

## **Auckland Transport Rural Road Signage and Delineation Plan**

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## ABSTRACT

The signage and delineations treatments in the greater Auckland area is a legacy from seven councils who were Road Controlling Authorities (RCA) before Auckland Transport was formed. The legacy councils signed and delineated their network differently from one another and this has contributed to the inconsistent signing and delineation across Auckland.

The Rural Road Signage and Delineation Plan (RRSDP or 'the plan') has been prepared by AT with the aim of highlighting bends in a consistent manner to approaching drivers.

This plan has been developed based on the safe system approach with a core focus on safe road and roadsides. This methodology allows practitioners to quickly analyse the rural road network and to provide a standardised methodology of progressive and consistent signing and delineation in line with principles used in the Manual of Traffic Signs and Markings (MOTSAM) and the NZ Transport Agency's State Highway Geometric Design Manual.

The aim of this plan is to provide road users with a consistent series of messages about the severity of approaching bends and other hazards and allow them to negotiate them in a safer manner, thereby reducing casualty on the rural road network

It is also anticipated that this methodology will provide significant time and cost saving through the investigation and design process.

The plan is a mass action treatment for the whole of Auckland Transport's rural road network. The treatments sits under the safety management treatment philosophy and is anticipated to cost approximately \$10,000 per km. An assumption of 20-25% casualty reduction is expected once the plan has been fully implemented.

Assuming a 20-25% crash saving, the payback period for the project will be in the region of 6 to 8 months. However the payback period will be shorter if greater crash reduction is achieved through the implementation of the scheme.

## INTRODUCTION

In November 2010, Auckland Transport (AT) was formed as a council-controlled organisation of Auckland Council. Through the amalgamation process AT was delegated responsibility for the safe and efficient management of Auckland's transport network.

Prior to the formation of Auckland Transport, each council signed and delineated their network differently from one another and this has contributed to inconsistent signing and delineation across Auckland Transport's (AT) rural road network. This is particularly evident at bends and increases the risk of loss of control type crashes through drivers misinterpreting the road environment.

The Rural Road Signage and Delineation Plan (RRSDP or 'the plan') has been prepared by AT with the aim of highlighting bends in a consistent manner to approaching drivers. The plan is one of a number of initiatives to reduce road trauma on AT's rural road network. The plan's focus aligns with the most recent Safer Journeys Action Plan (2016 to 2020) which seeks to identify low cost safety improvements to address risks on local rural roads.

In accordance with the NZ Transport Agency 'High Risk Rural Roads Guide':

- A rural road is a motorway, state highway, expressway, local road or private road with a speed limit greater than 70km/h.

This plan has been developed based on the safe system approach with a core focus on safe road and roadsides.

## ISSUES

The project was initiated due to the following emerging issues:

- The signage and delineation regime across AT's rural road network varies considerably. This is due to the previous eight councils / road controlling authorities (RCA) having individual and different approaches to signing and delineating on their network.
- On some routes it is apparent that crash reduction study's (CRS) focusing on identified crash cluster sites have been undertaken, resulting in individual bends being substantially over treated with enhance signage and delineation in isolation. Other nearby corners of a similar severity have been ignored because there had been no complaints or collision history at them. These CRS have produced a significant reduction in crashes at treated bends but as time progressed, we have seen an increase in Death and Serious injuries (DSi) at untreated locations where there has been no previous crash history. The inconsistent signage may have led to crash migrations.
- The High Risk Rural Road Guide produced by the NZ Transport Agency (NZTA) states that crashes in the rural road network are typically highly dispersed. This is borne out in Auckland, where approximately 37% of DSI's on the rural road network have occurred at locations where no other injury crashes has been recorded in the past five years.
- A substantial number of injury collision occur on AT's rural road network including 22% of all DSI's from 2011 to 2015.
- There is an increasing upward trend in the total number of death and serious injuries on AT's rural road network.
- Increasing urbanisation in the rural areas is putting pressure on the existing road network by increasing traffic volumes and crash risk exposures. The drivers on this network anecdotally are moving from urban road environments to rural with extended travel distances, higher speeds and less forgiving roads.
- Through the development of the Safe Roads for Auckland Strategy, the RoadSafe Auckland Executive have identified High Risk Rural Roads as an area for increased focus over the next four years. This focus aligns with the most recent Safer Journeys Action Plan (2016 to 2020) which seeks to identify low cost safety improvements to address risks on

local rural roads.

