) and day or night.

The specific **roads and roadside factors** that need to be understood are straights versus curves, wet or dry road conditions, objects struck, and other road factors (such as surface material, sight distance).

Issues to consider in addressing these include consistency and readability of the alignment, signage and delineation, carriageway width, skid resistance, median treatments, and hazard removal, protection or mitigation.

The specific **speed factors** that will need to be understood include drivers travelling too fast for the conditions versus speeding (ie exceeding the posted speed limit) and time of day and traffic conditions for speed-related crashes.

The specific **road user factors** that need to be taken into consideration include their age, sex, licence status, and if alcohol, speed, fatigue or inattention was involved etc.

The specific **vehicle factors** that need to be understood are the age, type and condition of the vehicle.

When developing solutions, both crash data and road user information is needed to understand the level of use and road issues associated with motorcyclists both along and across the road corridor.

If crash analysis or community and key stakeholder feedback has identified that a significant number of motorcyclists use this route, then considering appropriate facilities for these types of road users is important when developing any treatment.

Motorcyclists have well-defined main crash types, with a distinct pattern (see section 3 for detailed crash types and issues for motorcyclists).

For further information and analysis on environmental factors (wet and dark crashes), other vulnerable road users (pedestrian and cyclists) can be found within the NZTA *High-risk rural roads guide*, NZTA's *Pedestrian and planning design guide* NZTA's website ([www.nzta.govt.nz](http://www.nzta.govt.nz)), and cycling aspects of Austroads guidelines.

# 7 Programme implementation, monitoring and evaluation

Monitoring targets for motorcyclists are currently included in the Safer Journeys strategy and are to reduce:

- fatal and serious injury crashes involving motorcycles and moped riders per 100,000 population
- motorcyclist and moped riders on learner or restricted licences at fault in fatal and serious injury crashes
- the number people killed or injured in motorcycle crashes per million hours spent travelling.

With the development of this document, additional monitoring targets were defined by analysis of motorcyclist crashes nationally and therefore identified as high risk. These targets include a reduction in:

- all injury crashes involving motorcyclist/mopeds in rural areas<sup>20</sup>.

## 7.1 Introduction

The focus of this document is to identify high-risk motorcycle routes and sites and develop countermeasures that reduce all injury (including fatal and serious) crashes along a route or at a site. Once these locations and measures have been identified, a suitable programme of implementation is important, along with a system to monitor the effectiveness of these countermeasures. 'The effectiveness of treatments guides investment in road safety programmes and reliable and accurate information will be necessary to determine the effectiveness of treatments'.<sup>21</sup>

This section looks at issues associated with developing programmes for treating high-risk motorcycle routes and sites and then monitoring the effectiveness of those programmes to:

1. identify the benefits and the effectiveness of the various treatments
2. identify the most effective packages of treatments
3. assess the levels of investment that may be required to achieve various levels of crash reduction
4. prove that funding has been invested wisely.

