Level crossing risk assessment guide

DRAFT FOR CONSULTATION

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New Zealand Government

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More information

Published March 2013

ISBN 978-0-478-40736 (online)

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Foreword from the Chief Executive of the NZ Transport Agency

I welcome this ALCAM (Australian Level Crossing Assessment Model) *Level crossing risk assessment guide.* The report is a joint initiative between all Australian states, the NZ Transport Agency and KiwiRail. It applies the ALCAM crash prediction methodology to identify and risk-rank each of New Zealand's road/rail level crossings.

The guide uses the Safe System approach to help road controlling authority and rail staff to work together to treat key safety issues at high-risk road/rail level crossings. It also provides road controlling authorities with a consistent method to prioritise work in their asset management plans and applications for funding from the National Land Transport Fund.

Safer Journeys (New Zealand's road safety strategy for 2010–20) has a vision of 'a safe road system increasingly free of death and serious injury'. Safer Journeys describes how focusing our efforts on developing a Safe System will provide the greatest gains. The Safe System approach represents a fundamental shift in the way we think about, and act on, road safety. It involves road designers, transport and network managers and users sharing responsibility for a roading system that protects road users from death and serious injury.

This ALCAM *Level crossing risk guide* follows other Safer Journeys initiatives, including the NZ Transport Agency's *High-risk rural roads guide* and *High-risk intersection guide*.

Geoff Dangerfield

Chief Executive

NZ Transport Agency

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Executive summary

This *Level crossings risk assessment guide* provides a reliable picture of the risks and characteristics of all public level crossings in New Zealand. The report is based on survey information gathered during the last four years and uses the Australian Level Crossing Assessment Model (ALCAM).

ALCAM reveals that infrastructure at New Zealand's 1268 road level crossings is generally in reasonable condition, although there is a need for continued vigilance and site-specific improvements. Level crossings in Auckland and Wellington and on the passenger routes warrant special scrutiny because of the high volume of train services.

In contrast, the infrastructure at the 682 pedestrian level crossings is not good and many fail to meet national standards. Fortunately the work required to address this is often relatively minor and inexpensive. There is relatively little regional variability.

ALCAM predicts that there will be 147 vehicle–train collisions with 44 equivalent fatalities on New Zealand public level crossings over the next 10 years. This reflects an ongoing decrease in the number of collisions at level crossings; from approximately 130 annual collisions in the 1950s to approximately 20 annual collisions in recent years.

Although the total number of level crossing collisions is low by roading standards, the consequences are often more serious. A collision between a vehicle and a train is 13.2 times more likely to result in a fatality than a normal road crash.

In addition, the risk profile of rail is quite different from road and more like the aviation industry, in that there is always the potential for a low-probability but high-consequence accident involving passenger trains. KiwiRail and road controlling authorities cannot therefore just react to the collision record and instead need to take a more proactive approach to managing level crossing risk.

ALCAM is a proactive tool that can be used to identify risk, prioritise spending, and help identify value-for-money solutions. Pilot programmes in Rodney and the Waikato have shown that significant improvements in safety can be achieved, using ALCAM to target specific risks and implement low-cost improvements.

This report recommends an increased focus on these low-cost solutions, particularly in relation to level crossings on passenger lines, pedestrian level crossings and specific risks on road level crossings. This requires collaboration at a local level between KiwiRail and road controlling authorities and ultimately results in fewer accidents at level crossings.

1 Introduction

1.1 Purpose

The *Level crossings risk assessment guide* aims to raise awareness of the issues relating to public level crossings so that KiwiRail and road controlling authorities (RCAs) can work together to develop cost-effective safety improvements, recognising that these crossings are managed by more than one particular party.

The Australian Level Crossing Assessment Model (ALCAM) forms the basis for this report and can be used to identify risk and help determine appropriate treatments. This is not a one-size-fits-all approach, but is expected to help build a dialogue between individual RCAs and KiwiRail on what improvements can be made and how to prioritise funding. The ALCAM model, through this risk report, demonstrates that simple, cost-effective solutions can often reap significant benefits.

This report is a one-off document. It is not intended to become an annual report card on public level crossing risks. Instead it is intended to provide a national snapshot of risks and issues for KiwiRail and RCA representatives to build from and create a partnership to best manage their connected rail and roading networks.

1.2 Scope

This report is aimed solely at New Zealand's public level crossings, both for pedestrian and road users. Level crossings on private roads or associated with the operation of a heritage rail line are a separate matter and are not dealt with in this report.

ALCAM is a valuable risk management tool, but should not be used in isolation to determine risks at rail level crossings or the best form of mitigation. Best practice risk management requires a number of factors including sound engineering judgment, local knowledge, collision and near-collision history, and an understanding of standards and international best practice.

As this report is looking specifically at public level crossings, it only considers collisions that have occurred in these locations. This document does not consider all rail accidents and it should not be seen as a holistic review of issues such as trespassing, vandalism or suicide. Accidents involving KiwiRail personnel are also not included in this report.

1.3 Target audience

The information in this document is intended to highlight potential risks at rail level crossings to RCA and KiwiRail managers in order to support informed decision making on improvements that can be made by practitioners, including:

- NZTA engineers and representatives
- RCA engineers and representatives
- KiwiRail engineers and representatives
- planners
- funders.

1.4 Definitions

A **level crossing** is where a road or a pedestrian footpath crosses one or more railway tracks at the same level.

A **passive level crossing** is one where the only traffic control devices provided to road users are fixed signs – refer to section 4.1 for more details.

An **active level crossing** is one where active traffic control devices are provided to warn road users of the approach of a train or trains. Active controls are flashing warning lights and bells which in some cases are supplemented by automatic half arm barriers – refer to section 0 for further details.

A **collision** at a level crossing is defined as an impact between a motor vehicle, pedestrian or cyclist and a train. A single vehicle incident such as a car leaving the road due to driver inattention or speed is not considered to be a collision for the purposes of this report.

1.5 Structure of the document

The structure of this document is as follows:

Section 1	Introduction	
Section 2	Background and context	Outlines the scope of this report, provides reasons for reducing risk, and discusses how accident risk is currently managed
Section 3	The ALCAM model and its use in New Zealand	Details the structure and history of the ALCAM model
Section 4	Road level crossings	Provides a national analysis of the profile (ALCAM inputs) and risks (ALCAM outputs) at the 1268 road level crossings
Section 5	Pedestrian level crossings	Provides a national analysis of the profile (ALCAM inputs) and risks (ALCAM outputs) at the 682 pedestrian level crossings
Section 6	Addressing risk at level Crossings	Outlines possible treatment options and how funding can be obtained for road and pedestrian level crossings
Section 7	Summary	Summarises the key messages from this report
Section 8	Next steps	Provides a recommended way forward for RCAs and KiwiRail area offices
Appendix A	Summary reports	One-page snapshot summary for each RCA, regional council and KiwiRail area
Appendix B	Demarcation of responsibilities	From the NZTA Traffic Control Device Manual – Part 9 (2013) which sets out road and rail maintenance responsibilities
Appendix C	Contact details	RCAs and local KiwiRail offices

2 Background and strategic context

2.1 Background

New Zealand's rail system was largely developed to provide for expanding settlement in an era before good roads and motor vehicles were available. The rail network has been shaped by the landscape and topography of New Zealand, with rail lines following the contours of the land for ease of construction, resulting in frequent curves and gradients, and limiting speeds able to be achieved by trains. In many cases such topographical constraints mean that roads and railways share the same corridors, resulting in many level crossings being positioned right next to the state highway.

Today rail's primary role is freight transport, with 15.7 million tonnes of freight moved in 2011, including transporting around one third of New Zealand's exports to ports for companies such as Fonterra and West Coast coal producers. Recent investment in new locomotives and wagons, together with infrastructure maintenance and asset renewals, has led to growth in rail freight volumes and revenues.

Rail's second role is to provide urban commuter services in the main centres of Auckland and Wellington. Wellington has always had a strong commuter rail network with 11.3 million journeys made by rail in 2010/11. In Auckland there has been significant investment by both central and local government in improved services, trains and infrastructure, and this has resulted in annual passenger numbers growing from under 2 million in 2002 to 10.9 million for the year ended June 2012. Auckland rail passenger journeys are expected to continue to grow with the introduction of electric trains and reach 20 million annually by 2021.

The third role is to operate long distance passenger services between Wellington and Auckland, Picton and Christchurch, and Christchurch and the West Coast. These routes are primarily targeted at tourists or locals keen to experience a different type of trip, enjoying New Zealand's landscape and scenery.

Historically, rail played an important part in opening up the country, with towns and cities growing up around rail lines and stations as the network expanded. The legacy of this is that pedestrians and drivers regularly have to cross the rail, and while good town planning provides locals with bridges or underpasses, cost considerations mean that the presence of level crossings is inevitable in some areas. While in some cases rail lines are not as busy as in the past, growth in road traffic volumes means that the risk of level crossing collisions remains real throughout New Zealand.

This interaction highlights the need for KiwiRail and all local authorities to work together to manage and maintain New Zealand's level crossings in a safe condition.

2.1.1 Level crossings and the environment

Some of the risks at level crossings can be quite regionalised, due to historic or geographic differences. Visibility at level crossings may be restricted by curves or vegetation on private land in hilly parts of the country. This poses more of a problem in areas like the West Coast.

On flat sections of the country (Canterbury being a good example), where rail and state highway run in parallel in close proximity to each other, there is often a 'stacking' risk where trucks can be forced to rest over the tracks before turning on to the state highway. The problem has become more apparent as traffic volumes and truck lengths have increased.

Urban centres face their own level crossing challenges as traffic patterns and vehicle sizes have changed over time. In urban centres, designated pedestrian level crossings are often needed, sometimes immediately next to a road and sometimes on their own. Typically, these have not had the same attention as road level crossings and the infrastructure is often below standard. This is becoming increasingly important in Australia

and New Zealand as the number of road level crossing collisions drop and pedestrian accidents consequently make up an increasing portion of the statistics.

Snapshot profile of New Zealand public level crossings	
Road level crossings:	1268
Pedestrian level crossings:	682
Length of rail network:	~3800km
Average distance between road level crossings:	2.4km
Commuter rail services:	Auckland and Wellington
Long-distance passenger services:	Christchurch to Picton Christchurch to Greymouth Auckland to Wellington
Average train movements per level crossing (commuter lines):	78 per day
Average train movements per level crossing (elsewhere):	8 per day
Average vehicle movements per level crossing:	1793 per day
Total train movements over level crossings (for all of NZ):	14,800 per day
Total vehicle movements over level crossings (for all of NZ):	2280,000 per day
Average collisions:	15–30 per year
Average pedestrian collisions:	3–5 per year

Despite some regional challenges, the overall profile and the risks posed by New Zealand's level crossings are similar to what most road and rail authorities across the world face. This is helpful as it allows New Zealand to learn from overseas research, best practice, collision records and subsequent lessons learned.

2.1.2 Private level crossings

New Zealand has approximately 1600 private level crossings. Unlike public level crossings, the road controlling authority (RCA) has no maintenance responsibilities and private level crossings are intended to be jointly managed between KiwiRail and the adjacent landowner.

Unfortunately, identifying a single landowner is not easy and there are a number of poorly maintained 'private' level crossings that have a higher degree of public use than official public crossings. This situation often occurs after residential subdivisions have been established or where the public access a business on the other side of the rail corridor. Their 'private' status has meant that these level crossings do not fall under the maintenance programmes of either an RCA or KiwiRail, and therefore some of these present a higher accident risk.

To avoid creating future problems, councils should be aware of any potential effects that a development may have on level crossing safety. Many local councils have been proactive and have already included level crossing controls in their district plans.

KiwiRail is identifying the risks at all private level crossings as part of a separate programme. Some RCAs are likely to be approached to discuss the management of some of these crossings where there is a high degree of public use and no single identifiable owner. Private Level Crossings are not covered further in this report.

2.1.3 Collision statistics

The number of collisions at level crossings has been steadily decreasing from approximately 130 collisions per year in the 1950s to approximately 30 collisions per year in the early 2000s. This is despite a 700% growth in the number of registered vehicles on New Zealand roads.

In the last 10 years road level crossing collisions have continued to trend downwards, with a reduction from approximately 30 to 20 per year. As with any statistical exercise there is significant inter-annual variability, and it takes a number of years to see a trend emerging. There are around five pedestrian collisions at level crossings per year.

Environment	Level crossing collisions	Road crashes
Accidents in past 10 years	257	379,948
Fatal and serious accidents in past 10 years	75	24,004
Average social cost per accident	$700,000	$120,000
Total social cost	$179 m	$45,374 m

Table 1 Level crossing collisions and road crashes by social cost (2002-2011)

Some may argue that the decrease is relative to the reduction in the number of trains operating on a smaller network, however, the primary reason for the reduction is the increase in the number of level crossings with automatic alarms fitted (from 50 in the 1950s to 994 currently). These tend to be on busier roads in urban areas rather than in rural areas. RCAs and KiwiRail have made a concerted effort to ensure all public level crossings have sufficient visibility and signage.

In many ways a level crossing is similar to a road intersection, with a few key distinctions:

1. Responsibility rests on the motor vehicle driver or pedestrian: A train is unable to stop or swerve, meaning the onus is purely on one party to prevent an accident. On roads there is greater redundancy as a second driver can often react and avoid a collision.
2. Severity of collisions: While the severity of a collision is high, level crossing collisions only make up approximately 1 % of all fatal collisions on New Zealand roads. However, level crossing collisions have some important distinctions from road crashes in that:
    - a driver is 13.2 times more likely to die in a level crossing collision,
    - a driver is 3.4 times more likely to be seriously injured,
    - 2.7 times more males than females are involved in level crossing collisions (1.9 times for general road accidents), and
    - a higher percentage of collisions occur in open road conditions areas: 48 % vs 31 % for general road accidents.
3. Complacency: While a driver commonly expects to see another vehicle at a road intersection, on many lines it would be rare for a driver to have to stop for a train. This can lead to a sense of complacency and explains why a number of collisions involve drivers who are regular users of a level crossing.
4. Visibility: Without good signage and roadmarking, many passive level crossings can be more difficult to spot as there are few visual clues available to drivers (i.e. two steel rails, and a narrow rail corridor that is often surrounded by vegetation).

Over the past 10 years there have been 257 collisions between trains and vehicles at level crossings on local roads and state highways within New Zealand. Most occur on local roads because of the limited number of passive level crossings remaining on state highways (Figure 1).

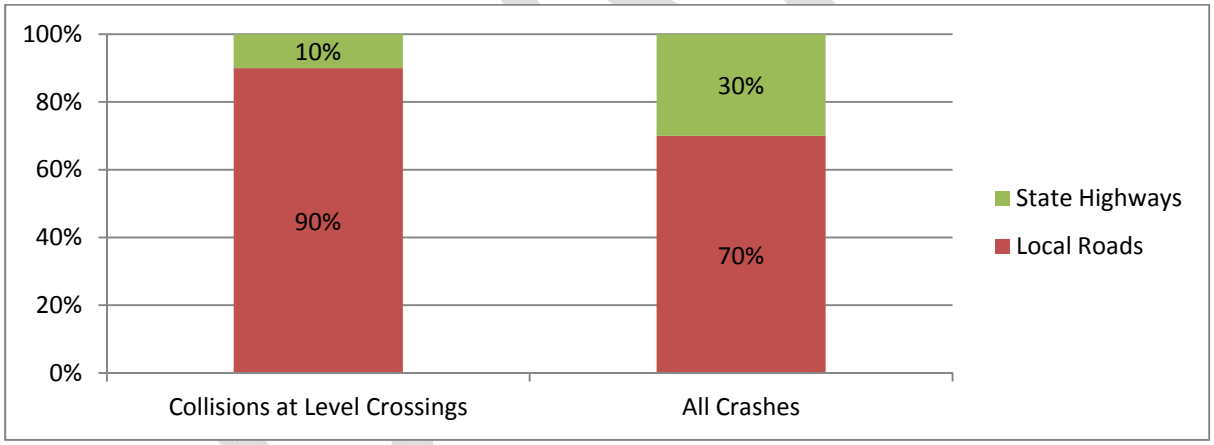


Figure 1 Level crossing collisions and road crashes by location (2002-2011)

These accidents have resulted in 31 fatalities and 44 serious accidents over the last 10 years. This represents 29% of all level crossing collisions, and is significantly higher than the 6% of road crashes that result in a serious injury or fatality (figure 2).

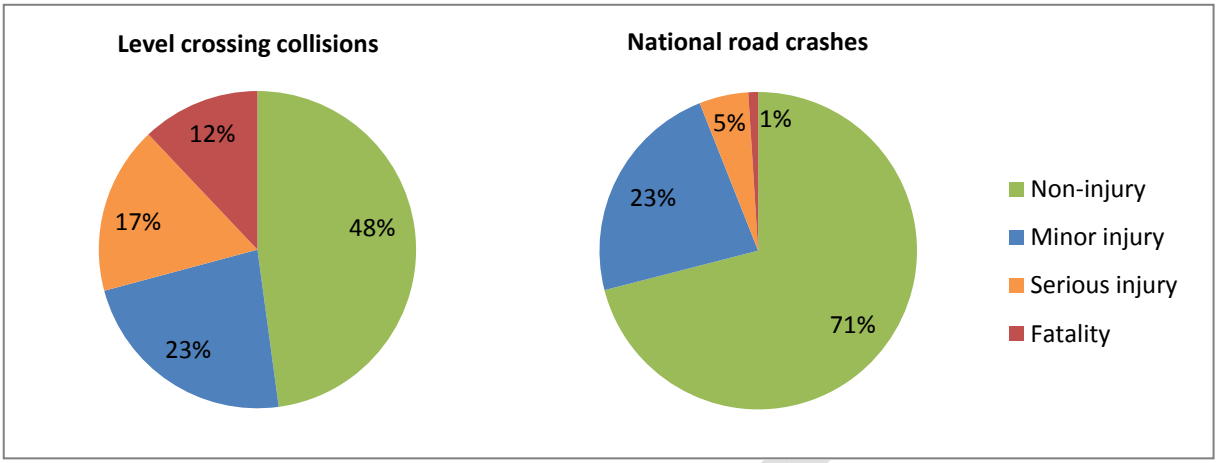


Figure 2 Comparison of level crossing collisions and road crash outcomes (2002-2011)

Given the low number of public level crossing collisions the accident record cannot be used to get a statistically robust picture of the collision risk. This is different to the typical approach used for roading improvements where crash data helps to determine the nature and severity of the risk. Because of the serious nature of level crossing accidents and the potential for a high-consequence collision involving a passenger train, a more proactive approach, such as ALCAM, is required to determine the extent of the risk and to best prioritise level crossing improvements.

Within New Zealand there is a general move toward this sort of approach, and NZTA has recently released tools and guides to proactively manage the risk on state highways (KiwiRAP) and at intersections.

2.2 Strategic context

2.2.1 Safe Systems

New Zealand's current road safety strategy is based on a holistic 'safe systems' approach, targeting safer vehicles on safer roads, driving at safer speeds. This risk management approach is contained in the Ministry of Transport's Safer Journeys Strategy 2020 and is consistent with international best practice.

Safer Journeys is a national strategy to guide improvements in road safety for the period between 2010 and 2020 and sets out a long-term vision for New Zealand of a 'safe road system increasingly free of death and serious injury'. Level crossings and rail in general are not mentioned in Safer Journeys. However, there is merit in having systems that are consistent with this risk management approach for the rail network and crossings.

While New Zealand does not have an over-arching rail safety strategy, the Railways Act 2005 requires that 'all practical steps' are taken to minimise harm. This expectation is met by NZTA and KiwiRail by managing and co-funding the installation of alarms and by sponsoring educational campaigns to raise awareness of risks and responsibility at level crossings. Co-funding the ALCAM level crossing national surveys was a further step to ensure the requirements of the Act are met.

Beyond the Railways Act, KiwiRail also has a number of National Rail System Standards (NRSS) that are applied to the operation of rail service vehicles on the national rail system. These standards cover safety, rail operations, incident and occurrence reporting and other factors that align with the identification and management of issues regarding rail level crossings.

In particular, NRSS 2 relates to safety management and details the minimum requirements of a Safety System required under the Railways Act 2005. Like NZTA's approach, KiwiRail's Safety System is an

integrated combination of physical, procedural, and human elements. ALCAM is a key tool to bridge any gap between what NRSS 2 says and how KiwiRail acts on this.

The ISO31000 internationally recognised risk assessment framework emphasises the need to understand the context of the risk, and to frame an issue in terms of the objectives that an organisation is trying to achieve. A complete risk management approach requires supplementing the use of the ALCAM model with wider operational considerations. This includes elements such as minimising damage in accidents, and refining response and recovery plans to reduce the potential for consequential damage and operational delay for rail in the passenger networks.

2.2.2 Managing risk at level crossings

There has been a tendency to view and treat level crossing risks in the same manner as roading risks. Overseas experience suggests this is an inappropriate, simplistic view as there are a few key differences between rail and roading risk profiles. They are:

1. Asymmetric accident risk: While level crossing collisions occur far less frequently than road accidents, the consequences can be much greater (for example, if a truck or bus collides with a passenger train). In analysing an accident simply extrapolating the historic record will not demonstrate the level of the risk, as a single serious event significantly distorts the safety record of a level crossing. In this sense, rail is similar to the aviation industry.
   There are a number of high-profile overseas examples of this, including:
   - Germany (1964): Passenger train and fuel tanker (94 deaths)
   - Switzerland (1982): Train and bus (39 deaths)
   - Australia (1943): Freight train and bus at Wondoga (25 deaths)
   - Australia (2007): Passenger train and truck at Kerang (11 deaths and 23 injured)
   - Egypt (2012): Freight train and school bus (47 deaths).

   In New Zealand there have been a few collisions where train passengers have been injured or killed. In particular, a 1993 accident where the Southerner collided with a truck killing three and seriously injuring seven and a 2001 accident where the Southerner was again involved in a collision with a truck injuring 29 passengers.
2. Consequential losses: There is a far greater potential for consequential losses in the rail industry than the roading industry. While the most noticeable impact is deaths or injuries sustained in a vehicle or on the train, there can also be significant costs regarding:
   - clearing tracks and damage to rolling stock and alarms;
   - delays to passengers and the flow-on effect to the road network;
   - delays to freight and loss of business confidence; and
   - loss of public confidence.
3. Need for a proactive approach: Road engineering has a long history of injury and non-injury collisions that can be used to prioritise upgrades. In contrast, level crossings have a much lower number of reported collisions and near-collisions. This requires the use of a proactive tool such as ALCAM to identify risks.

2.2.3 Reducing risk through higher-cost upgrades

Typically, level crossing risk reduction improvements have concentrated on moving from signs to automatic alarm systems. NZTA, RCAs and KiwiRail have been installing alarms on level crossings since 1921 and, short of grade separation, it remains the best way to reduce the risk of a collision.

KiwiRail currently prioritises these upgrades based on an holistic view of the crossing, considering its collision record, visibility, traffic and train volume. This is known as the Accident Priority List. With the ALCAM surveys now completed, future prioritisation will be based on an ALCAM risk score and the collision history; however, the transition between systems is expected to take a few years due to earlier commitments made. The benefits will be an internationally recognised prioritisation system that aligns with good practice in accident data analysis and research.

While the most straightforward way to manage risk would be to put alarms and barriers on all crossings, this would potentially take another 100 years at current rates to complete, at a cost of over $100 million. Therefore an alternative approach is needed to address crossings where alarms cannot be justified, that are low on the priority list to receive alarms, or that have already been upgraded but have a specific residual risk.

This is where the ALCAM model can make a positive impact because it provides more cost-effective and prioritised solutions for specific crossings.

2.2.4 The importance of cooperation between rail and road

In New Zealand there are 60 RCAs and 4 NZTA Regions that have level crossings within their boundaries. KiwiRail is the primary rail access provider in New Zealand and manages 3,800 km of track. However, there are over 70 other licensed rail access providers or operators whose policies and operating procedures may differ in detail to some degree.

Historically, co-operation between road controlling authorities and KiwiRail has been inconsistent. It has often been hard to clearly define responsibilities and meeting the cost of work has been dependent on the level crossing's history.

Funding responsibilities for installation and maintenance costs for upgrading level crossings to active protection are clearer, thanks to an existing agreement between NZTA and KiwiRail. These costs are split 50/50 between KiwiRail and the relevant RCA with the RCA then claiming a 100% rebate back from the NZTA. However, funding for level crossings with signs or pedestrian infrastructure is less clear cut.

Responsibility for road surfacing, signage and vegetation costs depends on whether the level crossing is issued under grant, or whether it is officially a 'road-over-rail' or 'rail-over-road' crossing. In most areas, KiwiRail carries out work within the rail corridor (signs, alarms, surfacing, and vegetation clearance). The RCA normally carries out road marking, advanced warning signage and other activities located more than 5m from a rail corridor. Unfortunately this is not always the case and the responsible party can be difficult to find.

It has been possible to recover costs for level crossings with alarms under the 50/50 agreement. However, recovering costs for passive crossings rarely happens.

Unclear responsibilities and ineffective cooperation in the management of level crossings between road and rail authorities over the years in New Zealand have contributed to issues such as:

- confusion about responsibilities for maintenance and addressing risks such as replacing damaged signs
- lack of a single point of contact for dealing with infrastructure that is in poor condition
- inadequate pedestrian infrastructure at level crossings except where there has been recent investment
- disjointed crossing surface maintenance causing an uneven ride for motorists, or worse creating an environment where vehicles become stuck (such as the collision at Paekakariki in 2011 where a bus became trapped and was struck by a freight train).

In 2012, the New Zealand Level Crossing Working Group, in an attempt to better define these maintenance responsibilities, included a new appendix in the to the NZTA Traffic Control Devices Manual, Part 9 – Level Crossings. In this appendix, maintenance responsibilities are defined, firstly by reference to legislation and

then, where no legislation exists, in a practical and fair means[1]. The appendix was circulated for public consultation and is due to be released in 2013. It is included in Appendix B of this document for reference.

2.2.5 Interface agreements

The need for road and rail cooperation is not unique to New Zealand and was arguably even more of an issue in Australia where they have multiple rail authorities for a single piece of track. The Federal parliament recognised this and passed legislation in 2006 requiring all parties to sign Safety Interface Agreements within three years.

An interface agreement is effectively a Memorandum of Understanding and could be a single document signed between the RCA and KiwiRail. This document is likely to include such things as planning, joint risk assessment, cost allocation, maintenance responsibilities, work coordination, emergency management and dispute resolution procedures.

#

[1] Any existing agreements between RCAs and KiwiRail will always take precedence.

3 The ALCAM model and its use in New Zealand

3.1 The ALCAM model

The Australian Level Crossing Assessment Model (ALCAM) is a tool used to identify and help manage potential risks at road and pedestrian level crossings.

The model began as a Level Crossing Risk Scoring Matrix, developed by Queensland Rail. It was seen as an innovative risk assessment tool and, having widespread support, was formally adopted at an Australian Transport Council meeting in May 2003. ALCAM is now applied across all Australian States and in New Zealand. It is overseen by an Australia-New Zealand committee who ensure its development and application is consistent.

There are three separate components to the ALCAM model, which, when combined, produce a unique risk score for each level crossing:

ALCAM risk score = infrastructure factor x exposure factor x consequence factor

The ALCAM risk score is expressed in terms of an expected number of equivalent fatalities per year with an equivalent fatality seen as a combination of all types of harm using the ratio:

1 fatality = 10 serious injuries = 200 minor injuries

It is the equivalent fatalities per year that allows comparison of level crossings against each other within a given jurisdiction based on the level of risk. By sorting level crossings in relation to their ALCAM risk score, a priority listing can be created, which can then be used to develop a safety improvement programme.

The mechanics of the ALCAM model are illustrated in Figure .

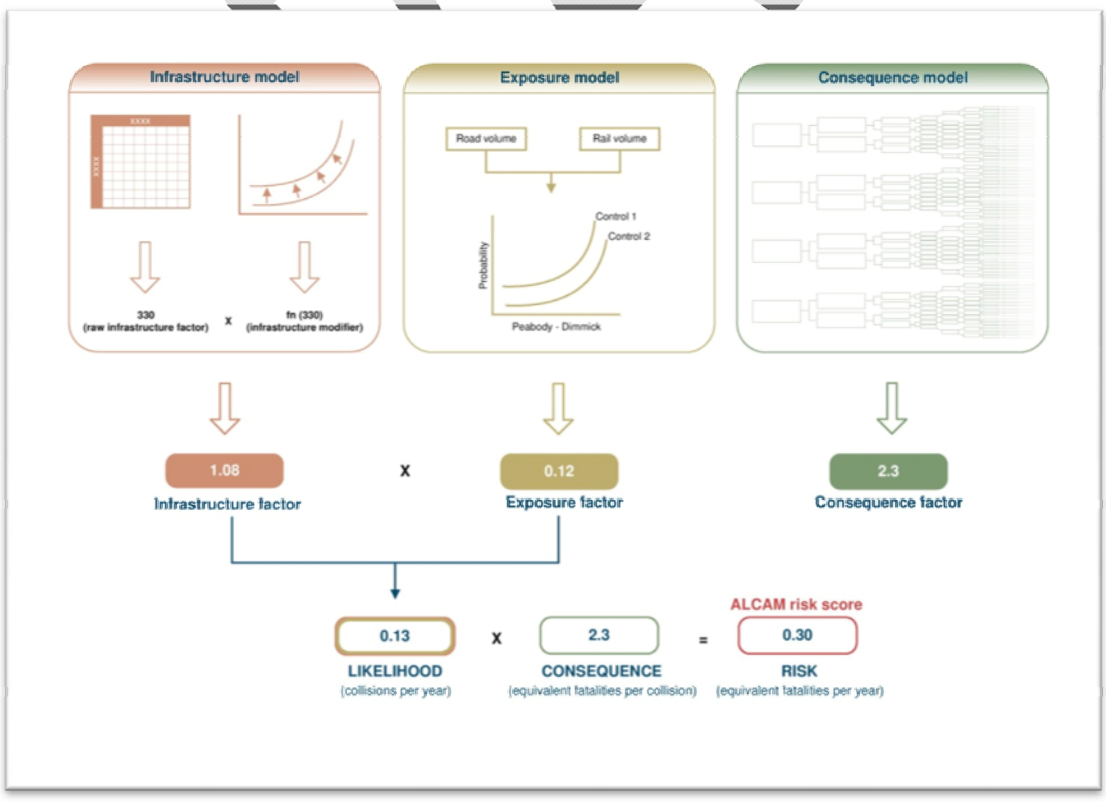


Figure 4 ALCAM model structure

The weightings within the model have been determined by analysing collisions in Australia and New Zealand and through a series of workshops by an expert group. All three components of the model have also been validated against 10 years of Australian and New Zealand level crossing collision data.

ALCAM can be used to:

- quantify the probability of an accident
- quantify the expected consequences of an accident
- compare the relative risk between crossings within a region or jurisdiction
- carry out a cost-benefit analysis of any improvements
- highlight where specific risks or deficiencies exist, and
- model the effect of cost-effective treatments to address these risks.

A total data management system, the Level Crossing Management System (or LXM), is used to effectively manage ALCAM data as well as other important information. LXM contains a number of additional reporting and modelling tools, which help with the overall decision-making process. While ALCAM is a comprehensive assessment tool to understand level crossing hazards, it cannot be applied in isolation and does not preclude the need for sound engineering judgement.

As an assessment tool, ALCAM does not authorise upgrades, nor does it attempt to define a 'safe' or acceptable level of risk. This is a decision for each jurisdiction and depends on the standard of existing crossings, upgrade budgets and the level of risk that is tolerable.

It is also very important to ensure that all stakeholders associated with a particular level crossing are involved in determining the final treatment.

3.2 Use of the ALCAM model in New Zealand

The New Zealand Level Crossing Working Group, which includes representatives of KiwiRail, NZTA and the RCA Forum, first became aware of ALCAM in 2002 and was invited to participate in the work of an inter-state working group as an observer.

The model appeared to offer advantages in terms of identifying and prioritising level crossing safety issues and was considered worthy of investigation for possible application in New Zealand.

During 2005 a series of surveys was carried out at 36 level crossings, applying the ALCAM methodology. Further surveys were carried out on a number of level crossings in the busier Auckland and Wellington rail corridors to assess, the then recently developed, ALCAM for pedestrian level crossings. The results indicated that ALCAM should be adopted in New Zealand.

This view was endorsed by the New Zealand Level Crossing Working Group in 2007 resulting in KiwiRail and NZTA co-funding a project to gather data and implement ALCAM in New Zealand.

3.3 The New Zealand ALCAM project

In 2008 the ALCAM survey methodology was modified by the project team to reflect New Zealand conditions[2] and surveys of level crossings were carried out around the country. While the survey method is well defined, much can be gained through local knowledge. For this reason 12 survey teams were trained, with each team working in the region closest to home.

The data gathered by the survey teams was checked, supplemented by office-sourced data[3] and entered into the Infrastructure and Consequence components of the ALCAM model by the project team.

In total there were over 130 variables entered into the model, many of which could influence the risk of an accident. Further details on these can be found in the *ALCAM in detail* (2012) manual.

The surveys were completed in March 2012, followed by the ALCAM project team carrying out an extensive quality control process. Two main things were identified during this process:

1. Some ALCAM inputs relied on significant local knowledge, including the proportion of heavy vehicles using the crossing, the likelihood of sunstrike and the proportion of time that the crossing was in fog.
2. There was insufficient information for some ALCAM inputs (ie volumes of pedestrians using level crossings or the proportion of heavy vehicles).

While local survey teams had provided their own estimates, these were obviously influenced by conditions at the time of the survey and use of their information could potentially create a temporal or regional bias. To ensure a nationally consistent and objective dataset, it was decided to use default values for these variables[4]. In this way level crossings could be compared nationally without introducing any artificial bias; however, the knowledge of local rail and road authorities is still required to identify and address some specific risks.

The survey programme ran from 2008-2012. However, most of the Auckland, Waikato, and the lower-North Island regions have had refresher surveys carried out within the last 12 months.

Over 200 level crossings have been upgraded using ALCAM as a design tool to identify risks and determine cost-effective treatments. This has occurred in the Waikato region, in Auckland and in Whanganui, and has involved over 10 RCAs. This is discussed further in section 0.

ALCAM has also been used for traffic management planning, resource consent applications and to help the NZTA to assess applications to run heritage and tourist services.

[2] Including changes to maximum vehicle lengths, terminology, and standards being assessed etc

[3] Including train speeds, train sizes and volumes, traffic volumes (from RAMM data), and proximity to schools and other facilities (identified off aerial photographs).

[4] Ie, 10% of the traffic being heavy vehicles, sunstrike 1 day/month, an average of 100 pedestrians/day.