- Route studies have been undertaken for a large portion of AT's high risk rural road corridors. This has seen an increase in safety performance on these routes however there appears to have been an increase in injury crashes on routes that have been designated as having medium risk to road users. If only the high risk roads are targeted as at present, with the provision of enhanced signage and delineations, other lower risk routes are likely to have a different signage and delineation regime. As such, there is the potential that some drivers may get confused when they travel from a high risk road, which has been well signed and delineated onto an equivalent road with a lower crash risk and does not have the same level of advance warning provided.

## CRASH STATISTICS

For the 5 year period between 2011 and 2015 there have been 1,438 injury collisions on Auckland Transport's network with a speed limit greater than 70 km/h. Of these, 61 were fatal crashes and 290 were serious crashes (Figure 1). This resulted in 64 people being killed and 345 seriously injured (409 DSI's).

There have been a decrease in death and serious injuries in 2014, however as shown in Figure 2, the overall DSI trend is increasing.

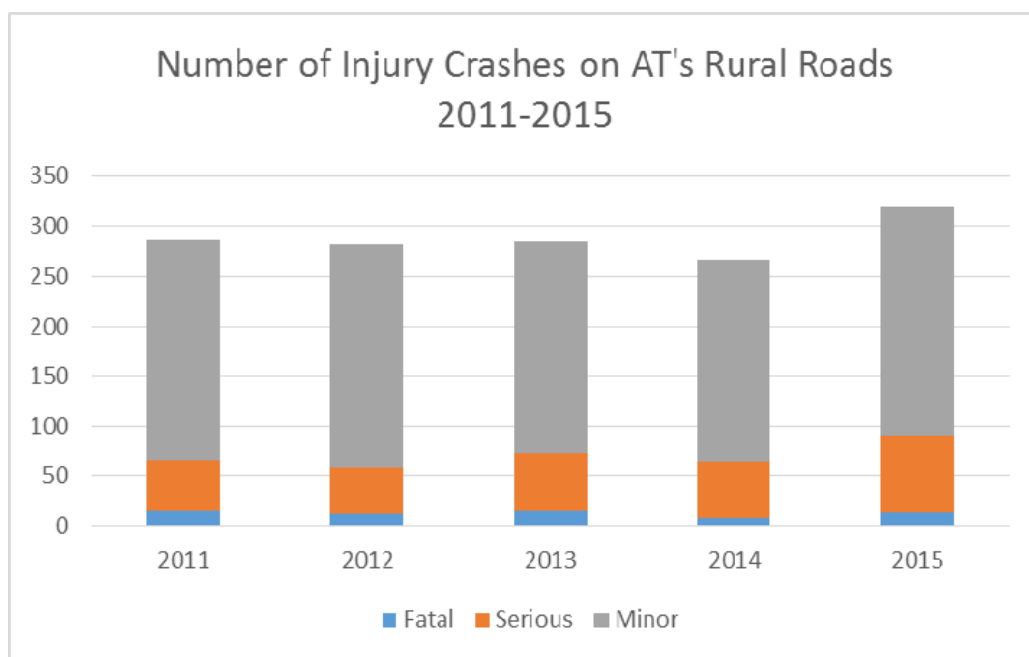


Figure 1 – Graph showing the number of injury crashes on AT's rural roads (2011 – 2015).