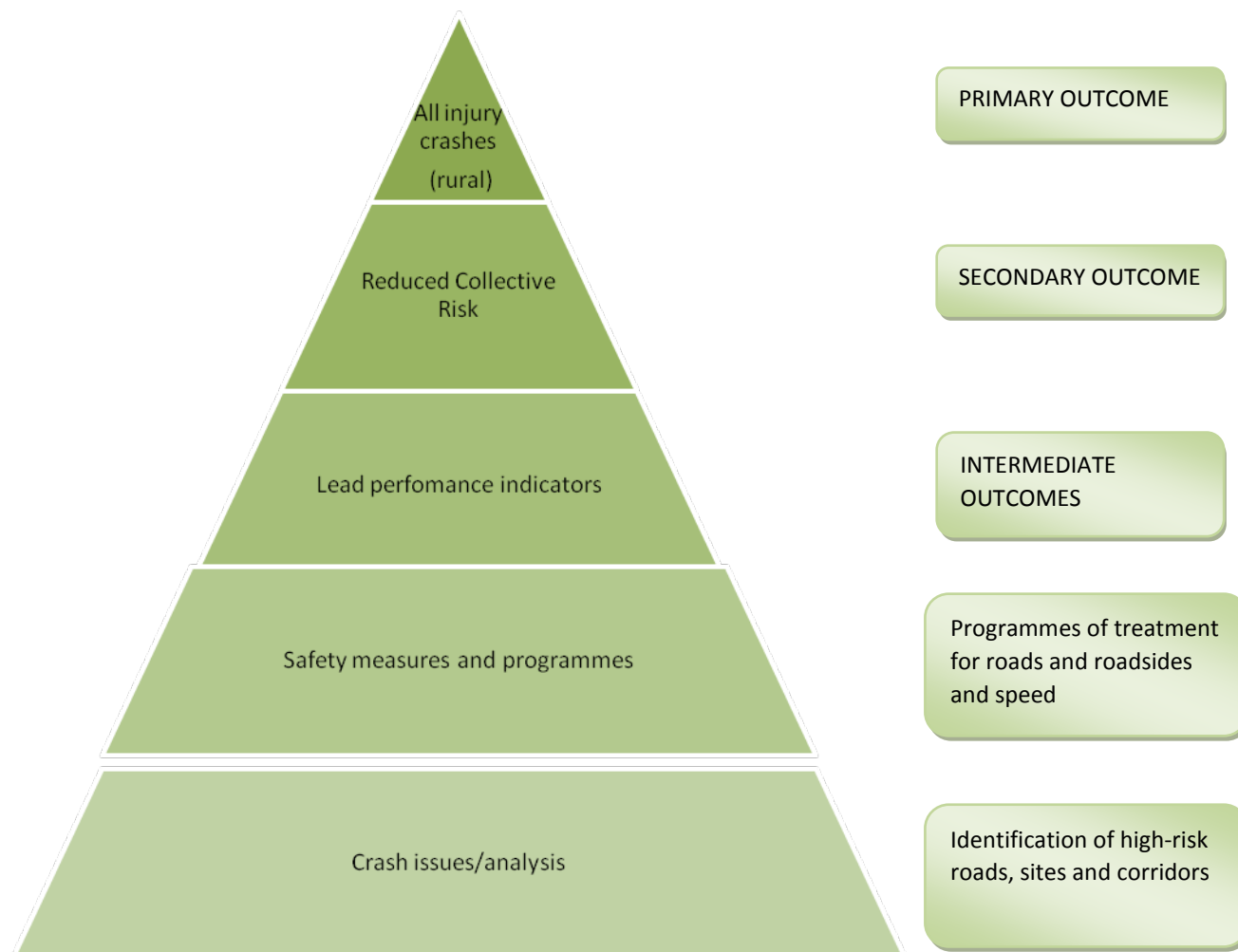
Figure 7.1 is a modified version of the safety management triangle. Working from the base up, the foundation of this triangle is the identification and analysis of crash issues, which would include the means of identifying high-risk motorcycle routes, corridors or sites (see section 4).

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<sup>20</sup> As previously stated urban targets are yet to be developed. This will be confirmed with the analysis completed and subsequent publication of the NZTA *High-risk intersection guide* ( see comment box in section 4.4.1)

<sup>21</sup> *National risk assessment model, program development and trials: interim report 2009/10*; ARRB

Figure 7-1: Road safety management triangle



Note: As previously stated, urban targets are yet to be developed. This will be confirmed once the analysis is completed and subsequent publication of the NZTA *High-risk intersection guide* (see comment box in section 4.1).

Having identified our sites/routes and clarified our safety concerns, this document discusses some possible treatments or strategies that could be used to improve the safety of our high-risk rural motorcycle routes, and reduce the risk of injury crashes, the primary outcome.

In an ideal world, the analysis of the effectiveness of each treatment or programme item would be assessed by applying only one specific treatment to a range of sites and monitoring the performance of the treatment over time, before applying the next treatment. However, in New Zealand, the number of people killed or seriously injured in any one location is too small while the risk of doing nothing could be too severe. Combined with the delays associated with the post-implementation data collection and the immorality of ‘playing with people’s lives’, this precludes such a purist approach. So in order to facilitate the necessary analysis, the road safety management triangle introduces the concept of intermediate and secondary outcomes.

In this section we begin by looking at the development of a programme of treatments, and how to establish the appropriate intermediate measures. We then look at the monitoring site-specific secondary and primary measures.

## 7.2 Programme development

It is important to remember that even though Safe System infrastructure measures are significantly beneficial, other low-cost safety management treatments still apply and are probably more appropriate on high-risk motorcycling routes.

