A New Zealand guide to the treatment of crash locations

A companion document to the Austroads Guide to traffic engineering practice. Part 4. Treatment of crash locations

Land Transport NZ
Ikiiki Whenua Aotearoa

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Organisational change

On 1 December 2004, the Land Transport Safety Authority (LTSA) and Transfund New Zealand (Transfund) merged to form Land Transport New Zealand (Land Transport NZ). The development of this document prior to the merger was managed by the LTSA with guidance provided by a project team. The organisations listed below reflect those represented when the project team was formed. All other references in this document have been changed to reflect the formation of Land Transport NZ who finalised and printed the document.

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Status

This document provides best practice guidance on the process for treating crash locations in New Zealand. Its use may be required for crash reduction studies funded by Land Transport NZ.

Disclaimer

Although this publication is believed to be correct at the time of printing, Land Transport NZ does not take any responsibility for any consequences arising from the use of the information contained in it. People using the information should apply, and rely on, their skill and judgement to the particular issue they are considering.

This document replaces:

Transit New Zealand and Ministry of Transport, October 1990: *Policy guidelines for traffic accident reduction and prevention.*

Transit New Zealand and Ministry of Transport, January 1991: *Accident investigation procedures.*

References

1. Austroads, 2003: *Guide to traffic engineering practice. Part 4. Treatment of crash locations.*
2. Transfund New Zealand, May 1997: *Project evaluation manual.*
3. Land Transport Safety Authority/Transit New Zealand, January 1994: *Accident investigation monitoring system coding manual (version 2.0).*
4. New Zealand Government, October 2003: *Road Safety to 2010.*

See also the list of references on page 115 of Austroads Pt 4 (above).

See Appendix A for a list of websites where additional information can be found.

Table of contents

List of figures and tables

Definitions

Accident
See ‘crash’.

Austroads Pt 4
Austroads *Guide to traffic engineering practice. Part 4. Treatment of crash locations* (2003).

BCR
Benefit cost ratio.

Black spot
Now replaced by the term ‘crash location’ or ‘crash cluster’.

CAS
Crash analysis system. This is a database containing all the Police traffic crash reports (TCRs) received by Land Transport NZ together with crash analysis software and basic road data.

CBD
Central business district of a city or town.

Crash
A crash is a **rare, random, multi-factor** event preceded by a situation in which one or more persons **failed to cope** with their environment. The term ‘accident’ is sometimes still used and these terms are interchangeable.

Crash cluster
A number of crashes at one location that may be of the same or related crash type.

Crash location
A location where a limited range of crash types occurs repeatedly, suggesting that there are common causes, rather than the crashes being the result of mere chance. A location can be a crash site, a route or an area.

Crash severity
The most severely injured casualty occurring as a result of a crash.

Fatal: A death occurring as the result of injuries sustained in a road crash within 30 days of the crash.

Serious: Injury (fracture, concussion, severe cuts or other injury) requiring medical treatment or removal to and retention in hospital.

Minor: Injury which is not ‘serious’ but requires first aid, or which causes discomfort or pain to the person injured.

Non-injury: Property damage only (PDO).

Crash site
A ‘crash cluster’ where a limited range of crash types occur repeatedly, suggesting that there are common causes, rather than the crashes being the result of mere chance. A type of ‘crash location’.

CRS
Crash reduction study. A systematic process where crash clusters and known crash locations are analysed and investigated, and treatments are recommended to reduce the future incidence or severity of similar crashes. It includes the collection of site data for entering into the CRS monitoring system and the evaluation crash reductions as a result of the implementation of the recommended treatments.

COPTTM
Code of practice for temporary traffic management. A temporary traffic management manual produced by Transit New Zealand.

Factor codes
Standard numeric codes used to abbreviate and describe factors that may have contributed to a crash.

Factor grid
A list of crashes at a crash location in tabular form showing particular factors, eg wet road, darkness, speed etc, which may have contributed to each crash. A factor grid is used to identify factors that are common to several crashes.

FE
Feasibility estimate.

Land Transport NZ
Land Transport New Zealand. A Crown entity formed by the merger of the Land Transport Safety Authority and Transfund New Zealand on 1 December 2004.

LTCCP
Long term council community plan

LTSA
Land Transport Safety Authority. A former Crown entity which became part of Land Transport New Zealand on 1 December 2004.

Monitoring system
A Land Transport NZ system (part of CAS) for monitoring the effectiveness of CRSs.

Movement codes
Standard alphabetic codes used to abbreviate and describe the movement of vehicle(s) and pedestrians involved in a crash before impact or leaving the roadway.

New Zealand Road Safety Programme
Also called the Safety Administration Programme (SAP). This is a government funded programme of road safety enforcement (by the Police), safety information and CRS (by Land Transport NZ) and the Community Road Safety Programme (by local authorities).

OE
Option estimate.

PAC
Preliminary assessed cost.

PDO
Property damage only crash: same as ‘non-injury’.

PEM
Project evaluation manual. A Land Transport NZ document for the economic evaluation of roading projects.

PFM
Project funding manual. A Land Transport NZ document that sets out criteria for the funding of projects.

PV
Present value.

RCA
Road controlling authority. Typically territorial local authorities or Transit New Zealand, but may include forestry or electricity corporations, and airport authorities.

ROC
Rough order cost.

RSEW
Road safety engineering workshop.

RSIR
Road safety issues report. Summary report prepared for RCAs focusing on the top road safety issues.

RSR
Road safety reports. Detailed crash statistics report prepared for RCAs.

Rural
Roads or areas with a posted speed limit greater than 70 km/h.

SAP
See above 'New Zealand Road Safety Programme'.

SMS
Safety management system. A method of managing the roads of an RCA to improve their safety by documenting road safety strategies, policies, standards, procedures, staff expertise, management and audit systems so that road safety becomes an integral part of the management system for that road network.

TCR
Traffic crash report. A report on a standard form (usually completed by the Police) containing details of a crash involving one or more vehicles, located in an area to which the public have access.

TLA
Territorial local authority.

TMP
Traffic management plan: a document describing the design, implementation, maintenance and removal of an activity being carried out on the carriageway, or within a road reserve, or on a footpath or adjacent to and affecting the road reserve, and how road users will be managed by traffic management measures. This plan is of particular relevance in this document for field inspections.

Transit
Transit New Zealand.

Transfund
Transfund New Zealand. A former Crown entity which became part of Land Transport New Zealand on 1 December 2004.

Urban
Streets or areas with a posted speed limit less than or equal to 70 km/h.

VMC
Vehicle movement coding sheet.

Refer to Austroads Pt 4, section 1.4 for further definitions.

1 Introduction

1.1 Purpose

This guide provides procedures for the treatment of traffic crash locations in New Zealand. It outlines practices and policies specific to New Zealand and forms a companion document to Austroads *Guide to traffic engineering practice. Part 4. Treatment of crash locations* (Austroads Pt 4).

While the procedures outlined in this document will allow an experienced traffic or road safety engineer to lead a team of people to undertake a crash reduction study (CRS), it should be read in conjunction with Austroads Pt 4. The Austroads document gives additional information on road safety engineering, the crash scene in general and the CRS process. It also includes nine practical examples (including one from New Zealand) and documents a complete case study of a crash location and its suggested treatment. The relationship between sections of the two documents is shown in Figure 1.1 overleaf.

This guide also draws strongly on the road safety engineering workshop (RSEW) which is a highly recommended training course for engineers, planners, analysts, police and others who wish to undertake a CRS or a safety audit and improve their road safety knowledge and skills. The five-day course is run jointly by Transit, Land Transport NZ and local authorities, and includes a worked practical example of a CRS (and of a safety audit).

CRSs are an important part of the New Zealand government's *Road Safety to 2010* strategy, which includes action to improve engineering, education and enforcement. They are an integral part of safety management systems (SMSs) which road controlling authorities (RCAs) are progressively introducing, and in developing low cost solutions to crash problems on the state highway and local road networks. CRSs can also assist in improving safety for pedestrians and cyclists and improving road safety expertise among transportation planners and road designers. They provide desirable background information for planning and prioritising medium to high cost transport improvement projects. CRS teams are encouraged to assist RCAs in developing road safety programmes where they see a need for improvements in engineering, education and/or enforcement.

Figure 1.1 Corresponding chapters in Austroads Pt 4 and *A New Zealand guide to the treatment of crash locations* (NZ Guide)

Austroads Pt 4 chapters		**NZ Guide chapters**	
1	Purpose	1	Introduction
2	Road crash situation	2	Context
3	Components of traffic system		
4	Taking action to improve road safety		
5	Road crash data		
6	Steps in the crash location treatment process	3	Initiating a CRS
7	Identifying the crash locations	4	Identifying the crash locations
8	Diagnosing the crash problems	5	Investigation procedures
9	Selecting the countermeasures	6	Developing solutions
10	Designing a safe remedial treatment		
11	Justifying the expenditure		
12	Writing the report	7	Reporting
13	Ranking treatments to include in works programme		
14	Implementing the treatment	8	Implementation
15	Monitoring treated locations and evaluating treatment programme	9	Monitoring

1.2 Definition of CRSs

CRSs are the process of identifying treatable crash problems by the analysis of historical crash data, inspection of the site and the selection, implementation and monitoring of appropriate countermeasures to relieve those identified problems.

While the treatments have traditionally been low to medium cost engineering measures, consideration also needs to be given to enforcement and education solutions.

The key principles of CRSs are that they are:

- systematic processes with a common methodology
- crash data driven
- undertaken by a multi-disciplined team that may involve a number of key stakeholders
- focused on low to medium cost recommendations for road improvement
- monitored and evaluated.

1.3 Crash reduction vs prevention

Refer to Austroads Pt 4, section 1.2.

The treatment of crash locations and the process of a road safety audit both involve the application of road safety engineering knowledge and experience to make roads safer.

- The **treatment of crash locations** is a ‘reactive’ process, responding to an existing crash problem where countermeasures are implemented to reduce the incidence and severity of similar crashes.
- A **road safety audit** is a ‘proactive’ process, which assesses a project before or immediately after it is built (before crashes happen), or assesses the state of existing roads to identify any feature which could be altered to reduce the likelihood or severity of a crash.