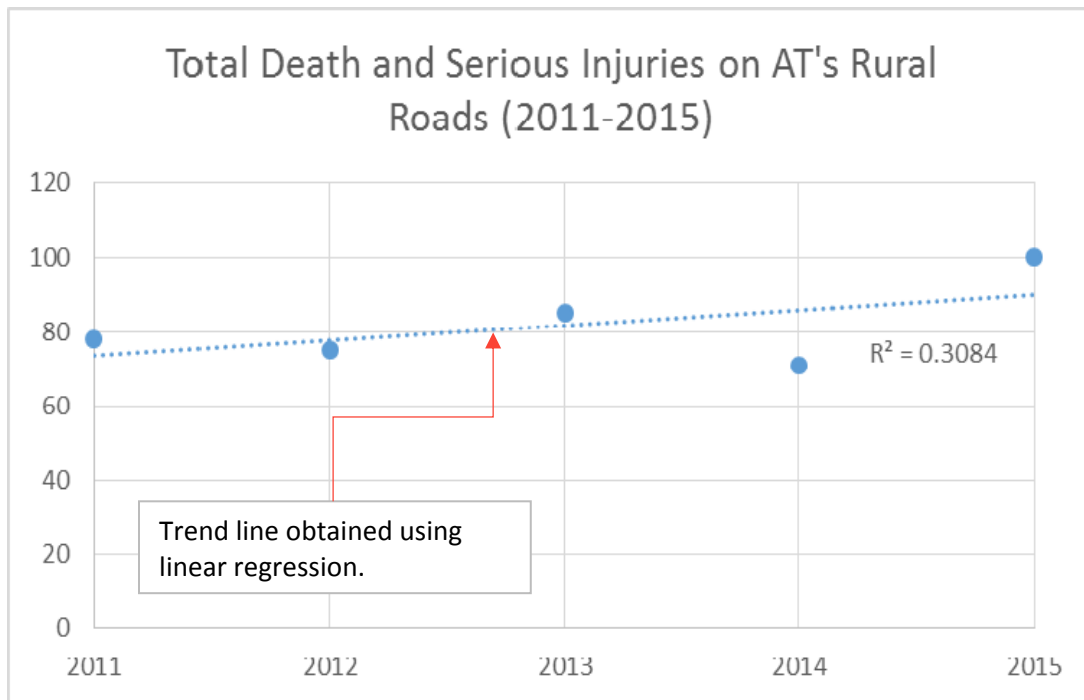


Figure 2 – Graph showing the total death and serious injuries on AT’s rural roads (2011 – 2015)

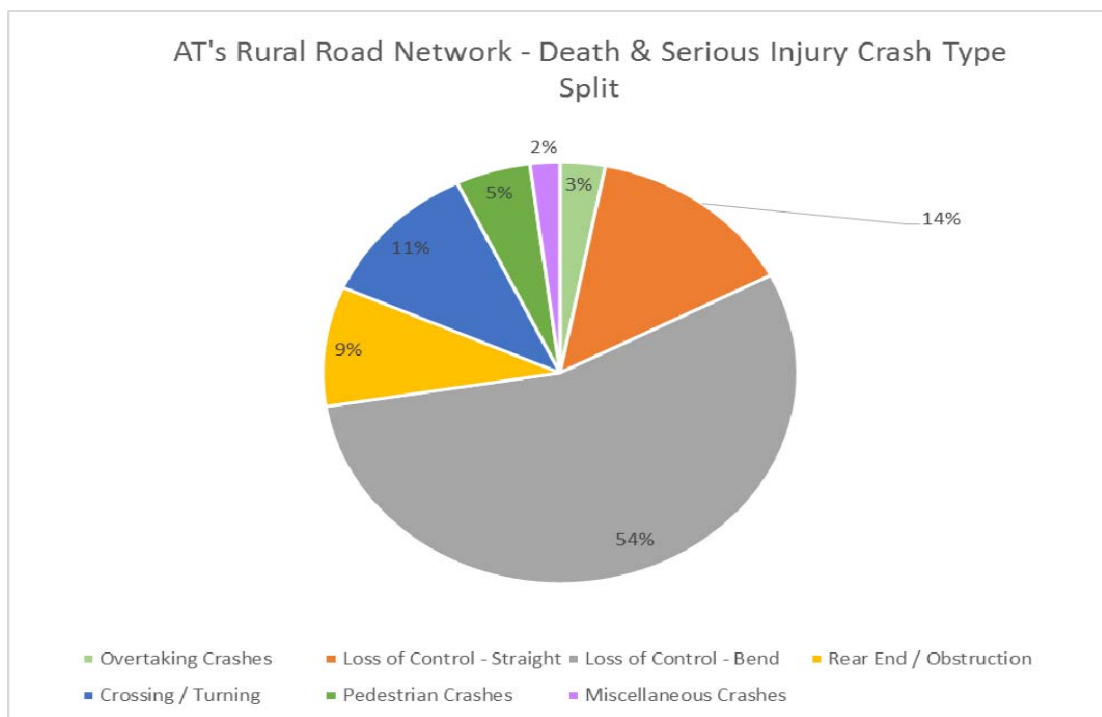


Figure 3 – Graph showing the crash type percentage split on AT’s rural road network (2011 – 2015).