The assessment of rural road risks in section 4 identifies the longer-term plan for a particular highway. In some regions there will be no rural road sections that have long term larger infrastructure or corridor improvements

planned and therefore a programme of ongoing safety improvement should be considered and tailored to fit the appropriate end game. Analysing the data and understanding the issues are important and are discussed in more detail in sections 5 and 6.

For more information on programme prioritisation, challenges to implementation and programme implementation refer to the NZTA *High-risk rural roads guide*.

### **7.2.1 Focus on incremental improvements across networks**

The focus for a programme of works should concentrate on incremental improvements across networks to help achieve larger benefit-cost ratios. So what are incremental improvements?

Having identified that a route may have plans for larger infrastructure/capital projects to produce a Safe System transformation (table 5-2), the end result has to some degree been confirmed. However, given the limited funding and associated priorities, together with the lead time associated with getting major infrastructure projects to construction (as a result of RoNs, Safe System, high-risk rural roads and other safety projects), doing nothing until that project eventuates continues to place motorcyclists at an increased risk of death or injury.

As responsible road safety practitioners and network managers, we need to consider this risk. Incremental improvements are viable if they:

- contribute to a reduction in the cost of the final project, ie providing incremental benefit and costs, or
- return an economic road safety benefit over the intervening period, ie between now and the realistic date for delivery of the major project.

If, however, the final solution involves a completely new alignment, any proposed works will have a reduced economic life and should be analysed over the pre-implementation period.

### **7.2.2 Consistency and road classification**

The road environment should provide the road user with strong indications with what to expect, how to behave and safe operating speeds. The consistency of road environment messages along the road corridor is important. These messages are delivered through the carriageway width, alignment, access management, signs and markings standards and other traffic control devices.

The basis for determining the service levels for both travel time and safety is the road hierarchy or for the state highway network, the recently published road classification. Hence, in developing road safety programmes, the road hierarchy needs to be considered and safety measures applied that are both appropriate and consistent with the road function and the traffic volumes it carries.

As well as determining the appropriateness of the safety measures, the road classification is likely to be a determinant in prioritisation for funding.

### **7.2.3 Driver awareness measures/self-explaining roads**

Driver awareness measures for self-explaining roads provide clear direction and unambiguous information to all road users which drivers can use to make decisions and modify their behaviour depending on the design and function of a road and the associated risks. These measures are more likely on routes where there are higher levels of personal risk but low to medium levels of collective risk.

## **7.3 Key stakeholder engagement**

### **7.3.1 General consultation and engagement**

It is vital to engage with key stakeholders (community, affected and interested parties) when developing projects in order to create a common sense of purpose, draw on and learn from other's perspectives, make better decisions, align mutual interests, identify and mitigate risks, and find shared solutions to challenges.

Relationship building, the basis for effective engagement, takes time. Many of the hallmarks of good relationships – trust, mutual respect and understanding – are intangibles that develop and evolve over time. Early engagement provides a valuable opportunity to set a positive tone with stakeholders from the outset of a project. The absence of established relationships and communication channels can put your project at an immediate disadvantage.

Establishing and maintaining good relationships requires a long-term view. Organisations that take this approach see the value of consistently following through on their commitments to stakeholders. They take grievances seriously and deal with them in a reliable and timely manner. They continually invest in communicating about their work in a way that makes sense to their stakeholders. Effective engagement and communication will ultimately ensure the project's success. Effective engagement and communication will ultimately ensure the project's success. See NZTA's *Effective engagement toolkit*.

As stated within the Austroads research report<sup>22</sup>:

An ideal consultation with road users and other stakeholders is one that:

- consists of a number of clearly defined stages, each with their own specific objectives
  - includes both external stages (ie those that include road users and stakeholders) and internal stages (ie that include employees of the road agency only)
  - is iterative in nature, that is, is part of an ongoing and iterative cycle of learning, refinement and improvement embedded within the development process rather than an isolated event that takes place externally to it.
- The development of levels of service and intervention criteria for maintenance and improvement activities through community consultation is complex and requires careful planning. The process consists of several iterative stages: listen, communicate, reflect and plan, implement, monitor and measure. The process alternates stages that involve the community with stages that require bi-internal agency assessment and evaluation. Each stage is conducted in a structured manner and requires specific techniques and specialised skills.
- The process begins with a two-way communication (listen and communicate) between the road agency and the community with the purpose of gaining a common understanding of community concerns, priorities, current road classification system and levels of service as well as agency issues, priorities and budget limitations. This part of the process also helps the development of a common language and the identification of the most effective channels for further communication of road maintenance issues. The two way communication establishes the foundation for a transparent and strong relationship between the road agency and the community.