Both processes are needed. The **treatment of crash locations** is as important as conducting road safety audits, and possibly more so. In the United Kingdom, with its long history of road authority accident investigation and prevention (AIP) programmes, experience has shown that an effective road safety engineering programme requires three times as much effort (ie in treatment of crash locations) as is put into a road safety audit of new road and traffic designs (Austroads Pt 4, 1.2 and 4.1).

1.4 History of CRSs

CRSs, in their present form, were initiated in the mid-1980s with a visit to New Zealand by Ms Barbara Sabey {Transport Research Laboratory (TRL), UK}. As at March 2003, over 4,100 crash locations had been studied with remedial works being completed at approximately 2,400 of these. These works have resulted in an overall 34 percent reduction in the expected number of injury crashes (50 percent reduction in fatalities) with an estimated social cost saving of $3 billion.

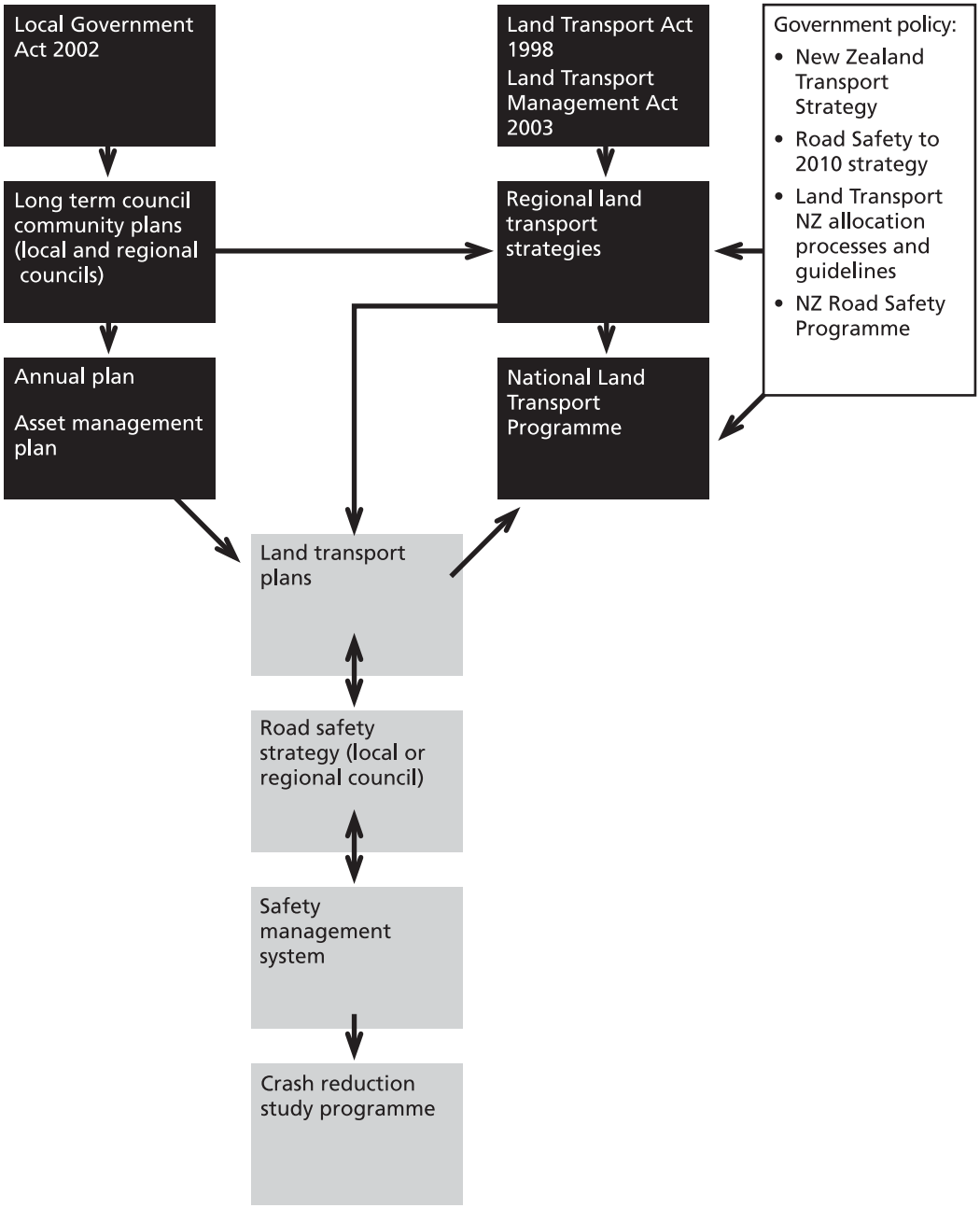
The original intention was to repeat the studies throughout RCAs on an average of five-yearly intervals. In recent years SMSs, and the safety monitoring requirements of many network management contracts, have resulted in the approach to CRS being varied by many RCAs. Furthermore, emphasis on cluster sites (formerly referred to as black spots) has reduced somewhat in favour of route, area wide, theme and corridor studies. However, the fundamentals of CRS remain, irrespective of the how or by whom they are instigated and carried out.

2 Context

A CRS fits within the requirements of a number of statutory and strategy documents aimed at safely managing New Zealand's road network and reducing road trauma. Figure 2.1 below outlines how these documents inter-relate and where a CRS lies.

There are essentially two parallel complementary streams of legislation which work together leading to the development of land transport plans, road safety strategies, SMSs and CRS programmes.

Figure 2.1 Legislative and policy framework



3 Initiating a CRS

3.1 SMSs and reviewing the safety of the road network

In an effort to achieve road safety goals and co-ordinate the efforts of all stakeholders, RCAs are being encouraged to develop SMSs. This is a key initiative in the government's *Road Safety to 2010* strategy (October 2003).

A CRS is one of the crash reduction tools within the SMS toolbox, although it may take various forms. There may be the requirement for periodic (annual to six-yearly) programmed formal CRSs or the unprogrammed reactive response to recent or developing crash problems.

An RCA needs to periodically review crash trends on its road network. Road safety problems that have been identified in Land Transport NZ's *Road safety issues reports* and by local Police, local residents, transport operators and other road safety partners should be considered in identifying priorities for CRSs.

Crash sites or routes with an increasing incidence of crashes should receive particular attention along with sites or routes with a continuing relatively high crash rate. Assistance should be sought from Land Transport NZ or other specialist road safety engineers in predicting the likely crash reductions that may be possible from initiating a CRS to devise treatments for these locations.

For background information see sections 2, 3 and 4 of Austroads Pt 4.

3.2 CRS initiation and management

RCAs throughout New Zealand have varying approaches to initiating and managing both programmed and unprogrammed CRSs. They include:

- studies being initiated and managed by in-house staff
- studies being initiated and managed by Land Transport NZ
- specific consultant contracts for individual studies
- long-term (three to five years) CRS professional services contracts
- crash monitoring and the management of studies by consultants or contractors within a network management type contract.

There are advantages and disadvantages for the various arrangements. However, the following issues need to be considered.

- The RCA should have an ongoing knowledge and ownership of the crash situation on its network. It should also have a commitment to reducing crashes.
- There are some advantages of ownership of the CRS process by the RCA from instigation through to implementation and evaluation.
- It is desirable to have multi-discipline, highly skilled, experienced teams and to continually develop a pool of new people with CRS skills.
- It is desirable and important to periodically have fresh eyes and ideas involved in CRSs.
- A good outcome requires a thorough crash and site analysis.
- Until the initial crash analysis has been undertaken it is often difficult to scope the type of study, or the number of crash locations or the skills required.

Contractual arrangements for undertaking any CRS need to recognise the importance of the above and ensure the briefing process and financial arrangements encourage the best results from the CRS process.

The establishment of an on-going CRS programme should ensure there is a continuing source and availability of funding for CRSs and that the personnel involved in the studies develop expertise and experience in reducing the road crash problems in that area.

3.3 Programming and funding the study

Funding for programmed CRSs is available through Land Transport NZ {Refer to the *Project funding manua*l (PFM)}.

Land Transport NZ also make staff resources available subject to the CRS being programmed and identified within the New Zealand Road Safety Programme. Depending upon resource availability, Land Transport NZ may also assist in unprogrammed, responsive type studies.

3.4 The CRS process

The CRS process is diagrammatically shown in figure 3.1, with each phase being described in more detail in the following sections.

Figure 3.1 The CRS process

Pre-study

Steps	Responsibility	Comment	Refer
Determine need for study by analysing crash data	RCA/Network management consultant/ contractor/ Land Transport NZ	In accordance with SMS requirements; may be a cyclic study, or identified through annual safety monitoring, or in response to a specific problem	Section 3
Programme study funding Land Transport NZ support	RCAs in conjunction with Land Transport NZ	Land Transport NZ programmed studies included in NZ Road Safety Programme. Land Transport NZ funding available. Unprogrammed studies may not receive specific Land Transport NZ resources	Section 3

Typical Crash Study Scope

Steps	Responsibility	Comment	Refer
Initiate study	RCAs/ consultants	Various in-house, or consultant arrangements used. Short and long term CRS contracts	Section 3
Identify crash locations	RCAs/ consultants/ Land Transport NZ	This may be undertaken prior to initiating the study or by the CRS team. The CRS initiation may be in response to a specific crash	Sections 4.1, 4.2, 4.3, 4.4
Form team	RCA/ consultant	Team member skills specific to the crash problems and environment. Study team may identify crash locations	Section 5.3
Data collection Introduction report	RCA/ consultant/ Land Transport NZ	Traffic volumes, aerial photos, maps, road data, collision diagram etc	Section 5.2
Preliminary diagnosis	CRS team	Usually undertaken prior to site inspections	Section 5.3
Field inspections and follow-up inspections	CRS team	Drive-over, inconspicuous observations, and any follow-up investigations required	Sections 5.4, 5.5, 5.6
Identify problems	CRS team	Play detective and identify problems by thoroughly investigating both data and location	Section 5.7
Develop solutions	CRS team	Countermeasures targeted to safety problems identified. Follow-up visits and measurements may be required	Section 6
Estimate/ economics	CRS team	Usually undertaken by the team leader or one member. Economics dependent on funding sources and requirements	Section 6
Reporting	CRS team	Draft report prepared and reviewed by all team members. Final draft may be sent to the RCA for comment. Final report to include monitoring set-up forms for Land Transport NZ.	Section 7
Monitoring forms	CRS team	Site problem and recommendation forms sent back to Land Transport NZ who then sends implementation forms to the RCA	Section 9.2

Post-study

Steps	Responsibility	Comment	Refer
Design, construction and imple-mentation	RCA/ consultant/ network management consultant/ contractor	Timing, responsibility dependent on contractual arrangements and funding source. May or may not form part of the CRS	Section 8
Safety audit	CRS team or independent team (not designers or installers of improvement works)	Check that improvement works will achieve the crash savings stated in report	Section 8.3 and 'Road safety audit proce-dures'
Monitoring	RCA/Land Transport NZ	Implementation forms completed by the RCA or consultant and returned to Land Transport NZ. Monitoring results produced by Land Transport NZ	Section 9

4 Identifying crash locations

4.1 Crash period

The most recent five full calendar years of crash data is recommended, although this may be increased to 10 years in areas with low traffic volumes and/or crash numbers or when studying longer trends. Shorter periods could be used in heavily trafficked networks or areas where road changes are recent or ongoing.