4 Road level crossings

4.1 National profile (ALCAM input)

There are 1268 level crossings located on public roads in New Zealand. While no two road level crossings have an identical profile, they will all have one of the following traffic control devices:

- Stop or give way signs (570 crossings: 45 %).
- Flashing lights and bells (424 crossings: 33 %).
- Half-arm barriers (274 crossings: 22 %).[5]

Signs

Flashing lights and bells

Half-arm barriers

Figure 3 Road level crossings – types of traffic control device

The type of traffic control device is determined by several factors, with the main considerations being road volumes, train volumes and any collision history.

Figure 4 shows the distribution of road level crossings by control type for each of the regional council areas in New Zealand.

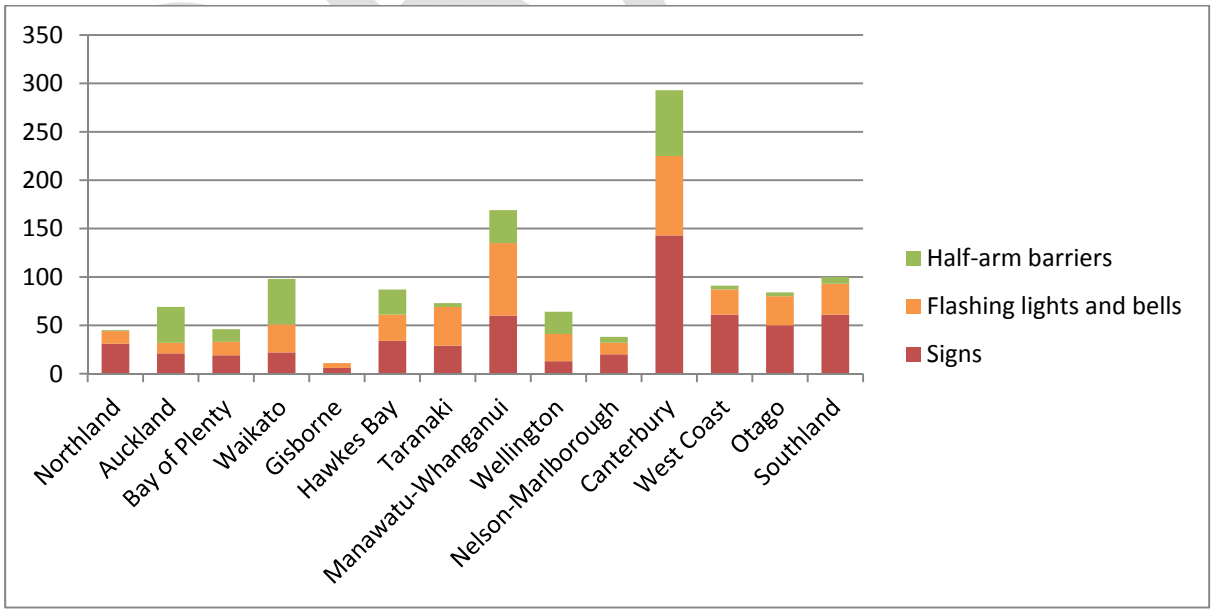
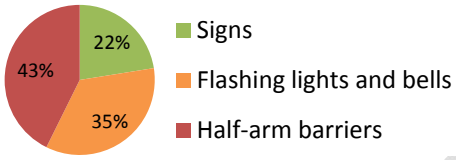
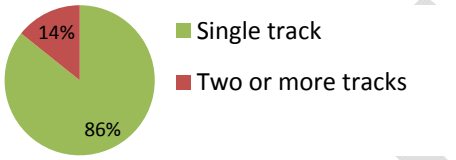
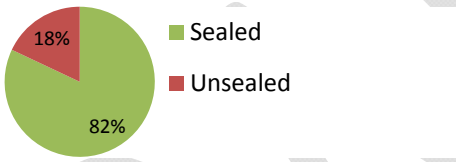
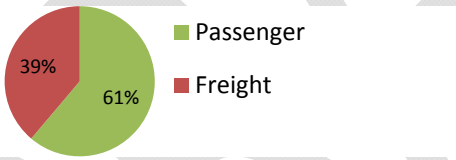
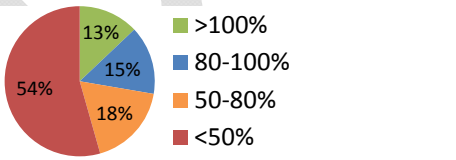


Figure 4 Road level crossings – population by regional council area

[5] These also have flashing lights and bells, but for simplicity are just referred to as 'half-arm barriers.'

The concentration of road level crossings is highest in Gisborne (1 per 1.6km) and Taranaki (1 per 1.9km), and lowest in Manawatu-Whanganui and Waikato (both 1 per 3.1km). The large number of level crossings in Canterbury reflects both the size of the region and the fact that there are approximately 640km of railway in Canterbury (about 17% of the national network).

Every road level crossing has more than 130 physical characteristics that need to be entered into ALCAM, with many of these identified as affecting the overall risk of an accident. Some of the key variables are listed in Table 2.

ALCAM input	Distribution	Comment
Control type		
Number of tracks		Two or more tracks are predominantly in Wellington and Auckland.
Road surface		
Train types		Passenger train routes are listed in **Error! Reference source not found.**.
Seasonal train variability		Seasonal is mainly associated with trains carrying dairy products.
Restart visibility		Visibility along track is essential for passive crossings, but less important for crossings with alarms.
Condition of control		
Road quality and configuration		Includes road-rail angle and road surface condition.

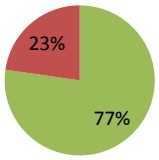
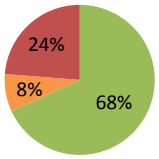
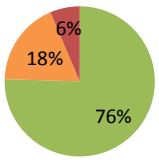
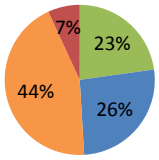
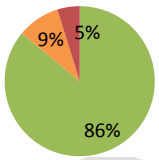
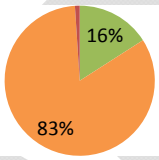
Hump, dip or rough surface		Can lead to vehicles stalling or getting stuck.
Likelihood of short stacking		Based on physical stacking distance only and assumes use by a 25 m long vehicle.
Possibility of queuing from adjacent intersection		Mainly an issue in urban centres.
Highest train speed		
Approach speed of vehicle		Free-flow traffic speed
Compliance with standard		Partial compliance where signs are present, but out of position or are an old design.

Table 2 Road level crossings – key ALCAM inputs

#

4.1 National risks (ALCAM output)

4.1.1 National risk profile

ALCAM predicts that approximately 147 collisions and 44 equivalent fatalities will occur at New Zealand public road level crossings over the next ten years (**Error! Reference source not found.**). This assumes no improvement work is carried out and all other factors remain constant.

	Signs	Flashing lights and bells	Half-arm barriers	TOTAL
Level crossings	570	424	274	**1268**
Collisions per 10 years	52	58	37	**147**
Equivalent fatalities per 10 years	14	18	12	**44**

Table 3 Road level crossings – Modelled collisions in ALCAM

Comparing these predictions to the historic accident record (2002-2011) there are two differences:

1. The predicted number of collisions (147) is **lower** than the historical number of collisions (257). This is largely due to the ongoing investment in level crossing safety[6].
2. The predicted number of equivalent fatalities (44) is **higher** than the actual number of equivalent fatalities (36). The difference occurs because the ALCAM model includes an allowance for a multiple-facility accident, generally involving a passenger train or bus. These are rare and fortunately New Zealand has not had one of these accidents in the last 10 years.

	Signs	Flashing lights and bells	Half-arm barriers	TOTAL
Average collisions per crossing	0.09	0.14	0.14	**0.12**
Average number of fatalities or serious injuries per collision	0.27	0.31	0.32	**0.30**
Average daily vehicles	202	1,599	5,435	**1,793**
Average daily trains	7	8	27	**12**

Table 4 Road level crossings – Modelled collisions in ALCAM 2

On a per crossing basis, the average number of collisions is similar for all types of level crossing (0.09-0.14) (**Error! Reference source not found.**). However, the average number of vehicles using level crossings with half-arm barriers is 3 times higher than those crossings with flashing lights and bells, and 27 times higher than crossings with only signs.

[6] In particular, there have been 63 level crossings upgraded to active protection since 2002. Most of these have been at level crossings with a collision record or with high train and vehicle volumes.

Normalising by both vehicle and train volumes reveals that half-arm barriers are 10 times more effective at reducing the risk of a collision than flashing lights and bells on their own. For this reason, both NSW and WA have policies in place that only half-arm barriers will be installed in any new upgrades. ALCAM data and Australasian collision statistics were used to support the introduction of both policies.

4.1.2 Regional risk profile

Table 5 reflects the expected distribution of accidents across New Zealand, and includes the effect of traffic and train volumes. As such, it is not surprising that Auckland (13%) and Wellington (15%) have a higher overall level of accident risk than the quieter rail lines and roads in Southland (10%) and the Hawke's Bay (9%).

	Level crossings	Collisions per 10 years	Fatalities per 10 years	Likelihood of a collision per crossing	Average infrastructure factor
Northland	45	4	1	9%	1.09
Auckland	69	12	3	18%	1.03
Bay of Plenty	46	6	2	13%	1.14
Waikato	98	11	4	11%	1.04
Gisborne	11	1	0	7%	0.96
Hawkes Bay	87	9	2	10%	1.10
Taranaki	73	7	2	9%	1.10
Manawatu-Whanganui	169	20	7	12%	1.10
Wellington	64	9	3	15%	0.98
Nelson-Marlborough	38	6	2	15%	1.28
Canterbury	293	34	11	12%	1.08
West Coast	91	9	1	10%	1.07
Otago	84	8	2	10%	1.09
Southland	100	10	2	10%	1.07
National total	**1268**	**147**	**44**	**12%**	**1.08**

Table 5 Road level crossings – modelled collisions by region

The last column in Table 5 presents the average infrastructure factor for each region. This number quantifies the effect of road slopes, rail speeds, viewlines, surface type, and all other characteristics gathered during the ALCAM assessments. A value below 1 means that the average quality of the infrastructure is better than the Australian and New Zealand average; while a value above 1 means that the infrastructure is worse than this average.

The ALCAM analysis suggests that Auckland (1.03), Waikato (1.04) and Wellington (0.98), have level crossing infrastructure that is similar in risk to the average Australasian level crossing. This is not altogether surprising, as a significant amount of money has been spent over the past 10 years on improving level crossings in these areas. Most other regions have a risk level similar to the New Zealand average (1.08), with the Nelson-Marlborough region being the outlier with a comparatively poor quality of level crossing infrastructure (1.28).

Overall the level of risk posed by New Zealand's level crossing infrastructure is about 8% higher than the Australasian average. Note that not all of these factors that make up the Infrastructure Factor are within the control of KiwiRail or roading authorities, and the undulating New Zealand landscape presents a set of risks that is not faced by most Australian states.

A further breakdown on risk by regional council area and by KiwiRail area is shown in Appendix A.

4.1.3 Types of risk

Analysing the ALCAM model output on a national level reveals that the specific risks faced at level crossings are heavily dependent on the type of control. The breakdown shown in Figure 5 reflects not only the effect of the type of control, but also the type of environment in which the controls are usually used.

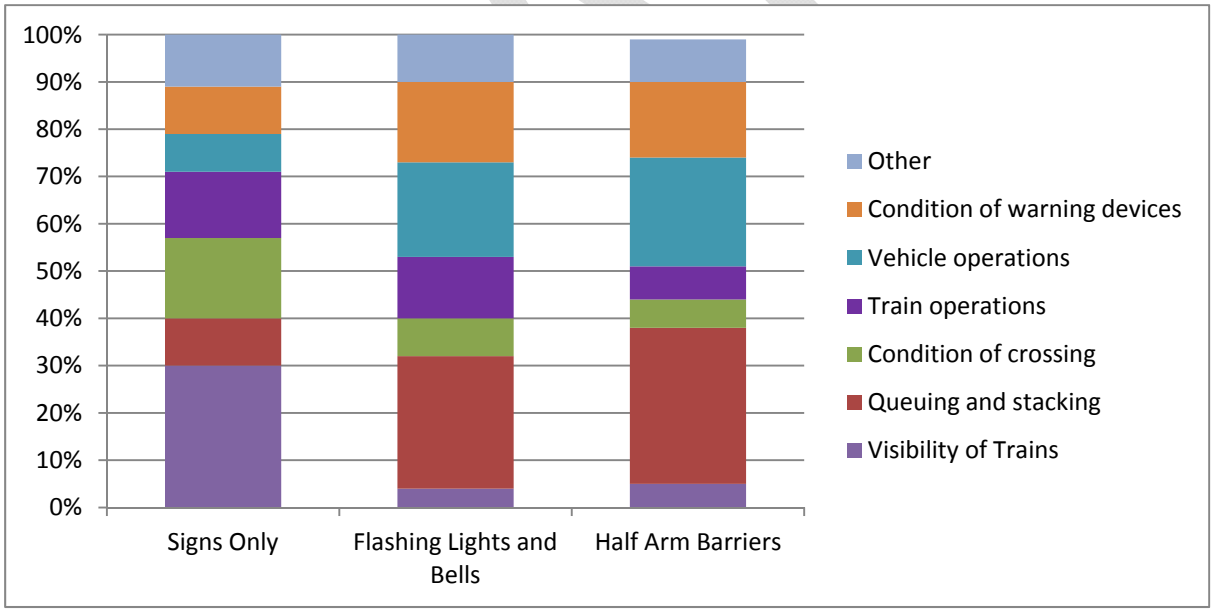


Figure 5 Road level crossings – national infrastructure risks

The *queuing and stacking* risk is a good example of the relationship between the type of environment and the type of traffic control. Half-arm barriers tend to be used on busier roads, often in built-up urban areas or on a main road adjacent to a state highway. Therefore it is not surprising that the risk of vehicles queuing back over the level crossing stacking makes up 33% of the overall risk profile for these crossings.

Unsurprisingly, *visibility of trains* makes up a higher proportion of the risk for level crossings with signs (30%) than it does for level crossings with active control such as flashing lights and bells or half-arm barriers (4% and 5% respectively). This is because installing alarms that are activated by a train largely negates the requirement for long view lines along the rail corridor.

The *condition of the crossing* reflects the type of surface, the skew angle between road and rail, and the potential for vehicles to stall to get stuck on a hump. Again, these risks are proportionally higher for level crossings with signs, probably because such level crossings are found on low-volume rural roads and therefore re-grading or re-aligning is harder to justify.

The *vehicle operations* risk appears across all level crossings and is largely driven by a default proportion (10%) of heavy vehicles within the NZ ALCAM system. Unfortunately the heavy vehicle information was not available for individual level crossings; however, users should be aware that a higher proportion of heavy vehicles can significantly increase the risk of an accident at a level crossing, particularly when combined with an unsealed crossing with a humped profile.

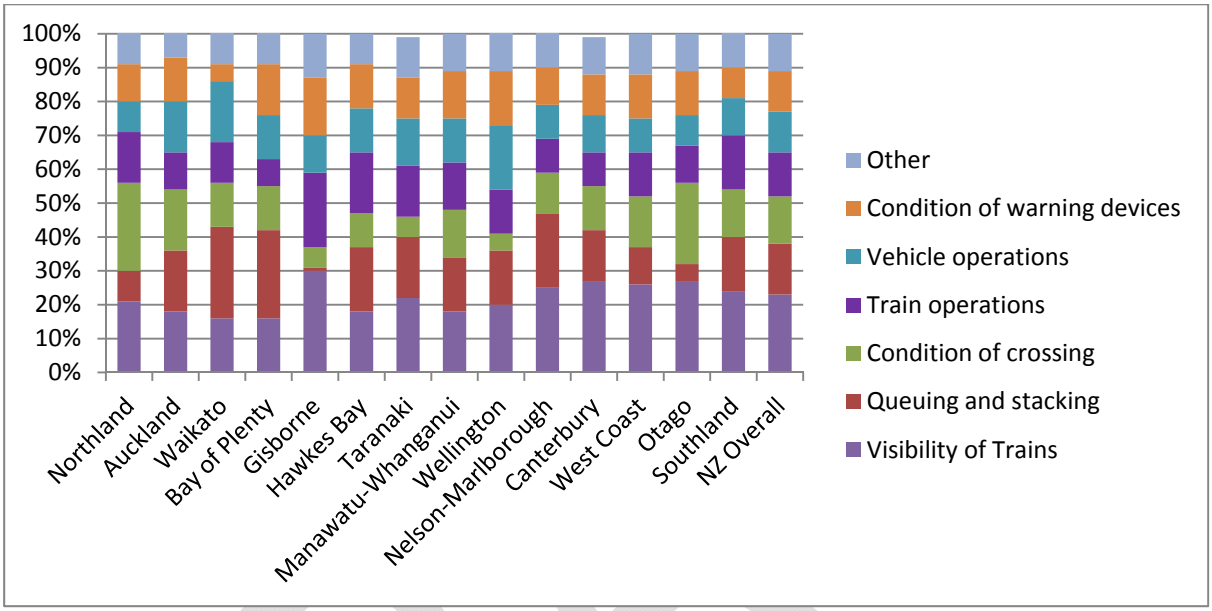


Figure 6 Road level crossings – regional infrastructure risks

Figure 6 presents the breakdown of risks on a regional level. This includes both the type of controls used in each region as well as the long-term investment in level crossings and the road surface by individual RCAs and KiwiRail. In brief we can see that:

- there is a proportionally higher number of crossing with issues to do with *visibility of trains* in Gisborne and the South Island
- higher *condition* of *crossing* risks exist in Northland and Otago
- the higher *train operation* risks in Gisborne, Hawke's Bay and Northland reflect low volumes and the unpredictable timing of train movements
- *queuing and stacking* is more common in the North Island from Hamilton through to Wellington.

While these risk metrics are of interest on a national and regional level, the real benefit comes from using ALCAM to identify and analyse the site-specific risks at individual level crossings. This gives engineers a strong lead as to what sort of targeted treatments are the most suitable, and enables them to achieve the best 'value-for-money' and the largest safety returns on the investment.

4.1.4 Personal versus collective risk

The distinction between the *personal* risk to a driver and the *collective* risk of an accident at a crossing (the ALCAM risk score) is illustrated in Figure 7. This distinction is a common risk assessment tool and is reproduced in the one-page summary reports for individual roading authorities and KiwiRail regions (Appendix A).

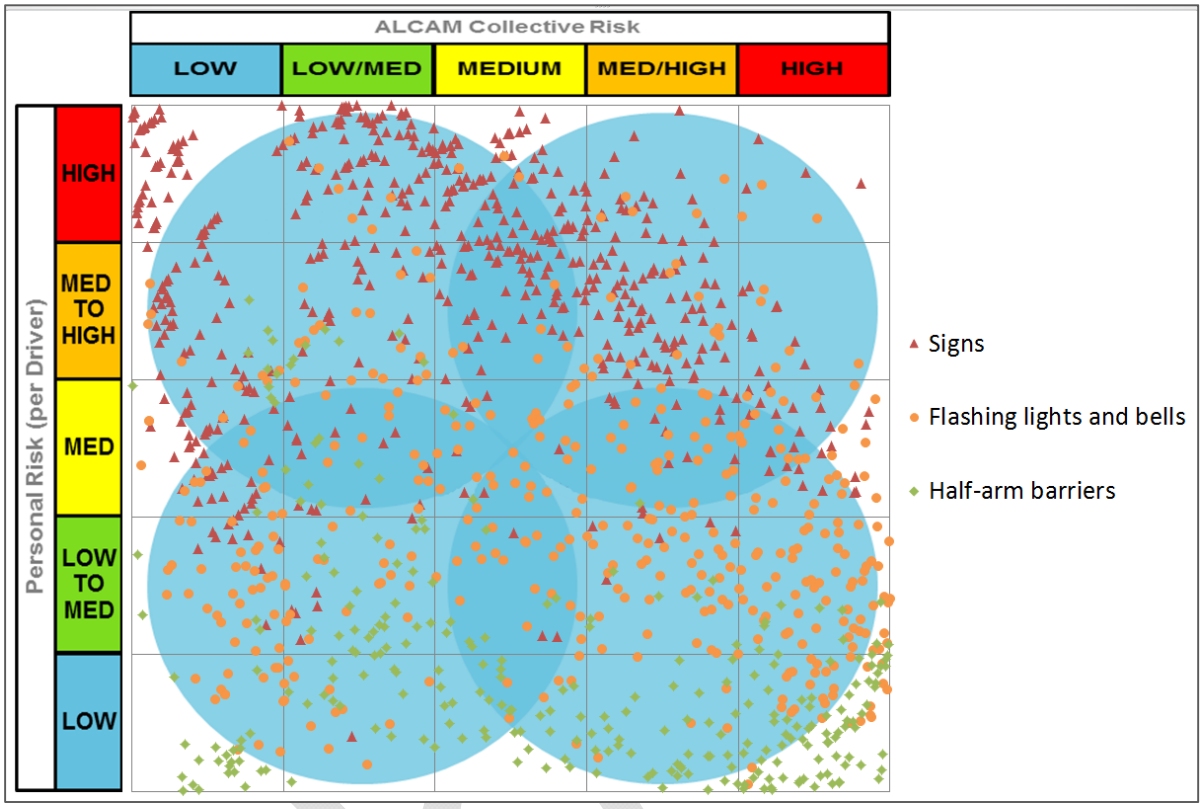


Figure 7 Road level crossings distribution of personal versus collective risk

The broad patterns in figure 8 show that the personal risk for drivers is highest for level crossings with signs and lowest for those with half-arm barriers. However, even level crossings with half-arm barriers may still have a small residual risk (i.e. queuing) that will result in a greater collective risk where there are high volumes of trains and vehicles.

This diagram is a particularly powerful tool in that the position of a level crossing on the diagram can be used to broadly determine how much expenditure can be justified on a particular level crossing. As an example, the level crossings toward the top right of the diagram are strong candidates for an upgrade to half-arm barriers (approximately $200,000). Level crossings in the top-left and bottom-right have lower traffic flows but could use a basic review of signs, road surface, vegetation and markings (less than $10,000) to address specific risks. Longer-term the aim would be to shift the distribution of level crossings toward the bottom-left of the graph.

Appendix A provides further guidance on interpreting this diagram, and section 0 provides an indication as to suitable treatments.

5 Pedestrian level crossings

5.1 National profile (ALCAM input)

There are 682 official public pedestrian level crossings located on the New Zealand rail network. These fall into two broad categories:

- 563 (83%) are *adjacent* crossings, where the pedestrian level crossing is next to a road[7], and
- 119 (17%) are *stand-alone* crossings, where there are no nearby roads.

Adjacent crossing

Stand-alone crossing

Figure 8 Pedestrian level crossings – photos of two types

Approximately 89% of adjacent pedestrian crossings have some form of bells or alarms. Most of the time the lights are positioned to alert road vehicles; however, in some cases, KiwiRail has installed additional pedestrian alarms. These are often near commuter train stations or at heavily-used crossings.

Stand-alone pedestrian level crossings are typically located in high-pedestrian areas where there are no nearby road crossings. Approximately 46% of these have some form of alarms, while the remainder just have signs, road-markings, mazes or approach fencing.

There are a number of other pedestrian level crossing locations that are not officially recognised by KiwiRail or by local councils. Often these have limited use, have no formed path, are unsafe, or are used to as an access point to the rail corridor. KiwiRail treat use of these as a trespass issue and may fence these off.

[7] A road with a footpath on either side would be classed as having two adjacent-pedestrian crossings.

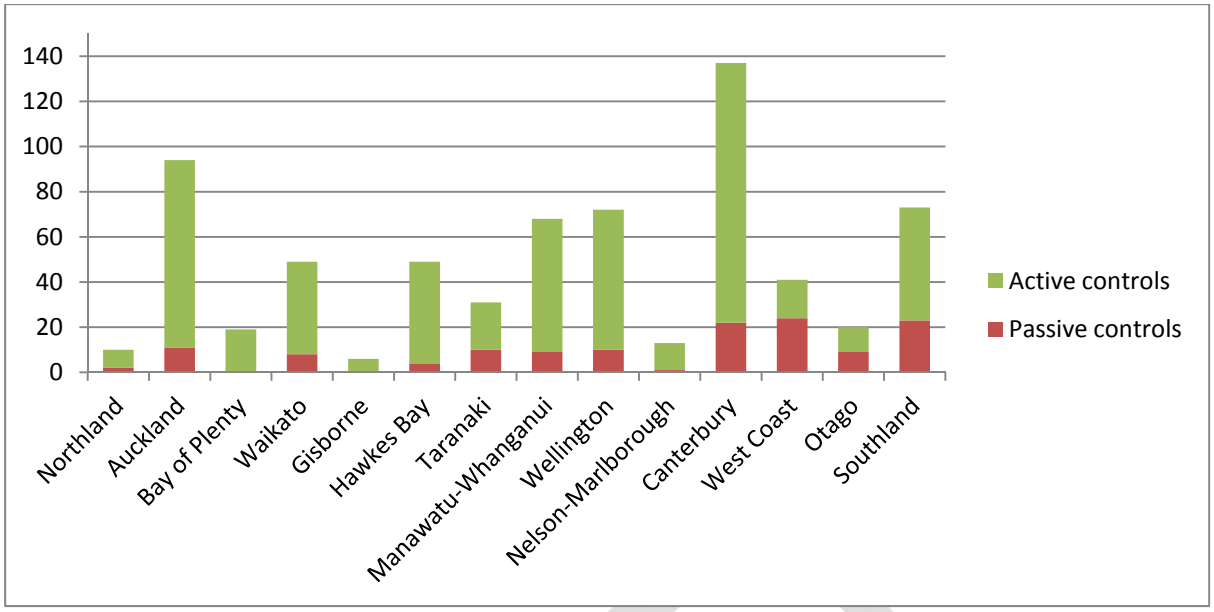
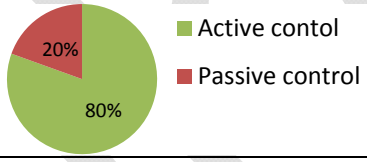
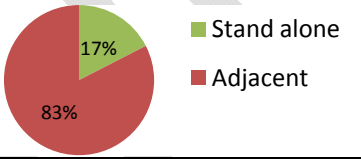
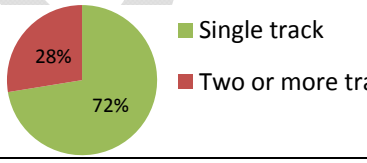
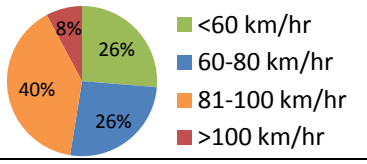
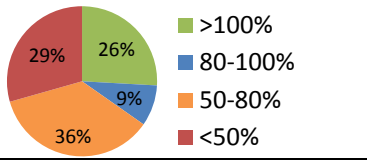


Figure 9 Pedestrian level crossings – population by region

Figure 9 shows the distribution of pedestrian level crossings by control type for each of the regional council areas in New Zealand. The distribution reflects a concentration in urban areas, with large numbers of pedestrian level crossings being found in Auckland, Wellington and Christchurch.

As with the road level crossings, most of the ALCAM information was gathered on-site by local survey teams. Back in the office, mapping and GIS systems were also used to determine the proximity to schools and other facilities, and this information was used to infer the type of pedestrians using the level crossing. Table 6 outlines some of the key inputs required for ALCAM.

ALCAM input	Distribution	Comment
Type of control		Most active controls are footpaths next to roads with level crossing alarms
Type of crossing		
Number of tracks		Mostly in Auckland or Wellington. Presents a 'second train coming' risk for pedestrians
Train speed		
Visibility of train		Visibility along track is essential for passive crossings, but less important for crossings with alarms.

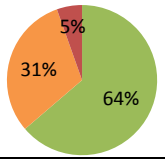
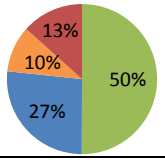
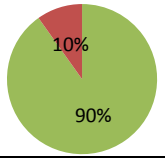
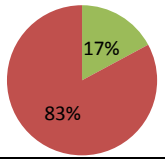
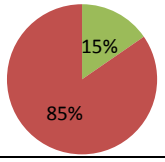
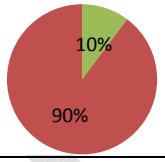
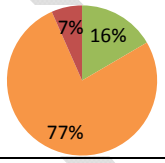
ALCAM input	Distribution	Comment
Presence of Adjacent Distractions		
Proximity to schools		
Path alignment		Includes angle of footpath approach and whether there is a defined path
Maze		Recommended in urban areas and where two or more tracks
Tactile Pavers		Required by NZTA Traffic Control Devices Manual – Part 9 Level Crossings
Painted Hold Line		Sometimes used as a temporary measure in lieu of tactile pavers
Conformance with Standard		Common to have some signs, pavement markings or tactical pavers missing

Table 6 Pedestrian level crossings – key ALCAM inputs

5.2 National risks (ALCAM output)

5.2.1 National risk profile

The ALCAM pedestrian model follows the same structure as the ALCAM road model, although all the characteristics and weightings have been developed to reflect human behaviour and features around pedestrian level crossings. There are three main differences from the road model:

1. the data has not yet been compared against an Australasian accident record, and hence the output is expressed in different metrics;
2. pedestrian volumes are not known and are set at a constant value, meaning the exposure component of the model is entirely dependent on the number of trains; and
3. a fixed consequence value is used to model the impact of a collision.

The infrastructure factor and exposure factor in the ALCAM *pedestrian* model are useful for comparing level crossings in relative terms. However, they do not represent the probability of an accident in real terms, and hence there is little benefit in displaying national averages.

5.2.2 Regional risk profile

	Pedestrian level crossings	Average infrastructure factor	Average exposure factor	Average ALCAM risk score x 1,000
Northland	10	237	3	0.7
Auckland	94	223	85	19.7
Bay of Plenty	19	190	20	4.1
Waikato	49	249	18	4.5
Gisborne	6	369	1	0.4
Hawkes Bay	49	232	6	1.3
Taranaki	31	221	4	0.9
Manawatu-Whanganui	68	278	11	3.2
Wellington	72	267	77	22.1
Nelson-Marlborough	13	333	9	3.1
Canterbury	137	269	12	3.1
West Coast	41	334	3	1.0
Otago	20	314	6	1.9
Southland	73	299	4	1.3
National total	**682**	**265**	**26**	**6.7**

Table 7 Pedestrian level crossings – risk by region

Table 7 provides a summary of the risk profile of pedestrian level crossings. On a regional level there is relatively little variation in the quality of the pedestrian infrastructure. In contrast there are clear differences in the exposure factor, with Auckland and Wellington again showing the risks associated with operating a commuter rail network.

This influence of train volumes is reflected in the total ALCAM risk score, with the two main centres having a net risk about ten times higher than the rest of the regions. While New Zealand does not have a large pedestrian accident rate, most of the recent pedestrian accidents at level crossings have occurred in these two regions[8].

Unfortunately there is no nationally consistent dataset of pedestrian volumes, and having this information on a national scale would allow much better identification of heavily used level crossings that have the potential to be a risk hotspot. In the meantime, local knowledge is needed to ensure that the busiest pedestrian level crossings have the lowest infrastructure factor. Particular attention should be paid to level crossings near railway stations, schools, shops or event venues as these locations often experience high pedestrian numbers, particularly at certain times of the day.

5.2.3 Types of risk

Analysing the ALCAM pedestrian model output on a national level reveals that that there are a number of risks that contribute to the probability of a pedestrian being struck by a train (Figure 10).

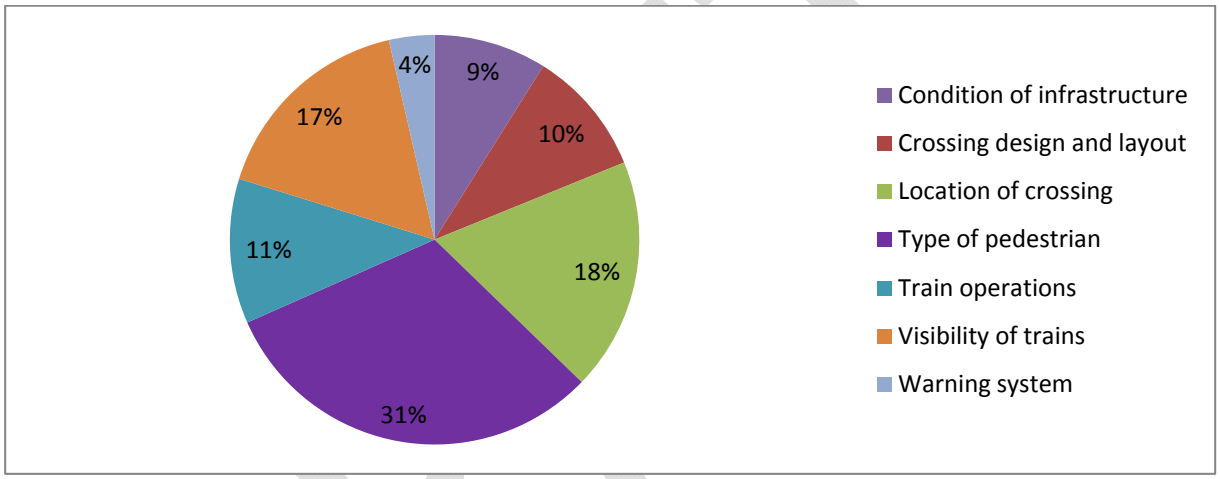


Figure 10 Pedestrian crossings key risk categories- all control types

The *type of pedestrian* using the level crossing accounts for 31% of all national risk, and features at level crossings located near schools, retirement villages, or licensed venues. Each type of pedestrian has certain needs that may need to be considered in the design of the level crossing (ie smooth surface and manoeuvring space, additional fencing to stop shortcuts).

The *location of crossing* represents 18% of the national accident risk, and is particularly relevant near train stations where pedestrians may be in a hurry to cross the tracks to avoid being delayed. Shunting of trains also increases the potential for pedestrians to make mistakes or misjudge train movements.

Visibility of trains, *condition of infrastructure*, and the *crossing design and layout* are three factors that together make up 35% of the risk. These risks are comparatively cheap and easy to address and include ensuring that all pedestrian level crossings have adequate viewlines, appropriate signs, hold lines, guidelines, tactile pavers, fencing and mazes and a smooth surface for walking on.

Only 14 % of all pedestrian level crossings fully meet the national standards set down in the NZTA's *Traffic control devices manual – Part 9 – Level crossings* (2008). Another 23% have minor non-compliances which would have a negligible effect on the risk (ie an older sign design)

[8] Collisions with people walking along the rail corridor remain a greater problem than level crossing pedestrian accidents. This trespassing is a nationwide issue.