### 7.3.2 Case study: Coromandel Loop Pilot project

A joint motorcycle pilot project with ACC and NZTA was recently undertaken within the Coromandel area. The purpose of the Thames-Coromandel pilot project is to determine and implement suitable interventions and road safety improvements for motorcyclists using the Safe System approach, with the intent of enhancing road safety and minimising motorcycle crash risk. This pilot route is a 130 km loop of state highways popular among recreational motorcyclists. This includes SH 25A Kopu to Hikuai, SH 25 Hikuai to Waihi, SH 2 Waihi to Paeroa and SH26 Paeroa to Kopu. (figure 7-2).

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<sup>22</sup> Community consultation process and methods for quantifying community expectations on the levels of service for road networks, AP-R290-06



Figure 7-2: Motorcycle pilot project route. Source: [www.nzta.govt.nz](http://www.nzta.govt.nz)

As part of that project the NZTA, MOTO and ACC commenced consultation with motorcycle groups both regionally and nationally who were encouraged to join in on a ride over the route and provide input to the project. In addition to the New Zealand key stakeholders, maintenance teams and local safety coordinators, a number of international motorcycling experts from VicRoads and Monash University were invited to help identify safety issues and recommend suitable interventions. As a result of that ride over, a list of issues and possible solutions were raised.

The process of engagement with the community and motorcycle groups was a vital part of this project. Further encouragement and opportunity was provided by the project team for motorcyclists to provide feedback on their ride over or general comments regarding the route via an information centre set up on the day or adding comments to a specific project web pages managed by ACC and MOTO.

## 7.4 Monitoring and evaluation

Monitoring and evaluation of Safe System treatments is important in gauging the effectiveness of different treatments. This is also important when developing types of countermeasures for specific issues and implementation procedures for future programmes. Specifically:

- **Monitoring** involves an assessment of progress and collecting information through the course of a project, can be before, during and after to gather results for which to do an evaluation (see section 7.3.1).
- An **evaluation** analyses the results of monitoring and determines the results and effectiveness of the types of treatments used (see section 7.3.2).

### 7.4.1 Monitoring

Monitoring and collection of data for evaluation will help to identify if road safety has been improved. 'Systematic recording of data and analysis of trends from which goals and targets (see section 7.3.3) can be calculated allows the most recent values of measures and their trends to be compared with target levels.'<sup>23</sup>

### 7.4.2 Evaluation

As stated in Austroads report ST 1571<sup>24</sup> the role of evaluation is to:

- ensure that recently delivered programmes are effective and enable remedial action if they are not
- build up a reliable knowledge base about the effectiveness of different interventions, which will allow more effective programmes to be developed in the future.

There are effectively two levels of monitoring and evaluation:

<sup>23</sup> Guide to road safety part 2: Road safety strategy and evaluation

<sup>24</sup> Turner, B., Jurewicz, C. et al. National risk assessment model, program development and trials; interim report 2009/10;

- Strategic monitoring and then evaluating the effectiveness of the overall programme or strategy, which is made up of various projects or initiatives.
- Individual monitoring and evaluating of specific projects or initiatives that makes up the overall programme or strategy.

While good monitoring and evaluation will support future road safety improvement programmes, the monitoring and evaluation effort should not consume excessive amounts of staff time or other resources that could be used to undertake more road safety initiatives. As a general observation, many people and organisations undertake little or no monitoring, while others seek to monitor an extraordinary number of items, arguing that the various measures do not take account of every minute impact.

In the following sections we look at the monitoring and evaluation of individual initiatives or projects and then the monitoring of the overall strategy.

For further information of evaluation of treatments, evaluation methods refer to the NZTA high-risk rural roads guide.