A five-year period is preferred because:

- it is long enough to provide a sufficient number of crashes for meaningful results
- it is short enough to limit the number of traffic and environmental changes that may bias results
- it helps remove statistical fluctuation and reduces the impact of the regression-to-the-mean effect
- it provides a consistent base for before and after comparisons.

Although full calendar years are normal and desired for some of the reasons outlined above, in some instances it may be appropriate to use part years and/or the most up to date data available. This includes when works have been implemented during the usual crash period of the study that would affect the crash pattern or, for reactive studies at developing crash locations where due to urgency, a part-year period may be used.

4.2 Sources of crash data

The primary source of crash data in New Zealand is the crash analysis system (CAS) database, which contains and summarises Police reported crashes {Traffic crash reports (TCRs)}, including fatal, injury and non-injury crash types.

Road safety reports and road safety issues reports are produced annually by Land Transport NZ. These summarise the crash data for RCAs giving indications of trends and key safety issues. Road safety issues reports are available on the Land Transport NZ website www.landtransport.govt.nz/regions/index.html. Road safety reports can be provided by Land Transport NZ on request.

It should be recognised that reported crashes are often only the tip of the iceberg and account for approximately one-fifth of all crashes. Locally reported crashes from the public, contractors, ambulance, tow truck agencies, etc can be added to the CAS database by the RCA. Many organisations also have their own database of locally reported crashes. These locally reported crash databases and local knowledge can add to the identification of safety issues and crash locations. However, the potentially incomplete nature and/or inaccuracy of the data can make detailed analysis and sound decision-making difficult. Furthermore, care must be taken to avoid duplication of locally reported and Police reported crashes.

Refer to Austroads Pt 4, section 5.

4.3 Defining crash locations

4.3.1 Background

Determining what should be investigated is the most important and often most difficult aspect of a CRS. It sets the scene for the remainder of the study.

Historically, emphasis has been given to investigating crash black spot sites (crash locations) as it is a relatively simple process to 'cluster' crashes. However, in many areas, particularly in RCAs with lower traffic densities, most crash locations have now been investigated and there are a limited number of new crash locations developing. Crash problems can also result from route or area deficiencies and hence treating an individual crash site alone may not necessarily solve the problem and could simply move it from one location to another (crash migration).

While there will still be many situations or instances where investigating specific crash clusters is still appropriate, greater emphasis should now be given to investigating routes, areas of road networks or common crash movement types and/or factors (themes).

Austroads Pt 4, section 7 gives guidance on the identification and selection of locations worthy of study. In New Zealand, the road safety reports and road safety issues reports give good guidance as to crash types, factors and locations worthy of evaluation. The Road Safety to 2010 strategy also places emphasis on high severity crash types and locations in an effort to reduce the social cost and impact of crashes (road trauma).

The advent of CAS with its mapping capability has made the identification of crash locations much simpler. It is now possible to identify and plot clusters, routes and areas based upon crash numbers, social cost, crash severity, movement type, factors and location during the selection stage.

The following gives some guidance as to the various crash location types.

4.3.2 Crash sites

These are small areas or short lengths of road that have one or more of the following:

- crash numbers above a pre-determined threshold. It is up to the RCA to determine what may constitute an appropriate threshold level for the study. Historically five (sometimes three) injury crashes have been adopted as a trigger level for clusters worthy of consideration and this is still appropriate for rural clusters or small urban centres. Where injury crash data is sparse, reported non-injury crashes can be used if the RCA considers this to be appropriate. However, on a busy urban network 10–15 crashes may be an appropriate trigger level
- over-representation in crash numbers compared with the expected number of crashes. Various documents, including the PEM, can be used to determine the expected number of crashes based on crash rates or crash models
- commonality of treatable crash types, ie three loss of control on wet road and/or at night
- a high social cost of crashes (ie high crash severity).

Traditionally 30 m and 250 m radii have been adopted for urban and rural sites respectively; this may still be an appropriate default for initial clustering of crashes. However, experience has shown that it is necessary to check crashes near the fringes of these sites and either extend or reduce the boundaries to capture the crashes that relate to the features of the site.

4.3.3 Routes

Routes are lengths of road where the road character is reasonably homogeneous. They could be selected on the basis of the number of crashes, high crash rate (per 10^8 veh-km), crash cost density (social cost/km/year), high social cost rate (per 10^8 veh km), and commonality of crash type or factors, eg cyclist crashes.

4.3.4 Network areas

It may be appropriate to study an area of a road network that has a high number of crashes and/or multiple crash clusters.

This type of study is particularly appropriate to urban networks including CBDs where there may be intersection conflicts across the network area or commonality of crash types, eg pedestrians, along various roads.

In studying these areas, it is important to understand the road network and hierarchy and ensure that any counter-measures such as changing intersection priorities do not inappropriately redistribute the traffic flows and/or crashes to different sites within the network.

4.3.5 Theme studies (movement type or factor)

Land Transport NZ's road safety reports and road safety issues reports highlight over-representation or high frequency of various crash movement types and common factors across a network. It may be appropriate to investigate these crashes and apply either site specific mitigation measures or mass action treatments across the network where similar features exist. Examples could be:

- loss of control crashes in a rural environment where widespread upgrading of the delineation or improving of skid resistance could be appropriate, or
- the installation of edge lines in urban areas to address a collision with parked cars problem.

These studies in particular, lend themselves to collaboration with agencies involved in enforcement and education where a multi-discipline approach to solutions may be appropriate.

4.3.6 Locations of safety concern

Locations of safety concern are where a problem has been identified by the RCA from local residents' or transport operators' reports but where there may presently be a lack of Police reported crashes or where a crash trend is developing.

4.4 Previous CRSs and crash locations

When initiating a new CRS, previous CRSs and the crash locations (sites, routes or areas) in those studies should be reviewed to:

- identify locations that have previously been studied to avoid duplication of effort or disturbing countermeasures being monitored
- determine if previous recommendations have been implemented
- determine if the location is worthy of further investigation.

The relevant Land Transport NZ monitoring results are required for this (refer to section 9).

5 Investigation procedures

The investigation procedures are well documented in Austroads Pt 4, chapter 8. The following outlines additional information relevant to New Zealand.

5.1 Team selection

A team with the appropriate expertise should undertake the CRS.

The size, selection and organisation of the team usually lies with the RCA and/or the study team leader.

While the size of the team may vary, the importance and benefits of a multi-member team include:

- diverse backgrounds, different approaches and perspectives of different people
- the cross-fertilisation of ideas which can result from discussions
- simply having more pairs of eyes.

The team skills and experience should be relevant to the road network (ie urban versus rural) and identified crash locations.

The types of skills and experience that should be considered include:

- someone experienced in road safety engineering (essential); this person is needed to fulfil the role as team leader. They should have been a team member on several previous CRSs and have suitable training for this role, eg attending a RSEW or a similar course. This person could be the RCA representative, Land Transport NZ's road safety engineer or a consultant
- an RCA representative familiar with the network and its management
- a Police officer who has experience in road safety and who is familiar with the area
- a fresh set of eyes, ie someone unfamiliar with the area of the study but who has experience in similar environments

- other safety engineering personnel who are either experienced team members or observers wishing to extend their knowledge and experience; desirably these members will have attended a RSEW
- a road safety co-ordinator or someone with a road safety education background
- specialists with expertise relevant to the crash locations or crash problems such as:
  - traffic signal experts
  - motorway designers
  - behavioural scientists
  - pavements/surfacing experts (for skid resistance problems).

In determining the team composition, consideration also needs to be given to the overall team size. An ideal team size is three to five people. Teams beyond five can be difficult to arrange transport for and safely manage on-location. One option is to have a larger team in the preliminary investigation meeting and diagnosis phase, with a limited number of people actually involved in the investigations at the crash locations.

5.2 Data collection / introduction report

Sound decision-making requires good background data. Any analysis is only as good as the information available.

Having selected the study locations, the next step is to produce and collate all the background data required. This includes:

- a specific crash listing for each crash location. The team can use both the plain English and coded crash listings. With experience, most investigators prefer to use the coded crash listing reports, as they are easier to scan for commonalties and provide more information in respect to crash and environmental factors. However, the Police, road safety co-ordinators and others not familiar with the coding system will prefer the plain English version. Refer to Appendix B for a copy of Land Transport NZ's *Vehicle movement coding sheet* (VMC) and the environment and driver factor codes. For the most up to date VMC, refer to the Land Transport NZ website
- factor grids (refer to Austroads Pt 4, figure 8.2 'Factor matrix') and/or a detailed crash location summary report
- collision diagrams. Although these can be produced in CAS, manually producing them provides a better understanding of the safety issues and identification of problems, errors in the crash coding, exact crash location and lane use at intersections

- individual TCRs where appropriate (refer 5.3 below) or notes from TCRs
- aerial photographs, maps or plans
- traffic volumes and turning flows where appropriate
- speed survey data if available
- relevant maintenance records – seal age/skid resistance and high speed data measurements if available
- works history of the location: any changes to signs, signals, islands, barriers, chevrons, planting, road markings or type of surfacing within the crash study period
- any traffic signal phasing and timing data
- any relevant previous CRS data.

It is desirable that this data is collated into one document or folder. This is sometimes referred to as an 'introduction report'. Much of the data can be tabulated on a crash location summary sheet that can form the basis of the final study report (refer to Appendix C). The introduction report should also outline how the need for the study was identified and how the crash locations or clusters to be studied were selected.