The final large risk is associated with unusual *train operations* increasing the chance of a pedestrian mistake (ie high speed trains, seasonal train use, two tracks). For example, a leading cause of level crossing fatalities in Melbourne is pedestrians ignoring alarms and stepping onto the tracks once a train has passed, only to be stuck by a second train travelling in the opposite direction. This particular risk can be minimised through electronic gates or the use of a flashing 'second train coming sign'. Electronic gates have been installed at particularly high-risk pedestrian crossings in New Zealand.

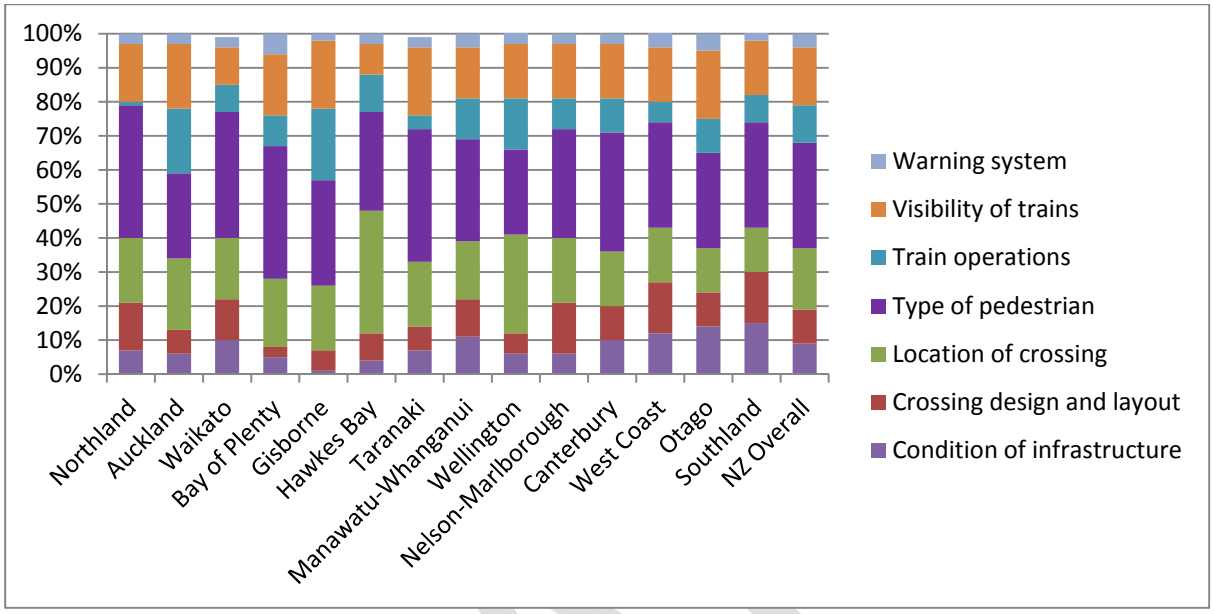


Figure 11 Pedestrian level crossings – regional infrastructure risks

Figure 11 presents the breakdown of risks at pedestrian level crossings on a regional level. The geographically consistent pattern suggests that all regions face similar risks with their pedestrian level crossings. Obviously any infrastructure risks are magnified in Auckland and Wellington due to much higher train volumes. Note that in some regions there are relatively few crossings and comparisons may not have statistical significance. As with road level crossings, the real value of ALCAM lies in being able to identify and treat the risks at an individual crossing level.

6 Addressing risk at level crossings

Once the profile of a level crossing has been established, ALCAM can be used to model safety improvements and examine the theoretical reduction in the overall and specific risk scores.

As outlined in section 0, the ALCAM risk score for a level crossing is calculated as follows:

ALCAM risk score = infrastructure factor x exposure factor x consequence factor,

On a national level the ALCAM risk score can be used to develop a priority list, which can then be used as one of the inputs to a safety improvement programme. On a local level it will not usually be practical to address the exposure risk at a level crossing, short of closing it or grade separation, as this is largely determined by the volumes of vehicles, pedestrians and trains. Therefore focusing on ways of mitigating the infrastructure risks or potential consequences will usually be the most effective way to improve safety at a crossing.

Although it is a comprehensive tool for the assessment of level crossing hazards, ALCAM cannot be applied in isolation. Any risk assessment and treatment also needs to consider other factors, including:

- changes to the level crossing since the original ALCAM surveys
- collision and near-collision history
- engineering experience (both rail and road)
- local knowledge and observations of driver or pedestrian behaviour, and
- standards and international best practice.

It is important to ensure that all stakeholders associated with a particular level crossing are involved with the determination of the final recommended treatment. In particular, experience from the pilot applications of ALCAM in New Zealand, has shown that local level collaboration between KiwiRail and RCAs can be very effective in ensuring that appropriate risk mitigation measures are implemented in a timely and affordable manner.

Figure 12 indicates the type of treatments which may be appropriate for level crossings relative to their position on the personal versus collective risk diagram.

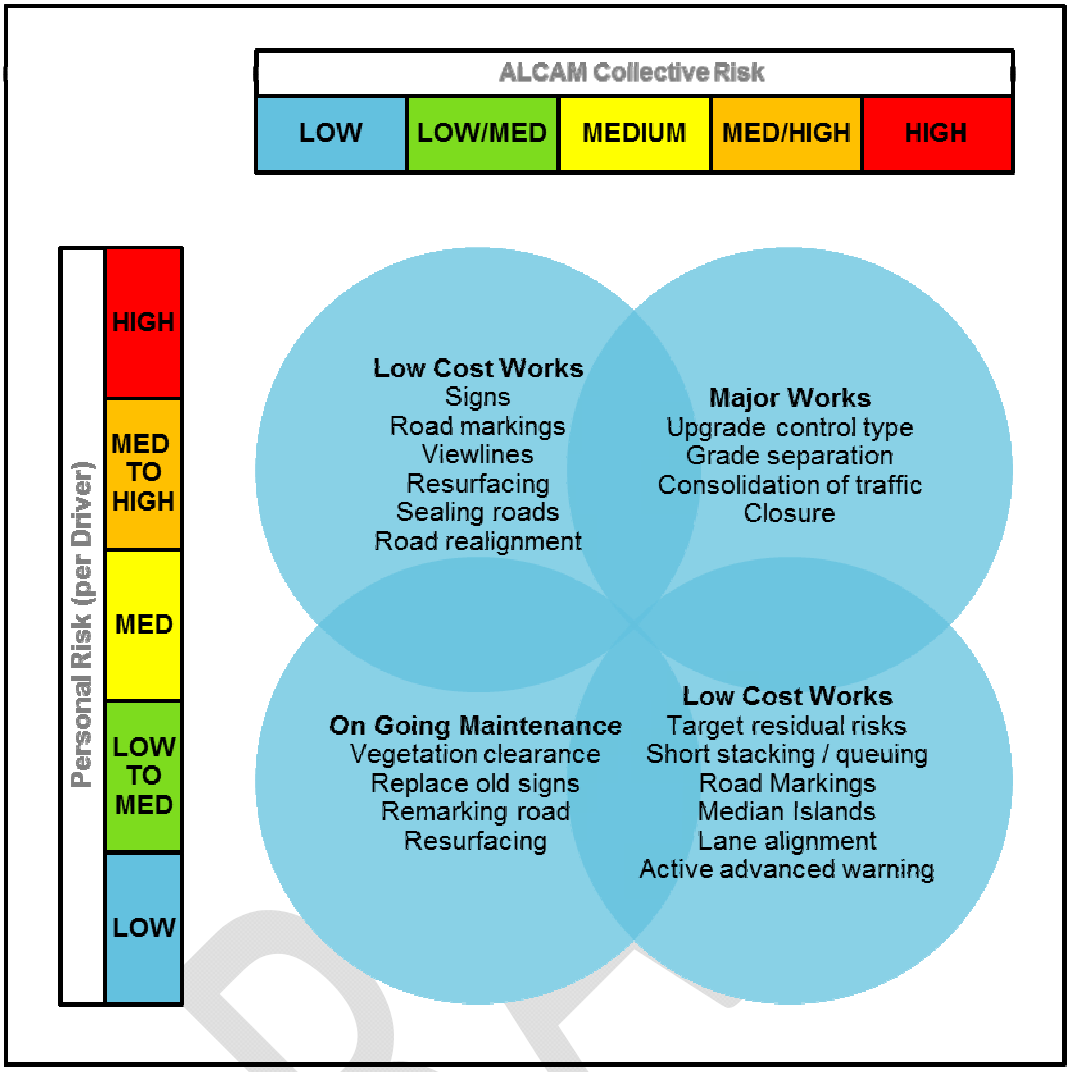


Figure 12 Personal versus collective risk – potential road safety improvements

6.1 Treatment options

Table 8 and Table 9 outline some suggested engineering treatments together with indicative costs for mitigating key infrastructure risks at level crossings. This information is provided for guidance only and can be used in conjunction with individual ALCAM risk reports. The tables should not take the place of site specific assessments and the costs may vary significantly at some level crossings.

Note that many of the low cost treatments in Table 8 and Table 9 can be used to address multiple risks. For example, sealing a road surface helps with acceleration and braking, may remove a hump and allows the RCA to add roadmarkings to increase the visibility of the level crossing. Many different signs that can be used to raise driver awareness of a particular risk are detailed in the NZTA's *Traffic control devices manual Part 9 – Level crossings.*

The first important message is that large improvements in safety can be gained by targeting specific hazards at each level crossing. For example, at a level crossing where short-stacking has been identified as the main hazard, the introduction of active controls such as half-arm barriers may have little impact on the risk profile. A more suitable solution may be an acceleration lane on the adjacent road, an escape zone, banning right turns or interfacing with adjacent traffic lights.

The second message is that engineers are encouraged to think laterally when looking into treatment options, as often general traffic calming, changing area-wide traffic patterns or driver behaviour will produce big safety improvements. The views of local residents can sometimes provide a useful insight into driver behaviour.

ALCAM risk characteristic	Infrastructure risk reduction	Treatment	Indicative Cost	Comments
Visibility of train				
Visibility of train from restart position (S3)	22%	Remove vegetation	$2,000	Can vary from $500 to $10,000 depending on extent of clearance. May require vegetation clearance on private land
Visibility of train from road approach (S2)	9%	Trim embankment or widen cutting	$5,000	
Visibility of the crossing from approach	-	Install flashing lights and bells	$200,000	
Visibility of control at the crossing from approach	4%	Declaration and turning lanes off adjacent roads	$20,000	Provides driver with more time to turn and look before crossing a passive crossing
		Close crossing	$10,000	
		Planning controls in district plans		To manage buildings, development or shelter belts in sightline triangles
Condition of crossing				
Condition of crossing panel surface	25%	Raise or lower road surface either side of crossing	$20,000	Could cost from $10,000-$80,000 depending on extent of work.
Condition of road surface on approach	11%	Reform level crossing panel	$20,000	Rubber panels are many times this cost
		Seal level crossing panel	$5,000	These treatments address the potential for vehicles to become stuck, to stall, and a reduced braking and acceleration performance
		Seal road at least 50 m on either side	$15,000	
Queuing and stacking				
Possibility of short stacking	18%	Close crossing	$10,000	
Queuing from adjacent intersections	17%	Ban right turn	$500	
		Restriction on vehicle length	$500	
		Provide emergency escape zone	$5,000	Could be sealed or unsealed shoulder with parking restrictions
		Provide acceleration lanes on adjacent road	$20,000	
		Signal coordination with crossing alarms	$10,000	Only effective when level crossing and road intersection are in close proximity
		Short-stacking sign	$500	
		Yellow cross-hatching	$1,000	
		Active advanced warning sign	$5,000	
		Area-wide strategic traffic management		
Train operations				
High train speed	4%	Publicity campaigns		
Seasonal or infrequent train patterns	9%	Advisory signage	$500	Potentially for heritage operations
Low volume of trains (driver complacency)	5%	Median islands and flush medians	$5,000	To prevent driving around barriers
Slow train speed	2%	Upgrade from flashing lights to half-arm barriers	$50,000	These treatments address the potential for drivers attempting to race trains,
Long train length	3%			
High volume of trains	1%			
Number of operational rail tracks	5%			
Vehicle operations				
Proportion of heavy vehicles		Greater scrutiny on other characteristics		Particularly stacking distance, surfaces and hump or dip on crossing
Road traffic approach speed (85%ile)	3%	Area-wide strategic traffic management		To reroute HVs or change traffic flow in area
Level of vehicle congestion	2%			
Proximity to road intersection	5%			
Condition of warning devices				
Distance from advance warning sign to crossing	6%	Relocate signage	$500	
Non-conformance with NZTA Part 9 standard	7%	Add supplementary distance sign	$200	These treatments address an insufficient reaction time, potential for drivers confusic
Condition of control at the crossing	10%	Improve or replace signage or roadmarking	$3,000	
Condition of crossing panel surface (hump, dip, rough surface)	25%	Pre warning signage	$1,000	
		Road markings	$1,000	
		General traffic calming	$5,000	Markings, islands, signs to reduce vehicle approach speed
Other				
Presence of adjacent distractions	5%	Change angle of approach road	$50,000	
Potential for sun glare masking crossing controls from road approach	2%	Tree plantings on roadside to shade from sunrise or sunset	$1,000	Take care to avoid visibility restrictions or roadside hazard
Potential for sun glare masking train from restart position	4%	Whistle boards on rail	$200	To ensure train horn is sounded ahead of the crossing
Temporary visual impediment of crossing controls from road approach	1%	Advanced warning signage	$500	
Temporary visual impediment of trains from restart position	2%	Suitable TTMPs signed off by rail		To avoid misconception that trains are not operating
Proximity to siding or shunting yard	7%	Yard operational procedures		To avoid masking by stationary wagons
Proximity to passenger station	3%	Remove distraction or restrict advertising	$1,000	

Table 8 Road level crossings – potential safety improvements

ALCAM risk characteristic	Infrastructure risk reduction	Treatment	Indicative Cost	Comments
Visibility of trains				
Presence of adjacent distractions	3%	Clear vegetation along track	$2,000	
Visibility of trains from pedestrian holding line	8%	Clear vegetation around crossing	$2,000	
Potential for sun glare masking train	4%	Planning controls in district plans		To manage buildings, development or shelter belts in sightline triangles
Temporary visual impediments of trains	1%	Whistle boards on rail	$200	To ensure train horn sounded
Masking of moving or stationary trains	6%	Remove distraction or restrict advertising	$1,000	
Crossing design and layout				
Angle of crossing and width of flange gap	3%	Tactile pavers	$1,000	
Gradients, widths or manoeuvring space of pathway or maze	14%	Path edge markings	$500	
Alignment of footpath approaching crossing	1%	Realign pathway	$5,000	
Non-conformance with NZTA Part 9 standard	2%	Painted hold line	$100	
		New pedestrian maze	$10,000	
		Pedestrian signage	$200	
Condition of infrastructure				
Maintenance of level crossing equipment	6%	Patch repairs to surface	$1,000	
Condition of footpath surface or fencing	17%	Maintain maze	$2,000	
Location of crossing				
Proximity to passenger station	17%	Along track fencing	$10,000	
Proximity to siding or shunting yard	8%	Approach or funnel fencing	$5,000	
Proximity to event venue (pub, sport grounds etc)	11%	Close crossing	$10,000	Requires additional fencing
Proximity to school, playground, or aged care facilities	6%	Targeted publicity campaigns		
Train operations				
High volume of trains	6%	Second train coming passive sign	$200	
Seasonal or infrequent train patterns	6%	Second-train coming active sign	$20,000	
Highest train speed	7%	Operational considerations		
Longest train length	1%	Move crossing	$30,000	
Number of operational rail tracks	7%			
Trains stand across the crossing	1%			
Type of pedestrian				
Volume of pedestrians in peak time flow	1%	No-flange gap rubber surface	$20,000	Grade separation
Volume of children pedestrians	25%	Electronic pedestrian gate	$150,000	
Volume of physically disabled pedestrians		Grade separation	$500,000	Close crossing
Volume of sensory disabled pedestrians		Additional pedestrian signals	$10,000	
Volume of intellectually disabled pedestrians		New pedestrian alarms (away from road)	$150,000	
Volume of cyclists, wheelchairs or pram pedestrians	14%	Cyclist skew sign	$200	
Warning system				
Shortest warning time from start of flashing lights		Directional pedestrian audible signals		
Longest warning time from start of flashing lights		Streetlight illumination of crossing	$10,000	
Background noise or audibility of crossing alarm	6%	New pedestrian alarms (away from road)	$150,000	
Condition of pedestrian control at the crossing	2%	Suitable TTMPs signed off by rail		To avoid misconception that trains are not operating
Visibility of pedestrian control at the crossing	1%			

Table 9 Pedestrian level crossings – potential safety improvements

6.1.1 Case study: Waikato low-cost ALCAM upgrades

In 2010, the Waikato Regional Council allocated $1 million from a JOG funding package to undertake low-cost safety improvements at 130 level crossings in the Waikato. This was comprised of 90 road crossings and 40 pedestrian crossings. Centrally managed, the project was innovative in its pooling of all funding from KiwiRail, RCAs, Waikato Council and eight RCAs.

The project's objectives were to reduce risk on rail freight routes, get a geographic spread of improvements and ensure that all work met value-for-money criteria. ALCAM surveys had been carried out in 2008 and the model was adopted as the design tool to identify risks and treatments.

Meetings were held between KiwiRail and each of the eight Waikato RCAs to develop treatments based on ALCAM risk reports and modelling. The aim was to ensure that all level crossings firstly met NZTA design standards, and secondly that the residual risk was reduced to a medium or low level.

The upgrades involved a variety of activities to improve visibility and reduce the chance of a driver or pedestrian mistake. These included tactile pavers, fencing, resurfacing, paths, adding emergency escape zones and other items set out in Figure 13. Single contractors and suppliers were used to keep costs down. In total $895,000 was spent, averaging $7200 per level crossing.

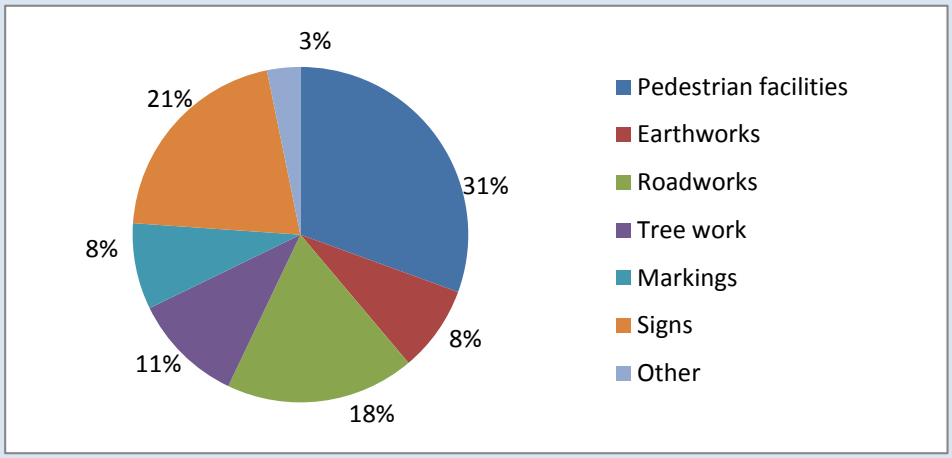


Figure 13 Waikato level crossing risk mitigation expenditure breakdown

A post-completion ALCAM assessment in 2012 showed that for road crossings there had been:

- an average 15 % reduction in the overall level of infrastructure risk, and
- an average 72 % reduction in the manageable infrastructure risks[9].

Similar benefits were achieved for pedestrian level crossings:

- An average 7 % reduction in the overall level of infrastructure risk, and
- An average 73 % reduction in the manageable infrastructure risks.

The Waikato low-cost ALCAM upgrade project showed that there are significant:

1. cost savings from RCAs and KiwiRail working together on a regional level, and
2. risk reductions from targeted upgrades that cost less than $10,000.

[9] There is an inherent risk associated with most level crossings that is driven by factors such as the number and frequency of trains, the potential for sunstrike and the use by young pedestrians. It is very difficult to address these, and hence the 'manageable' risks have been provided separately.

6.2 Funding safety improvements at level crossings

6.2.1 NZTA funding assistance for active level crossing upgrades

The NZTA provides funding to approved organisations for level crossing alarms under its Work category 131: level crossing warning devices. These approved organisations are normally road controlling authorities (RCAs).

To qualify for funding, the level crossing alarms must be included in the list of planned works that KiwiRail provides to the NZTA, and only upgrades that are on the list are eligible for funding assistance. The list is based on the Accident Priority List (see section 2.2.3) and programmed around the National Land Transport Programme three-year funding cycle. The next cycle is 2015–18, with programmes needing to be determined by 2014.

KiwiRail and the RCA usually share equally the cost of installing and maintaining level crossing alarms. However, where the level crossing is held under a Deed of Grant the RCA may be required to pay the full cost.

The NZTA currently reimburses the approved organisation 100% of its share of the cost.

6.2.2 NZTA funding assistance for low-cost level crossing upgrades

Work to improve the safety of level crossings can also be carried out under the NZTA's Work category 341: minor improvements.

Minor improvements are all low cost and low risk projects that can be completed for less than $250,000 per project. This includes bridge replacements and similar small projects. RCAs can get up to 5% of their maintenance programme value as of right, but further funding may be obtained if that can provide value for money justification of the programme and costs

Funding under Work category 341 is more flexible than Work category 131, with each RCA having to advise the NZTA of their total minor improvement budget in advance of the next financial year. There is then some flexibility as to what work is carried out under this minor improvement budget, provided that the work is done using a prioritised list of acceptable minor improvement works and that the budget is fully spent by the end of the financial year. The NZTA have provided an Excel template to assist with prioritising works if required.

Projects require the approval of the NZTA's regional representative and evidence is required to demonstrate value for money. An ALCAM calculation of risk at a level crossing before and after the minor improvement may assist with demonstrating value for money to the NZTA

The funding assistance rate for minor improvements varies between local authorities but is typically about 50%.

6.2.3 KiwiRail funding

KiwiRail funds active level crossing upgrades through a national priority list system that is based on a combination of collisions, train volumes, road volumes, and some level crossing characteristics. This approach has been successfully used for over 30 years. ALCAM information will be integrated into this list,

but given that both models are fundamentally based on the same principles it is expected to make little difference to the order in which these higher-cost active upgrades are carried out. The cost for these active level crossing upgrades is split evenly between KiwiRail and the relevant RCA.

Low-cost upgrades are done on a more regional basis, with KiwiRail area managers applying KiwiRail policy and engineering judgement to determine where limited funds are best spent. Often these upgrades are carried out in conjunction with other work, such as station platform improvements, drainage work, level crossing panel renewals, or improvements to the adjacent road.

KiwiRail has set aside a limited pool of funds to carry out low-cost improvements at 50–100 level crossings per year. The ALCAM model will be used to ensure that the improvements represent value-for-money, and priority will be given to addressing risks in regions where there is cooperation and co-funding from the local RCA.

6.3 Guidance for level crossing upgrade work

As a starting point, both RCAs and KiwiRail are strongly encouraged to review the individual level crossing risk reports for their area and arrange a meeting to discuss a plan of improvements, timing and funding issues, and any coordination with other planned road or rail work. The contact details for the relevant RCA and KiwiRail offices are found at the back of each individual level crossing risk report.

Guidance on low-cost upgrade options can then be found through:

- this national report (particularly Table 8 and Table 9)
- the use of ALCAM by KiwiRail staff or trained consultants
- engineers experienced in level crossing or road improvements
- ALCAM documentation and user manuals, and
- NZTA *Traffic control devices manual Part 9 – Level crossings* (found on the NZTA website).

A table setting out general installation and maintenance responsibilities has recently been released for public consultation and subsequently ratified by the New Zealand Working Group (*NZTA Traffic control devices manual Part 9 – Appendix E*). A copy of this table is included in Appendix B of this report.

Note that the table does not cover the responsibilities for funding the work and this will need to be worked out between KiwiRail and the relevant RCAs. Where the upgrade costs are relatively small, both parties are encouraged to take a pragmatic approach and split costs down the middle[10].

If either an RCA or KiwiRail has any issues around the implementation of this table then they should contact their respective representative on the New Zealand Working Group. The issue can be raised to a national level for consideration by all parties.

[10] This approach occurred in the Waikato upgrade project (see case study) and is already taken for the maintenance of all level crossing alarms with KiwiRail undertaking the work and invoicing the RCAs. This simple approach reduces administrative overheads for both parties.

7 Summary

The ALCAM model suggests that the 1268 public road crossings in New Zealand will have 147 collisions with 44 equivalent fatalities over the next 10 years.

This number is lower than the 257 collisions over the past 10 years and the difference is likely to be due to the ongoing level crossing upgrade programmes that have been funded by KiwiRail, NZTA and some regional councils. This reflects an ongoing decrease in the number of collisions at level crossings; from approximately 130 collisions per year in the 1950's to approximately 30 collisions per year in the early 2000s. This is despite a 700% growth in the number of registered vehicles on New Zealand roads.

On average the risks around New Zealand's level crossing infrastructure are about 8% greater than the Australasian average. This is not altogether surprising, as New Zealand's topography presents some unique risks that are hard or expensive to mitigate.

Road level crossing infrastructure is generally in reasonable condition, although there is some variation between regions. Level crossings in Auckland, Wellington and on the passenger routes warrant special scrutiny because of the high volume of train services. While high consequence accidents involving passenger trains are rare, it is important that this is not taken for granted and that all care is taken to prioritise safety.

Pedestrian level crossing infrastructure is not good and many fail to meet national standards. Fortunately the work required to address this is often relatively minor and inexpensive. There is relatively little regional variability.

Although the total number of level crossing collisions is low by roading standards, the consequences are often more serious with a collision between a vehicle and a train being 13.2 times more likely to result in a fatality than a normal road crash.

In addition the overall risk profile of rail is quite different from road in that there remains the potential for a low-probability but high-consequence accident. KiwiRail and RCAs therefore cannot just react to the collision record, and instead need to use tools like ALCAM and take a more pro-active approach to managing level crossing risk (similar to the aviation industry).

ALCAM is a tool that can be used to identify risk, prioritise spending, and help identify value-for-money solutions. Pilot programmes in Rodney and the Waikato have shown that significant improvements in safety can be achieved by targeted low-cost solutions, and ultimately this results in fewer accidents at level crossings.

Cooperation between KiwiRail and RCAs is essential to identify and address risks in a cost-effective manner. There are also significant savings to be made from pooling resources and treating a number of level crossings at the same time.

8 Next steps

In conjunction with the release of this report, RCAs and KiwiRail will be able to access an individual ALCAM risk report for every public level crossing in New Zealand. These reports are linked to the KiwiRail website and contain background information, risk scores, photographs, sketches, an accident and near-miss history, the overall, and the individual hazards that may increase the probability of an accident.

The risk reports are targeted at road and rail engineers as a practical document that will help guide local prioritisation and upgrade programmes. It is important that these risk reports are read in conjunction with the interpretation guides, as it helps to put the results into a wider context and to avoid any misinterpretation.

RCAs and KiwiRail are strongly encouraged to review the individual level crossing risk reports for their area and jointly determine a plan of improvements, giving consideration to timing and funding issues and any coordination with other planned work.

The RCAs and KiwiRail area managers may then choose to:

- carry out level crossing improvements on a site-by-site basis
- carry out a one-off local improvement programme
- carry out a one-off regional improvement programme
- include level crossing improvements in local deficiency databases
- integrate level crossing improvements into general maintenance programmes
- assess risk and improvements as part of regional safety or planning strategies, and/or
- accept their current standard of level crossing infrastructure.

This decision making process is left to managers inside each RCA and KiwiRail region. An ALCAM-trained engineer from KiwiRail will be available to help guide decisions and provide advice on the model if requested, but will not, however, be actively approaching any RCAs.

The establishment of memorandums of understanding between KiwiRail and the various RCAs to identify risks, coordinate work and determine funding and maintenance arrangements around level crossings will help minimise confusion over roles. Such agreements in Australia have been shown to have a significant influence on rail level crossing safety.

Appendix A

One-page Summary Reports

Appendix A contains:

- Reports for New Zealand
- Reports for Road Controlling Authorities – North Island
- Reports for Road Controlling Authorities – South Island
- Reports for Regional Council management areas
- Reports for NZTA zones (state highways only)
- Reports for KiwiRail management areas

All - All

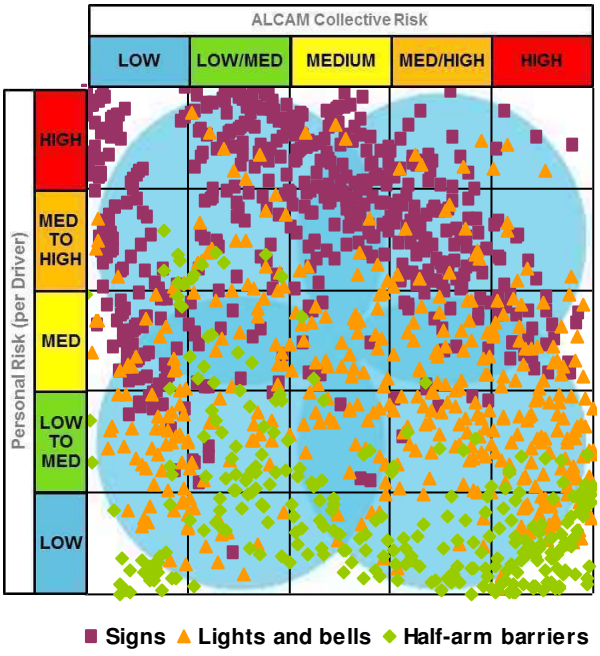
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	570	424	274
• percentage	45%	33%	22%
• in urban areas	34	111	162
• with unsealed road surface	206	13	8
• with stacking distance < 25m	137	114	55
• with a hump or dip	242	32	13
Vehicles per day (mean)	193	1,592	5,436
Vehicles per day (maximum)	11,559	18,780	24,100

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 8	0 - 8	0 - 88
Freight trains per day	1 - 26	1 - 26	0 - 26
Total trains per day	1 - 55	1 - 55	1 - 204

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	1268	1268	100%
Collisions per 10 years	147.0	147	100%
Fatalities per 10 years	43.8	44	100%

Key collision factors	Authority	NZ
Visibility of trains	23%	23%
Queuing or stacking	15%	15%
Train operations	13%	13%
Vehicle operations	12%	12%
Condition of warning devices	12%	12%
Condition of crossing	14%	14%
Other	11%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	20%	20%	20%	20%	20%
Exposure	21%	19%	20%	20%	20%
Consequence	21%	26%	15%	30%	8%
Total ALCAM risk score	**20%**	**20%**	**20%**	**20%**	**20%**

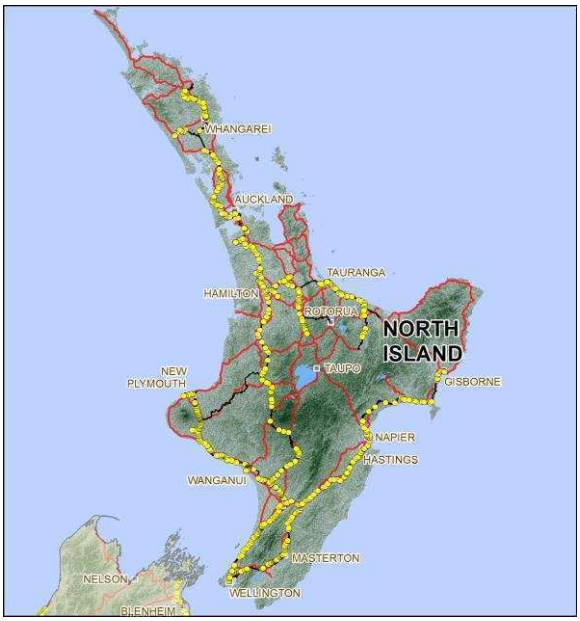
Comments

Island - North

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

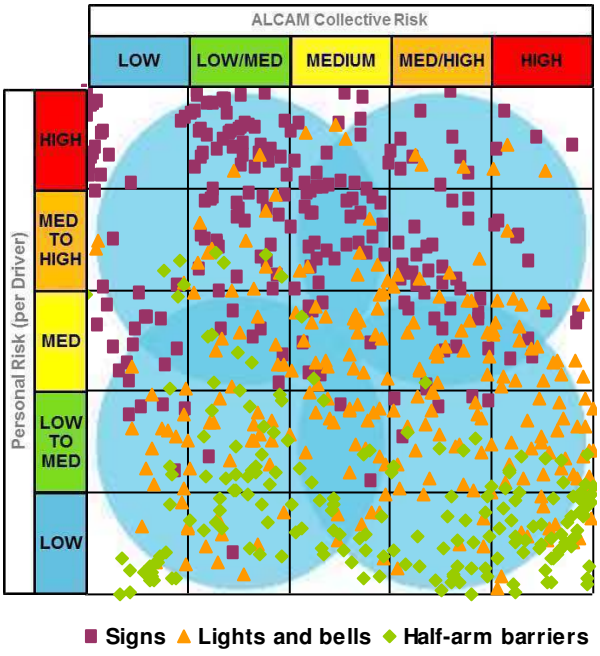
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	235	242	185
• percentage	35%	37%	28%
• in urban areas	9	61	105
• with unsealed road surface	81	9	5
• with stacking distance < 25m	54	68	41
• with a hump or dip	96	15	10
Vehicles per day (mean)	216	1,643	4,763
Vehicles per day (maximum)	11,559	18,780	23,548

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 8	0 - 8	0 - 88
Freight trains per day	1 - 26	1 - 26	0 - 26
Total trains per day	1 - 55	1 - 55	1 - 204



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	662	1268	52%
Collisions per 10 years	79.1	147	54%
Fatalities per 10 years	25.1	44	57%

Key collision factors	Authority	NZ
Visibility of trains	19%	23%
Queuing or stacking	18%	15%
Train operations	14%	13%
Vehicle operations	14%	12%
Condition of warning devices	12%	12%
Condition of crossing	13%	14%
Other	10%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	24%	23%	17%	14%	22%
Exposure	23%	16%	19%	22%	20%
Consequence	14%	42%	13%	17%	14%
Total ALCAM risk score	**14%**	**25%**	**21%**	**20%**	**21%**

Comments

Island - South

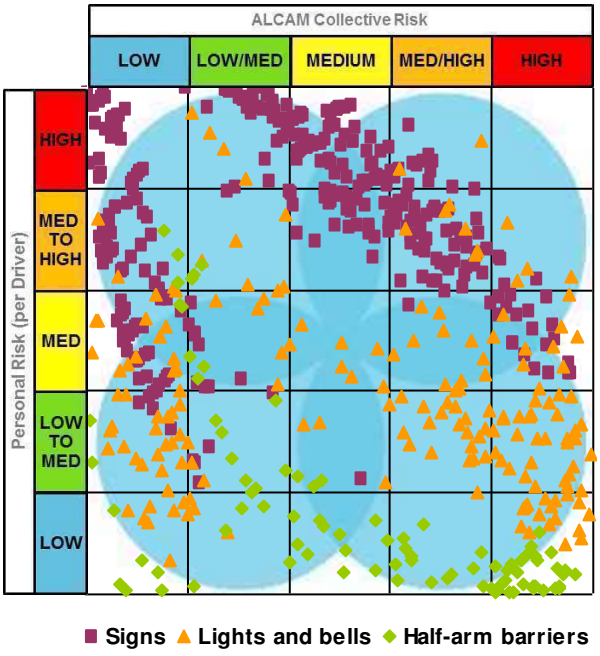
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	335	182	89
• percentage	55%	30%	15%
• in urban areas	25	50	57
• with unsealed road surface	125	4	3
• with stacking distance < 25m	83	46	14
• with a hump or dip	146	17	3
Vehicles per day (mean)	177	1,523	6,833
Vehicles per day (maximum)	6,000	16,200	24,100

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	0 - 2
Freight trains per day	1 - 13	1 - 13	3 - 21
Total trains per day	1 - 15	1 - 15	3 - 23

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	606	1268	48%
Collisions per 10 years	67.9	147	46%
Fatalities per 10 years	18.8	44	43%

Key collision factors	Authority	NZ
Visibility of trains	26%	23%
Queuing or stacking	14%	15%
Train operations	12%	13%
Vehicle operations	10%	12%
Condition of warning devices	12%	12%
Condition of crossing	15%	14%
Other	11%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	16%	17%	23%	27%	17%
Exposure	18%	23%	21%	18%	20%
Consequence	28%	9%	17%	44%	1%
Total ALCAM risk score	**27%**	**15%**	**19%**	**20%**	**19%**

Comments

Road Controlling Authority Management Areas

- North Island

- Far North District Council *
- Whangarei District Council *
- Kaipara District Council *
- Auckland Council
- Waikato District Council
- Hamilton City Council *
- Matamata- Piako District Council *
- South Waikato District Council *
- Western Bay Of Plenty District Council *
- Tauranga City Council *
- Whakatane District Council *
- Waipa District Council *
- Otorohanga District Council *
- Waitomo District Council *
- Ruapehu District Council *
- New Plymouth District Council
- Stratford District Council *
- South Taranaki District Council
- Wanganui District Council
- Rangitikei District Council
- Manawatu District Council *
- Palmerston North City Council *
- Gisborne District Council *
- Wairoa District Council *
- Hastings District Council
- Napier City Council
- Central Hawkes Bay District Council
- Tararua District Council
- Horowhenua District Council
- Kapiti Coast District Council *
- Porirua City Council *
- Masterton District Council *
- Carterton District Council *
- South Wairarapa District Council *
- Upper Hutt City Council *
- Hutt City Council *
- Wellington City Council *

* Contains fewer than 20 level crossings, meaning that some of the risk data may be statistically insignificant.