#### 7.4.2.1 CAS monitoring, data requirements

The key to effective evaluation of specific works is to ensure the data required for evaluation of individual projects, treatments or initiatives is collected over the course of the programme and staff are not faced with the arduous task of trawling back through project files to identify when and which works have been completed.

The best way of addressing this issue is to ensure the project monitoring is stepped up at the start of a project and, as discussed above, the entering of monitoring data forms part of the contract, inhouse service agreement or task plan for the works. This is best done using the Crash Analysis System (CAS).

CAS has the ability to record three types of site:

- **Sites of interest** (figure 7-3) – these are simply locations that users can identify spatially and for which crash data can be recalled. Once recalled the user can then analyse the effects of a programme of works. Recording works as sites of interest relies on recording key data about the works undertaken elsewhere, so sites of interest may be useful when monitoring areas to determine ongoing trends, whether these are related to improvement programmes or not.
- **Safety improvement projects or crash reduction monitoring sites** (figure 7-4 and figure 7-5) – these two types of site are essentially the same in terms of the inputs required. The first data entry screen (figure 6-3) allows the user to input site description data (the sites are spatially defined later in the process).

Figure 7-3: CAS sites of interest

Site of Interest Entry

Page 1

Study Name [dropdown]  
 Type: Sites of Interest ID [dropdown]  
 Owner [text]  
 User [text] Status: Public [dropdown]

Site Name [text]  
 Number [text] ID [text]  
 Owner [text]  
 User [text] Status: Public [dropdown]

Road Type: 1=Local 2=SH Transit NZ Region No. [text]  
 Site Implemented Date [text] YYYYMMDD

Local Authorities [dropdown] [dropdown] [dropdown]

Urban/Rural  U/R

Data Checks Save Cancel/Exit Help

Entering New Site

Figure 7-4: Monitoring site data entry screen 1

Monitoring Site Entry

Page 1 | PDR

Study name [dropdown]  
 Study Period (years)  
 Injury Data [text] - [text] Non-Injury Data [text] - [text]

Location name [text]  
 Location no. [text] Report Date [text] (YYYYMM)

Road type:  Local road  State highway  
 TNZ region [dropdown]

Local Authorities [dropdown] [dropdown] [dropdown]

Location type:  Intersection  Non-intersection  Route  Area

Site specific location type [dropdown] Other [text]  
 Speed limit [text]  
 Road classification [dropdown]

Roadside development:  Rural  Residential  Industrial  Commercial  Recreational  School  Other

Environmental changes/unusual conditions [text area]

Data Checks Save Cancel/Exit Help

Entering New Site

Figure 7-5: Monitoring site data entry screen 2

The screenshot shows a software window titled "Monitoring Site Entry" with a "Page 1 PDR" tab. The main area is divided into several sections:

- PROBLEM CODING:** A table with columns "Prob No", "Crash Type", and "Details Optional". Row 1 has a red bar under "Crash Type".
- RECOMMENDATIONS:** A table with columns "Action No", "ACTION OBJECT Code", "Traffic Sign Code", and "Effect" (1 Major, 2 Minor, 3 None). Rows 1-15 are visible.
- LINKING:** A table with columns "Links to Problem(s)".
- IMPLEMENTATION:** A table with columns "Status" and "Date YYYYMM".
- COSTINGS:** Fields for "Estimated \$" and "Actual \$".
- CRASH DATA:** Fields for "Injury" and "Non-Injury" counts, and a "Description of addressed crashes" text area.
- Stop Monitoring Date:** A field with "YYYYMM" format.
- Buttons:** "Delete Problem", "Data Checks", "Save", "Cancel/Exit", "Help".
- Status Bar:** "Entering New Site".

The second screen is used to identify the crash issues at the site and explicitly links the proposed solutions to the problems and the expected crash savings. While entering projects as safety improvement projects or monitoring sites involves a larger amount of more detailed data, monitoring site performance data automatically adjusts for potential regression to the mean impacts.

It is, however, important to recognise that, under the Safe System approach, we are looking toward more proactive treatment, rather than waiting for crash histories to develop, and implementing synergetic corridor treatments to increase consistency. It is therefore quite likely that in some situations works will be undertaken with a view to decreasing risks rather than to treat a documented crash history.

In such situations crash performance monitoring may well be invalid because of a lack of a 'before' crash risk. In these situations we need to monitor and evaluate our programme as a whole, or develop some other key performance measures.