5.3 Preliminary diagnosis

Crash diagnosis is the foundation on which the selection of effective countermeasures is based. Preliminary diagnosis involves a detailed analysis of all the assembled background data. It should be undertaken as a desktop exercise before going to visit the location. During the diagnosis phase, common factors from the crashes should be identified. This should include consideration of crash movements, directions, time, contributing factors, driver ages, vehicle types, road, weather and traffic conditions.

The most detailed information about a crash is shown on the scanned images of the TCRs, which are available in CAS. These images contain driver and witness comments, crash diagrams and additional information such as driver age, sex, lane position etc that is not available on the coded crash reports. The extent to which TCRs are referenced during the CRS is dependent on circumstances. They should be referenced on studies or locations with a relatively small number of crashes and where it is practical to do so.

For crash locations with a large number of crashes it may be impractical to study all TCRs but reference can still be made to specific TCRs to gain a better understanding of

issues. An example would be to check TCRs to identify whether ‘failure to give way’ at an intersection was due to an inconspicuous intersection or whether the driver stopped but failed to see the conflicting vehicle.

TCRs are also referenced if something such as the crash location, vehicle direction or some other factor appears incorrect on the crash coding. Any incorrect data must be brought to the attention of Land Transport NZ so that it can be corrected. TCRs contain confidential and personal information such as names, addresses etc and must not be published in any reports. Individuals who are identified in TCRs must not be contacted under any circumstances.

Notes from the TCRs can be added to the collision diagram or crash listing as useful references for the team. It is often not necessary to copy the whole TCR.

During the diagnosis phase, care needs to be taken not to prematurely judge the total problems and treatments. Instead, potential problems/causes etc should be identified for discussion and confirmation at the location. The location visits often reveal contributing factors and features that cannot be identified from the crash records.

5.4 Preparation for field inspections

5.4.1 Items required

The following data and equipment is required for the field inspection:

- introduction report/background data referred to in 5.2 above
- copies of TCRs where appropriate
- a map to find the location and understand the adjacent roading network and environment
- a camera for a visual record of locations and problems
- a measuring wheel to find precise locations, measure visibility distances, road widths etc. This is preferable to a tape measure for safety reasons
- appropriate vehicle for the team numbers and with the required safety equipment
- a copy of the traffic management plan (TMP)
- high visibility jackets for all team members that comply with the RCA’s TMP requirements or the *Code of practice for temporary traffic management (COPTTM)*

- weather protective gear, ie raincoats, umbrellas, sunblock, etc as needed to comply with health and safety plans
- monitoring forms (see section 9).

The following optional additional items may also be needed, depending on the particular location or crash problem that has been identified:

- an electronic level if one is available to check gradients, crossfalls etc
- a light test meter, if required, for night-time inspections in urban areas or intersections
- an audio tape recorder
- a video camera
- a laser speed/distance measuring device.

5.4.2 Traffic management plan (TMP)

A TMP must be prepared and approved in accordance with the RCA's requirements such as the COPTTM. The TMP sets out the protective equipment and procedures required for the team members, where and how they can operate. The study team should be briefed on the TMP prior to the location visit and should preferably sign the document to declare that they are familiar with its requirements (while Appendix D provides an outline of a TMP, the relevant RCA must be contacted to establish their specific requirements).

5.5 Field inspections

All field inspections must be undertaken in a safe manner and in accordance with the TMP.

Field inspections are a detailed examination of the location and driver behaviour. They should not be rushed. The physical details of the locations can be obtained under any convenient conditions, but a visit should be undertaken during conditions that are prevalent for most of the crashes, eg peak hour traffic, day/night and possibly in wet conditions if appropriate.

Field inspections should commence with a drive-over from all directions to observe the environment. It is desirable to have a team member unfamiliar with the area drive so that they respond to the messages from the environment as opposed to 'local

knowledge' (gained from driving over the route previously). Other team members should observe the driver's actions and responses, noting vehicle speeds, travel path etc.

On completion of the drive-over, the vehicle should be parked in a safe and preferably inconspicuous location, to avoid influencing other traffic and driver behaviour. The team should observe the traffic behaviour while remaining as inconspicuous as possible.

Where appropriate, walk over the location and inspect the layout and facilities at close quarters taking photographs depicting observed problems and potential remedial works. These activities must be undertaken in a safe manner, in accordance with the TMP, preferably clear of the traffic lanes. If stepping onto the carriageway, team members should always move to avoid traffic and not expect traffic to slow down or move for them.

Photographs or even video recordings are invaluable for referencing use in reports, identifying problems and solutions, and simply as a record of features at the location for subsequent referral. Having the front seat passenger take photographs while traversing a crash location is often a useful tool for depicting the driver's view of the location.

Field investigations should desirably be limited to a maximum duration of three days. Experience has shown that focus and quality are difficult to maintain over longer periods.

5.6 Follow-up investigations

Follow-up investigations at a subsequent time and date may be required to:

- observe driver behaviour and traffic flow in different conditions from the initial visit to the location
- take more detailed location measurements and photographs
- measure traffic speeds, skid resistance, road geometry, lighting levels etc
- consult other experts.

It may be more appropriate that specific testing to confirm suspected deficiencies is recommended by the CRS team as a separate exercise prior to the final design and implementation of remedial works.

5.7 Problem identification

Before leaving the location, the team should consolidate ideas, define the problem and note the deficiencies of the location or features contributing to the problem. It is also desirable to discuss potential solutions on-location to determine if they are practical and the potential effects, construction issues, costs etc.

Austroads Pt 4, tables 8.1 and 8.2 provide good checklists for the field inspections and guidance on possible crash contributing factors that should be considered.

A further discussion, consolidation of ideas and proposals can be undertaken in the office following the inspections or follow-up investigations if necessary. It can be quite useful not to make final decisions immediately after the initial location visits as it often takes time for ideas to gel and a solution may not be initially obvious.

6 Developing solutions

Refer to Austroads Pt 4, chapter 9 for additional information on developing solutions.

6.1 Selecting countermeasures

Having identified the elements of the road and traffic environment or driver behaviour, which may have contributed to the crashes, it is now time to consider countermeasures. There are no 'general' road safety solutions; for a solution to be effective, it must be applied to a particular problem, which it is known to affect. It must be an *effective countermeasure.*

Although a large proportion of crashes are deemed to be a result of driver error, with engineering measures, it is possible to:

- modify driver behaviour
- modify the road and environment that led to the error
- make the environment more accepting of human error.

The most important aspect of developing solutions is to link the specific countermeasures to the specific problems identified. The countermeasures could include engineering, enforcement and education. Enforcement and education recommendations need to be forwarded to the appropriate agencies for programme development and implementation.

There are various sources available for identifying countermeasures that target the problems identified and showing their potential effectiveness. These include:

- Land Transport NZ monitoring analysis reports
- prior knowledge and experience of the CRS team
- Austroads Pt 4, tables 9.1–9.4
- Transit *Accident countermeasures literature review research report no 10,* 1992
- Transportation Research Board Special report 214. *Designing safer roads practices for resurfacing, restoration and rehabilitation* (1987)

- various other road safety text books and websites (as set out in Appendix A).

There are many organisations undertaking research into effective road crash reduction countermeasures. The available range of road safety engineering improvements will develop further. If a countermeasure is shown to reduce crashes overseas in conditions similar to those in New Zealand, then it may be considered for trial in New Zealand. Team leaders should contact road safety experts who have successfully used such a countermeasure and Land Transport NZ regional engineers for approval before recommending countermeasures new to New Zealand.

Typically, a CRS has focused on low to medium cost engineering solutions and these have proven to be very effective with excellent economic returns. However, in some cases a significant crash reduction may only be achieved through larger scale, more substantial improvements. If this is the case, the CRS team would generally recommend a more detailed study be carried out to investigate these more substantive options rather than to delay the overall study pending more detailed analysis.

The degree to which these more substantive solutions are developed is dependent upon the CRS brief. The RCA may widen the study brief to include consideration of medium to high cost options. The expertise of the team members may need to be broadened to accommodate this and other aspects such as traffic flow, environmental impact, mobility, accessibility and sustainability.

6.2 Estimating crash savings

Estimating the crash reductions or effectiveness of the countermeasures can be undertaken by:

- subjective assessment of crash reduction based upon knowledge and prior experience

- assessing which crashes in the crash history would be influenced by the treatment and subjectively estimating the number of crashes that might be saved

- utilising a vast amount of the national and international data available. Sources include:
  - Land Transport NZ monitoring analysis reports
  - Austroads Pt 4, tables 9.5 and 9.6
  - PEM, Appendix A6
  - Transit *Accident countermeasures literature review report no 10,* 1992
  - various road safety text books, papers and websites
  - Austroads road safety risk manager software: ARRB.

- reducing the over-represented crash numbers or rate to the national average. This would assume that the countermeasures remove the anomalies associated with the location and would not generate or leave any other abnormal crash potential.

Calculating the reduction in crashes can be undertaken by computing:

(i) a percentage reduction in the targeted crashes or crash types only

(ii) a weighted average reduction for the entire location based upon percentage reductions for each crash type and possibly potential increases in some lesser severity crash types

(iii) adjusting the severity of crashes only, eg a barrier may reduce severe injury crashes but increase minor or non-injury crashes

(iv) using the crash rate analysis to calculate the reduction of injury crashes. Crash rate models for various intersection and road forms are given in PEM, Appendix A6.

Whichever methodology is adopted, it is important that the team agree on the estimated crash savings and that they are not over-estimated. A reason for over-optimistic predictions of crash reduction could be crash migration (where the crash occurs at some other site on the network – recognising that human error may still be present).

6.3 Estimating cost of treatment

Typically, the engineering estimates within a CRS are normally of a rough order cost (ROC) or preliminary assessed cost (PAC). It is normally based upon a concept sketch for the treatment, not detailed design plans. In Transit's terms, this may be a feasibility estimate (FE) or an option estimate (OE). More detailed estimates are usually prepared at subsequent phases such as the detailed design phase or scheme assessment for larger scale projects. The estimate requirements may be linked to the source of implementation funding, eg signs and markings implemented through maintenance budgets may require little or no estimating whereas larger scale treatments requiring specific project funding may ultimately go through various stages of estimating.