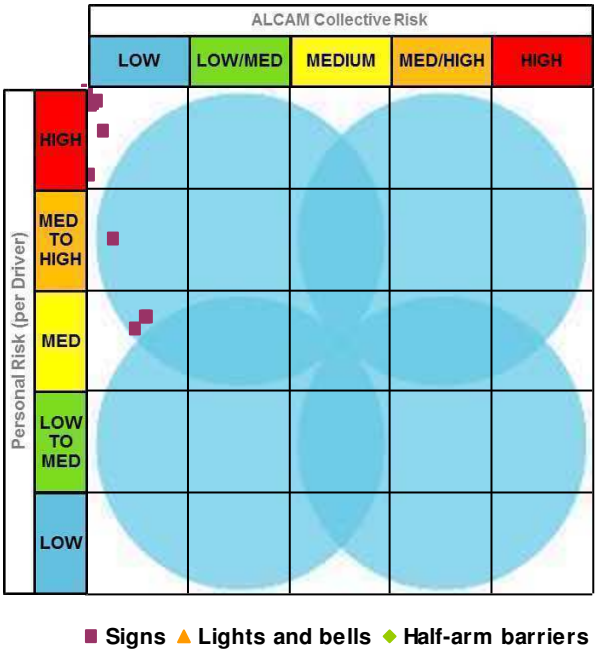
Roading Authority - Far North District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	12	0	0
• percentage	100%	0%	0%
• in urban areas	0	0	0
• with unsealed road surface	8	0	0
• with stacking distance < 25m	1	0	0
• with a hump or dip	9	0	0
Vehicles per day (mean)	64	0	0
Vehicles per day (maximum)	200	0	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0	0
Freight trains per day	3 - 3	0	0
Total trains per day	3 - 3	0	0

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	12	1268	1%
Collisions per 10 years	0.7	147	0%
Fatalities per 10 years	0.0	44	0%



Key collision factors	Authority	NZ
Visibility of trains	28%	23%
Queuing or stacking	3%	15%
Train operations	12%	13%
Vehicle operations	7%	12%
Condition of warning devices	9%	12%
Condition of crossing	29%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	8%	17%	17%	50%	8%
Exposure	67%	8%	25%	0%	0%
Consequence	92%	8%	0%	0%	0%
Total ALCAM risk score	**100%**	**0%**	**0%**	**0%**	**0%**

Comments

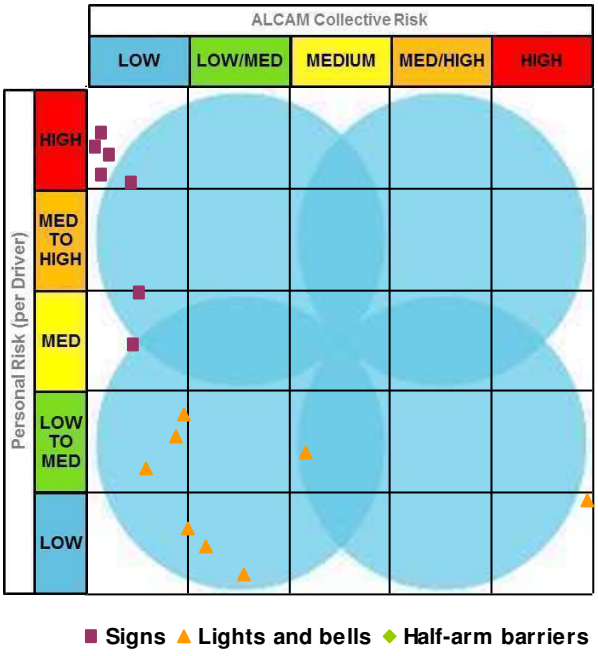
Roading Authority - Whangarei District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	7	8	0
• percentage	47%	53%	0%
• in urban areas	1	4	0
• with unsealed road surface	3	0	0
• with stacking distance < 25m	1	2	0
• with a hump or dip	4	1	0
Vehicles per day (mean)	76	5,451	0
Vehicles per day (maximum)	235	18,780	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	3 - 3	3 - 5	0
Total trains per day	3 - 3	3 - 5	0

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	15	1268	1%
Collisions per 10 years	2.0	147	1%
Fatalities per 10 years	0.3	44	1%



Key collision factors	Authority	NZ
Visibility of trains	16%	23%
Queuing or stacking	16%	15%
Train operations	14%	13%
Vehicle operations	11%	12%
Condition of warning devices	15%	12%
Condition of crossing	19%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	20%	13%	13%	20%	33%
Exposure	33%	0%	20%	20%	27%
Consequence	80%	13%	7%	0%	0%
Total ALCAM risk score	**73%**	**13%**	**7%**	**0%**	**7%**

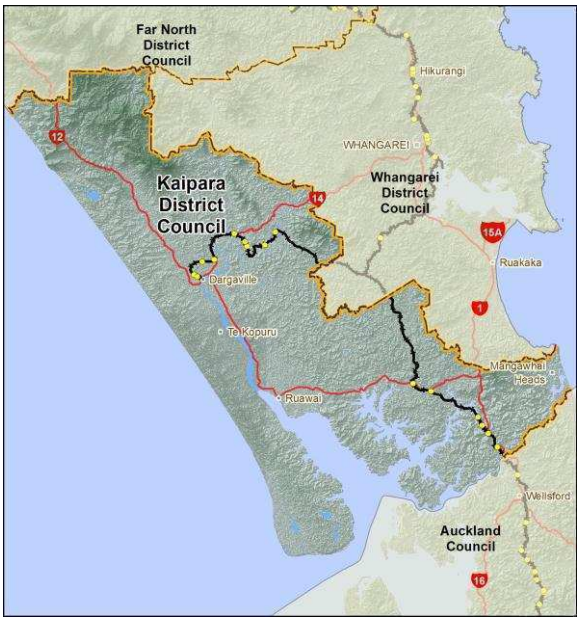
Comments

Roading Authority - Kaipara District Council

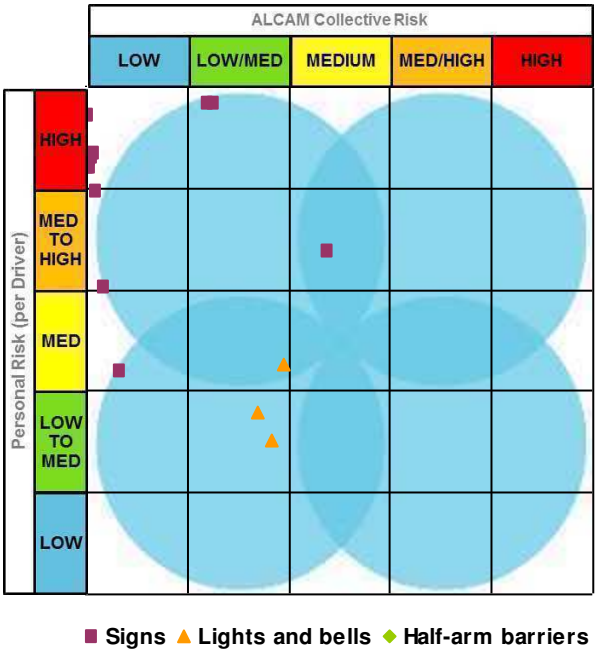
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	12	3	0
• percentage	80%	20%	0%
• in urban areas	0	0	0
• with unsealed road surface	9	0	0
• with stacking distance < 25m	4	0	0
• with a hump or dip	10	0	0
Vehicles per day (mean)	51	416	0
Vehicles per day (maximum)	267	600	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	1 - 3	3 - 3	0
Total trains per day	1 - 3	3 - 3	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	15	1268	1%
Collisions per 10 years	0.8	147	1%
Fatalities per 10 years	0.2	44	0%



Key collision factors	Authority	NZ
Visibility of trains	19%	23%
Queuing or stacking	9%	15%
Train operations	17%	13%
Vehicle operations	8%	12%
Condition of warning devices	10%	12%
Condition of crossing	28%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	13%	7%	27%	53%	0%
Exposure	67%	27%	7%	0%	0%
Consequence	60%	33%	7%	0%	0%
Total ALCAM risk score	**60%**	**33%**	**7%**	**0%**	**0%**

Comments

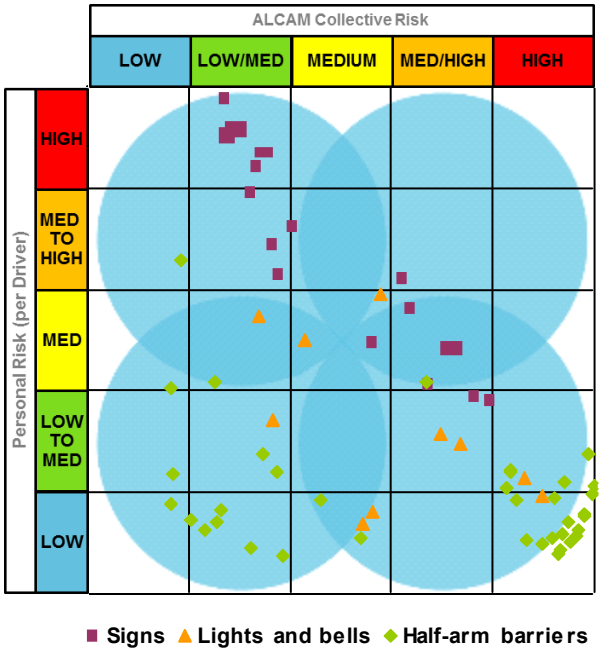
Roading Authority - Auckland Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	21	10	37
• percentage	31%	15%	54%
• in urban areas	1	0	30
• with unsealed road surface	10	0	1
• with stacking distance < 25m	7	1	3
• with a hump or dip	12	0	4
Vehicles per day (mean)	182	1,317	6,534
Vehicles per day (maximum)	750	3,200	14,469

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	105 - 82
Freight trains per day	3 - 9	3 - 9	0 - 26
Total trains per day	3 - 9	3 - 9	45 - 204

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	68	1268	5%
Collisions per 10 years	12.2	147	8%
Fatalities per 10 years	3.3	44	8%



Key collision factors	Authority	NZ
Visibility of trains	18%	23%
Queuing or stacking	19%	15%
Train operations	10%	13%
Vehicle operations	15%	12%
Condition of warning devices	12%	12%
Condition of crossing	17%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	22%	26%	19%	13%	19%
Exposure	16%	7%	7%	29%	40%
Consequence	1%	84%	4%	0%	10%
Total ALCAM risk score	**6%**	**32%**	**12%**	**16%**	**34%**

Comments

ALCAM surveys for the Onehunga Branch were taken prior to the level crossing upgrade work and the reopening of the line. There have also been a number of recent safety improvements carried out in Auckland that may change the overall risk profile of the area.

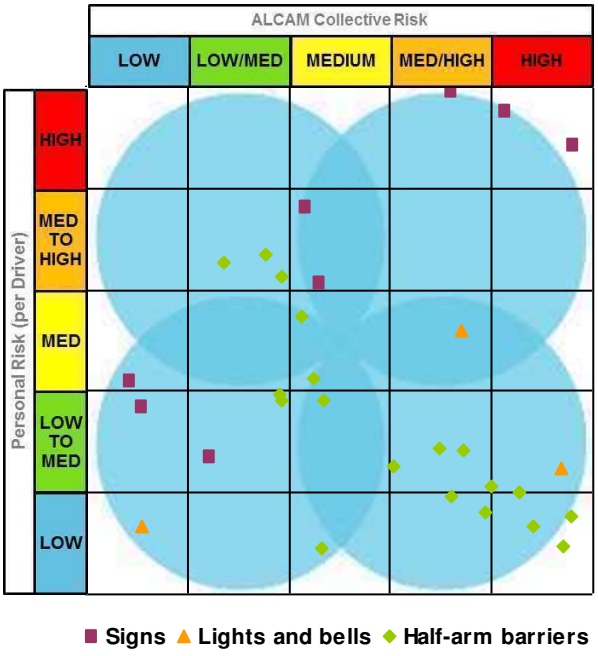
Roading Authority - Waikato District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	8	3	19
• percentage	27%	10%	63%
• in urban areas	0	0	7
• with unsealed road surface	3	0	0
• with stacking distance < 25m	2	0	4
• with a hump or dip	3	0	2
Vehicles per day (mean)	447	1,547	1,542
Vehicles per day (maximum)	2,409	2,645	6,750

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 29	0 - 29	0 - 29
Freight trains per day	2 - 26	2 - 26	8 - 26
Total trains per day	2 - 55	2 - 55	8 - 55

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	30	1268	2%
Collisions per 10 years	2.9	147	2%
Fatalities per 10 years	1.2	44	3%



Key collision factors	Authority	NZ
Visibility of trains	16%	23%
Queuing or stacking	24%	15%
Train operations	12%	13%
Vehicle operations	18%	12%
Condition of warning devices	5%	12%
Condition of crossing	15%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	27%	33%	10%	10%	20%
Exposure	27%	17%	23%	17%	17%
Consequence	13%	10%	0%	0%	77%
Total ALCAM risk score	**10%**	**20%**	**20%**	**27%**	**23%**

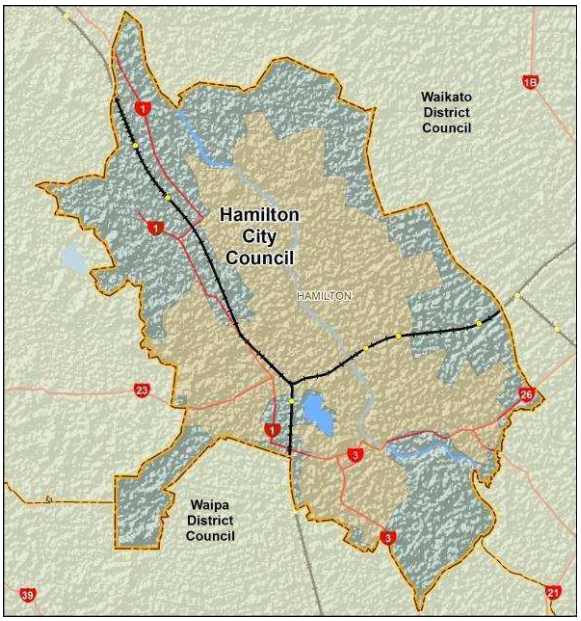
Comments

Roading Authority - Hamilton City Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

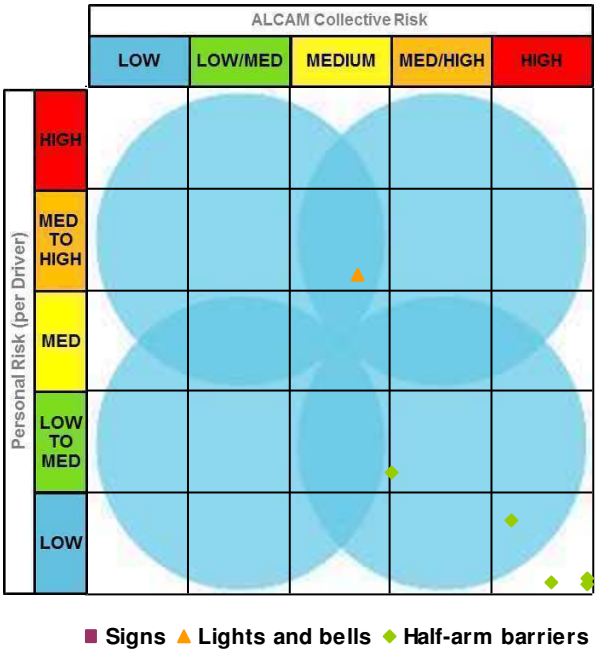
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	1	5
• percentage	0%	17%	83%
• in urban areas	0	0	2
• with unsealed road surface	0	0	1
• with stacking distance < 25m	0	0	1
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	77	12,083
Vehicles per day (maximum)	0	77	21,920

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0 - 0	0 - 2
Freight trains per day	0	16 - 16	12 - 24
Total trains per day	0	16 - 16	14 - 26



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	6	1268	0%
Collisions per 10 years	0.9	147	1%
Fatalities per 10 years	0.5	44	1%

Key collision factors	Authority	NZ
Visibility of trains	9%	23%
Queuing or stacking	21%	15%
Train operations	16%	13%
Vehicle operations	37%	12%
Condition of warning devices	0%	12%
Condition of crossing	0%	14%
Other	17%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	33%	50%	17%	0%	0%
Exposure	0%	33%	0%	17%	50%
Consequence	0%	0%	0%	17%	83%
Total ALCAM risk score	**0%**	**0%**	**17%**	**17%**	**67%**

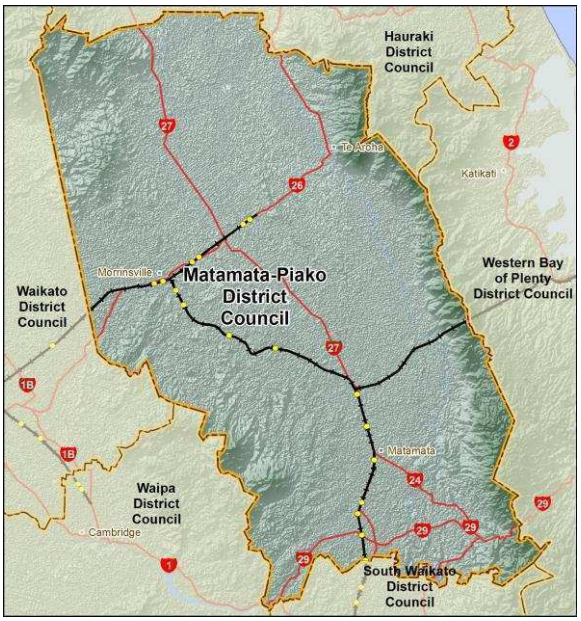
Comments

Roading Authority - Matamata-Piako District Council

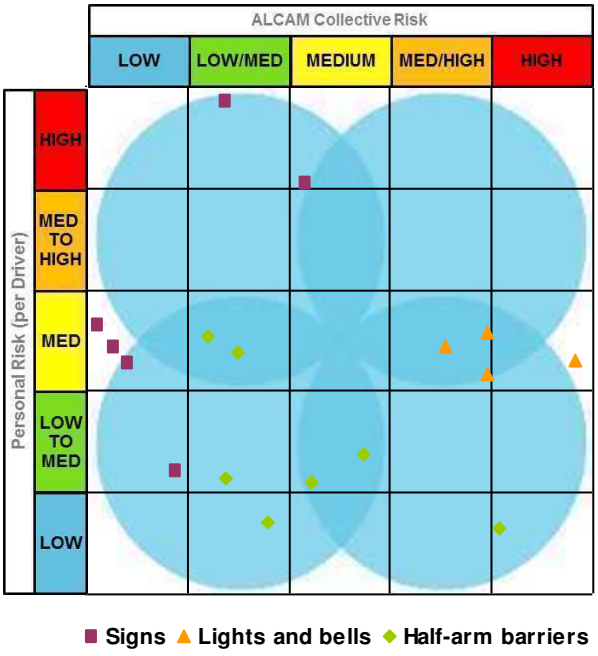
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	6	4	7
• percentage	35%	24%	41%
• in urban areas	0	0	2
• with unsealed road surface	1	0	0
• with stacking distance < 25m	2	2	2
• with a hump or dip	1	0	1
Vehicles per day (mean)	393	355	964
Vehicles per day (maximum)	1,734	603	2,686

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 7	7 - 15	7 - 16
Total trains per day	1 - 7	7 - 15	7 - 16



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	17	1268	1%
Collisions per 10 years	1.3	147	1%
Fatalities per 10 years	0.5	44	1%



Key collision factors	Authority	NZ
Visibility of trains	16%	23%
Queuing or stacking	28%	15%
Train operations	16%	13%
Vehicle operations	17%	12%
Condition of warning devices	7%	12%
Condition of crossing	7%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	29%	35%	12%	0%	24%
Exposure	41%	24%	18%	18%	0%
Consequence	24%	0%	0%	41%	35%
Total ALCAM risk score	**24%**	**29%**	**18%**	**18%**	**12%**

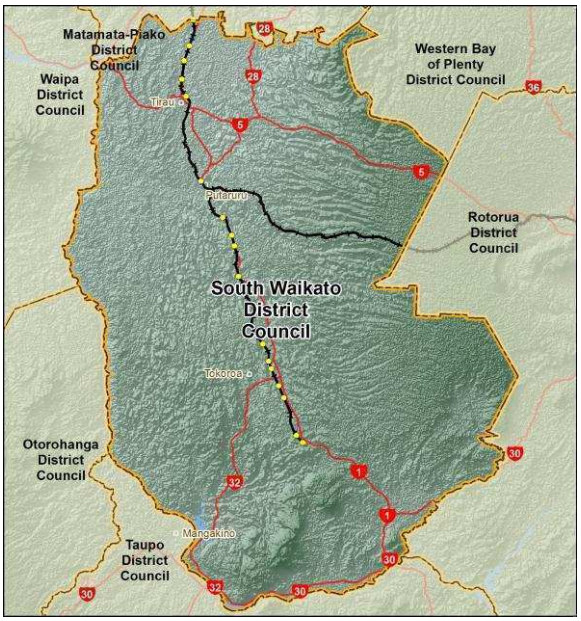
Comments

Roading Authority - South Waikato District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

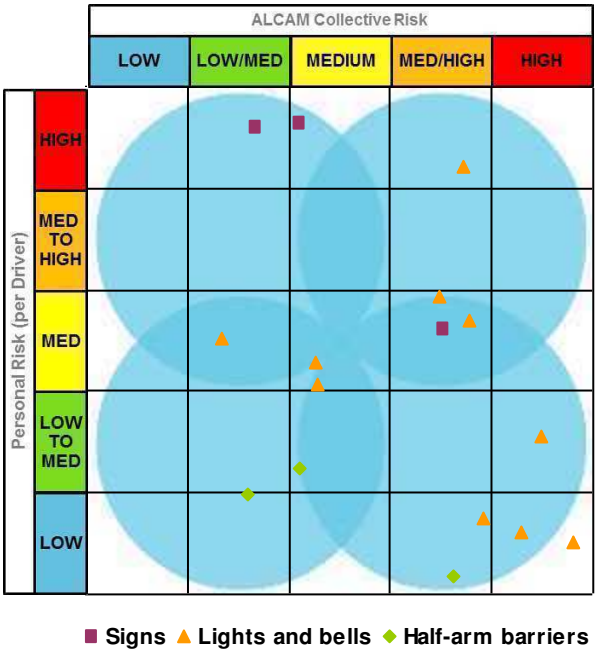
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	3	10	3
• percentage	19%	63%	19%
• in urban areas	0	3	1
• with unsealed road surface	0	0	1
• with stacking distance < 25m	2	3	1
• with a hump or dip	1	2	0
Vehicles per day (mean)	103	2,163	3,145
Vehicles per day (maximum)	266	10,125	7,839

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	7 - 7	7 - 7	7 - 7
Total trains per day	7 - 7	7 - 7	7 - 7



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	16	1268	1%
Collisions per 10 years	1.8	147	1%
Fatalities per 10 years	0.6	44	1%

Key collision factors	Authority	NZ
Visibility of trains	18%	23%
Queuing or stacking	29%	15%
Train operations	12%	13%
Vehicle operations	17%	12%
Condition of warning devices	2%	12%
Condition of crossing	12%	14%
Other	9%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	38%	19%	6%	13%	25%
Exposure	31%	13%	19%	13%	25%
Consequence	0%	69%	0%	25%	6%
Total ALCAM risk score	**0%**	**19%**	**25%**	**38%**	**19%**

Comments

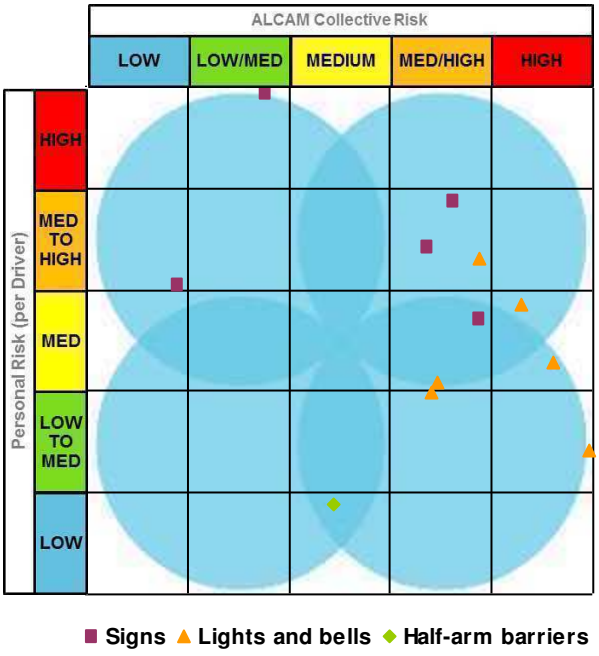
Roading Authority - Western Bay of Plenty District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	5	6	1
• percentage	42%	50%	8%
• in urban areas	0	0	0
• with unsealed road surface	1	0	0
• with stacking distance < 25m	1	4	1
• with a hump or dip	2	0	0
Vehicles per day (mean)	143	1,142	1,684
Vehicles per day (maximum)	279	4,677	1,684

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	11 - 16	11 - 16	11 - 11
Total trains per day	11 - 16	11 - 16	11 - 11

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	12	1268	1%
Collisions per 10 years	1.9	147	1%
Fatalities per 10 years	0.6	44	1%



Key collision factors	Authority	NZ
Visibility of trains	18%	23%
Queuing or stacking	31%	15%
Train operations	7%	13%
Vehicle operations	12%	12%
Condition of warning devices	13%	12%
Condition of crossing	9%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	8%	8%	25%	17%	42%
Exposure	8%	8%	8%	58%	17%
Consequence	8%	92%	0%	0%	0%
Total ALCAM risk score	**8%**	**8%**	**8%**	**50%**	**25%**

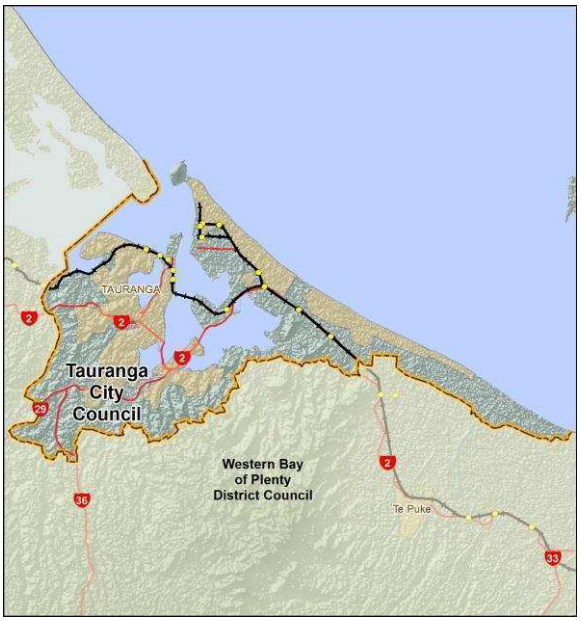
Comments

Roading Authority - Tauranga City Council

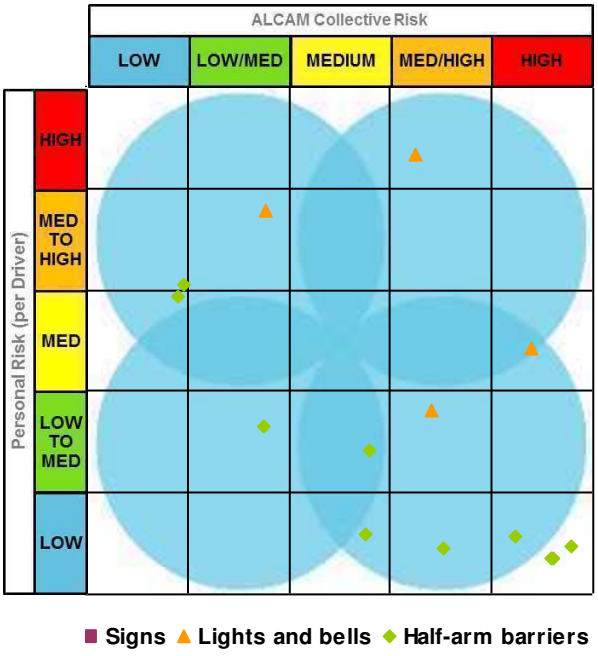
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	4	10
• percentage	0%	29%	71%
• in urban areas	0	1	6
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	1	3
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	319	4,404
Vehicles per day (maximum)	0	676	10,800

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0 - 0	0 - 0
Freight trains per day	0	11 - 26	16 - 26
Total trains per day	0	11 - 26	16 - 26



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	14	1268	1%
Collisions per 10 years	1.7	147	1%
Fatalities per 10 years	0.6	44	1%



Key collision factors	Authority	NZ
Visibility of trains	5%	23%
Queuing or stacking	35%	15%
Train operations	6%	13%
Vehicle operations	20%	12%
Condition of warning devices	21%	12%
Condition of crossing	0%	14%
Other	12%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	14%	36%	14%	7%	29%
Exposure	21%	21%	7%	21%	29%
Consequence	0%	86%	14%	0%	0%
Total ALCAM risk score	**14%**	**14%**	**14%**	**21%**	**36%**

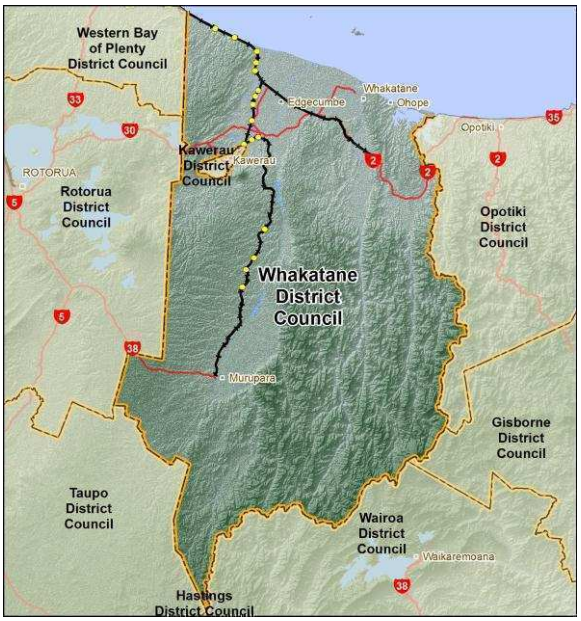
Comments

Roading Authority - Whakatane District Council

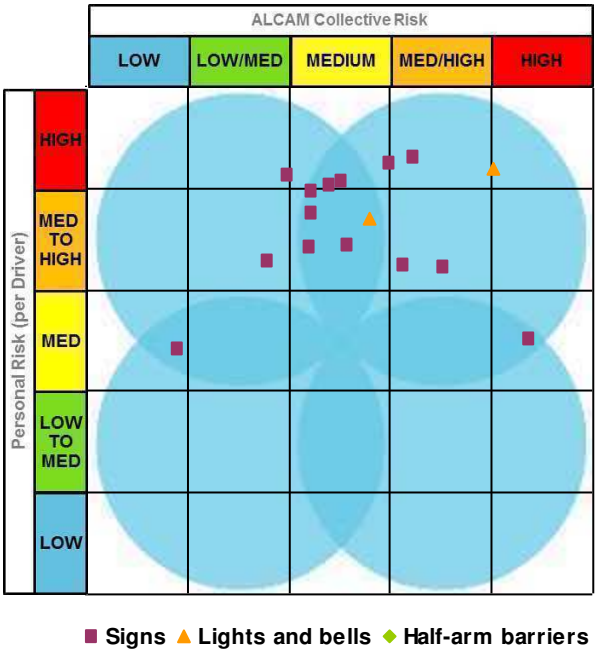
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	14	2	0
• percentage	88%	13%	0%
• in urban areas	0	0	0
• with unsealed road surface	5	1	0
• with stacking distance < 25m	4	1	0
• with a hump or dip	6	1	0
Vehicles per day (mean)	125	75	0
Vehicles per day (maximum)	452	75	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	6 - 11	11 - 11	0
Total trains per day	6 - 11	11 - 11	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	16	1268	1%
Collisions per 10 years	1.6	147	1%
Fatalities per 10 years	0.5	44	1%