### 7.4.3 Monitoring and evaluation performance measures

Referring back to figure 7-1, three types of road safety measures are available for monitoring and evaluation:

- **Primary outcomes** – the reduction in the number of motorcyclists injured in rural areas as a result of road trauma.
- **Secondary performance measures**, such as reductions in the collective risk. They can be measured in terms of reported crash numbers and patterns of crash types and factors.
- **Lead performance indicators** or intermediate measures describing the improvements to the road, road environment, speed or other features that have a known impact on road safety, eg the increasing investigatory levels to reduce loss of control crashes. These output measures are known to directly impact safety outcomes.

The latter are particularly important as stated in the OECD report<sup>25</sup>:

‘for a Safe System approach there is a need to switch from injury based data (final outcomes, such as traditional performance measures) to performance data (intermediate outcomes, such as lead performance indicators). Intermediate outcomes are on the basis that 100% achievement of safety performance is required in various sub targets.’

#### 7.4.3.1 Primary outcomes

The primary outcome target is the **reduction in injuries in rural areas**<sup>26</sup> over the highest-risk routes and intersections that contribute most to the total across the network.

#### 7.4.3.2 Secondary performance measures

This performance measure relates to reducing the crash risks on the network and on each high-risk rural route or intersection. Indicators could be reductions in all recorded crash types or particular subgroups:

Key secondary performance measures based on actual risk (crash data) could include a reduction in:	Key secondary performance measures based on predictive risk analysis may include a reduction in:
overall collective risk	the length of route (through realignment)
number and severity of loss of control crashes	
number and severity of intersection crashes	
number and proportion of crashes in the wet	
injuries to motorcyclists	

#### 7.4.3.3 Lead performance indicators

The smartest and most relevant lead performance indicators will relate most directly to the change in collective crash risk that is associated with improvements in the feature being assessed. Key lead performance indicators to benefit motorcyclists may include:

Key lead performance indicators
Proportion of highway (or travel on highways) with roadside barriers or hazard reduction
Proportion of highway (or travel on highways) with sealed shoulder widths of at least 1m
The length of routes subject to speed zoning below the default limit or under active speed management.
The change in network mean and/or 85th percentile speed (measured by the MoT)
The change in centreline or edge line encroachments

### 7.4.4 Goals and targets

Depending on which lead performance indicators are being used to monitor the effectiveness of the ongoing programme of safety improvements, goals can be set for one or more lead indicators. However, in all cases the goals should be:

<sup>25</sup> The Safe System approach: Towards zero ambitious road safety targets and the safe system. OECD International Transport Forum, Transport Research Centre, 2008

<sup>26</sup> As previously stated urban targets are yet to be developed. This will be confirmed with the analysis completed and subsequent publication of the NZTA high-risk intersection guide (see comment box in section 4.1)

- crash patterns for both:
  - high-severity crashes, ie those resulting in death or serious injury, as they may differ from lower-severity crashes
  - all crashes (the inclusion of minor and non-injury crashes will better highlight spatial, temporal and crash movement commonalities or factor patterns)
- the spatial location of crashes – whether they are clustered or distributed
- key risk factors such as lengths, proximity to road users and severity of hazardous roadsides
- consistency of expectation and provision of road features and roadside infrastructure.

#### 7.4.4.1 Goals – Primary outcomes

To achieve the vision of ‘A safe road system increasingly free of death and serious injury’, the key road safety issues have been addressed with the following goals. The goals in this document are consistent with the purpose and vision of providing a Safe System. The goals will contribute to achieving district, regional and national targets as outlined in the Safer Journeys strategy to 2020.

Goals are based largely on the primary outcomes, ie to reduce the:

- number of injury (including fatal and serious) motorcyclists crashes for rural areas<sup>27</sup>
- collective risk levels
- loss of control (run-off road) and intersection type crashes.

#### 7.4.4.2 Targets – Secondary outcome and lead performance indicators

Targets are those quantitative and measurable indicators that determine the effectiveness of the countermeasures. In addition to meeting the goals of primary outcomes, the following targets are based largely on the definitions of a high-risk motorcycle routes that have been determined through actual crash risk. Each road controlling authority (RCA) should develop a list of targets on key crash types and determine the appropriate reduction in motorcycle crashes over a certain period of time. To achieve a Safe System, the focus should be on the following:

- Increase the proportion of highway (or travel on highways) with:
  - roadside barriers or hazard reduction
  - sealed shoulder widths of at least 1m.
- The change in network mean and/or 85th percentile speed (measured regionally by the Ministry of Transport).