The following items should be separately estimated for inclusion in the overall project cost (where appropriate):

- professional services fees for survey, design, supervision and project management if required

- construction of drainage, kerbing, pavement, sealing, traffic islands, footpaths, grassing and landscaping
- installing crash barriers, chevron boards, traffic poles, signs and signals
- moving or installing new cables, street light poles and lanterns
- traffic management during construction
- removal of existing markings
- placement of new markings and delineation
- hazard removal (eg lay new electricity cable and remove power poles)
- visibility improvement (eg trim or remove vegetation)
- land procurement costs
- on-going maintenance costs.

The project cost specified in the CRS report does not normally identify on-going maintenance costs unless they are likely to be significantly different to the do-nothing option.

6.4 Treatment ranking

Ranking of the recommended treatments within a CRS can assist an RCA to determine where limited resources are best assigned.

Various methodologies exist with RCAs for the ranking of minor safety works.

The process may be outlined in the SMS and could include:

- benefit to cost ratios
- utilising Austroads road safety risk manager software programme
- some form of subjective analysis on risk potential based on likelihood and outcome.

The RCA may require the CRS team to assist with ranking the recommendations although this is usually undertaken outside of the study as the RCA fits these within its work programme. A simple benefit cost ratio (BCR) can assist to demonstrate the worth of the project, the potential economic return to society and where the project should rank within other resource demands.

6.5 Treatment ranking economic assessment

The need for an economic assessment is dependent upon the funder's or the RCA's requirements, although as stated above it can assist with project ranking and demonstrating the value of the work.

In terms of Land Transport NZ's funding requirements:

- minor treatments funded from roading maintenance or minor safety projects categories do not require an economic evaluation
- larger or more expensive projects (requiring specific project funding requests) do require an economic evaluation undertaken in accordance with the PEM. Depending upon the value of the project, it may require either the simplified procedures or full procedures formats.

Notwithstanding the above, RCAs may require BCRs to be calculated to ensure that the recommended works are justifiable and/or to assist in the prioritisation of the works.

In most CRS economic evaluations, the emphasis is usually on the crash savings and it may not be necessary to calculate the travel time or vehicle operating costs. Exceptions are where travel speeds or intersection control strategies are altered and as a result, the safety benefits are achieved, but significant dis-benefits are also generated.

Appendix E outlines a simple economic assessment procedure that would suffice for the majority of low to medium cost CRS recommendations. The assessment period is dependent upon the likely duration of the mitigation measure. Whilst 25 years is Land Transport NZ's requirement for larger roading projects, a shorter (five or 10 year) duration may be appropriate for low-cost measures recognising the potential for future significant, environmental or traffic changes. Ongoing maintenance costs could be ignored unless they are deemed to be significant, or as a guide, the discounted present value (PV) would amount to more than 30 percent of the project cost.

7 Reporting

7.1 Report format and content

Having completed the investigation and developed the solutions, costs and economics, the next step is reporting. The report format will vary depending on whether the study is of one location or a network with several sites, areas and routes.

The sections that should be contained within a CRS report are described in table 7.1 below.

Table 7.1 Contents of a CRS report

Section	Description
1. Title page	• The authority undertaking the study • Study name and parameters • Study period
2. Introduction	An overview of the study area, crash history, study team and organisations, study process etc
3. Summary of recommendations	An executive summary of the recommendations for inclusion in the annual roading plan or minor safety projects list. It should include crash savings, cost estimates, BCRs (where applicable) for the locations covered in the study. For a multiple location study, this information is normally tabulated. The recommendation summary needs to clearly identify any recommendations pertaining to education and enforcement so that those can be forwarded onto the appropriate agencies.
4. Crash location summary sheets (One sheet for each crash location. Refer to Appendix C).	• Location name and location • Location description • Crash history (highlighting common factors) • Recent changes • Problem(s) • Solution(s) • Potential crash savings • Cost and economics (where applicable) • Recommendations for treating the location or other improvements • Crash listing • Collision diagram • Remedial works diagram • Photographs of the location
5. Appendices	• Map of network with study locations identified • Monitoring forms with location data and crashes entered • Other data relating to the study that may be appropriate such as the full crash listing and preliminary analysis, site selection, etc

In describing the problems, it is important to describe the actual crash problem, for example:

- ‘the intersection is not immediately obvious to approaching drivers resulting in them approaching the junction too fast to give way’

or

- ‘visibility of approaching traffic obstructed by parked vehicles and power poles resulting in drivers having problems in selecting safe gaps in the traffic stream’.

Solutions should be as descriptive as possible to allow another party to understand the intention, design and implementation as intended. A concept sketch is strongly recommended with road names, north point, route distance/position etc, clearly identifying the remedial measures, signs, markings, physical changes etc.

A draft report is prepared and circulated to the other study team members for comment. It may be necessary or appropriate for the team to reconvene to discuss the draft and final recommendations having completed the costs and economics etc. It may also be appropriate that a final draft report is sent to the RCA for comment.

The final report should be sent to the RCA for approval and distribution. Depending upon the recommendations, final approved copies of the report may need to be forwarded to the NZ Police for information and enforcement, the regional council, road safety co-ordinator and the network consultant/contractor. A copy containing the monitoring forms (refer to section 9) is sent to Land Transport NZ.

Note: The final report must not include copies of TCRs as personal information contained in crash reports must not be made public.

8 Implementation

8.1 Responsibility for implementing the recommendations

The design and implementation phase may or may not form part of the CRS team's or the contractor's responsibility. This will depend upon the CRS brief, contract arrangements and whether the team is led internally or externally.

Some of the recommendations may be forwarded to the network consultant/contractor for immediate implementation. Others may need to be programmed, placed on priority lists, or require further investigation.

Education and enforcement recommendations need to be forwarded to the appropriate agencies for consideration and implementation as appropriate.

8.2 Timing / funding

Recommendations should be implemented as soon as practical. Often the implementation will be dependent upon funding sources that generally include maintenance, minor safety or capital works funds (with or without Land Transport NZ funding).

Forward programming of capital works funding is required which often results in some delay over implementation. RCAs have some discretion over how they allocate the Land Transport NZ funded minor safety contributions with most RCAs having some methodology for ranking these works. Territorial local authority (TLA) funding may also be subject to the long term council community plan (LTCCP) process. However, in considering prioritisation of CRS recommendations, it should be noted that these are locations where crashes have occurred and for which there is generally a countermeasure available with proven success and a good economic return.

Where appropriate, the CRS recommendations should be undertaken in conjunction with other maintenance works, construction projects, street upgrade or traffic scheme works, etc. It may also be appropriate to arrange the timing of implementation concurrently with associated education and enforcement initiatives.

8.3 Design, reviews and safety audits

A concept sketch included in the CRS report is not intended as a detailed design. In some instances, such as positioning a sign or relocating markings, no further design may be required. However, in most instances some further measurements, survey and detailed design will be necessary.

Although the CRS team usually has all the skills necessary to make sound considered recommendations on the appropriate treatments, the design and implementation sometimes results in changes being made that have other safety consequences, which may need further consideration. It may be appropriate that the design is referred back to the CRS team for review.

Designs of countermeasure treatments should not be considered to be immune from potentially unsafe design flaws, and it would be unfortunate if new and unforeseen crash problems developed. As such, consideration must be given to a design and/or post construction safety audit. Dependent upon the project cost and source of funding safety audits may be a Land Transport NZ and/or an RCA safety management system requirement.

Reference should be made to the Land Transport NZ *Road safety audit procedures for projects* guidelines published in November 2004. It should be noted that a road safety audit:

- is to be carried out by people who are independent of the client, designer or contractor
- is not a substitute for a design check or peer review
- is applicable to all types of projects on all types of roads and off-road areas to which the public have access

Road safety audits are typically undertaken at the following stages of a project:

- feasibility/concept
- scheme/preliminary design (these may not be required for CRS)
- detailed design
- post-construction (at opening of facility).

The road safety audit team will produce a report which can recommend changes to the project to ensure that the safety benefits of the CRS are realised.

Some longer-term CRS contracts have requirements for review of the design and implementation and even some initial monitoring of the works.

8.4 Publicity, consultation and liaison

Raising public awareness of the need for safety improvements is an important part of gaining acceptance of the countermeasures, particularly if they are of a sensitive or controversial nature.

The responsibility for publicity or consultation would normally reside with the RCA. However, this may be delegated to a consultant/contractor responsible for design and implementation. A collaborative approach to publicity with the appropriate agencies should be given to proposals incorporating enforcement and/or education measures.

If widespread publicity is not undertaken, consultation with the local community, affected property owners/occupiers, key stakeholders etc is strongly recommended and probably essential for works that alter parking, restrict access, change traffic patterns or impede service or emergency vehicle access etc.

Liaison with service authorities, network consultants/contractors etc should also be undertaken through the design and implementation process.

9 Monitoring

9.1 Background

The crash investigation monitoring system has been set up by Land Transport NZ to monitor the effects of the CRS programme. Locations that are improved as part of the programme are monitored to determine the effectiveness of the improvements. Cumulative location data is used to calculate the overall effects of the CRS programme and various treatments.

Monitoring helps to identify if road safety has been improved and which countermeasures are most effective to enhance future crash saving predictions.

9.2 Process

The monitoring process, monitoring forms, instructions, codes etc are given in the LTSA/Transit NZ *Accident investigation monitoring system coding manual, version 2.0,* January 1994. The key steps to monitoring crash locations are:

a. CRS completed. Location details, problem and recommendation monitoring forms completed as part of study and included in the Land Transport NZ copy of the final report

b. monitoring forms sent to the Land Transport NZ regional engineering section for data entry. The normal practice is to have these as an appendix in the Land Transport NZ copy of the CRS report

c. an implementation report form produced by Land Transport NZ is sent back to the RCA

d. remedial works implemented

e. implementation report form is completed by the RCA or delegated to the consultant/contractor

f. the completed implementation report is returned to Land Transport NZ for a data update

g. monitoring results are published in the road safety reports and available on CAS.

Any uncompleted monitoring forms should be sent back to the RCAs on a regular basis for updating. Consideration also needs to be given as to whether it is appropriate or

not to continue with monitoring. Continuation of monitoring may not be appropriate where the physical or traffic environment has significantly changed or the location boundaries have been modified by a subsequent CRS.

9.3 Monitoring results

The overall results of the monitoring system and various treatments are available on the Land Transport NZ website http://www.landtransport.govt.nz/roads/crash-reduction-programme.html.