Key collision factors	Authority	NZ
Visibility of trains	19%	23%
Queuing or stacking	16%	15%
Train operations	10%	13%
Vehicle operations	10%	12%
Condition of warning devices	15%	12%
Condition of crossing	21%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	31%	13%	6%	13%	38%
Exposure	0%	38%	44%	6%	13%
Consequence	6%	94%	0%	0%	0%
Total ALCAM risk score	**6%**	**13%**	**50%**	**19%**	**13%**

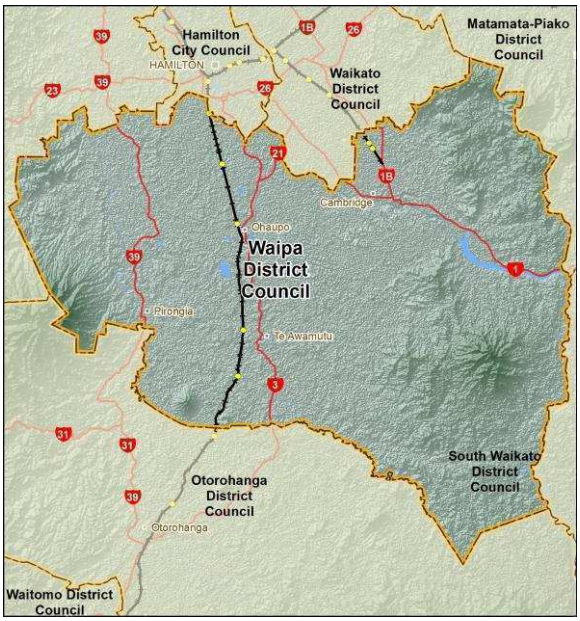
Comments

Roading Authority - Waipa District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

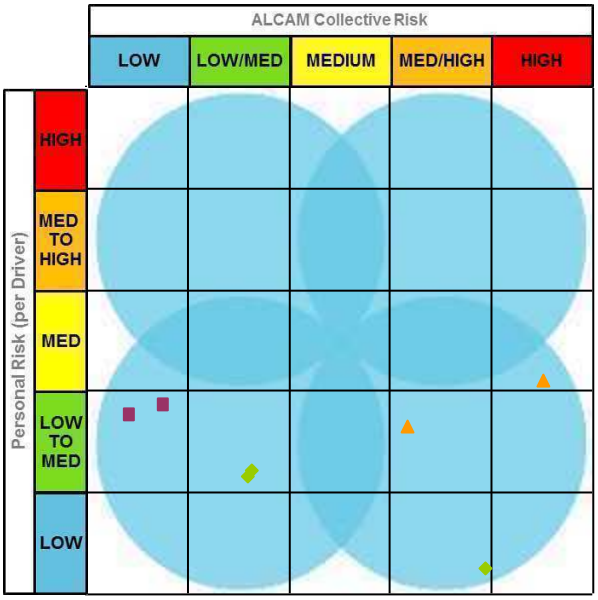
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	2	2	3
• percentage	29%	29%	43%
• in urban areas	0	0	1
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	0
• with a hump or dip	0	1	0
Vehicles per day (mean)	594	733	2,732
Vehicles per day (maximum)	657	740	6,723

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	2 - 2	2 - 2
Freight trains per day	2 - 2	12 - 12	12 - 12
Total trains per day	2 - 2	14 - 14	14 - 14



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	7	1268	1%
Collisions per 10 years	0.7	147	0%
Fatalities per 10 years	0.2	44	0%

Key collision factors	Authority	NZ
Visibility of trains	29%	23%
Queuing or stacking	4%	15%
Train operations	15%	13%
Vehicle operations	22%	12%
Condition of warning devices	2%	12%
Condition of crossing	14%	14%
Other	15%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	43%	29%	14%	0%	14%
Exposure	29%	0%	0%	71%	0%
Consequence	29%	0%	0%	71%	0%
Total ALCAM risk score	**29%**	**29%**	**0%**	**29%**	**14%**

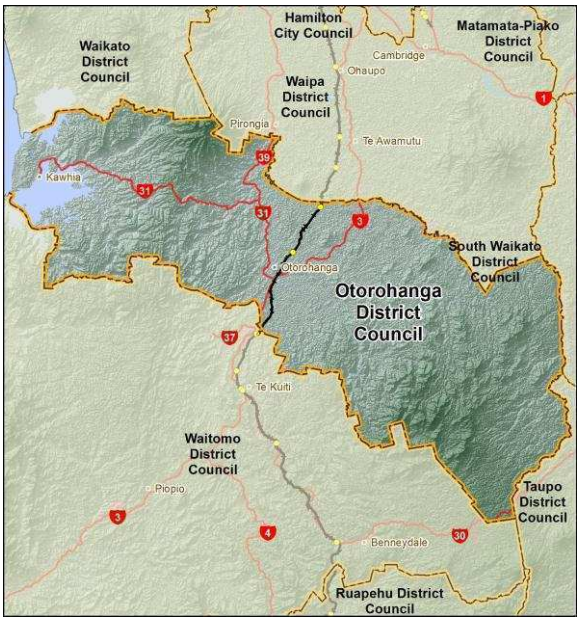
Comments

Roading Authority - Otorohanga District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

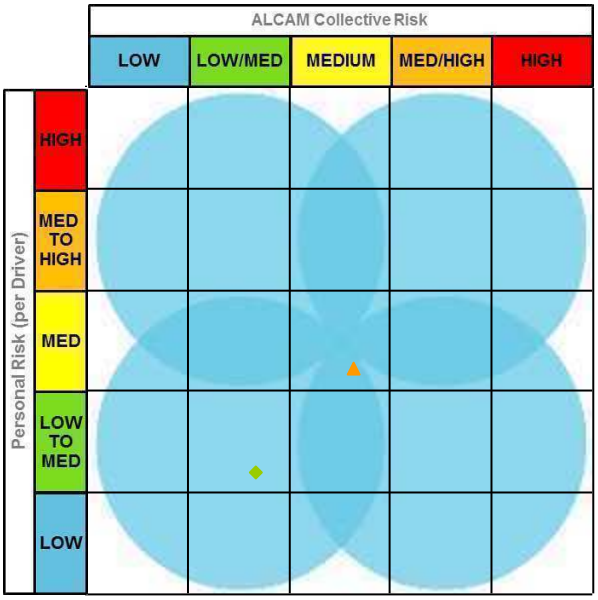
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	1	1
• percentage	0%	50%	50%
• in urban areas	0	0	0
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	0
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	301	733
Vehicles per day (maximum)	0	301	733

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	2 - 2	2 - 2
Freight trains per day	0	12 - 12	12 - 12
Total trains per day	0	14 - 14	14 - 14



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	2	1268	0%
Collisions per 10 years	0.1	147	0%
Fatalities per 10 years	0.1	44	0%

Key collision factors	Authority	NZ
Visibility of trains	10%	23%
Queuing or stacking	0%	15%
Train operations	20%	13%
Vehicle operations	39%	12%
Condition of warning devices	14%	12%
Condition of crossing	0%	14%
Other	17%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	50%	50%	0%	0%	0%
Exposure	50%	0%	0%	50%	0%
Consequence	0%	0%	0%	100%	0%
Total ALCAM risk score	**0%**	**50%**	**50%**	**0%**	**0%**

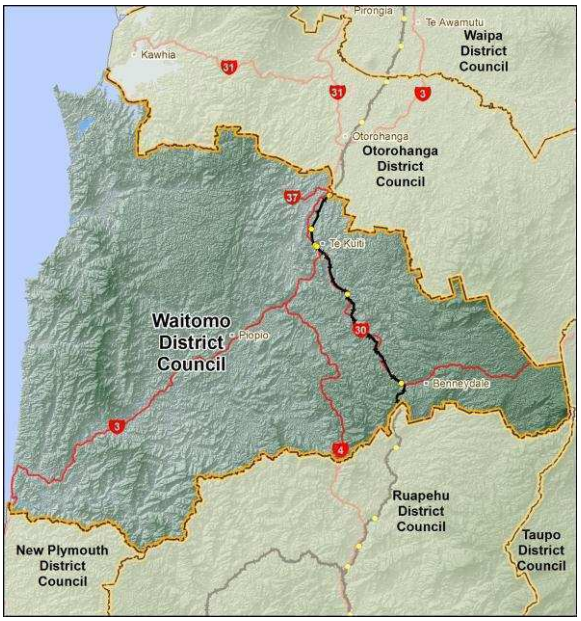
Comments

Roading Authority - Waitomo District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

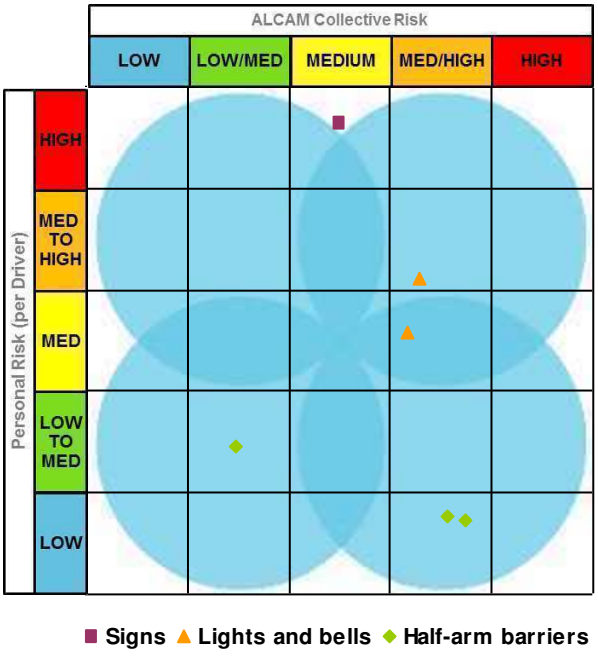
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	1	2	3
• percentage	17%	33%	50%
• in urban areas	0	0	2
• with unsealed road surface	1	0	0
• with stacking distance < 25m	0	0	2
• with a hump or dip	1	1	0
Vehicles per day (mean)	26	190	2,022
Vehicles per day (maximum)	26	230	3,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 2	2 - 2
Freight trains per day	9 - 9	9 - 12	12 - 12
Total trains per day	11 - 11	11 - 14	14 - 14



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	6	1268	0%
Collisions per 10 years	0.5	147	0%
Fatalities per 10 years	0.2	44	0%

Key collision factors	Authority	NZ
Visibility of trains	18%	23%
Queuing or stacking	27%	15%
Train operations	7%	13%
Vehicle operations	14%	12%
Condition of warning devices	5%	12%
Condition of crossing	21%	14%
Other	8%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	0%	33%	0%	17%	50%
Exposure	17%	17%	67%	0%	0%
Consequence	0%	0%	33%	67%	0%
Total ALCAM risk score	**0%**	**17%**	**17%**	**67%**	**0%**

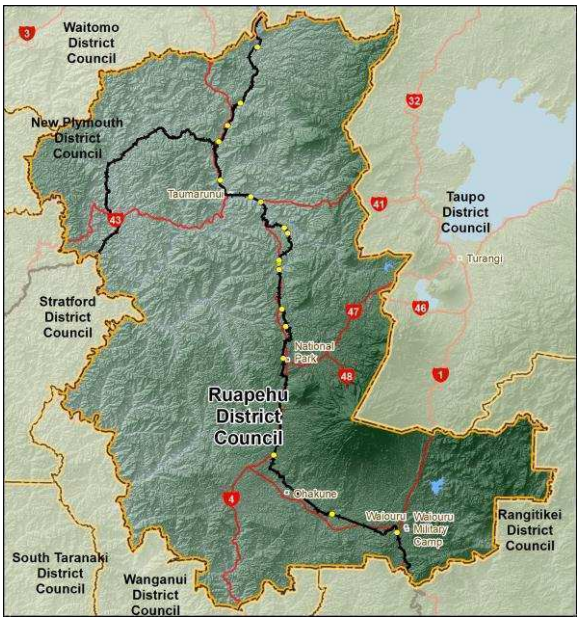
Comments

Roading Authority - Ruapehu District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

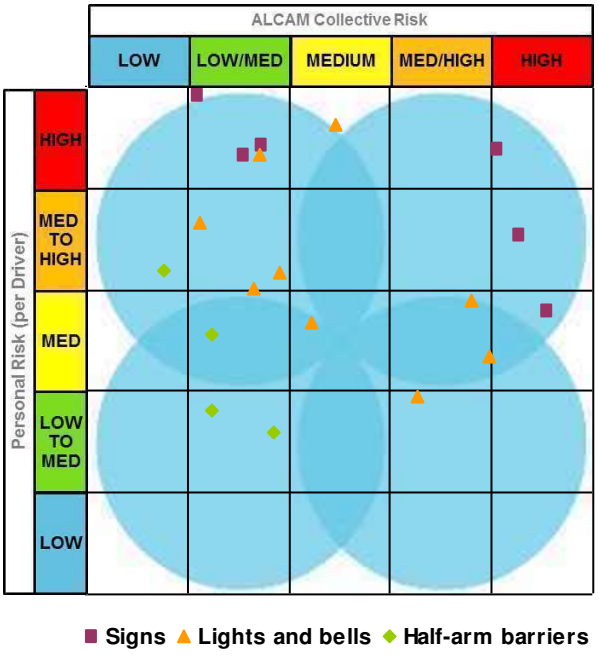
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	6	9	4
• percentage	32%	47%	21%
• in urban areas	0	0	0
• with unsealed road surface	5	3	1
• with stacking distance < 25m	0	1	0
• with a hump or dip	6	2	2
Vehicles per day (mean)	100	180	221
Vehicles per day (maximum)	358	500	500

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 2	2 - 2
Freight trains per day	9 - 10	9 - 9	9 - 10
Total trains per day	11 - 12	11 - 11	11 - 12



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	19	1268	1%
Collisions per 10 years	1.6	147	1%
Fatalities per 10 years	0.6	44	1%

Key collision factors	Authority	NZ
Visibility of trains	17%	23%
Queuing or stacking	8%	15%
Train operations	8%	13%
Vehicle operations	12%	12%
Condition of warning devices	12%	12%
Condition of crossing	32%	14%
Other	11%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	11%	16%	5%	26%	42%
Exposure	42%	11%	26%	16%	5%
Consequence	0%	42%	26%	11%	21%
Total ALCAM risk score	**5%**	**53%**	**11%**	**16%**	**16%**

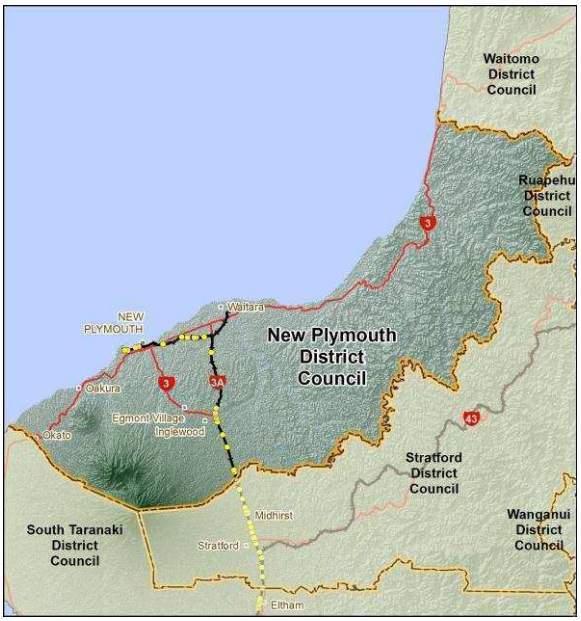
Comments

Roading Authority - New Plymouth District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

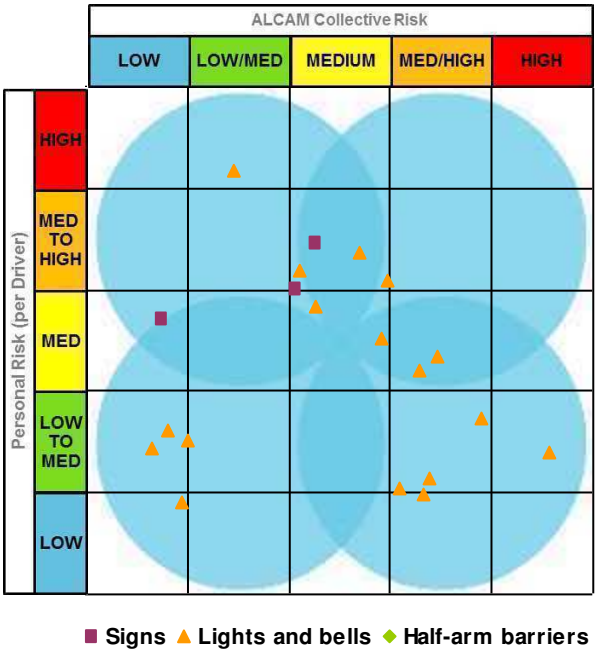
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	3	17	0
• percentage	15%	85%	0%
• in urban areas	1	5	0
• with unsealed road surface	0	0	0
• with stacking distance < 25m	1	11	0
• with a hump or dip	0	0	0
Vehicles per day (mean)	147	937	0
Vehicles per day (maximum)	240	3,000	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	4 - 4	4 - 4	0
Total trains per day	4 - 4	4 - 4	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	20	1268	2%
Collisions per 10 years	2.2	147	1%
Fatalities per 10 years	0.6	44	1%

Key collision factors	Authority	NZ
Visibility of trains	12%	23%
Queuing or stacking	31%	15%
Train operations	13%	13%
Vehicle operations	17%	12%
Condition of warning devices	14%	12%
Condition of crossing	0%	14%
Other	13%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	20%	5%	10%	5%	60%
Exposure	15%	20%	15%	45%	5%
Consequence	20%	80%	0%	0%	0%
Total ALCAM risk score	**20%**	**10%**	**35%**	**30%**	**5%**

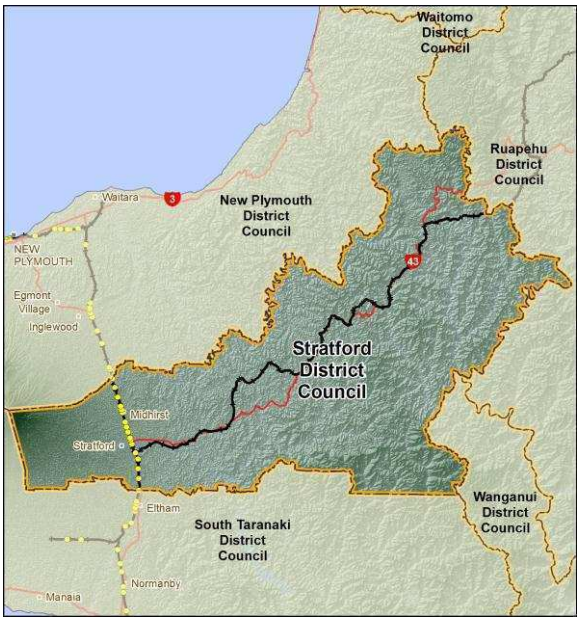
Comments

Roading Authority - Stratford District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

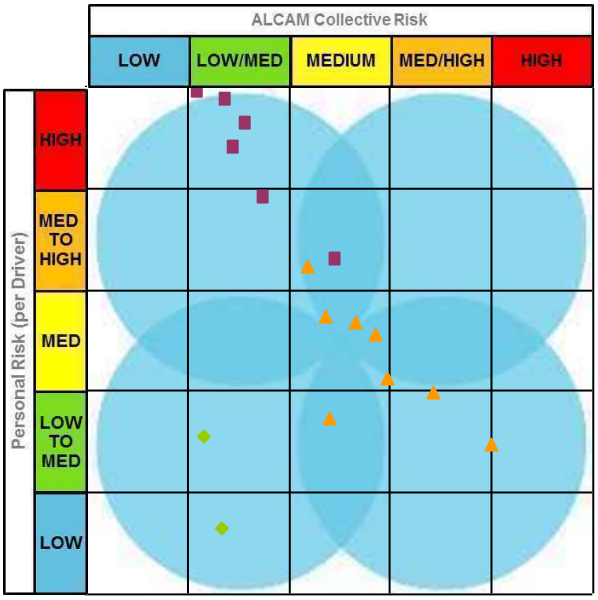
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	6	8	2
• percentage	38%	50%	13%
• in urban areas	0	2	1
• with unsealed road surface	2	0	0
• with stacking distance < 25m	6	5	0
• with a hump or dip	2	0	0
Vehicles per day (mean)	34	433	932
Vehicles per day (maximum)	101	1,300	1,500

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	4 - 4	4 - 5	4 - 5
Total trains per day	4 - 4	4 - 5	4 - 5



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	16	1268	1%
Collisions per 10 years	1.2	147	1%
Fatalities per 10 years	0.4	44	1%

Key collision factors	Authority	NZ
Visibility of trains	17%	23%
Queuing or stacking	28%	15%
Train operations	12%	13%
Vehicle operations	15%	12%
Condition of warning devices	11%	12%
Condition of crossing	9%	14%
Other	9%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	13%	0%	25%	13%	50%
Exposure	44%	31%	19%	6%	0%
Consequence	0%	100%	0%	0%	0%
Total ALCAM risk score	**0%**	**44%**	**44%**	**13%**	**0%**

Comments

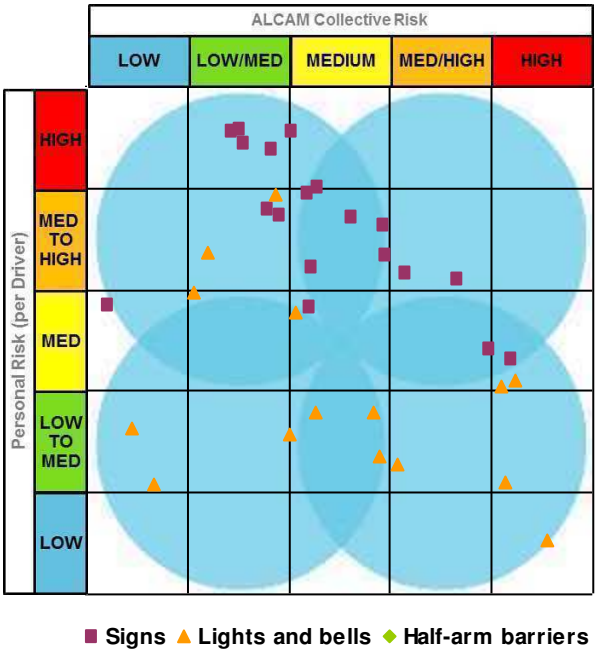
Roading Authority - South Taranaki District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	19	15	0
• percentage	56%	44%	0%
• in urban areas	0	5	0
• with unsealed road surface	3	1	0
• with stacking distance < 25m	2	3	0
• with a hump or dip	3	0	0
Vehicles per day (mean)	114	1,129	0
Vehicles per day (maximum)	490	7,050	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	2 - 9	2 - 9	0
Total trains per day	2 - 9	2 - 9	0

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	34	1268	3%
Collisions per 10 years	3.2	147	2%
Fatalities per 10 years	1.0	44	2%



Key collision factors	Authority	NZ
Visibility of trains	30%	23%
Queuing or stacking	8%	15%
Train operations	18%	13%
Vehicle operations	12%	12%
Condition of warning devices	12%	12%
Condition of crossing	6%	14%
Other	14%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	38%	24%	21%	9%	9%
Exposure	18%	24%	29%	18%	12%
Consequence	6%	94%	0%	0%	0%
Total ALCAM risk score	**9%**	**29%**	**35%**	**12%**	**15%**

Comments

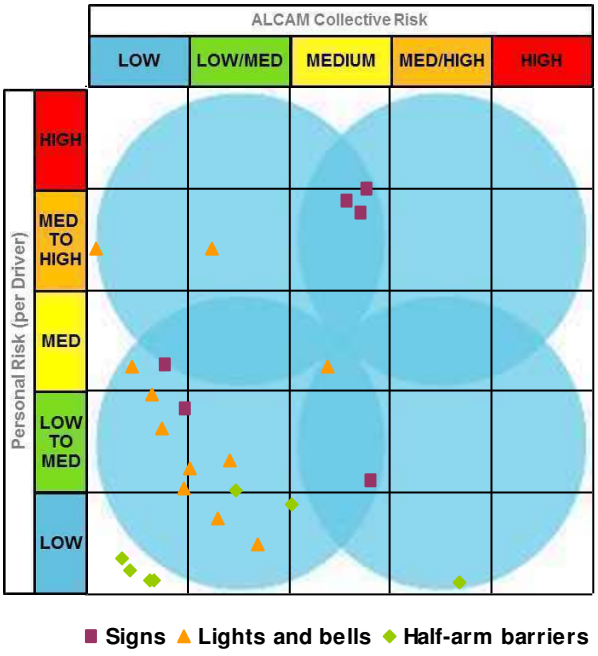
Roading Authority - Wanganui District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	6	11	7
• percentage	25%	46%	29%
• in urban areas	3	9	7
• with unsealed road surface	1	0	0
• with stacking distance < 25m	3	1	1
• with a hump or dip	1	0	0
Vehicles per day (mean)	1,304	2,533	5,243
Vehicles per day (maximum)	6,261	12,000	9,900

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	4 - 9	4 - 10	6 - 9
Total trains per day	4 - 9	4 - 10	6 - 9

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	24	1268	2%
Collisions per 10 years	3.3	147	2%
Fatalities per 10 years	0.4	44	1%



Key collision factors	Authority	NZ
Visibility of trains	15%	23%
Queuing or stacking	20%	15%
Train operations	16%	13%
Vehicle operations	17%	12%
Condition of warning devices	15%	12%
Condition of crossing	5%	14%
Other	12%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	13%	42%	25%	13%	8%
Exposure	13%	8%	29%	21%	29%
Consequence	67%	33%	0%	0%	0%
Total ALCAM risk score	**46%**	**25%**	**25%**	**4%**	**0%**

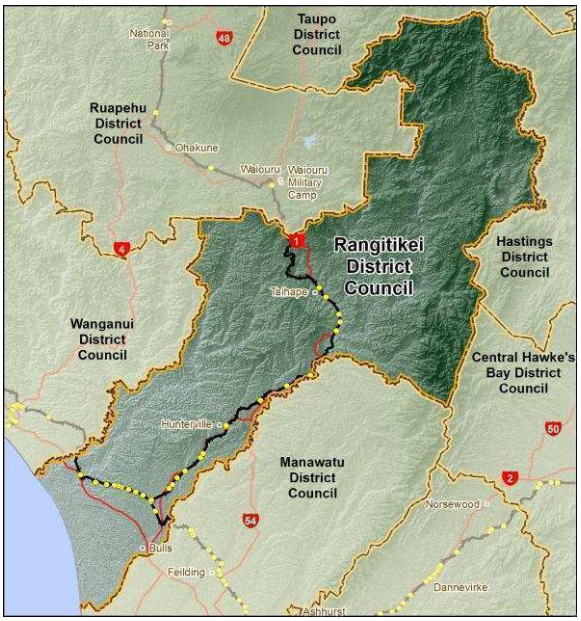
Comments

Roading Authority - Rangitikei District Council

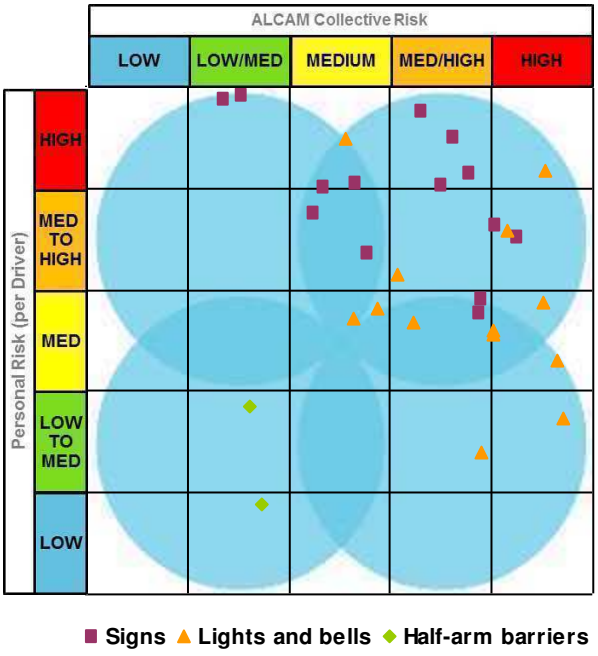
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	14	13	2
• percentage	48%	45%	7%
• in urban areas	0	1	2
• with unsealed road surface	6	0	0
• with stacking distance < 25m	0	3	0
• with a hump or dip	6	2	0
Vehicles per day (mean)	80	347	775
Vehicles per day (maximum)	260	1,372	1,300

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	0 - 2
Freight trains per day	10 - 10	10 - 20	10 - 10
Total trains per day	10 - 12	10 - 22	10 - 12



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	29	1268	2%
Collisions per 10 years	2.8	147	2%
Fatalities per 10 years	1.2	44	3%



Key collision factors	Authority	NZ
Visibility of trains	19%	23%
Queuing or stacking	9%	15%
Train operations	17%	13%
Vehicle operations	13%	12%
Condition of warning devices	14%	12%
Condition of crossing	17%	14%
Other	12%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	21%	28%	10%	24%	17%
Exposure	14%	21%	45%	14%	7%
Consequence	0%	31%	3%	0%	66%
Total ALCAM risk score	**0%**	**14%**	**24%**	**31%**	**31%**

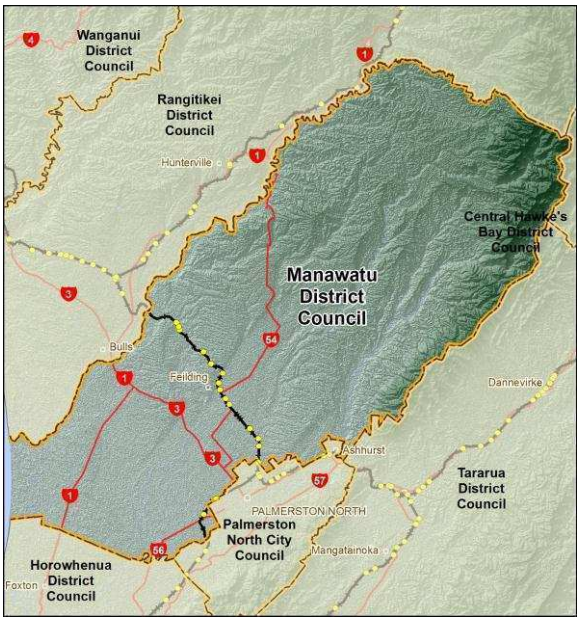
Comments

Roading Authority - Manawatu District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

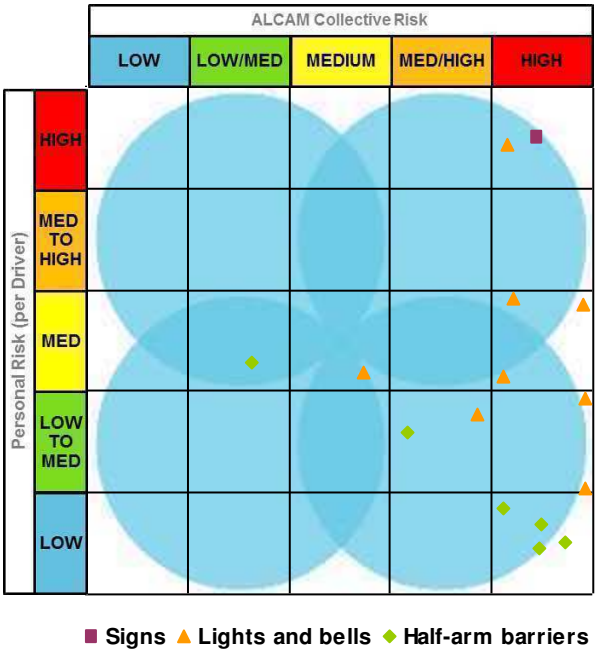
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	1	8	6
• percentage	7%	53%	40%
• in urban areas	0	1	2
• with unsealed road surface	1	0	0
• with stacking distance < 25m	1	4	4
• with a hump or dip	1	1	0
Vehicles per day (mean)	50	1,026	3,082
Vehicles per day (maximum)	50	4,493	6,365

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 4	2 - 2
Freight trains per day	20 - 20	15 - 20	20 - 20
Total trains per day	22 - 22	19 - 22	22 - 22



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	15	1268	1%
Collisions per 10 years	2.2	147	1%
Fatalities per 10 years	1.0	44	2%

Key collision factors	Authority	NZ
Visibility of trains	8%	23%
Queuing or stacking	38%	15%
Train operations	9%	13%
Vehicle operations	18%	12%
Condition of warning devices	11%	12%
Condition of crossing	10%	14%
Other	6%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	27%	13%	7%	27%	27%
Exposure	7%	13%	13%	33%	33%
Consequence	0%	0%	13%	0%	87%
Total ALCAM risk score	**0%**	**7%**	**7%**	**13%**	**73%**

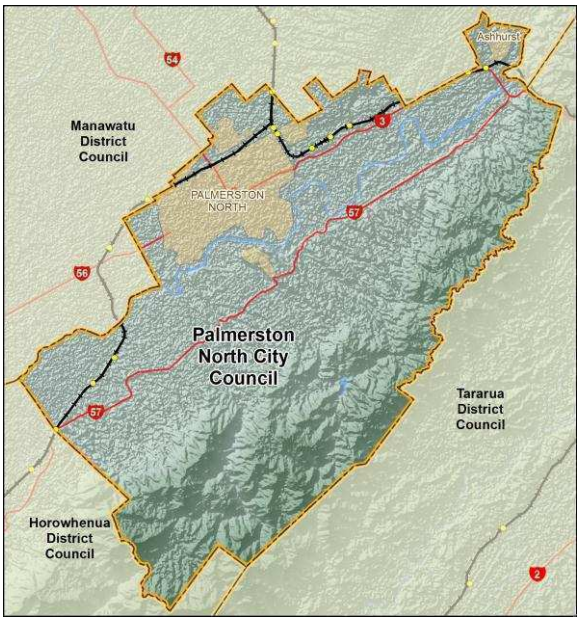
Comments

Roading Authority - Palmerston North City Council

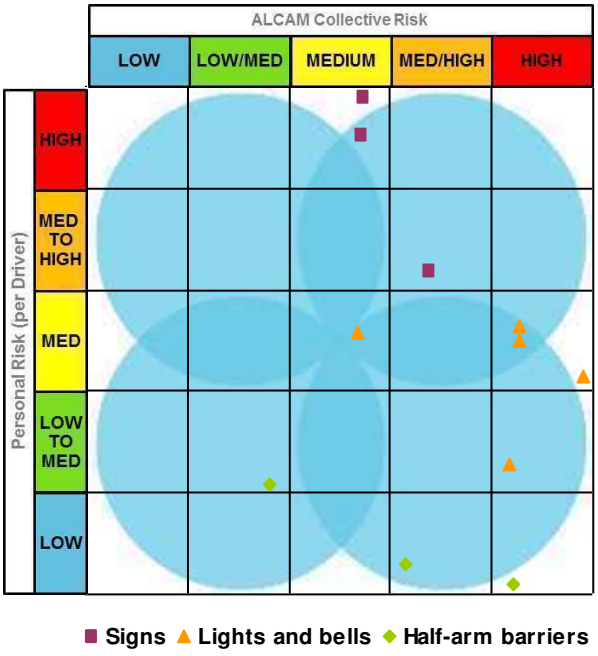
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	3	5	3
• percentage	27%	45%	27%
• in urban areas	0	0	0
• with unsealed road surface	2	0	0
• with stacking distance < 25m	1	2	0
• with a hump or dip	2	1	0
Vehicles per day (mean)	58	723	5,963
Vehicles per day (maximum)	130	1,590	12,200