As can be seen in Figure 3, loss of control crashes are the most common type crashes on AT’s rural road network. It accounts for 68% of death and serious crashes on AT’s rural road for the period 2011-2015. A large proportion (54%) of these loss of control type crashes occurred on a bend.

## OBJECTIVES

The objectives of this plan are to:

- Significantly reduce the number of casualties which have occurred from crashes over the length of the route as a result of improved signage and delineation.
- Provide drivers with a consistent message regarding the severity of the bends across the entire Auckland rural road network.
- Develop a methodology that can be adopted by Auckland Transport and other road controlling authorities to consistently delineate the network. This methodology will deliver substantial time and cost savings to designers and RCA's.

## METHODOLOGY

This plan has been developed using the NZ Transport Agency's State Highway Geometric Design Manual (SHGDM) and Manual of Traffic Signs and Markings (MOTSAM). A critical element in the development of this plan uses the design / operating speed of the route.

As per NZTA SHGDM, the design speed / operating speed is defined as the speed applied to individual elements which make up a road alignment. It must be a speed that is unlikely to be exceeded by most drivers and should not be less than the estimated 85<sup>th</sup> percentile of the speed distribution.

This methodology operates on the principal of determining the difference in the actual operating speed of a section of road when compared to what the design speed would be for the individual bends based on their measured radii. This allows a quantitative assessment to be made as to how much it is 'out of context' when compared with the operating speed of a route.

The greater the difference in the actual operating speed of the straight on a route when compared to the design speed of an individual curve, the greater the level of delineation that will be required to appropriately inform drivers of the severity of the bend.

The differences in the overall operating speed of the route when compare to individual curve elements are grouped within 10 km/h bands.

The vertical alignment of the route is not considered as part of this methodology, however designer / engineer should undertake site visit during the design process. Any signage / delineation required for substandard vertical alignment should be identified and incorporated at this time.

## RURAL ROAD SIGNAGE AND DELINEATION PLAN




There are four levels of signage and delineation treatments in this plan (Table 1). For signage, this plan has been based on the signage hierarchy contained in MOTSAM (Page 6-95a May 2008 and Appendix A3). For edge marker post (EMP) spacing, refer to MOTSAM Table 5.2 and Table 5.4 for rural road with traffic volume less than and greater than 1,500 vehicles per day respectively.



The curves are categorised from 1 to 4, with curve 1 having a 10km/h difference in operating speed and curve 4 being greater than 30 km/h difference.

The level of delineation gradually increases from edge and centre line for category 1 bends to closely spaced edge marker posts, advance warning signs, chevrons speed advisory signs and RRPMS for category 4 curves.

In addition, Category 3 and 4 curves will require a side thrust gauge speed survey to determine if speed advisory speed is warranted and if so, what the speed advisory would be.

**Table 1 Rural Road Signage and Delineation Plan**

<p><b>Category 1</b> (0-10 km/h out of context)</p>	<p><b>Collector Road (see Note 1)</b></p> <ul style="list-style-type: none"> <li>100 mm edge line and centre line</li> <li>Edge Marker Posts</li> <li>Bi-directional RRPMS on centre line @ 20 m spacing</li> </ul> <p><b>Arterial Road</b></p> <ul style="list-style-type: none"> <li>150 mm edge line and centre line</li> <li>Edge Marker Posts</li> <li>Bi-directional RRPMS on centre line @ 20 m spacing</li> </ul>	
<p><b>Category 2</b> (10-20 km/h out of context)</p>	<p><b>Collector Road (see Note 1)</b></p> <ul style="list-style-type: none"> <li>100 mm edge line and centre line</li> <li>Edge Marker Posts</li> <li>Bi-directional RRPMS on centre line @ 20 m spacing</li> <li>Curve Warning Sign</li> </ul> <p><b>Arterial Road</b></p> <ul style="list-style-type: none"> <li>150 mm edge line and centre line</li> <li>Edge Marker Posts</li> <li>Bi-directional RRPMS on centre line @ 20 m spacing</li> <li>Curve Warning Sign</li> </ul>	
<p><b>Category 3</b> (20-30 km/h out of context)</p>	<p><b>Collector Road (see Note 1)</b></p> <ul style="list-style-type: none"> <li>100 mm edge line and centre line</li> <li>Edge Marker Posts</li> <li>Bi-directional RRPMS on centre line @ 20 m spacing</li> <li>Red mono-directional RRPMS on left hand edge line around curve @ 20 m spacing</li> <li>Curve Warning Sign with PW 67 Chevrons (with speed advisory if required)</li> </ul> <p><b>Arterial Road</b></p> <ul style="list-style-type: none"> <li>150 mm edge line and centre line</li> <li>Edge Marker Posts</li> <li>Bi-directional RRPMS on centre line @ 20 m spacing</li> <li>Red mono-directional RRPMS on left hand edge line around curve @ 20 m spacing</li> <li>Curve Warning Sign with PW 67 Chevrons (with speed advisory if required)</li> </ul>	
<p><b>Category 4</b> (&gt;30 km/h out of context)</p>	<p><b>Collector Road (see Note 1)</b></p> <ul style="list-style-type: none"> <li>100 mm edge line and centre line</li> <li>Edge Marker Posts</li> <li>Bi-directional RRPMS on centre line @ 20 m spacing</li> <li>Red mono-directional RRPM on left hand edge line around curve @ 20 m spacing</li> <li>Gated Curve Warning</li> </ul>	<p>4.1</p> 