Combined monitoring results specific to each RCA are published annually in conjunction with the road safety report.

The monitoring results of the specific locations are available in CAS or can be provided by Land Transport NZ on request.

Appendices

Appendix A
Reference websites for CRS information

New Zealand
Land Transport New Zealand **www.landtransport.govt.nz**
Transit New Zealand **www.transit.govt.nz**

Australia
ARRB Transport Research **www.arrb.org.au**
Roads and Traffic Authority (NSW) **www.rta.nsw.gov.au**
Victoria Roads **www.vicroads.vic.gov.au**
Austroads **www.austroads.com.au**

United States of America
American Association of State Highway
and Transportation Officials (AASHTO) **http://safety.transportation.org**
National Transportation Safety Board **www.ntsb.gov**
The Insurance Institute of Highway Safety **www.hwysafety.org**
The Institute of Transportation Engineers **www.ite.org**
Transportation Research Board **http://trb.org**
Ohio Department of Transportation **www.dot.state.oh.us/roadwaysafety/**

Canada
Canadian Council of Motor Transport Administration **www.ccmta.ca**

United Kingdom
Transport Research Laboratory (TRL) **www.trl.co.uk**
AA Foundation for Road Safety Research **www.aatrust.com**
The Institution of Highways and Transportation (IHT) **www.iht.org**
Royal Society for the Prevention of Accidents **www.rospa.org.uk**

Finland
Road Research Institute (VTT) **www.vtt.fi**

Netherlands
Institute for road safety research (SWOV) **www.swov.nl/en/**

Norway
The Institute of Transport Economics
and 'The Handbook of Road Safety Measures' **www.toi.no/?language=EN**

Sweden
Swedish Public Roads Administration (VV) **www.vv.se**
Swedish National Road and Transport
Research Institute (VTI) **www.vti.se/default____2782.aspx**
Swedish National Society for Road Safety (NTF) **www.ntf.se/english/default.asp**

Appendix B (1)
Vehicle movement coding sheet

For use with crash data from CAS (version 2.3 December 2004)

	TYPE	A	B	C	D	E	F	G	O
A	OVERTAKING AND LANE CHANGE	PULLING OUT OR CHANGING LANE TO RIGHT	HEAD ON	CUTTING IN OR CHANGING LANE TO LEFT	LOST CONTROL (OVERTAKING VEHICLE)	SIDE ROAD	LOST CONTROL (OVERTAKEN VEHICLE)	WEAVING IN HEAVY TRAFFIC	OTHER
B	HEAD ON	ON STRAIGHT	CUTTING CORNER	SWINGING WIDE	BOTH OR UNKNOWN *	LOST CONTROL ON STRAIGHT	LOST CONTROL ON CURVE *		OTHER
C	LOST CONTROL OR OFF ROAD (STRAIGHT ROADS)	OUT OF CONTROL ON ROADWAY	OFF ROADWAY TO LEFT	OFF ROADWAY TO RIGHT					OTHER
D	CORNERING	LOST CONTROL TURNING RIGHT	LOST CONTROL TURNING LEFT	MISSED INTERSECTION OR END OF ROAD					OTHER
E	COLLISION WITH OBSTRUCTION	PARKED VEHICLE	CRASH OR BROKEN DOWN	NON VEHICULAR OBSTRUCTIONS (INCLUDING ANIMALS)	WORKMANS VEHICLE	OPENING DOOR			OTHER
F	REAR END	SLOW VEHICLE	CROSS TRAFFIC	PEDESTRIAN	QUEUE	SIGNALS	OTHER		OTHER
G	TURNING VERSUS SAME DIRECTION	REAR OF LEFT TURNING VEHICLE	LEFT TURN SIDE SIDE SWIPE	STOPPED OR TURNING FROM LEFT SIDE	NEAR CENTRE LINE	OVERTAKING VEHICLE	TWO TURNING *		OTHER
H	CROSSING (NO TURNS)	RIGHT ANGLE (70° TO 110°)							OTHER
J	CROSSING (VEHICLE TURNING)	RIGHT TURN RIGHT SIDE	OBSOLETE	TWO TURNING					OTHER
K	MERGING	LEFT TURN IN	RIGHT TURN IN	TWO TURNING					OTHER
L	RIGHT TURN AGAINST	STOPPED WAITING TO TURN	MAKING TURN						OTHER
M	MANOEUVRING	PARKING OR LEAVING	"U" TURN	"U" TURN	DRIVEWAY MANOEUVRE	PARKING OPPOSITE	ANGLE PARKING	REVERSING ALONG ROAD	OTHER
N	PEDESTRIANS CROSSING ROAD	LEFT SIDE	RIGHT SIDE	LEFT TURN LEFT SIDE	RIGHT TURN RIGHT SIDE	LEFT TURN RIGHT SIDE	RIGHT TURN LEFT SIDE	MANOEUVRING VEHICLE	OTHER
P	PEDESTRIANS OTHER	WALKING WITH TRAFFIC	WALKING FACING TRAFFIC	WALKING ON FOOTPATH	CHILD PLAYING (TRICYCLE)	ATTENDING TO VEHICLE	ENTERING OR LEAVING VEHICLE		OTHER
Q	MISCELLANEOUS	FELL WHILE BOARDING OR ALIGHTING	FELL FROM MOVING VEHICLE	TRAIN	PARKED VEHICLE RAN AWAY	EQUESTRIAN	FELL INSIDE VEHICLE	TRAILER OR LOAD	OTHER

* = Movement applies for left and right hand bends, curves or turns

Appendix B (2)
Contributing factors

Factors probably contributing to crashes (Version 06/10/2003)