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 4	0 - 4	0 - 0
Freight trains per day	9 - 15	9 - 20	9 - 9
Total trains per day	9 - 19	9 - 22	9 - 9



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	11	1268	1%
Collisions per 10 years	1.4	147	1%
Fatalities per 10 years	0.5	44	1%



Key collision factors	Authority	NZ
Visibility of trains	16%	23%
Queuing or stacking	14%	15%
Train operations	12%	13%
Vehicle operations	13%	12%
Condition of warning devices	13%	12%
Condition of crossing	18%	14%
Other	14%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	18%	27%	9%	0%	45%
Exposure	9%	18%	27%	18%	27%
Consequence	0%	0%	27%	64%	9%
Total ALCAM risk score	**0%**	**9%**	**27%**	**18%**	**45%**

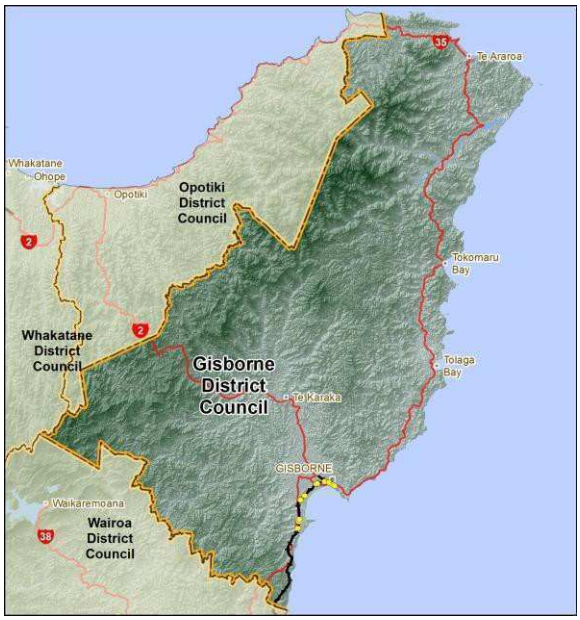
Comments

Roading Authority - Gisborne District Council

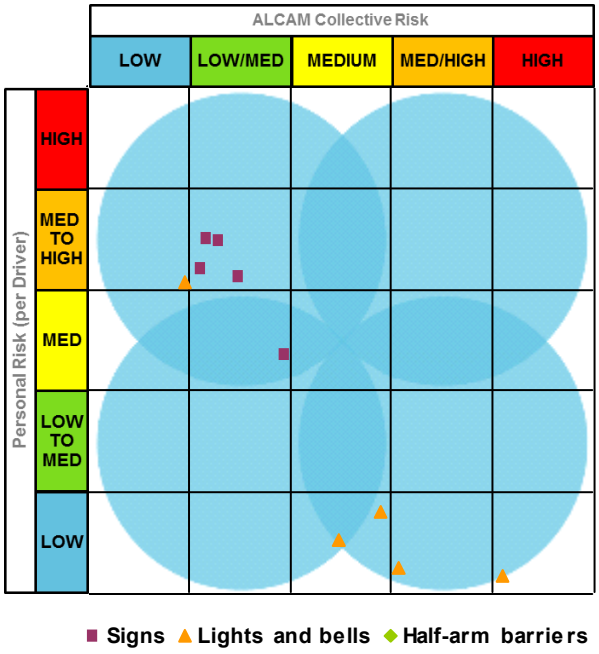
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	6	5	0
• percentage	55%	45%	0%
• in urban areas	0	1	0
• with unsealed road surface	2	0	0
• with stacking distance < 25m	0	0	0
• with a hump or dip	1	0	0
Vehicles per day (mean)	94	4,282	0
Vehicles per day (maximum)	220	10,370	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	1 - 1	1 - 1	0
Total trains per day	1 - 1	1 - 1	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	11	1268	1%
Collisions per 10 years	0.8	147	1%
Fatalities per 10 years	0.3	44	1%



Key collision factors	Authority	NZ
Visibility of trains	30%	23%
Queuing or stacking	1%	15%
Train operations	22%	13%
Vehicle operations	11%	12%
Condition of warning devices	17%	12%
Condition of crossing	6%	14%
Other	13%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	36%	27%	36%	0%	0%
Exposure	55%	9%	9%	18%	9%
Consequence	0%	73%	27%	0%	0%
Total ALCAM risk score	**9%**	**55%**	**18%**	**9%**	**9%**

Comments

This summary includes data for the PNGL north of Napier. It should be noted that this section of the line was officially mothballed in October 2012 and there are no trains currently using it. The train volumes for this section of the PNGL were obtained prior to this date.

Roading Authority - Wairoa District Council

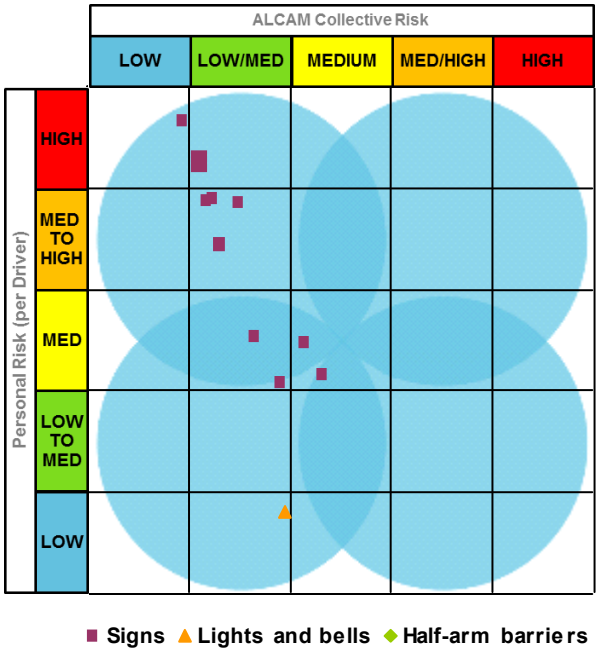
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	12	1	0
• percentage	92%	8%	0%
• in urban areas	0	0	0
• with unsealed road surface	5	0	0
• with stacking distance < 25m	2	0	0
• with a hump or dip	7	0	0
Vehicles per day (mean)	103	1,656	0
Vehicles per day (maximum)	313	1,656	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	1 - 1	1 - 1	0
Total trains per day	1 - 1	1 - 1	0

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	13	1268	1%
Collisions per 10 years	0.7	147	0%
Fatalities per 10 years	0.2	44	0%

Key collision factors	Authority	NZ
Visibility of trains	20%	23%
Queuing or stacking	5%	15%
Train operations	22%	13%
Vehicle operations	9%	12%
Condition of warning devices	12%	12%
Condition of crossing	23%	14%
Other	9%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	15%	23%	31%	23%	8%
Exposure	62%	31%	8%	0%	0%
Consequence	0%	100%	0%	0%	0%
Total ALCAM risk score	**8%**	**77%**	**15%**	**0%**	**0%**

Comments

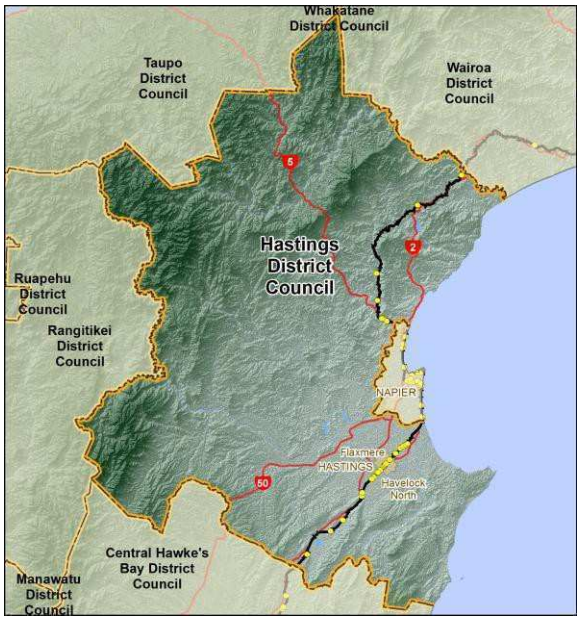
This summary includes data for the PNGL north of Napier. It should be noted that this section of the line was officially mothballed in October 2012 and there are no trains currently using it. The train volumes for this section of the PNGL were obtained prior to this date.

Roading Authority - Hastings District Council

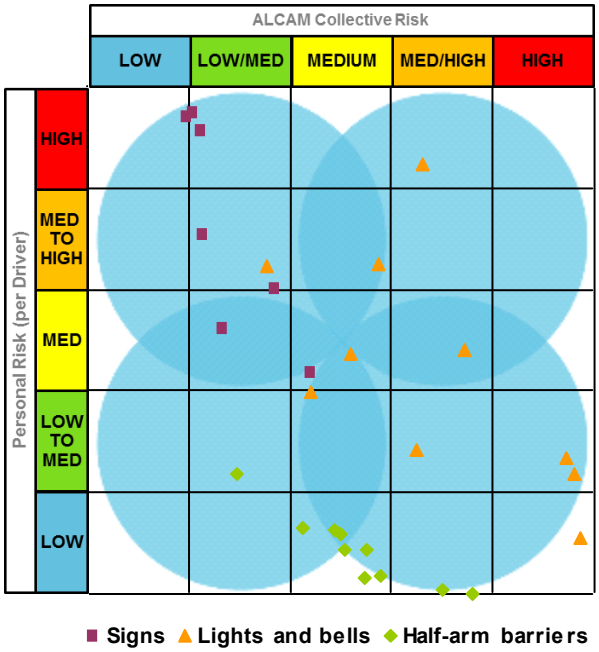
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	7	10	10
• percentage	26%	37%	37%
• in urban areas	0	1	6
• with unsealed road surface	4	1	0
• with stacking distance < 25m	1	3	3
• with a hump or dip	3	0	0
Vehicles per day (mean)	86	1,775	5,258
Vehicles per day (maximum)	300	10,000	15,500

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 1	4 - 7	4 - 7
Total trains per day	1 - 1	4 - 7	4 - 7



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	27	1268	2%
Collisions per 10 years	2.5	147	2%
Fatalities per 10 years	0.9	44	2%



Key collision factors	Authority	NZ
Visibility of trains	13%	23%
Queuing or stacking	23%	15%
Train operations	17%	13%
Vehicle operations	14%	12%
Condition of warning devices	14%	12%
Condition of crossing	10%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	11%	26%	22%	7%	33%
Exposure	41%	30%	7%	11%	11%
Consequence	0%	19%	7%	74%	0%
Total ALCAM risk score	**4%**	**26%**	**41%**	**19%**	**11%**

Comments

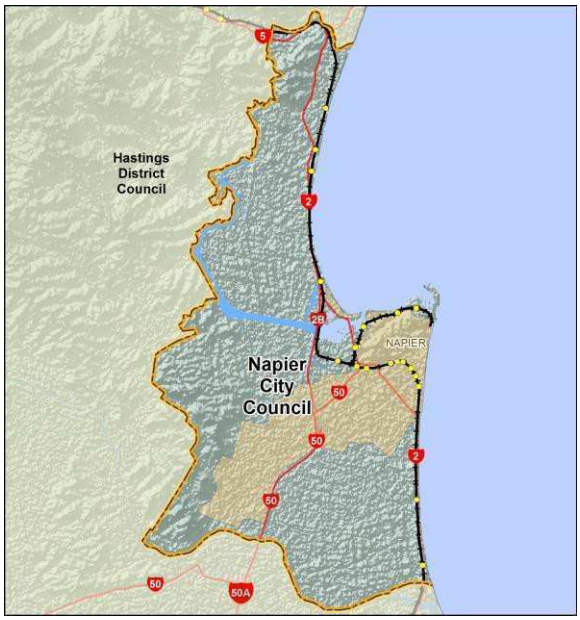
This summary includes data for the PNGL north of Napier. It should be noted that this section of the line was officially mothballed in October 2012 and there are no trains currently using it. The train volumes for this section of the PNGL were obtained prior to this date.

Roading Authority - Napier City Council

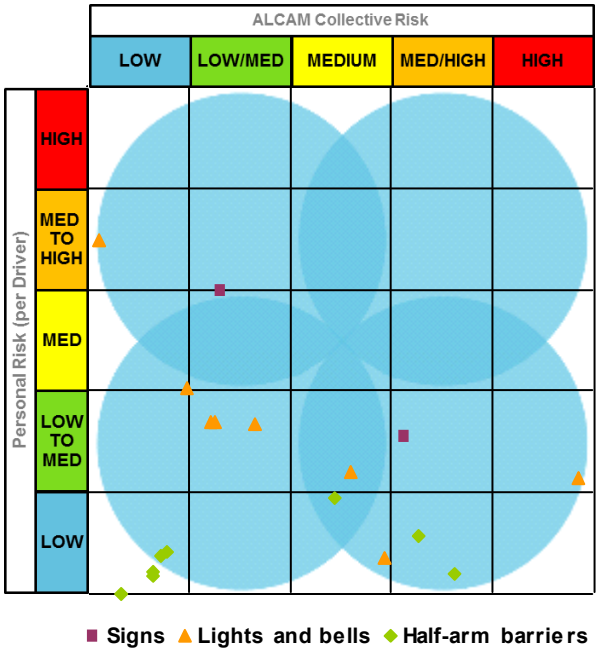
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	4	8	8
• percentage	20%	40%	40%
• in urban areas	1	5	3
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	4	4
• with a hump or dip	0	0	0
Vehicles per day (mean)	3,248	2,261	5,843
Vehicles per day (maximum)	11,559	5,411	11,559

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 1	1 - 10	1 - 10
Total trains per day	1 - 1	1 - 10	1 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	20	1268	2%
Collisions per 10 years	2.8	147	2%
Fatalities per 10 years	0.5	44	1%



Key collision factors	Authority	NZ
Visibility of trains	12%	23%
Queuing or stacking	36%	15%
Train operations	15%	13%
Vehicle operations	17%	12%
Condition of warning devices	12%	12%
Condition of crossing	0%	14%
Other	7%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	20%	20%	15%	10%	35%
Exposure	15%	15%	10%	35%	25%
Consequence	55%	25%	0%	20%	0%
Total ALCAM risk score	**35%**	**25%**	**20%**	**15%**	**5%**

Comments

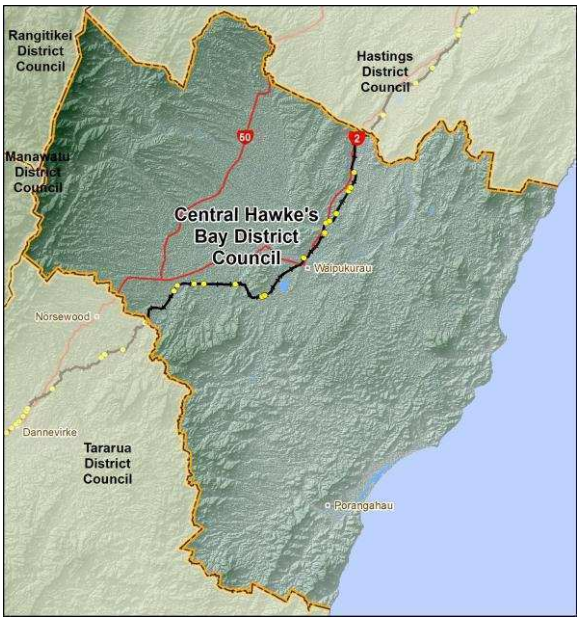
This summary includes data for the PNGL north of Napier. It should be noted that this section of the line was officially mothballed in October 2012 and there are no trains currently using it. The train volumes for this section of the PNGL were obtained prior to this date.

Roading Authority - Central Hawke's Bay District Council

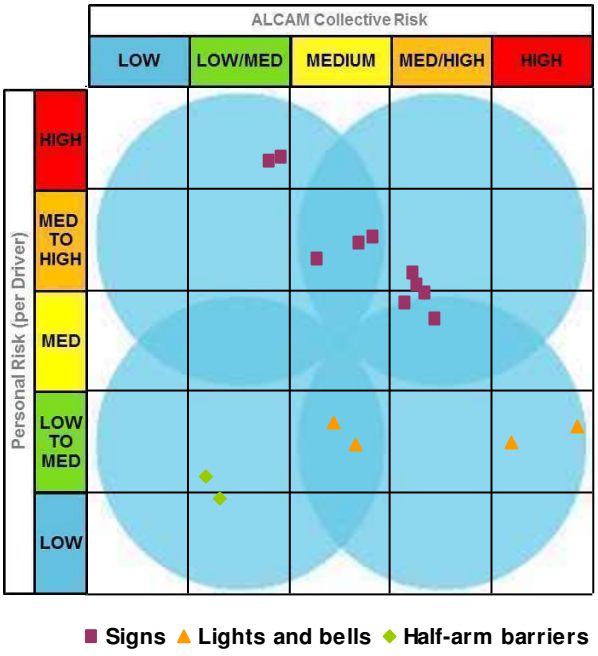
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	10	4	2
• percentage	63%	25%	13%
• in urban areas	0	2	0
• with unsealed road surface	0	0	0
• with stacking distance < 25m	3	1	0
• with a hump or dip	1	1	0
Vehicles per day (mean)	112	1,178	653
Vehicles per day (maximum)	208	2,171	793

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	4 - 4	4 - 4	4 - 4
Total trains per day	4 - 4	4 - 4	4 - 4



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	16	1268	1%
Collisions per 10 years	1.5	147	1%
Fatalities per 10 years	0.6	44	1%



Key collision factors	Authority	NZ
Visibility of trains	28%	23%
Queuing or stacking	16%	15%
Train operations	17%	13%
Vehicle operations	11%	12%
Condition of warning devices	11%	12%
Condition of crossing	6%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	13%	19%	19%	38%	13%
Exposure	25%	19%	44%	13%	0%
Consequence	0%	0%	0%	94%	6%
Total ALCAM risk score	**0%**	**25%**	**31%**	**31%**	**13%**

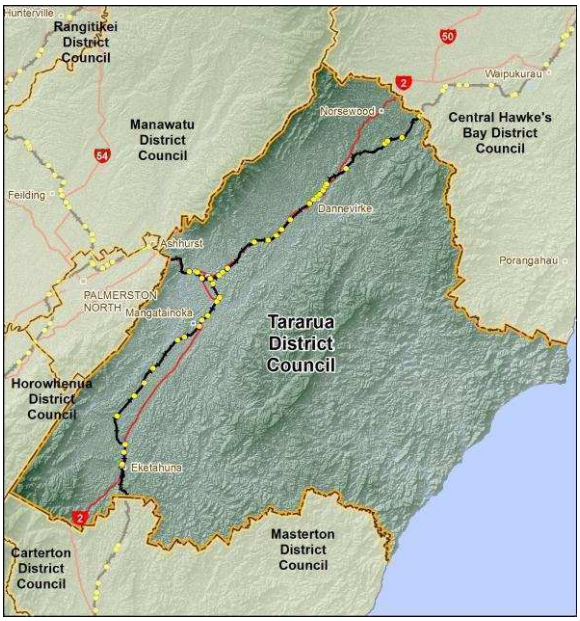
Comments

Roading Authority - Tararua District Council

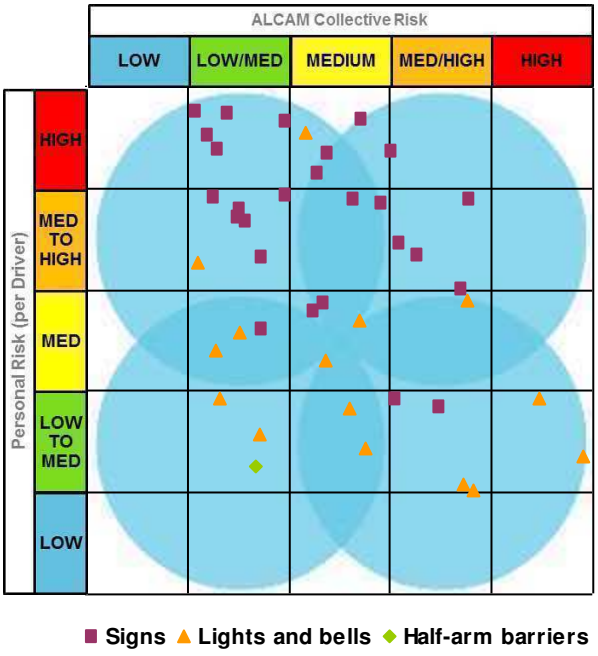
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	26	15	1
• percentage	62%	36%	2%
• in urban areas	1	6	1
• with unsealed road surface	6	0	0
• with stacking distance < 25m	3	3	1
• with a hump or dip	10	1	0
Vehicles per day (mean)	103	720	675
Vehicles per day (maximum)	640	3,463	675

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	2 - 9	2 - 8	4 - 4
Total trains per day	2 - 9	2 - 8	4 - 4



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	42	1268	3%
Collisions per 10 years	3.5	147	2%
Fatalities per 10 years	1.3	44	3%



Key collision factors	Authority	NZ
Visibility of trains	25%	23%
Queuing or stacking	10%	15%
Train operations	19%	13%
Vehicle operations	10%	12%
Condition of warning devices	13%	12%
Condition of crossing	12%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	21%	14%	33%	10%	21%
Exposure	38%	29%	17%	14%	2%
Consequence	0%	43%	0%	57%	0%
Total ALCAM risk score	**0%**	**43%**	**29%**	**24%**	**5%**

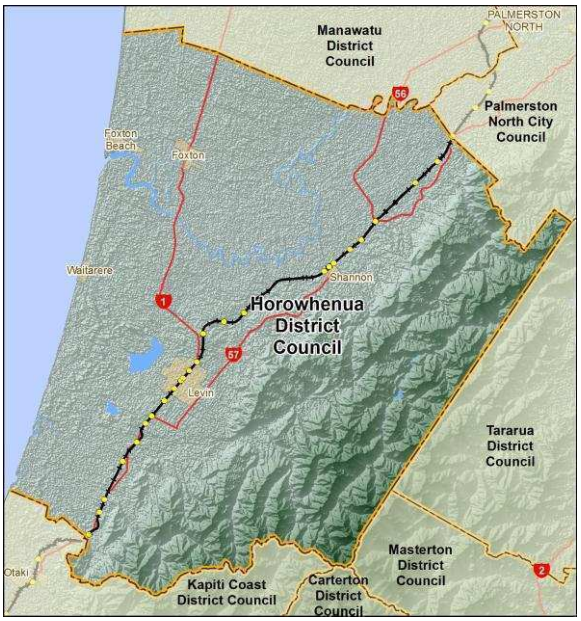
Comments

Roading Authority - Horowhenua District Council

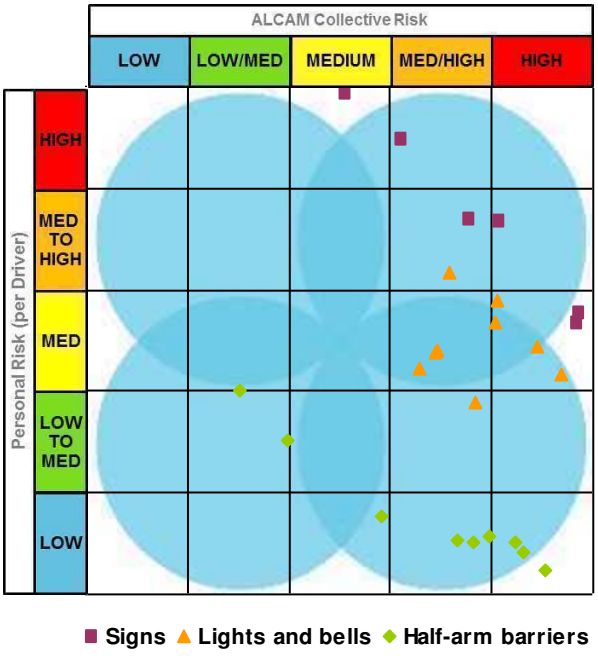
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	6	9	9
• percentage	25%	38%	38%
• in urban areas	0	2	5
• with unsealed road surface	1	0	0
• with stacking distance < 25m	5	5	4
• with a hump or dip	1	0	0
Vehicles per day (mean)	249	402	4,308
Vehicles per day (maximum)	635	829	10,810

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	4 - 4	4 - 4	4 - 4
Freight trains per day	15 - 15	15 - 15	15 - 15
Total trains per day	19 - 19	19 - 19	19 - 19



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	24	1268	2%
Collisions per 10 years	3.3	147	2%
Fatalities per 10 years	1.2	44	3%



Key collision factors	Authority	NZ
Visibility of trains	18%	23%
Queuing or stacking	26%	15%
Train operations	6%	13%
Vehicle operations	17%	12%
Condition of warning devices	19%	12%
Condition of crossing	4%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	13%	21%	17%	25%	25%
Exposure	8%	4%	13%	50%	25%
Consequence	0%	0%	96%	4%	0%
Total ALCAM risk score	**0%**	**8%**	**8%**	**42%**	**42%**

Comments

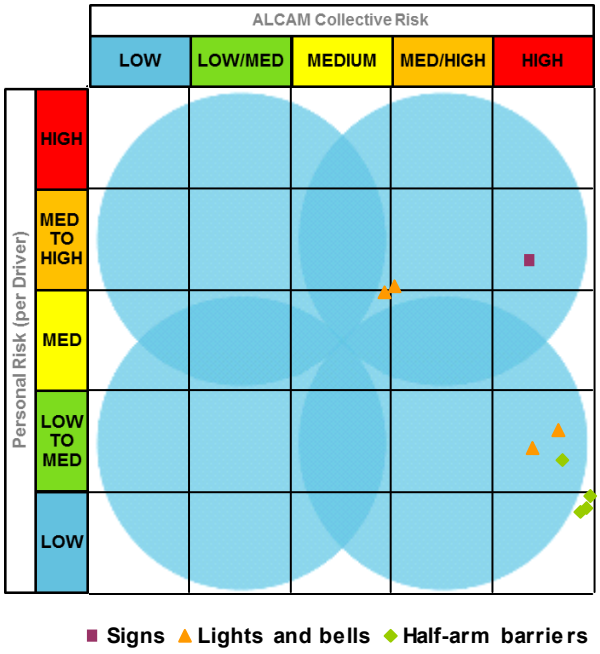
Roading Authority - Kapiti Coast District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	1	4	4
• percentage	11%	44%	44%
• in urban areas	0	0	3
• with unsealed road surface	0	0	0
• with stacking distance < 25m	1	3	2
• with a hump or dip	0	0	1
Vehicles per day (mean)	200	875	6,125
Vehicles per day (maximum)	200	1,600	8,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	4 - 4	4 - 4	79 - 79
Freight trains per day	15 - 15	9 - 9	9 - 9
Total trains per day	19 - 19	13 - 13	88 - 88

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	9	1268	1%
Collisions per 10 years	2.0	147	1%
Fatalities per 10 years	0.8	44	2%



Key collision factors	Authority	NZ
Visibility of trains	14%	23%
Queuing or stacking	36%	15%
Train operations	7%	13%
Vehicle operations	18%	12%
Condition of warning devices	9%	12%
Condition of crossing	7%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	11%	11%	33%	22%	22%
Exposure	0%	0%	22%	0%	78%
Consequence	0%	0%	78%	11%	11%
Total ALCAM risk score	**0%**	**0%**	**11%**	**11%**	**78%**

Comments

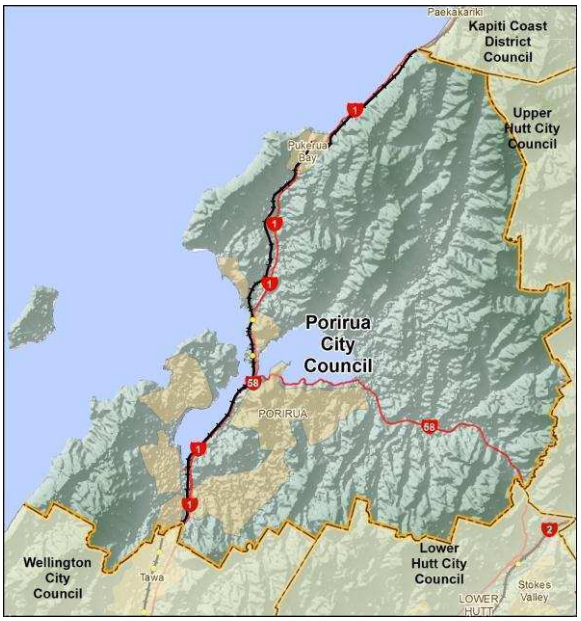
ALCAM surveys were carried out prior to the double-tracking and electrification on a 13 km section of the NIMT (MacKays Crossing to Waikanae). Some level crossings were upgraded as part of this work and the summary does not include all these changes.