Signs (with speed advisory signage) and Chevrons Arterial Road <ul style="list-style-type: none"> <li>• 150 mm edge line and centre line</li> <li>• Edge Marker Posts</li> <li>• Bi-directional RRPMS on centre line @ 20 m spacing</li> <li>• Red mono-directional RRPMS on left hand edge line around curve @ 20 m spacing</li> <li>• Gated Curve Warning Signs (with speed advisory signage) and Chevrons</li> </ul>	<b>4.2</b> 
	<b>4.3</b> 

Note 1

- In general, road marking and delineation devices (EMP, Signage and RRPM) are not recommended on roads with a traffic volume less than 1,000 vehicles per day and sealed width less than 5.5 m. They may however be considered over sections where there is a crash history indicating a need for additional road marking and delineation devices.
- In general, edge marker posts only are recommended on roads with a traffic volume of more than 1,000 vehicles per day but with a sealed width less than 5.5 m. Other road marking and signage could be considered over sections where there is a crash history indicating a need for additional road marking and delineation devices.

Table 2 below details the radii ranges between which the above categories of treatment should be used relative to the particular design speeds. These values have been extracted / extrapolated from NZTA’s SHGDM Figure 4.17.

**Table 2**

Operating /Design Speed (km/h)	100	90	80	70	60	50
Category 1 (0-10 km/h out of context)	810-570 m	570-350 m	350-230 m	230-160 m	160-110 m	110-71 m
Category 2 (10-20 km/h out of context)	570-350 m	350-230 m	230-160 m	160-110 m	110-71 m	71-47 m
Category 3 (20-30 km/h out of context)	350-230 m	230-160 m	160-110 m	110-71 m	71-47 m	47-32 m
Category 4 (>30 km/h out of context)	<230 m	<160 m	<110 m	<71 m	<47 m	<32 m



## COST & EFFECTIVENESS

The installation of the signage and delineation infrastructure recommended by this plan is estimated to cost on average \$10,000 per km. This includes the necessary supply and installation of edge marker posts, signage, raised reflective pavement markers, road marking and traffic management. This assumes that there is no existing signage and delineation in place. If signage and delineation is already present, cost will be lower than the estimated \$10,000 per km.

Future maintenance budgets will also need to be allowed for to ensure that level of signage and delineation is kept to a legal and adequate standard.

In terms of its effectiveness, the NZ Transport Agency's High Risk Rural Road Guide estimates that the percentage of collision reduction for the remedial measures suggested by this plan will be as follows:

- Edge lines: 8 – 35% reduction in total crashes.
- Edge Marker Posts: 30% crash effectiveness
- Curve Warning Signs
  - 40.8% reduction in crashes with the use of both curve warning and chevron signs.
  - 20-57% reduction in total crashes.
- Centreline: 25 – 40% reduction in casualty crashes
- RRPM: 5% reduction in crashes

Similar road marking and delineation plans have also been implemented internationally of which details of two are given below:

- United Kingdom - the Royal Society for the Prevention of Accidents found that improved signing and delineation in Oxfordshire at 102 locations reduced injury collisions at these sites by 20%.
- Scotland - South Lanarkshire Council treated 25 routes and achieved a 64% reduction in injury collisions. Injury crashes on the routes reduced from 66 per year to 24 per year post implementation. (South Lanarkshire Council info – the 2011 Chartered Institution of Highways and Transportation Awards (UK). RoSPA info is available on the RoSPA website)

Based on the NZ Transport Agency's High Risk Rural Road Guide, it is estimated that through the implementation of this plan, an average 20 – 25% reduction in the number of injury crashes could be achieved.