Driver Control

100 Alcohol or Drugs

101 Alcohol suspected

102 Alcohol test below limit

103 Alcohol test above limit or test refused

104 Alcohol test result unknown

105 Visibly intoxicated non-driver (pedestrian /cyclist/passenger

106

107

108 Drugs suspected

109 Drugs proven

110 Too Fast for Conditions

111 Cornering

112 On straight

113 To give way at intersection

114 Approaching railway crossing

115 When passing stationary school bus

116 At temporary speed limit

117 At crash or emergency

120 Failed to Keep Left

121 Swung wide on bend

122 Swung wide at intersection

123 Cutting corner on bend

124 Cutting corner at intersection

125 On straight section

126 Vehicle crossed raised median

127 Driving or riding abreast (cyclists more than 2 abreast)

128 Wandering or wobbling

129 Too far left/right

130 Lost Control

131 When turning

132 Under heavy braking

133 Under heavy acceleration

134 While returning to seal from unsealed shoulder

135 Due to road conditions: (requires road series code)

136 Due to vehicle fault (requires vehicle series code)

137 Avoiding another vehicle, pedestrian, party or obstacle on roadway

138 On unsealed road

139 End of seal

140 Failed to Signal in Time

141 When moving to left, pulling over to left

142 When turning left

143 When pulling out or moving to the right

144 When turning right

145 Incorrect Signal

150 Overtaking

151 Overtaking line of traffic or queue

152 Deliberately in the face of oncoming traffic

153 Failed to notice oncoming traffic

154 Misjudged speed or distance of oncoming traffic

155 At no passing line

156 With insufficient visibility

157 At an intersection without due care

158 On left without due care

159 Cut in after overtaking

160 Vehicle signalling right turn

161 Without care at a pedestrian crossing

170 Wrong Lane/Turned From Wrong Position

171 Turned right from incorrect lane

172 Turned left from incorrect lane

173 Travelled straight ahead from turning lane or flush median

174 Turned right from left side of road

175 Turned left from near centre line

176 Turned into incorrect lane

177 Weaving or cut in on multi-lane roads

178 Moved left to avoid slow vehicle

179 Motor vehicle in cycle lane

180 In Line of Traffic

181 Following too closely

182 Travelling unreasonably slowly

183 Motorist crowded cyclist

190 Sudden Action

191 Braked

192 Turned left

193 Turned right

194 Swerved to avoid pedestrian

195 Swerved to avoid animal

196 Swerved to avoid crash or broken down vehicle

197 Swerved to avoid vehicle

198 Swerved to avoid object or for unknown reason

200 Forbidden Movements

201 Wrong way in one way street, motorway or roundabout

202 When turning or U turning contrary to a sign

203 Contrary to “in” or “out” only driveway sign

204 Driving or Riding on Footpath

205 On incorrect side of island or median

206 Contrary to “no entry” sign

207 In Car Park

Vehicle Conflicts

300 Failed to Give Way

301 At Stop Sign

302 At Give Way Sign

303 When Turning to Non-turning traffic

304 When deemed turning by markings, not geometry

305 When turning left, to opposing right turning traffic

306 To pedestrian on a crossing

307 When turning at signals to pedestrians

308 When entering roadway from driveway

309 To traffic approaching or crossing from the right

310 Failed to Give way at one lane bridge/road

311 Failed to give way to pedestrian on footpath or verge

312 Entering roadway not from driveway or intersection

320 Did not Stop

321 At stop sign

322 At steady red light

323 At steady red arrow

324 At steady amber light

325 At steady amber arrow

326 At flashing red lights (Rail Xing, Fire Stn etc)

327 For police or flag-person

328 For school patrol/kea Xing

330 Inattentive: Failed to Notice

331 Car slowing, stopping or stopped in front

332 Bend in road

333 Indication of vehicle in front

334 Traffic lights

335 Intersection or its Stop/Give Way control

336 Other regulatory sign/markings

337 Warning sign

338 Direction, information signs/markings

339 Road-works signs

340 Lane use arrows/markings?

341 Obstructions on Roadway

350 Attention Diverted By:

351 Passengers

352 Scenery or persons outside vehicle

353 Other traffic

354 Animal or insect in vehicle

355 Trying to find intersection, house number, destination

356 Advertising or signs

357 Emotionally upset

358 Cigarette, radio, glove box etc

359 Cell phone or communications device

360 Driver dazzled

370 Did not see or look for another party until too late

371 Behind when reversing / manoeuvring

372 Behind when changing lanes position or direction (includes U-turns

373 Behind when pulling out from parked position

374 Behind when opening door or leaving vehicle

375 When required to give way to traffic from another direction

376 When required to give way to pedestrians

377 When visibility obstructed by other vehicles

378 When visibility limited by roadside features

379 When first in queue on receiving green light

380 Misjudged speed, distance, size or position of:

381 Other vehicle coming from behind or alongside

382 Other vehicle coming from another direction with right of way

383 Pedestrian movement or intention

384 Towed vehicle, or while towing a vehicle

385 Size or position of fixed object or obstacle

386 Of own vehicle

387 Misjudged intentions of another party

General Driver

400 Inexperience

401 in driving in fast, complex or heavy traffic

402 New driver showed inexperience

403 Driving strange vehicle

404 Overseas driver fails to adjust to local conditions

405 Driver under instruction

406 At towing trailer / other vehicle

407 Driver over-reacted

408 Unsupervised cyclist

410 Fatigue (Drowsy, Tired, Fell Asleep)

411 Long trip

412 Lack of sleep

413 Exhaust fumes

414 Worked long hours before driving

415 Exceeded driving hours

420 Incorrect use of vehicle controls

421 Started in gear

422 Stalled engine

423 Wrong pedal

424 Footrest, stand

425 Ignition turned off (steering locked)

426 Lights not switched on

427 Foot slipped

428 Parking brake not fully applied

429 Trailer coupling or safety chain not secured

430 Showing Off

431 Racing

432 Playing Chicken

433 Wheel spins/wheelies/doughnuts etc

434 Intimidating Driving

440 Parked or Stopped

441 Inadequately lit at night: (not lit by street lights or park lights off)

442 At point of limited visibility

443 Not as close as practicable to side of road

444 On incorrect side of road

445 Double parked

446 In ‘No Stopping’ area

447 Not Clear of rail crossing

General Person

500 Illness and Disability

501 Illness with no warning e.g. heart attack, unexpected epilepsy)

502 Physically disabled

503 Defective vision

504 Medical illness (not sudden) flu, diabetes

505 Mental illness (depression, psychosis)

506 Suicidal (but not successful)

507 Impaired ability due to old age

510 Intentional or Criminal

511 Deliberate homicide (only if succeeded)

512 Intentional collision

513 Committed suicide (only if succeeded)

514 Evading enforcement

515 Object deliberately thrown at or dropped on vehicle/shot at

516 Object thrown from vehicle

517 Stolen vehicle

520 Driver/Passenger, Boarding, Joining, In Vehicle

521 Boarding moving vehicle

522 Intentionally leaving moving vehicle

523 Riding in insecure position

524 Interfered with driver

525 Opened door inadvertently

526 Overloaded vehicle (with passengers)

527 Child playing in parked vehicle

530 Miscellaneous Person

531 Casualty drowned

532 Casualty thrown from vehicle

533 Equestrian not keeping to verge

534 Cyclist or M/cyclist wearing dark clothing

Vehicles

600 Lights and Reflectors at Fault or Dirty

601 Dazzling headlights

602 Headlights inadequate or no headlights

603 Headlights failed suddenly

604 Brake-lights or indicators faulty or not fitted

605 Tail-lights inadequate or no tail-lights

606 Reflectors inadequate or no reflectors

607 Lights or reflectors obscured

610 Brakes

611 Parking brake failed

612 Parking brake defective

613 Service brake failed

614 Service brake defective

615 Jack-knifed

620 Steering

621 Defective

622 Failed suddenly

630 Tyres

631 Puncture or blowout

632 Worn tread on tyre

633 Incorrect tyre type

634 Mixed treads/space savers

640 Windscreen or Mirror

641 Shattered windscreen

642 Windscreen or rear window dirty

643 Rear vision mirror not adjusted correctly

644 No rear vision mirror

645 Windscreen, or rear window misted/ frosted

646 Inadequate or no sun-visors

647 Inadequate or no windscreen wipers

648 Cycle/Motorcycle visor, glasses, goggles or screen

650 Mechanical

651 Engine failure

652 Transmission failure (including chains and gears)

653 Accelerator or throttle jammed

660 Body or Chassis

661 Body, chassis or frame (cycle, m/c) failure

662 Suspension failure

663 Failure of door catch or door not shut

664 Inadequate mudguards

665 Inadequate tow coupling

666 Inadequate or no safety chain

667 Bonnet catch failed

668 Wheel off

669 Broken axle

670 Inconspicuous colour

671 Blind spot

672 Seat belt/restraint failed

673 Air-bag failed to inflate (fully)

680 Load

681 Load interferes with driver

682 Not well secured or load moved

683 Over-hanging

684 Load obscured vision

685 Excess dimensions not adequately indicated

686 Overdimension vehicle or load

687 Load too heavy

688 Towed vehicle or trailer too heavy or incompatible

690 Miscellaneous Vehicle

691 Emergency Vehicle attending emergency

692 Vehicle caught fire

693 Being towed

694 Air-bag contributed to crash or injury

695 Seatbelt/restraint absent or unusable

696 Dangerous goods

Pedestrians

700 Walking along Road

701 Not keeping to footpath

702 Not keeping to side of road

703 Not facing oncoming traffic

704 Not on outside of blind curve

710 Crossing Road

711 Walking heedless of traffic

712 Stepping out from behind vehicles

713 Running heedless of traffic

714 Failed to use pedestrian crossing when one within 20 metres

715 Waiting on roadway for moving traffic

716 Confused by traffic or stepped back

717 Suddenly stepped onto pedestrian crossing

718 Not complying with traffic signals or school patrols

719 Misjudged speed and/or distance of vehicle

720 Miscellaneous

721 Pushing, working on or unloading vehicle

722 Playing on road or unnecessarily on road

723 Working on road

724 Wearing dark clothing

725 Vision obscured by umbrella or clothing

726 Child escaped from supervision

727 Unsupervised child

728 Sitting/lying on road

729 Pedestrian from School bus

730 Pedestrian behind reversing/ manoeuvring vehicle

731 Overseas pedestrian

Road

800 Slippery

801 Rain

802 Frost or ice

803 Snow or hail

804 Loose material on seal

805 Mud

806 Oil/Diesel/Fuel

807 Painted markings

808 Recently graded

809 Surface bleeding/defective

810 Surface

811 Potholed

812 Uneven

813 Deep loose metal

814 High crown

815 Curve not well banked

816 Edge badly defined or gave way

817 Under construction or maintenance

818 Unusually narrow

819 Broken glass

820 Obstructed

821 Fallen tree or branch

822 Slip or subsidence

823 Flood waters, large puddles, ford

824 Road works not adequately lighted

825 Road works not adequately signposted

826 Roadside Object fell on vehicle

827 Object flicked up by vehicle

830 Visibility Limited

831 Curve

832 Crest

833 Building

834 Trees

835 Hedge or fence

836 Scrub or long grass

837 Bank

838 Temporary obstruction, dust or smoke

839 Parked vehicle

840 Signs and Signals

841 Damaged, removed or malfunction

842 Badly located

843 Ineffective or inadequate

844 Necessary

845 Signals turned off

850 Markings

851 Faded

852 Difficult to see under weather conditions

853 Markings necessary

854 Not visible due to geometry or vehicles

855 Old markings not adequately removed

860 Street Lighting

861 Failed

862 Inadequate

863 Glare on wet road

864 Pedestrian crossing not adequately lighted

870 Raised Islands and Roundabouts

871 Traffic Island(s) difficult to see

872 Traffic Island(s) ineffective, badly located or designed

873 Cyclist squeeze point

Miscellaneous

900 Weather

901 Heavy rain

902 Dazzling sun

903 Strong wind

904 Fog or mist

905 Snow, sleet or hail

910 Animals

911 Household pet rushed out or playing

912 Farm animal straying

913 Farm animal attended, but inadequate warning or unexpected

914 Farm animal attended, but out of control

915 Wild animal

920 Entering or Leaving Land Use

921 Roadside Stall

922 Service Station

923 Specialised Liquor outlet

924 Take away foods

925 Shopping Complex

926 Car parking building/area

927 Other commercial

928 Industrial Site

929 Private house/farm

930 Other non-commercial

931 Mobile shop or Vendor

980 Unconverted old codes (not used after 1998)

977 Old 920: Equestrian

978 Old 950: Miscellaneous

979 Old 960: Special Codes

981 Old 131: Swinging wide on bend or intersection

982 Old 138: Lost control – head on collision

983 Old 147: When changing lanes

984 Old 157: Cut in

985 Old 188: At steady red/amber arrows

986 Old 225: Wrong way in one way street or other forbidden movement

987 Old 235: Misjudged speed of other vehicle

988 Old 236: Misjudged distance, size or position of vehicle

989 Old 238: In controlling skid

990 Old 273: Defective vision or illness (not sudden)

991 Old 503: In face of traffic

992 Old 504: Opened door in path of another party

993 Old 512: Interfered with driver or overloaded vehicle

994 Old 737: Physical defect or old age

995 Old 738: Unattended child

996 Old 952: Suicide

997 Old 400: Specific Cyclist Faults

998 Old 930: Bicycle Faults

999 Unknown

Appendix B (3)
Crash printout interpretation

Coded listings

Key (optional)

Key is optional. It provides a sequential number for each crash in the listing, or within each site if the data is grouped into sites.

Site Number (optional)

Where the crashes have been grouped into sites this variable provides a sequential numbering of the crash clusters.

First Street

Name of street, road or highway on which crash occurred.

Distance and Direction

This is the distance the crash occurred from the landmark or second street shown in 5. In metres e.g.

300 = 300 metres
10 = 10 metres
1500 = 1.5 km

DIR = Direction / Intersection

N = North W = West
S = South E = East
I = at intersection with
A = at landmark e.g. bridge

Second Street or Landmark

A crash is located from the second street or landmark e.g. bridge (BR), summit (SUM). A landmark is used where there is no nearby second street and is a highly prominent feature and likely to be on a map.

Crash Number (LTNZ reference number of crash)

The first two digits indicate which year the crash occurred.

From 2000 onwards, the first digit is '2'.

The last five digits indicate the severity and general location of the crash as below:

00001-00999 Fatal Crashes Northern Zone
01000-10999 Fatal Crashes Central Zone
02000-20999 Fatal Crashes Southern Zone

00100-09999 Injury Crashes Northern Zone
11000-19999 Injury Crashes Central Zone
21000-29999 Injury Crashes Southern Zone

30000-49999 Non Injury Northern Zone
50000-69999 Non Injury Central Zone
70000-89999 Non Injury Southern Zone

Date, Day of Crash

Date format is DD/MM/YYYY – day/month/year

Time of Day

24 hour clock ie. 7 am = 0700, 7 pm = 1900.