Targets should be:

- relevant
- measureable, and
- most importantly, achievable.

#### 7.4.5 Responsibilities for monitoring and evaluation

The responsibility for monitoring and evaluation at the highest level lies with the Ministry of Transport, which monitors the national trends in the numbers killed or seriously injured – the primary outcomes. However, the various RCAs should also be monitoring these primary outcomes for their respective networks. Where large networks, eg the state highway network or Auckland City, have been divided into sub-networks, the roading manager should also monitor the primary outcomes.

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<sup>27</sup> As previously stated, urban targets are yet to be developed. This will be confirmed with the analysis completed and subsequent publication of the NZTA *High-risk intersection guide* ( see comment box in section 4.1)

RCAs should also be monitoring the secondary outcomes, related to collective and personal risk, patterns of crash types and factors and changes in the risk profile of the routes and intersections being targeted.

RCAs will also focus on lead performance indicators as the measure of the work they are performing towards Safe System goals.

## 8 Other information sources

Document/reference	Website information (if any)
<i>Safer Journeys: New Zealand's road safety strategy 2010–2020</i> . Ministry of Transport, March 2010	<a href="http://www.transport.govt.nz/saferjourneys/Pages/default.aspx">www.transport.govt.nz/saferjourneys/Pages/default.aspx</a>
<i>Traffic control devices manual</i> . NZ Transport Agency	<a href="http://www.nzta.govt.nz/resources/traffic-control-devices-manual/index.html">www.nzta.govt.nz/resources/traffic-control-devices-manual/index.html</a>
Traffic Control Devices Rule and Traffic note. NZ Transport Agency	<a href="http://www.nzta.govt.nz/resources/results.html?catid=2">www.nzta.govt.nz/resources/results.html?catid=2</a>
Kiwi Road Assessment Programme (KiwiRAP). New Zealand Joint Agency	<a href="http://www.kiwirap.co.nz">www.kiwirap.co.nz</a>
<i>The handbook of road safety measures</i> . Elvik, 2004	<a href="http://books.google.com/books/about/The_handbook_of_road_safety_measures.html?id=f4NUAAAAMAAJ">http://books.google.com/books/about/The_handbook_of_road_safety_measures.html?id=f4NUAAAAMAAJ</a>
<i>Towards zero: Ambitious targets and safe system approach</i> . OECD, 2008	<a href="http://www.internationaltransportforum.org/jtrc/safety/targets/O8TargetsSummary.pdf">www.internationaltransportforum.org/jtrc/safety/targets/O8TargetsSummary.pdf</a>
<i>Motorcycle crashes into roadside barriers stage 1 and stage 2 reports</i> . (Monash Uni Study)	
Berg, F. A., Rucker, P., Gartner, M., Konig, J., Grzebieta, R., & Zou, R. (2005). <i>Motorcycle impact into roadside barrier- real-world accidents studies, crash tests and simulations carried out in Germany and Australia</i> in Proceedings of the 19th International Conference on the ESV, Washington: USA. pp.1-13	
<i>Evaluation of the safety impact of centre-of-the-road wire rope barrier (WRB) on undivided rural roads</i> . (Austroads AP-T135/09)	
Scooter survival (Accident Compensation Corporation <a href="http://www.scootersurvival.co.nz">www.scootersurvival.co.nz</a> )	
Ride forever (Accident Compensation Corporation: <a href="http://www.rideforever.co.nz">www.rideforever.co.nz</a> )	
The official New Zealand road code for motorcyclists (NZ Transport Agency: <a href="http://www.nzta.govt.nz">www.nzta.govt.nz</a> )	
<i>Motor vehicle crashes in New Zealand, 2010</i> . Ministry of Transport.	( <a href="http://www.transport.govt.nz/research/Pages/MotorVehicleCrashesinNewZealand2010.aspx">www.transport.govt.nz/research/Pages/MotorVehicleCrashesinNewZealand2010.aspx</a> )