Therefore, when this plan is implemented across the total rural road network, it is anticipated that there will be a reduction in injury crashes of between 288 and 360, with a corresponding reduction in DSI's of between 70 and 88 casualties.

## FIRST YEAR RATE OF RETURN

Between 2011 and 2015, there have been 1,438 injury collisions on AT's rural road network resulting in 1,895 casualties with 409 death and serious injuries. There have been 351 death and serious injury collisions.

This equates to 288 injury collisions per year and 70 death and serious collisions per year.

With references to the Ministry of Transport's 'Social Cost of Road Crashes and Injuries 2015' data, the social cost for rural road injury crashes is \$539,000. Therefore, each year the social cost of rural road injury crashes on AT network will be approximately \$155.2 million.

Based on the assumption that 20-25% of injury crashes will be reduce through the implementation of this plan, it is anticipated that the number of injury crashes will be reduced by between 58 and 72 per year. The death and serious injury collision is estimated to be reduced by between 14 and 18 per year. The social cost saving would be between \$31.3 million to \$38.8 million.

There are approximately 1,900 km length of sealed rural roads across the AT road network and the estimated costs for the implementation of this plan is calculated to be in the order of \$10,000 per km. Therefore, the total project cost to deliver the entire plan is in the order of \$19 million.

The First Year Rate of Return (FYRR) is calculated using the following formula:

$$\text{FYRR} = (\text{Total Social Cost Saving} / \text{Cost of Project}) \times 100$$

The calculated FYRR for the 20% and 25% reduction of injury crashes is in the order of 165% and 204% respectively. Therefore, it is expected that each dollar invested into this project will be pay back between 6 to 8 months.

## IMPLEMENTATION PLAN

There are approximately 1,900 km length of sealed rural roads across the AT road network. Due to the availability of funding and resources, the delivery of this plan will be spread over a number of years to ensure a comprehensive coverage of the network.

As stated previously the key objective of this plan is to reduce road casualties by providing to drivers a clear and consistent message when travelling across the entire rural road network in Auckland. To achieve this, the plan should be implemented on a geographical basis.

Therefore, the area with the highest number of rural road injury crashes will be prioritized for implementation first.

Table 3 below shows the number of injury crashes across different AT's sub regions. As rural south has the highest number of injury crashes, it is recommended that this area be treated first to maximise our initial casualty reduction. The plan will be comprehensively applied to the other areas in the following years until all the rural roads has been treated.

<b>Auckland Sub Region</b>	<b>Total Injury Crashes (Fatal, Serious &amp; Minor)</b>
Rural South	607
Rural North	445
Urban South	134
Urban North	119
West	88
Urban Central	37
Gulf Island	8

**Table 3 – Total Number Injury Crashes - Auckland Sub Region (2011 – 2015)**

Care is required when drivers are exiting an area where this plan has been applied, as there could be a potential for some crash migration. Therefore, liaison with adjacent Road Controlling Authorities (RCAs) should be undertaken to ensure that there is a smooth transition between neighbouring RCAs.

## RECOMMENDATIONS

It is recommended that a rural road signage and delineation plan be applied across the Auckland Transport network to provide a consistent message to drivers travelling on AT's rural road network.

Subject to funding and resources, Auckland Transport proposed to implement this plan over the next few years.

## **ACKNOWLEDGEMENTS**

The author would like to acknowledge Irene Tse (Team Leader Road Safety Central / South) and Michael Brown (Team Leader Road Safety North/West) for their support on the project and Kathryn King (Walking, Cycling and Road Safety Manager) for granting permission for this paper to be prepared.

## **REFERENCES**

### Guidelines / Standards

Transit New Zealand (2000). State Highway Geometrics Design Manual.

NZ Transport Agency (2010). Manual of traffic signs and road marking – Part 1.

NZ Transport Agency (2011). High Risk Rural Road Guide.

### Others

Ministry of Transport (2016). Social Cost of Road Crashes and Injuries 2015 update.