Roading Authority - Porirua City Council

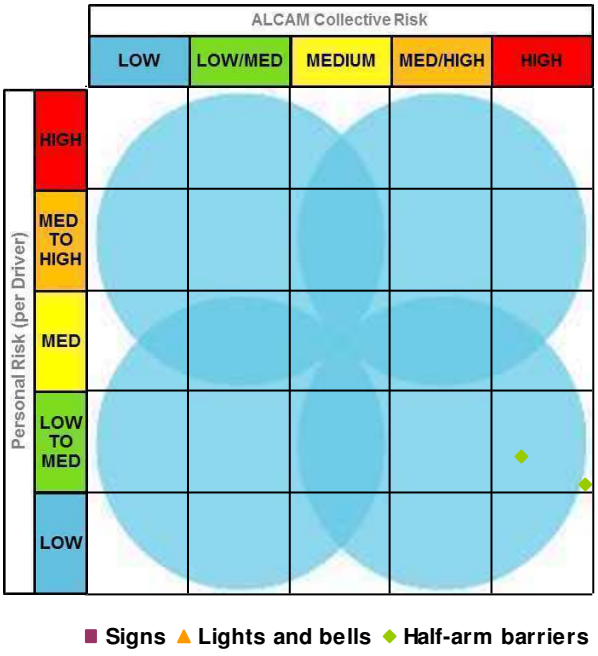
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	0	2
• percentage	0%	0%	100%
• in urban areas	0	0	2
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	0
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	0	3,523
Vehicles per day (maximum)	0	0	5,426

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0	88 - 88
Freight trains per day	0	0	9 - 9
Total trains per day	0	0	97 - 97



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	2	1268	0%
Collisions per 10 years	0.5	147	0%
Fatalities per 10 years	0.2	44	0%



Key collision factors	Authority	NZ
Visibility of trains	6%	23%
Queuing or stacking	36%	15%
Train operations	4%	13%
Vehicle operations	19%	12%
Condition of warning devices	26%	12%
Condition of crossing	0%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	0%	50%	0%	0%	50%
Exposure	0%	0%	0%	0%	100%
Consequence	0%	0%	0%	100%	0%
Total ALCAM risk score	**0%**	**0%**	**0%**	**0%**	**100%**

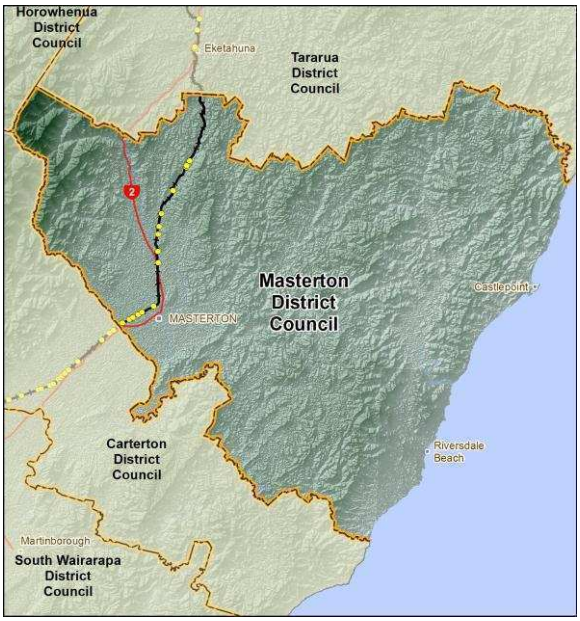
Comments

Roading Authority - Masterton District Council

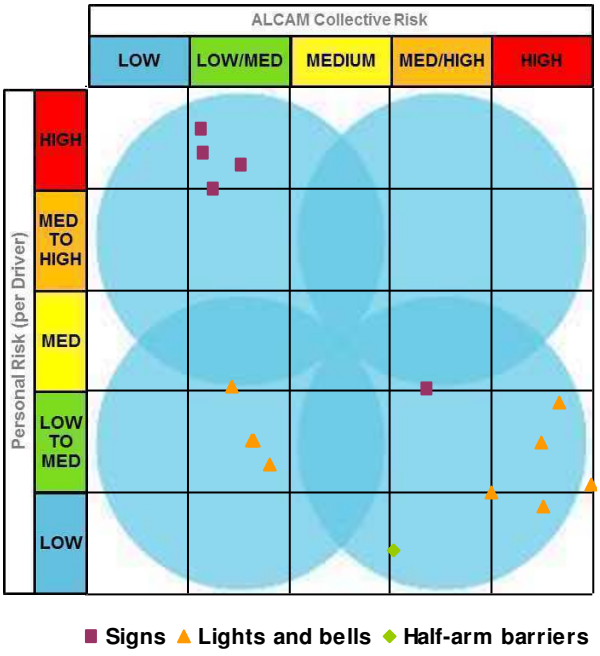
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	5	9	1
• percentage	33%	60%	7%
• in urban areas	0	2	0
• with unsealed road surface	1	0	0
• with stacking distance < 25m	0	1	0
• with a hump or dip	1	1	0
Vehicles per day (mean)	119	1,811	4,000
Vehicles per day (maximum)	500	5,300	4,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 8	8 - 8
Freight trains per day	2 - 2	2 - 2	2 - 2
Total trains per day	2 - 2	2 - 10	10 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	15	1268	1%
Collisions per 10 years	1.7	147	1%
Fatalities per 10 years	0.7	44	2%



Key collision factors	Authority	NZ
Visibility of trains	24%	23%
Queuing or stacking	9%	15%
Train operations	18%	13%
Vehicle operations	13%	12%
Condition of warning devices	14%	12%
Condition of crossing	10%	14%
Other	13%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	40%	13%	27%	0%	20%
Exposure	27%	20%	13%	7%	33%
Consequence	0%	60%	27%	0%	13%
Total ALCAM risk score	**0%**	**53%**	**0%**	**20%**	**27%**

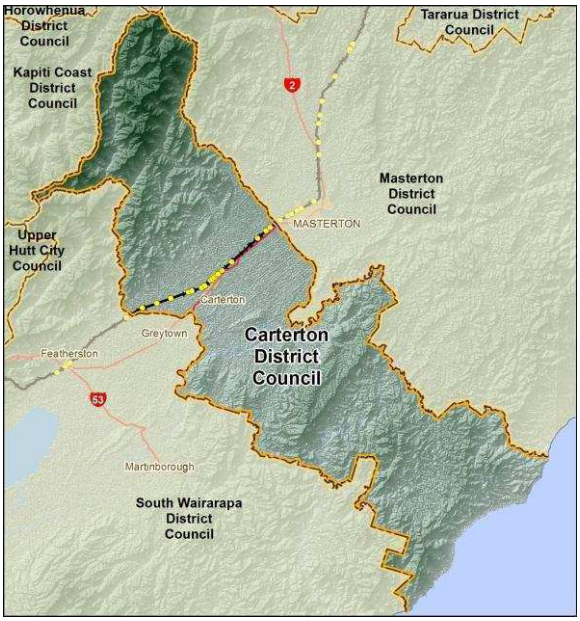
Comments

Roading Authority - Carterton District Council

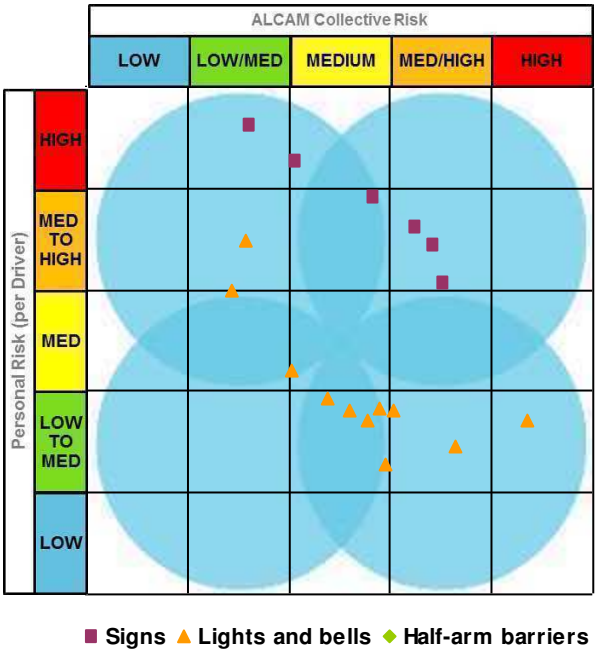
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	6	11	0
• percentage	35%	65%	0%
• in urban areas	0	5	0
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	0
• with a hump or dip	0	0	0
Vehicles per day (mean)	81	550	0
Vehicles per day (maximum)	170	1,100	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	8 - 8	8 - 8	0
Freight trains per day	2 - 2	2 - 2	0
Total trains per day	10 - 10	10 - 10	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	17	1268	1%
Collisions per 10 years	1.5	147	1%
Fatalities per 10 years	0.5	44	1%



Key collision factors	Authority	NZ
Visibility of trains	27%	23%
Queuing or stacking	4%	15%
Train operations	17%	13%
Vehicle operations	23%	12%
Condition of warning devices	14%	12%
Condition of crossing	0%	14%
Other	14%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	71%	12%	18%	0%	0%
Exposure	0%	24%	18%	53%	6%
Consequence	0%	0%	94%	0%	6%
Total ALCAM risk score	**0%**	**18%**	**47%**	**29%**	**6%**

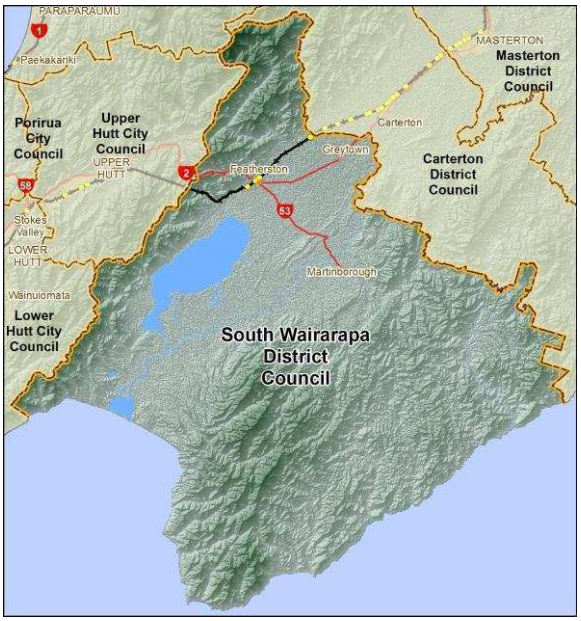
Comments

Roading Authority - South Wairarapa District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

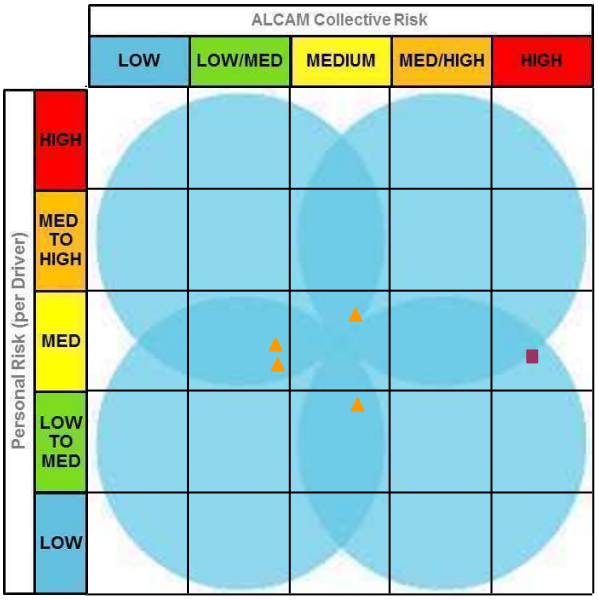
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	1	4	0
• percentage	20%	80%	0%
• in urban areas	0	3	0
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	0
• with a hump or dip	0	0	0
Vehicles per day (mean)	527	259	0
Vehicles per day (maximum)	527	478	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	8 - 8	8 - 8	0
Freight trains per day	2 - 2	2 - 2	0
Total trains per day	10 - 10	10 - 10	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	5	1268	0%
Collisions per 10 years	0.5	147	0%
Fatalities per 10 years	0.2	44	0%

Key collision factors	Authority	NZ
Visibility of trains	22%	23%
Queuing or stacking	6%	15%
Train operations	16%	13%
Vehicle operations	23%	12%
Condition of warning devices	19%	12%
Condition of crossing	0%	14%
Other	15%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	100%	0%	0%	0%	0%
Exposure	0%	20%	40%	20%	20%
Consequence	0%	0%	80%	0%	20%
Total ALCAM risk score	**0%**	**40%**	**40%**	**0%**	**20%**

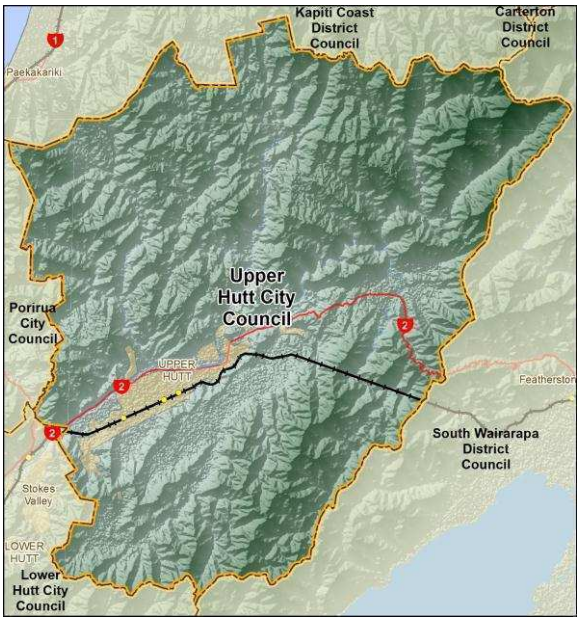
Comments

Roading Authority - Upper Hutt City Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

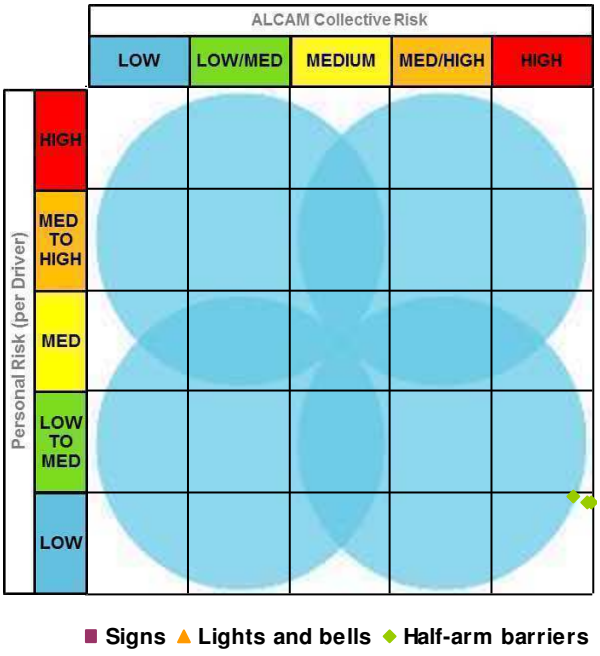
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	0	3
• percentage	0%	0%	100%
• in urban areas	0	0	3
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	1
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	0	6,340
Vehicles per day (maximum)	0	0	7,478

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0	104 - 104
Freight trains per day	0	0	2 - 2
Total trains per day	0	0	106 - 106



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	3	1268	0%
Collisions per 10 years	1.0	147	1%
Fatalities per 10 years	0.4	44	1%

Key collision factors	Authority	NZ
Visibility of trains	4%	23%
Queuing or stacking	46%	15%
Train operations	4%	13%
Vehicle operations	24%	12%
Condition of warning devices	15%	12%
Condition of crossing	0%	14%
Other	8%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	0%	33%	67%	0%	0%
Exposure	0%	0%	0%	0%	100%
Consequence	0%	0%	0%	67%	33%
Total ALCAM risk score	**0%**	**0%**	**0%**	**0%**	**100%**

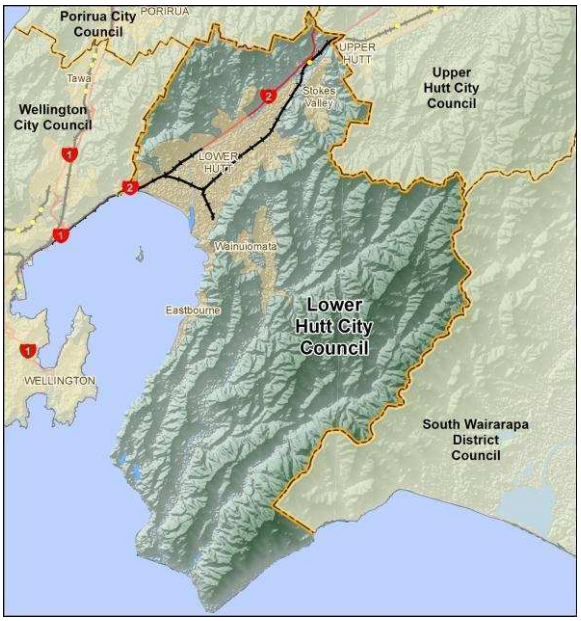
Comments

Roading Authority - Lower Hutt City Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

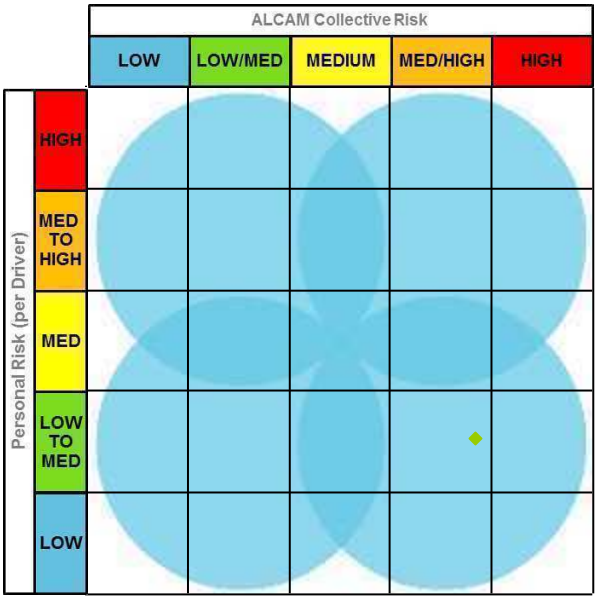
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	0	1
• percentage	0%	0%	100%
• in urban areas	0	0	0
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	0
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	0	1,000
Vehicles per day (maximum)	0	0	1,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0	104 - 104
Freight trains per day	0	0	2 - 2
Total trains per day	0	0	106 - 106



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	1	1268	0%
Collisions per 10 years	0.1	147	0%
Fatalities per 10 years	0.0	44	0%

Key collision factors	Authority	NZ
Visibility of trains	13%	23%
Queuing or stacking	1%	15%
Train operations	12%	13%
Vehicle operations	42%	12%
Condition of warning devices	20%	12%
Condition of crossing	0%	14%
Other	12%	11%



■ Signs ▲ Lights and bells ◆ Half-arm barriers

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	0%	100%	0%	0%	0%
Exposure	0%	0%	0%	100%	0%
Consequence	0%	0%	0%	100%	0%
Total ALCAM risk score	**0%**	**0%**	**0%**	**100%**	**0%**

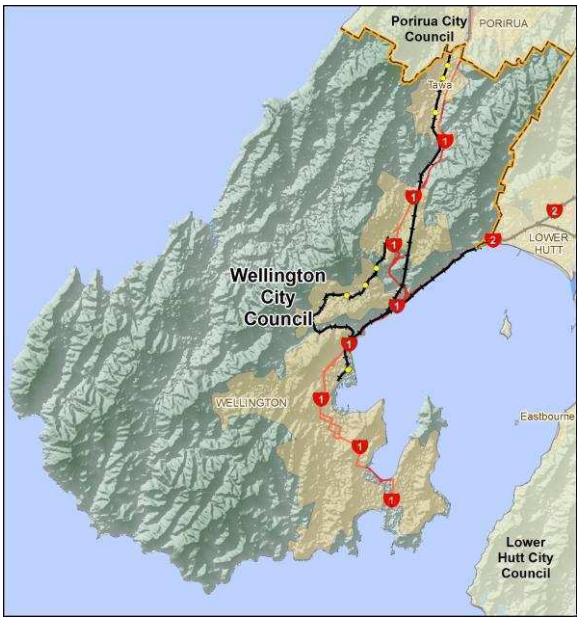
Comments

Roading Authority - Wellington City Council

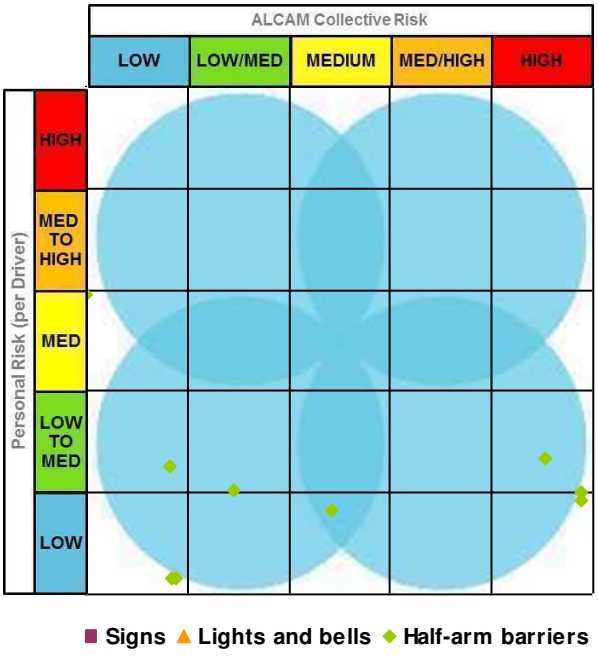
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	0	9
• percentage	0%	0%	100%
• in urban areas	0	0	7
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	0	2
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	0	4,924
Vehicles per day (maximum)	0	0	10,014

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0	0 - 75
Freight trains per day	0	0	0 - 10
Total trains per day	0	0	10 - 111



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	9	1268	1%
Collisions per 10 years	1.8	147	1%
Fatalities per 10 years	0.4	44	1%



Key collision factors	Authority	NZ
Visibility of trains	6%	23%
Queuing or stacking	21%	15%
Train operations	7%	13%
Vehicle operations	25%	12%
Condition of warning devices	26%	12%
Condition of crossing	0%	14%
Other	14%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	0%	67%	22%	11%	0%
Exposure	11%	0%	0%	33%	56%
Consequence	44%	22%	0%	22%	11%
Total ALCAM risk score	**44%**	**11%**	**11%**	**0%**	**33%**

Comments

Road Controlling Authority Management Areas

- South Island

- Marlborough District Council
- Kaikoura District Council *
- Hurunui District Council
- Waimakariri District Council
- Christchurch City Council
- Westland District Council *
- Grey District Council
- Buller District Council
- Selwyn District Council
- Ashburton District Council
- Timaru District Council
- Waimate District Council
- Waitaki District Council
- Dunedin City Council
- Clutha District Council
- Gore District Council *
- Southland District Council
- Invercargill City Council

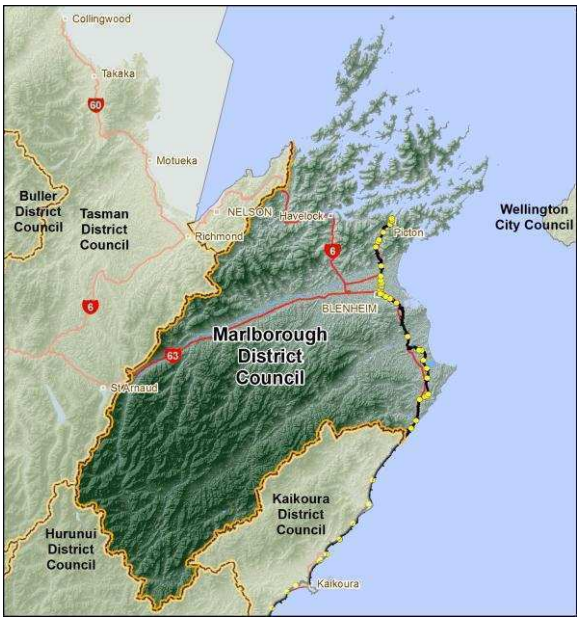
* Contains fewer than 20 level crossings, meaning that some of the risk data may be statistically insignificant.

Roading Authority - Marlborough District Council

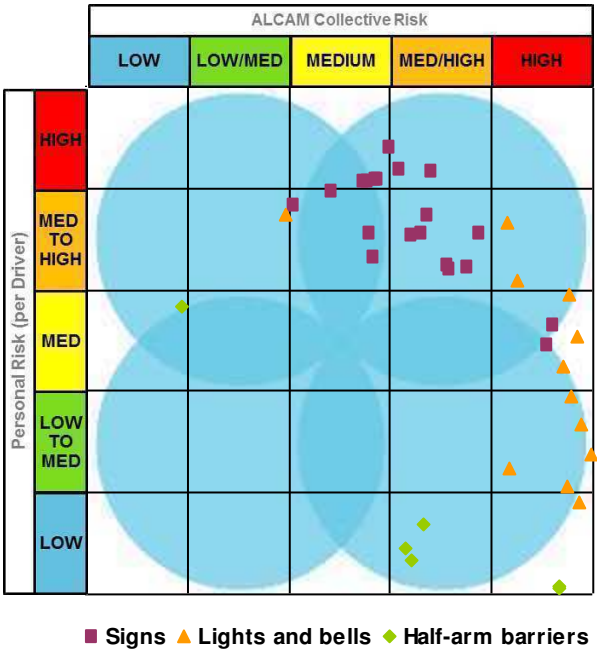
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	20	12	6
• percentage	53%	32%	16%
• in urban areas	1	5	5
• with unsealed road surface	3	0	0
• with stacking distance < 25m	4	7	2
• with a hump or dip	7	3	0
Vehicles per day (mean)	119	1,863	8,526
Vehicles per day (maximum)	510	5,400	20,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 2	2 - 2
Freight trains per day	7 - 8	7 - 8	7 - 8
Total trains per day	9 - 10	9 - 10	9 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	38	1268	3%
Collisions per 10 years	5.8	147	4%
Fatalities per 10 years	2.1	44	5%



Key collision factors	Authority	NZ
Visibility of trains	25%	23%
Queuing or stacking	22%	15%
Train operations	10%	13%
Vehicle operations	10%	12%
Condition of warning devices	11%	12%
Condition of crossing	12%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	8%	8%	24%	24%	37%
Exposure	5%	29%	21%	18%	26%
Consequence	0%	0%	87%	8%	5%
Total ALCAM risk score	**3%**	**3%**	**24%**	**32%**	**39%**

Comments

Roading Authority - Kaikoura District Council

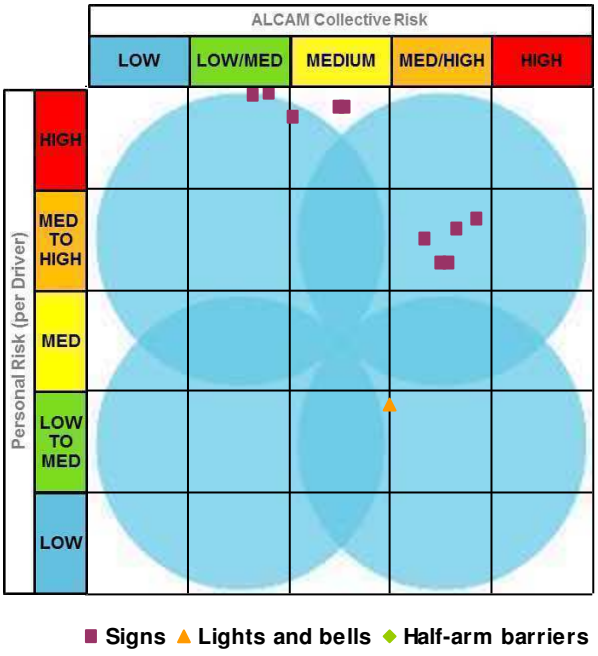
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	10	1	0
• percentage	91%	9%	0%
• in urban areas	0	0	0
• with unsealed road surface	7	1	0
• with stacking distance < 25m	5	0	0
• with a hump or dip	6	0	0
Vehicles per day (mean)	65	515	0
Vehicles per day (maximum)	135	515	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 2	0
Freight trains per day	7 - 7	7 - 7	0
Total trains per day	9 - 9	9 - 9	0

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	11	1268	1%
Collisions per 10 years	1.0	147	1%
Fatalities per 10 years	0.4	44	1%

Key collision factors	Authority	NZ
Visibility of trains	31%	23%
Queuing or stacking	14%	15%
Train operations	10%	13%
Vehicle operations	7%	12%
Condition of warning devices	8%	12%
Condition of crossing	20%	14%
Other	10%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	9%	0%	27%	18%	45%
Exposure	45%	0%	27%	27%	0%
Consequence	0%	0%	100%	0%	0%
Total ALCAM risk score	**0%**	**18%**	**36%**	**45%**	**0%**

Comments

Roading Authority - Hurunui District Council

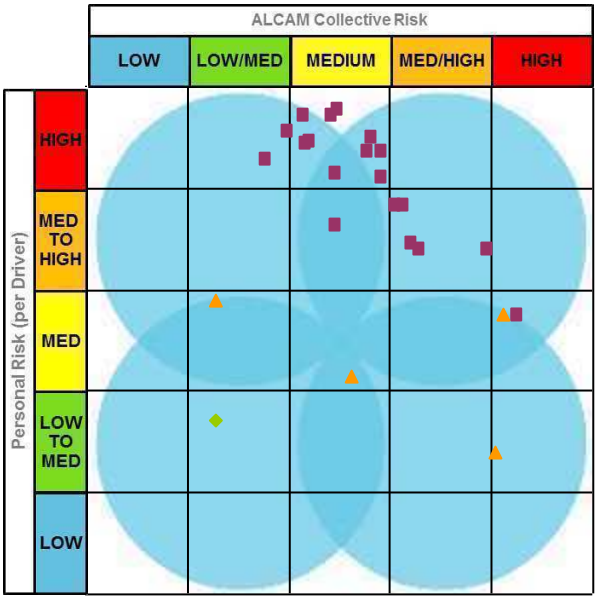
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	19	4	1
• percentage	79%	17%	4%
• in urban areas	0	1	0
• with unsealed road surface	8	0	0
• with stacking distance < 25m	7	1	0
• with a hump or dip	6	0	0
Vehicles per day (mean)	65	509	294
Vehicles per day (maximum)	300	1,359	294

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 2	2 - 2
Freight trains per day	7 - 7	7 - 7	7 - 7
Total trains per day	9 - 9	9 - 9	9 - 9

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	24	1268	2%
Collisions per 10 years	2.1	147	1%
Fatalities per 10 years	0.8	44	2%

Key collision factors	Authority	NZ
Visibility of trains	28%	23%
Queuing or stacking	16%	15%
Train operations	11%	13%
Vehicle operations	9%	12%
Condition of warning devices	10%	12%
Condition of crossing	13%	14%
Other	12%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	21%	4%	29%	29%	17%
Exposure	17%	42%	29%	4%	8%
Consequence	0%	0%	83%	4%	13%
Total ALCAM risk score	**0%**	**17%**	**50%**	**21%**	**13%**

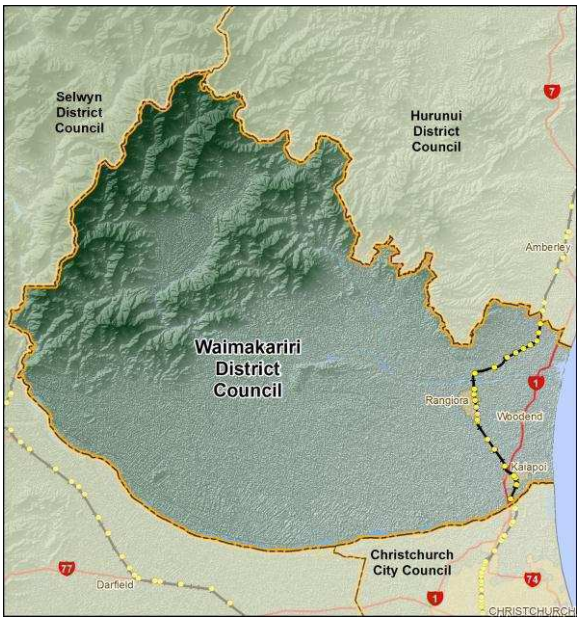
Comments

Roading Authority - Waimakariri District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

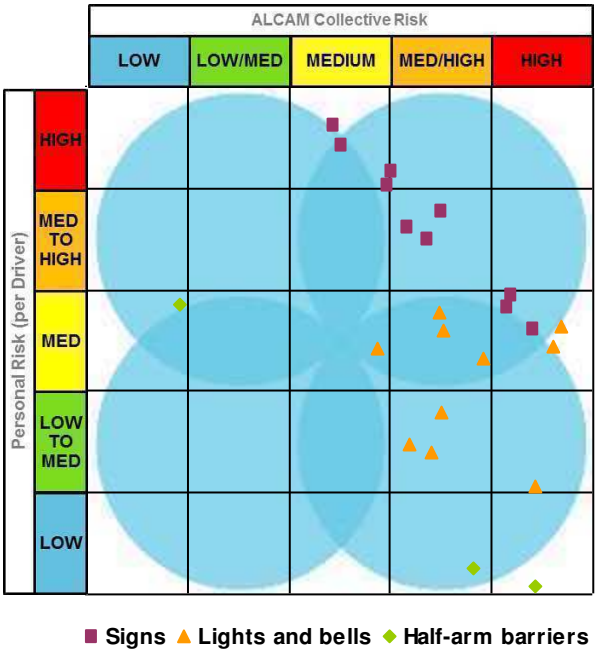
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	11	10	3
• percentage	46%	42%	13%
• in urban areas	1	4	3
• with unsealed road surface	3	0	0
• with stacking distance < 25m	7	4	0
• with a hump or dip	5	1	0
Vehicles per day (mean)	124	732	7,242
Vehicles per day (maximum)	380	2,525	15,116

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 2	2 - 2
Freight trains per day	7 - 9	7 - 9	9 - 9
Total trains per day	9 - 11	9 - 11	11 - 11



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	24	1268	2%
Collisions per 10 years	2.8	147	2%
Fatalities per 10 years	1.0	44	2%

Key collision factors	Authority	NZ
Visibility of trains	23%	23%
Queuing or stacking	23%	15%
Train operations	9%	13%
Vehicle operations	12%	12%
Condition of warning devices	11%	12%
Condition of crossing	14%	14%
Other	9%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	17%	21%	13%	29%	21%
Exposure	4%	8%	38%	29%	21%
Consequence	0%	0%	92%	8%	0%
Total ALCAM risk score	**4%**	**0%**	**17%**	**50%**	**29%**

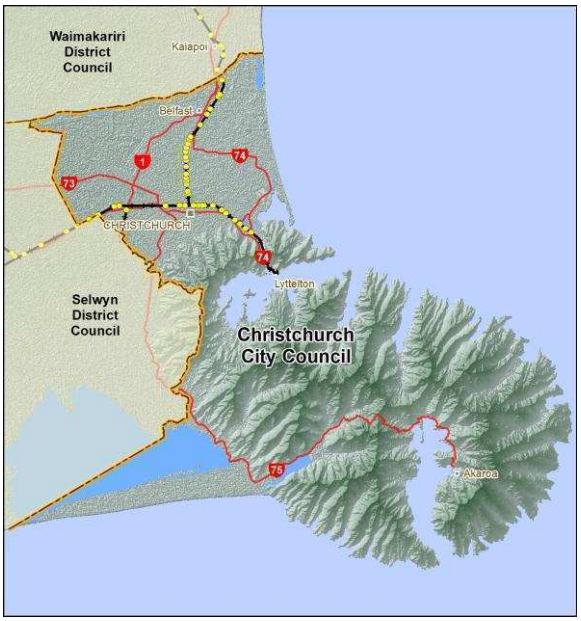
Comments

Roading Authority - Christchurch City Council

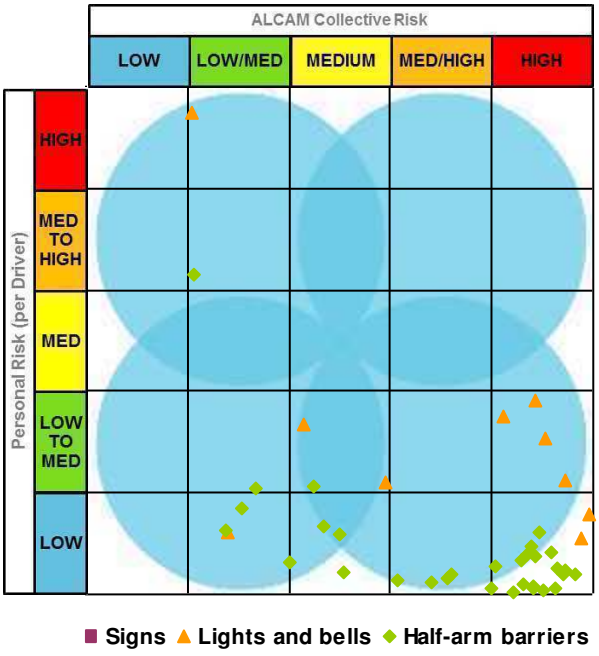
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	10	31
• percentage	0%	24%	76%
• in urban areas	0	5	26
• with unsealed road surface	0	1	3
• with stacking distance < 25m	0	0	1
• with a hump or dip	0	2	1
Vehicles per day (mean)	0	4,951	10,331
Vehicles per day (maximum)	0	16,200	24,100

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0 - 2	0 - 2
Freight trains per day	0	8 - 10	9 - 21
Total trains per day	0	8 - 11	10 - 23



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	41	1268	3%
Collisions per 10 years	7.4	147	5%
Fatalities per 10 years	2.1	44	5%



Key collision factors	Authority	NZ
Visibility of trains	6%	23%
Queuing or stacking	20%	15%
Train operations	7%	13%
Vehicle operations	23%	12%
Condition of warning devices	23%	12%
Condition of crossing	11%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	12%	37%	27%	10%	15%
Exposure	7%	7%	5%	12%	68%
Consequence	2%	51%	27%	20%	0%
Total ALCAM risk score	**0%**	**17%**	**15%**	**12%**	**56%**

Comments

Roading Authority - Westland District Council

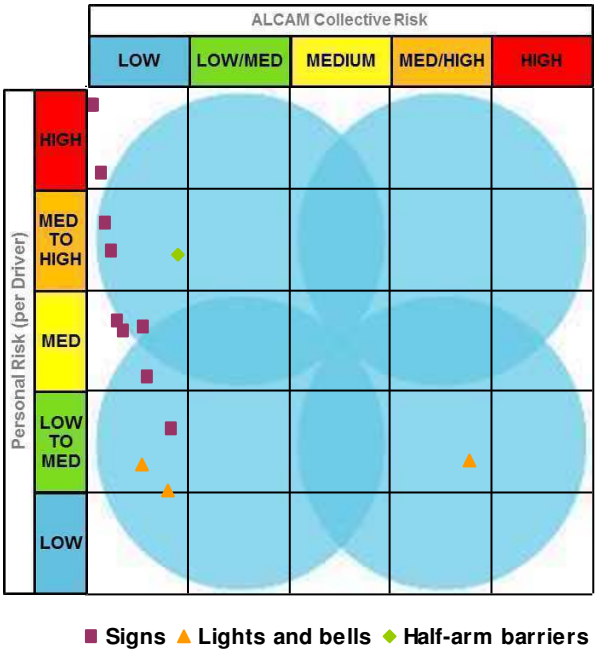
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	10	3	1
• percentage	71%	21%	7%
• in urban areas	2	2	0
• with unsealed road surface	2	0	0
• with stacking distance < 25m	5	0	0
• with a hump or dip	2	0	0
Vehicles per day (mean)	216	1,463	30
Vehicles per day (maximum)	1,050	1,983	30