Movement Code

See Vehicle Movement Coding Sheet for the first two alphabetic characters.

V1 - Key Vehicle

The key vehicle is the vehicle shown as the thicker (heavier) arrow on the movement coding sheet (See earlier page).

Note: Being a key vehicle does not automatically mean that vehicle is at fault.

C = car M= motorcycle
X = taxi P = power cycle
V = van, utility O = other or unknown
T = truck S = push cycle
B = bus L = school bus

DRN = Direction and Street on which Key Vehicle was travelling

If key vehicle is on first street then:
N1 = North on first street
S1 = South on first street
E1 = East on first street
W1 = West on first street

If key vehicle is on second street then:
N2 = Nth on second street
S2 = Sth on second street
E2 = East on second street
W2 = West on second street

V2, 3, 4 - Other Vehicle(s) / Road Users

The codes are same as those for V1 plus the following additional code letters. For non-motorised road users.

E = pedestrian
K = skateboard
Q = equestrian
W = wheeled pedestrian

Factors and Roles

See above for factor codes. These have changed with the introduction of CAS. Above shows the codes from 1/1/98.

Letter after the factor code indicates vehicle or driver to which that factor applies. A applies to V1; B applies to V2, etc.

Non-injury crashes don't always have vehicle/ driver codes, but will have environment/ pedestrian codes when coded.

Objects Struck

A driven or accompanied animals, ie under control
B bridge abutment, handrail or approach, includes tunnels
C upright cliff or bank, retaining walls
D debris, boulder or object dropped from vehicle
E over edge of bank
F fence, letterbox, hoarding etc.
G guard or guide rail
H house or building
I traffic island or median
J public furniture, e.g. phone boxes, bus shelters.
K kerb, when directly contributing to incident
L landslide, washout or floodwater
M parked motor vehicle
N train
P utility pole
Q broken down, workmen's vehicle, taxis picking up, etc.
R roadworks signs or drums, holes and excavations, etc
S traffic signs or signal bollards
T trees, shrubbery of a substantial nature
V ditch
W wild animal, stray, or out of control
X other
Y objects thrown at or dropped onto vehicles
Z into water, river or sea

Curve (degree of curvature of the road at the crash location)

R straight road
E easy curve
M moderate curve
S severe curve

Wetness (of road surface)

W wet
D dry
I ice or snow

Light

Natural light conditions
B bright sun
O overcast
T twilight
D dark

If Natural light conditions are T or D, the second letter means:

O street lights on
F street light off
N no street lights
U unknown
e.g. TF, DN

Weather

F fine
M mist
L light rain
H heavy rain
S snow

Second letter of weather code (optional)
F frost
S strong wind
e.g. FF

Junction

D driveway
R roundabout
X crossroads
T T junction
Y Y junction
M multileg

Control

T traffic signals
S stop sign
G give way sign
M pointsmen (1980 - 1988)
P school patrol or warden
N nil

Markings

X pedestrian crossing
R raised island
P painted island
L no passing line
C centreline
N nil

Speed limit

In kilometres per hour e.g. 100 = 100km/h
U unknown
LSZ limited speed zone

Injuries

This shows the number and classifications of injuries resulting from the crash.

FAT fatal injuries. Death caused by motor vehicle crash or within 30 days.

SER serious injuries e.g. all breaks, concussion etc

MIN minor injuries e.g. cuts, sprains, bruises etc

If blank - non-injury crash.

Pedestrian age

Age of pedestrian injured. If more than one pedestrian is injured, the age of the youngest pedestrian below 20 is shown. Otherwise this shows the age of the eldest pedestrian.

Cyclist Age

Age of cyclist injured. If more than one cyclist is injured, the age of the youngest cyclist below 20 is shown. Otherwise this shows the age of the eldest cyclist.

Grid Reference (optional)

The location of the crash in terms of the NZ Map Grid.

Grid ref = Grid reference

000000 000000 = Grid reference not yet calculated

999999 999999 = Grid reference not able to be determined

Appendix C
Crash Location summary sheet

Completed prior to Field Inspection

Location name	Location no.

Description of Location	Attachments
	Relevant Plans Aerial photograph Traffic counts

Crash history/common factors	Attachments
	Crash listing Detailed location summary report Notes from TCRs Collision diagram Factor grid

Completed after Field Inspection

Recent changes/previous CRS recommendations	Attachments
	Relevant plans/extracts

Description of problems identified

Description of possible remedial measures	Crashes addressed	Cost	BCR

Recommendations	Attachments
	Sketch plan Photographs Estimate Economics

Appendix D
Generic traffic management plan

The CRS team must contact the RCA to clarify its particular requirements for a TMP on the roads included in the study prior to and field inspections. The details in a particular TMP could vary depending on the road level, speed limit and other factors.

<table>
<tr><th colspan="5">Traffic management plan</th></tr>
<tr><td rowspan="2">Traffic management plan reference</td><td colspan="4"></td></tr>
<tr><td colspan="4">For office use only</td></tr>
<tr><td>Organisation</td><td colspan="2">Contractor
[CRS team]</td><td colspan="2">Client
[RCA]</td></tr>
<tr><td>Contract name / number</td><td colspan="2"></td><td colspan="2">RCA consent reference</td></tr>
<tr><td rowspan="2">Location</td><td rowspan="2">Road name(s)</td><td rowspan="2">Road level (LV, 1, 2, 3)</td><td rowspan="2">Speed limit</td><td>From RP</td></tr>
<tr><td>From RP</td></tr>
<tr><td>Description of activity</td><td colspan="4">CRS location inspections</td></tr>
<tr><td>Work programme</td><td colspan="4"></td></tr>
<tr><td>Proposed / restricted work hours</td><td colspan="4">Day and night time inspections</td></tr>
<tr><td>Traffic details (main route)</td><td colspan="2">AADT</td><td colspan="2">Peak hour flow</td></tr>
<tr><td rowspan="3">Proposed traffic management method
The team may need to be as inconspicuous as possible to observe driver behaviour. This should only be done from a safe place off the traffic lanes.</td><td colspan="4">Active: Daylight
During daylight hours the CRS vehicle is to park safely near the site; this could be in a nearby car park in urban situations, or in rural situations: on the berm, completely clear of the road and shoulder.
All team members shall wear hi visibility jackets. Where it is necessary to cross the road they should take due care as normal pedestrians.</td></tr>
<tr><td colspan="4">Unattended: Not applicable</td></tr>
<tr><td colspan="4">Night: During the hours of darkness the CRS vehicle is to park safely near the site; this could be in a nearby car park in urban situations, or in rural situations: on the berm, completely clear of the road and shoulder. If there is overhead lighting they should seek to operate in the vicinity of this light.
All team members shall wear hi visibility jackets and are to remain clear of the live lanes. Where it is necessary to cross the road they should take due care as normal pedestrians.</td></tr>
<tr><td>Proposed speed restrictions</td><td colspan="4">None</td></tr>
<tr><td>Positive traffic management measures</td><td colspan="4">None</td></tr>
<tr><td>Contingency plans</td><td colspan="4">In the event of poor visibility, heavy rain, or other inclement conditions that may pose a higher risk than normal, the inspection may be cancelled by the team leader.</td></tr>
</table>

Public notification	Not necessary			
Personal safety	The team must observe traffic discretely from a position away from live lanes and if required to go on the roadway, should always move to avoid traffic and not expect traffic to slow down or move for them.			
On-site monitoring	**Attended:** Check that all CRS team members maintain safe practices **Unattended:** Not applicable **Overnight:** Check that all CRS team members maintain safe practices **Other times:** Not applicable			
Other information	Not necessary			
Layout diagrams				
EED applicable?	Y/N			**Attached** Y/N
Traffic controllers	**Name** (STMS) **Cert no:**			**Phone** (24 hours)
	Name (TC) **Cert no:**			**Phone** (24 hours)
TMP prepared accurately to represent site conditions and submitted by	**Contractor / applicant** **Cert no:**			**Date**
Requires amendment	**Engineer:** **Cert no:**			**Date**

This TMP is approved on the following basis

1. To the best of the approving engineer's judgement this TMP conforms to the requirements of Transit New Zealand's *Code of practice for temporary traffic management.*
2. This plan is approved on the basis that the ***activity, the location and the road environment have been correctly represented by the applicant.*** Any inaccuracy in the portrayal of this information is the responsibility of the applicant. The STMS for the activity is reminded that it is the STMS's duty to 'postpone, cancel or modify operations due to the adverse traffic, weather or other conditions that affect the safety of this site' (reference A4.5).

Approving engineer:

Name and certificate number

Signature

Acceptance by TMC	**TMC:** **Cert no:** **Signature:**	**Date**

Appendix E
Economic evaluation procedure

Simple procedure benefit cost calculations for crash reduction studies

Date	
Submitted by	
Crash location	
Type (urban/rural)	

'Urban' refers to all speed limit areas of 70 km/h and under and limited speed zones.
'Rural' refers to all speed limit areas of over 70 km/h.

Treatment life (years)		**A**	
Crash record period	to	No. of crash years	**B**

COSTS

Cost of work	$	x	0.91	=	$	**C**
Additional annual maintenance	$	x		=	$	**E**

D Maintenance discount factor

Present value total costs = C + E $ **F**

BENEFITS

Either combine all movements or split into movement types.
Include fatal crashes in the injury total. For more detailed analysis use *Project evaluation manual* method.

	Movement		**Movement**		**Movement**	
	Injury	Non-injury	Injury	Non-injury	Injury	Non-injury
No. of crashes **G**						
No. of crash years **B**						
% crash reduction **H**						
Crash savings per year **(G/B) x .01 x H**						
Average crash cost **P**	$	$	$	$	$	$
Crash cost savings per year	$	$	$	$	$	$

Total cost crash savings per year $ **J**

Crash cost discount factor **K**

Present value total benefits = K x J $ **L**

B/C ratio $\frac{L}{F}$ = $ / $ =

Treatment life (5, 10, 25 years)	**A**		1	5	10	25
Maintenance discount factor	**D**		0.95	3.98	6.45	9.52
Crash discount factor	**K**	Urban	0.96	3.11	5.76	9.32
		Rural	0.95	2.94	5.23	7.82

*Average social cost per reported crash (at July 2004 prices)

P	Injury	Non-injury (PDO)
Urban	211,000	12,700
Rural	459,000	26,000