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 2	2 - 2
Freight trains per day	2 - 2	2 - 13	13 - 13
Total trains per day	2 - 2	2 - 15	15 - 15

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	14	1268	1%
Collisions per 10 years	1.1	147	1%
Fatalities per 10 years	0.1	44	0%

Key collision factors	Authority	NZ
Visibility of trains	24%	23%
Queuing or stacking	15%	15%
Train operations	21%	13%
Vehicle operations	10%	12%
Condition of warning devices	12%	12%
Condition of crossing	8%	14%
Other	10%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	7%	29%	29%	29%	7%
Exposure	43%	14%	21%	14%	7%
Consequence	86%	0%	0%	14%	0%
Total ALCAM risk score	**93%**	**0%**	**0%**	**7%**	**0%**

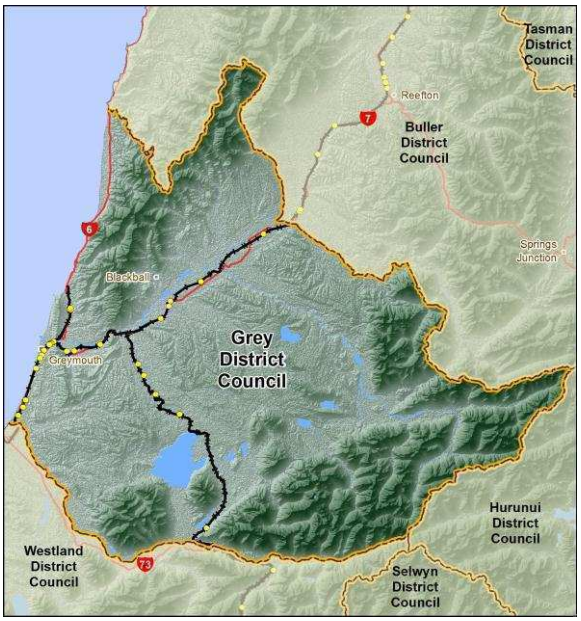
Comments

Roading Authority - Grey District Council

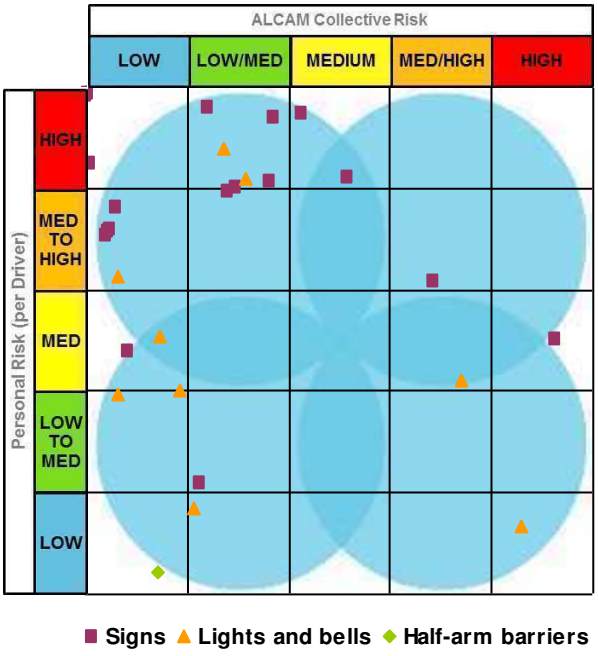
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	18	9	1
• percentage	64%	32%	4%
• in urban areas	4	5	1
• with unsealed road surface	2	0	0
• with stacking distance < 25m	2	5	1
• with a hump or dip	5	1	0
Vehicles per day (mean)	241	1,413	6,821
Vehicles per day (maximum)	2,925	6,454	6,821

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	2 - 2
Freight trains per day	2 - 13	2 - 13	5 - 5
Total trains per day	2 - 15	2 - 15	7 - 7



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	28	1268	2%
Collisions per 10 years	2.8	147	2%
Fatalities per 10 years	0.5	44	1%



Key collision factors	Authority	NZ
Visibility of trains	23%	23%
Queuing or stacking	12%	15%
Train operations	15%	13%
Vehicle operations	12%	12%
Condition of warning devices	15%	12%
Condition of crossing	13%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	21%	29%	11%	11%	29%
Exposure	25%	36%	11%	14%	14%
Consequence	54%	43%	0%	4%	0%
Total ALCAM risk score	**46%**	**32%**	**7%**	**7%**	**7%**

Comments

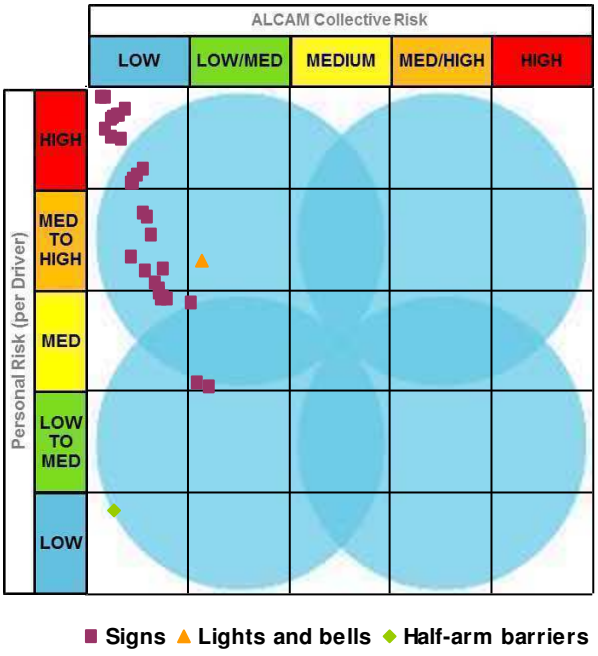
Roading Authority - Buller District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	30	1	1
• percentage	94%	3%	3%
• in urban areas	3	0	1
• with unsealed road surface	14	0	0
• with stacking distance < 25m	6	1	0
• with a hump or dip	16	1	0
Vehicles per day (mean)	145	250	1,500
Vehicles per day (maximum)	1,000	250	1,500

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	7 - 10	7 - 7	10 - 10
Total trains per day	7 - 10	7 - 7	10 - 10

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	32	1268	3%
Collisions per 10 years	3.3	147	2%
Fatalities per 10 years	0.2	44	0%



Key collision factors	Authority	NZ
Visibility of trains	27%	23%
Queuing or stacking	10%	15%
Train operations	8%	13%
Vehicle operations	8%	12%
Condition of warning devices	13%	12%
Condition of crossing	21%	14%
Other	13%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	0%	22%	19%	38%	22%
Exposure	28%	22%	19%	22%	9%
Consequence	94%	6%	0%	0%	0%
Total ALCAM risk score	**88%**	**13%**	**0%**	**0%**	**0%**

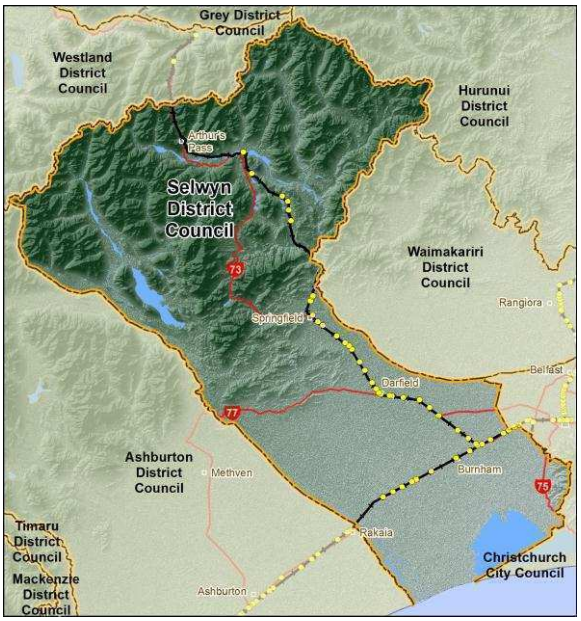
Comments

Roading Authority - Selwyn District Council

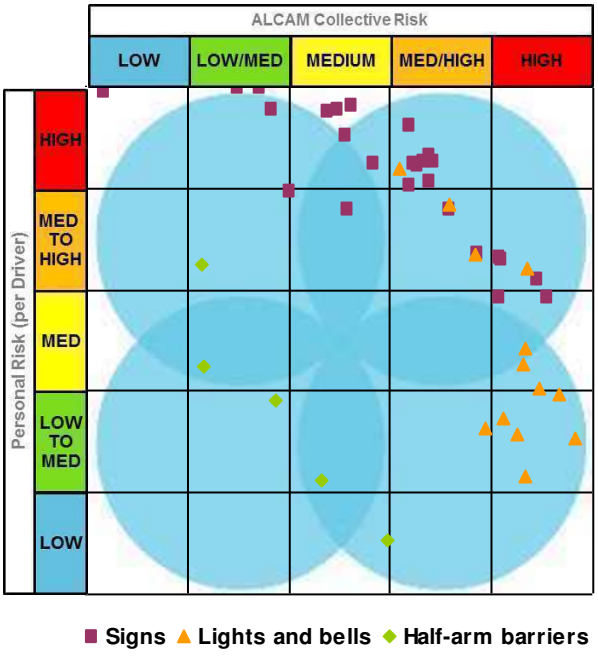
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	26	13	5
• percentage	59%	30%	11%
• in urban areas	0	1	0
• with unsealed road surface	11	1	0
• with stacking distance < 25m	7	6	3
• with a hump or dip	15	0	0
Vehicles per day (mean)	76	809	951
Vehicles per day (maximum)	308	2,182	3,175

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	2 - 2
Freight trains per day	9 - 13	9 - 13	7 - 21
Total trains per day	9 - 15	9 - 15	9 - 23



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	44	1268	3%
Collisions per 10 years	4.9	147	3%
Fatalities per 10 years	1.8	44	4%



Key collision factors	Authority	NZ
Visibility of trains	24%	23%
Queuing or stacking	19%	15%
Train operations	9%	13%
Vehicle operations	10%	12%
Condition of warning devices	12%	12%
Condition of crossing	17%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	9%	11%	23%	30%	27%
Exposure	14%	25%	25%	20%	16%
Consequence	2%	0%	2%	95%	0%
Total ALCAM risk score	**2%**	**14%**	**20%**	**32%**	**32%**

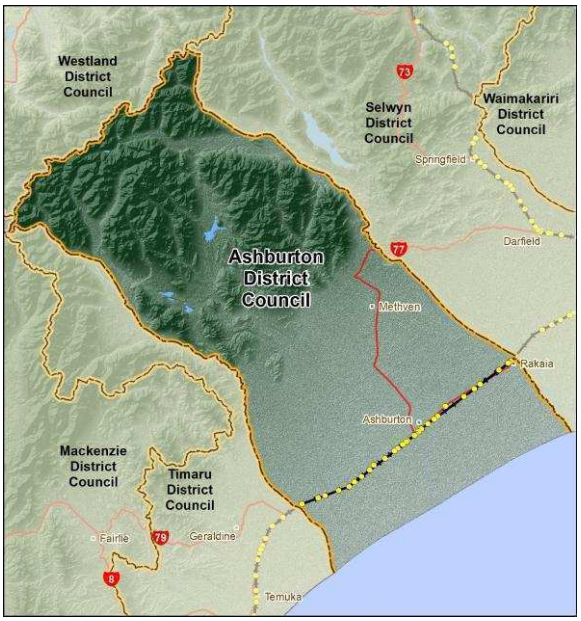
Comments

Roading Authority - Ashburton District Council

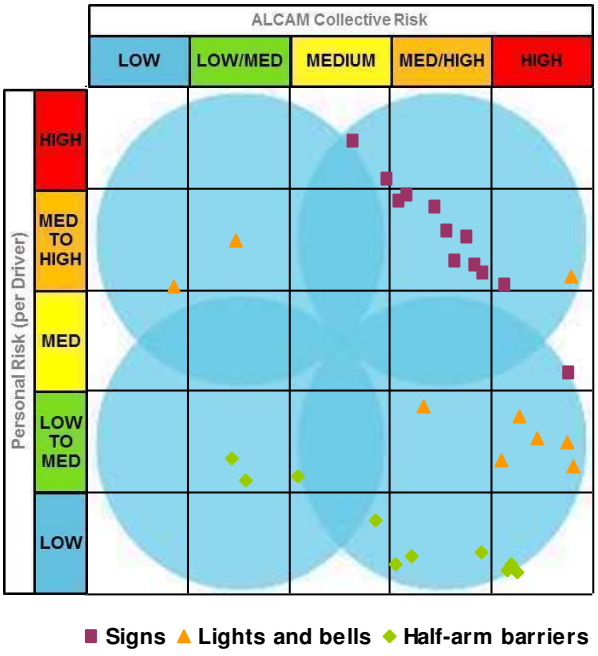
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	12	9	10
• percentage	39%	29%	32%
• in urban areas	0	2	6
• with unsealed road surface	8	0	0
• with stacking distance < 25m	2	3	5
• with a hump or dip	9	2	0
Vehicles per day (mean)	172	1,113	4,245
Vehicles per day (maximum)	921	3,015	9,082

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	9 - 9	9 - 9	6 - 9
Total trains per day	9 - 9	9 - 9	6 - 9



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	31	1268	2%
Collisions per 10 years	3.8	147	3%
Fatalities per 10 years	1.4	44	3%



Key collision factors	Authority	NZ
Visibility of trains	23%	23%
Queuing or stacking	18%	15%
Train operations	10%	13%
Vehicle operations	11%	12%
Condition of warning devices	11%	12%
Condition of crossing	19%	14%
Other	8%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	10%	6%	19%	45%	19%
Exposure	13%	10%	32%	29%	16%
Consequence	3%	0%	0%	94%	3%
Total ALCAM risk score	**3%**	**10%**	**13%**	**39%**	**35%**

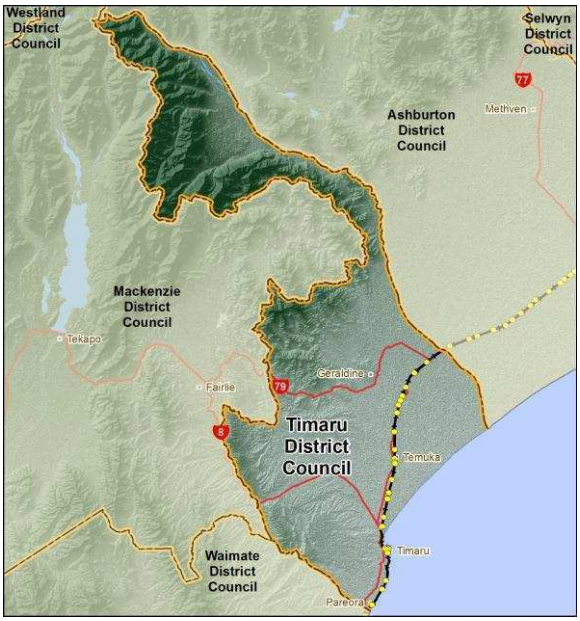
Comments

Roading Authority - Timaru District Council

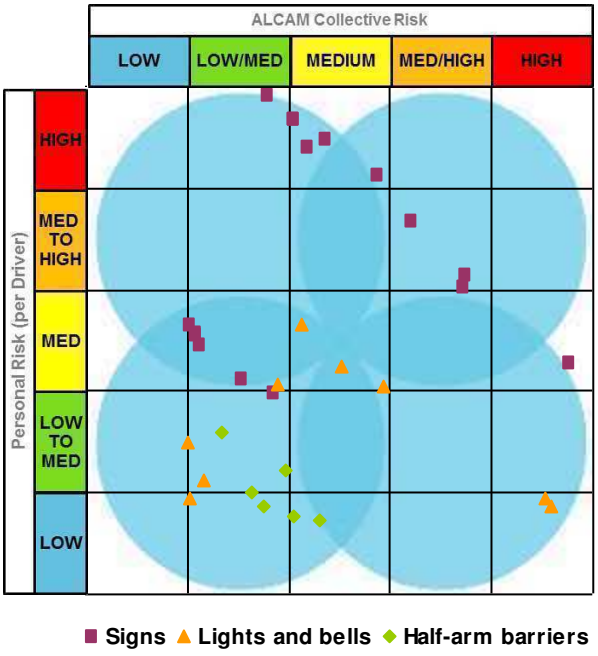
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	16	9	6
• percentage	52%	29%	19%
• in urban areas	2	3	1
• with unsealed road surface	0	0	0
• with stacking distance < 25m	4	0	0
• with a hump or dip	2	0	1
Vehicles per day (mean)	370	1,715	1,140
Vehicles per day (maximum)	1,550	3,752	1,900

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	9 - 10	9 - 10	9 - 10
Total trains per day	9 - 10	9 - 10	9 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	31	1268	2%
Collisions per 10 years	3.9	147	3%
Fatalities per 10 years	0.9	44	2%



Key collision factors	Authority	NZ
Visibility of trains	36%	23%
Queuing or stacking	7%	15%
Train operations	12%	13%
Vehicle operations	11%	12%
Condition of warning devices	11%	12%
Condition of crossing	6%	14%
Other	17%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	26%	19%	29%	26%	0%
Exposure	19%	19%	13%	10%	39%
Consequence	19%	10%	0%	71%	0%
Total ALCAM risk score	**0%**	**48%**	**32%**	**10%**	**10%**

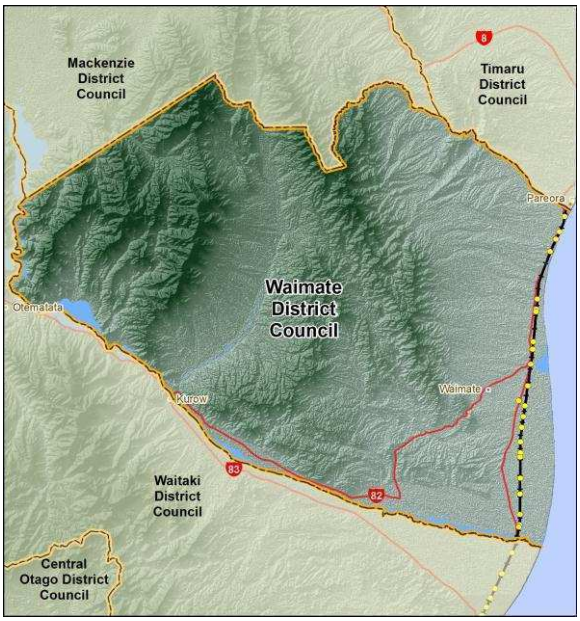
Comments

Roading Authority - Waimate District Council

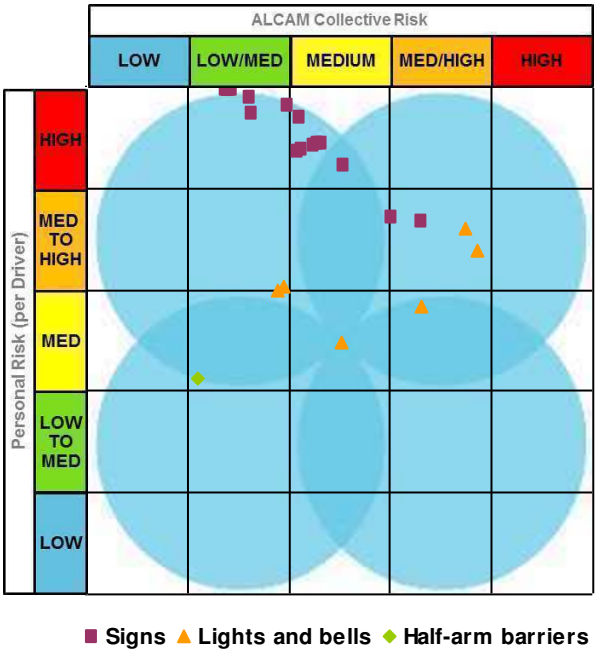
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	17	6	1
• percentage	71%	25%	4%
• in urban areas	0	0	0
• with unsealed road surface	7	0	0
• with stacking distance < 25m	1	2	0
• with a hump or dip	4	0	0
Vehicles per day (mean)	25	137	150
Vehicles per day (maximum)	80	210	150

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	10 - 10	10 - 10	10 - 10
Total trains per day	10 - 10	10 - 10	10 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	24	1268	2%
Collisions per 10 years	1.7	147	1%
Fatalities per 10 years	0.6	44	1%



Key collision factors	Authority	NZ
Visibility of trains	33%	23%
Queuing or stacking	8%	15%
Train operations	12%	13%
Vehicle operations	10%	12%
Condition of warning devices	12%	12%
Condition of crossing	12%	14%
Other	12%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	13%	25%	29%	25%	8%
Exposure	38%	46%	17%	0%	0%
Consequence	0%	0%	0%	100%	0%
Total ALCAM risk score	**0%**	**46%**	**33%**	**21%**	**0%**

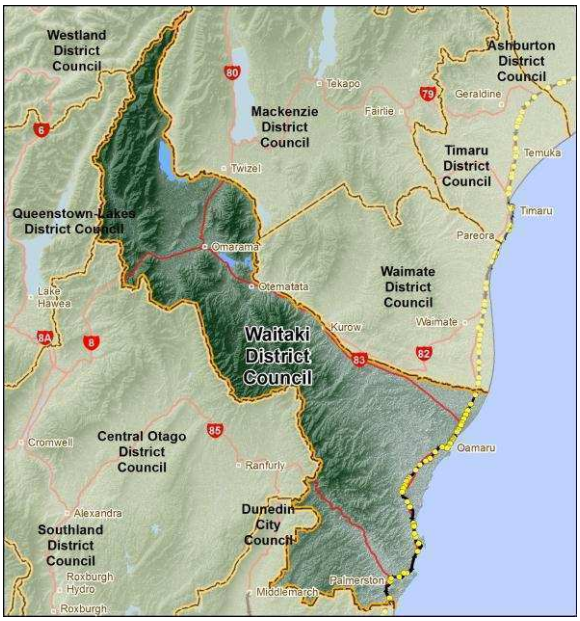
Comments

Roading Authority - Waitaki District Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

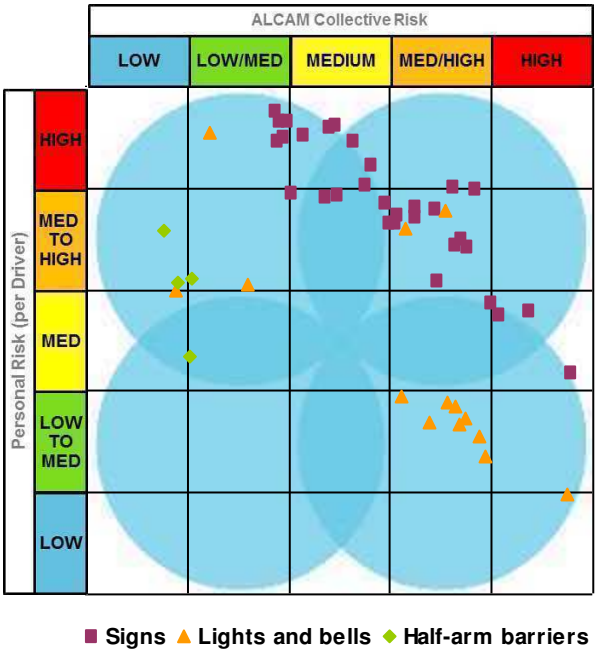
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	31	14	4
• percentage	63%	29%	8%
• in urban areas	4	3	1
• with unsealed road surface	5	0	0
• with stacking distance < 25m	7	3	1
• with a hump or dip	10	0	0
Vehicles per day (mean)	108	757	53
Vehicles per day (maximum)	931	3,859	100

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	8 - 10	8 - 10	8 - 10
Total trains per day	8 - 10	8 - 10	8 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	49	1268	4%
Collisions per 10 years	4.7	147	3%
Fatalities per 10 years	1.7	44	4%

Key collision factors	Authority	NZ
Visibility of trains	30%	23%
Queuing or stacking	12%	15%
Train operations	12%	13%
Vehicle operations	10%	12%
Condition of warning devices	15%	12%
Condition of crossing	10%	14%
Other	11%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	14%	22%	27%	20%	16%
Exposure	16%	29%	22%	24%	8%
Consequence	2%	6%	2%	90%	0%
Total ALCAM risk score	**6%**	**18%**	**22%**	**45%**	**8%**

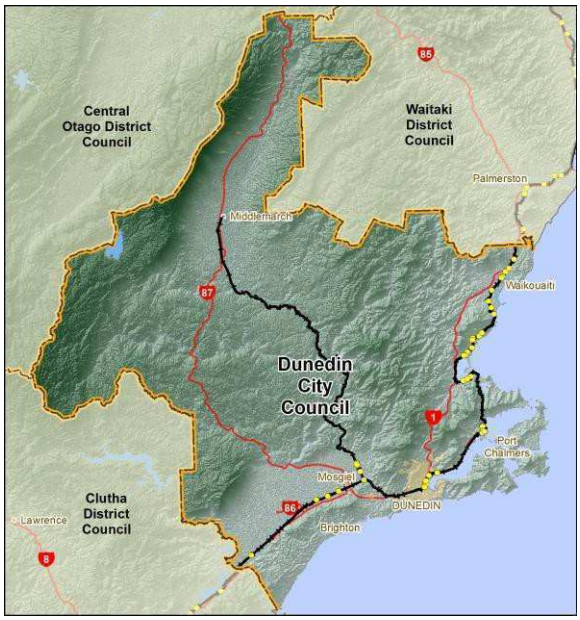
Comments

Roading Authority - Dunedin City Council

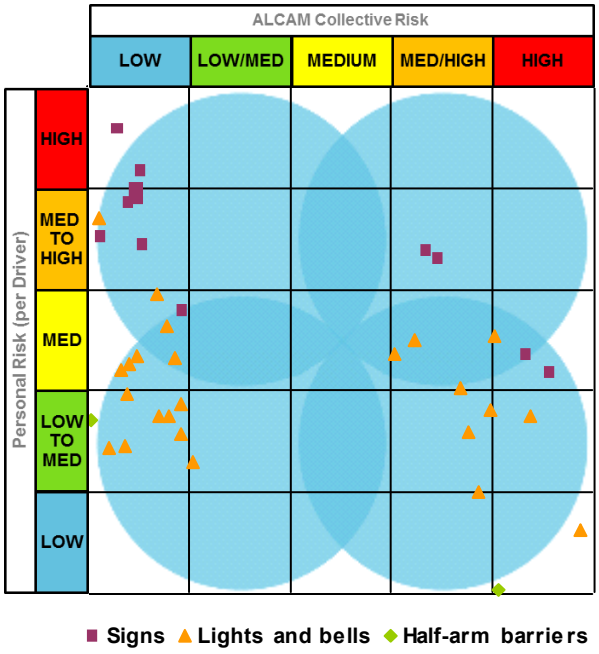
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	15	24	2
• percentage	37%	59%	5%
• in urban areas	4	4	1
• with unsealed road surface	8	0	0
• with stacking distance < 25m	2	0	0
• with a hump or dip	11	6	0
Vehicles per day (mean)	152	1,060	7,562
Vehicles per day (maximum)	765	10,280	14,852

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 8	1 - 10	6 - 8
Total trains per day	1 - 8	1 - 10	6 - 8



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	41	1268	3%
Collisions per 10 years	4.6	147	3%
Fatalities per 10 years	0.9	44	2%



Key collision factors	Authority	NZ
Visibility of trains	22%	23%
Queuing or stacking	7%	15%
Train operations	9%	13%
Vehicle operations	11%	12%
Condition of warning devices	16%	12%
Condition of crossing	24%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	17%	10%	17%	37%	20%
Exposure	10%	20%	34%	22%	15%
Consequence	61%	22%	5%	12%	0%
Total ALCAM risk score	**63%**	**2%**	**0%**	**20%**	**15%**

Comments

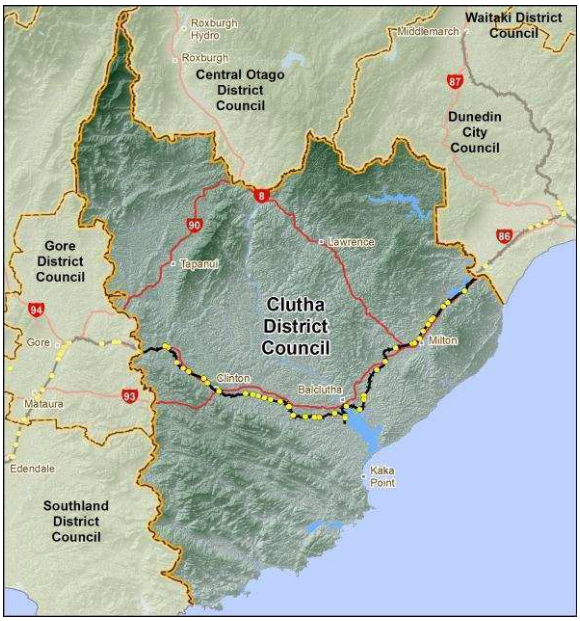
Summary excludes passenger trains operated as part of the Taieri Gorge Railway.

Roading Authority - Clutha District Council

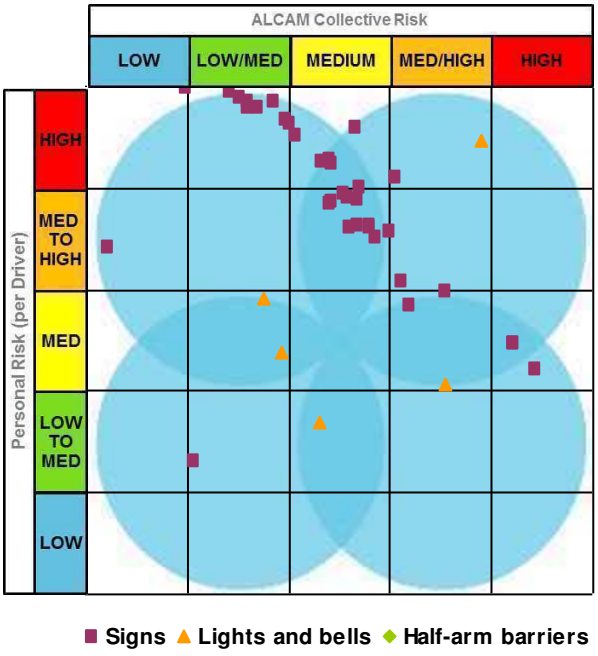
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	35	5	0
• percentage	88%	13%	0%
• in urban areas	1	0	0
• with unsealed road surface	23	1	0
• with stacking distance < 25m	2	1	0
• with a hump or dip	21	1	0
Vehicles per day (mean)	143	261	0
Vehicles per day (maximum)	2,038	516	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	2 - 6	6 - 6	0
Total trains per day	2 - 6	6 - 6	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	40	1268	3%
Collisions per 10 years	3.3	147	2%
Fatalities per 10 years	1.2	44	3%



Key collision factors	Authority	NZ
Visibility of trains	30%	23%
Queuing or stacking	4%	15%
Train operations	12%	13%
Vehicle operations	8%	12%
Condition of warning devices	12%	12%
Condition of crossing	25%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	10%	5%	35%	40%	10%
Exposure	33%	40%	13%	10%	5%
Consequence	5%	0%	0%	95%	0%
Total ALCAM risk score	**5%**	**25%**	**48%**	**15%**	**8%**

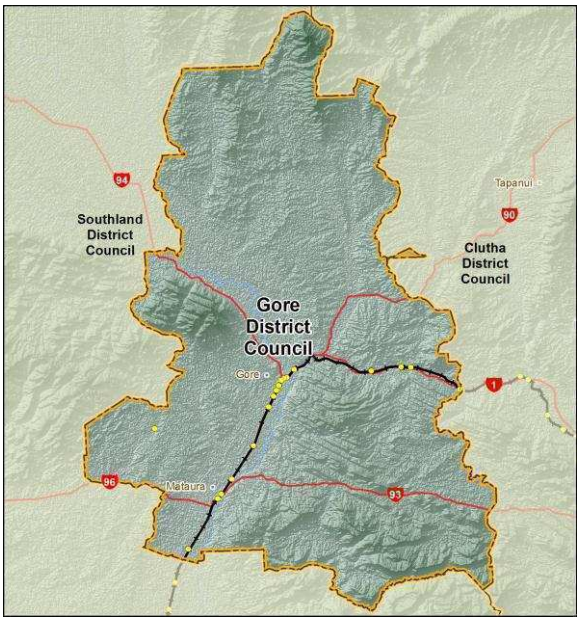
Comments

Roading Authority - Gore District Council

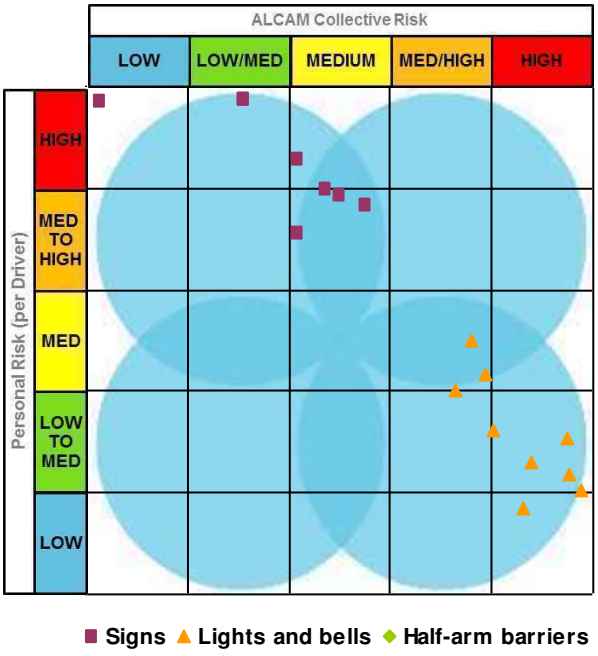
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	8	9	0
• percentage	47%	53%	0%
• in urban areas	0	5	0
• with unsealed road surface	3	0	0
• with stacking distance < 25m	4	5	0
• with a hump or dip	6	0	0
Vehicles per day (mean)	35	1,936	0
Vehicles per day (maximum)	62	5,043	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	6 - 6	6 - 6	0
Total trains per day	6 - 6	6 - 6	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	17	1268	1%
Collisions per 10 years	2.1	147	1%
Fatalities per 10 years	0.8	44	2%



Key collision factors	Authority	NZ
Visibility of trains	16%	23%
Queuing or stacking	22%	15%
Train operations	12%	13%
Vehicle operations	13%	12%
Condition of warning devices	10%	12%
Condition of crossing	17%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	12%	0%	18%	41%	29%
Exposure	18%	29%	18%	6%	29%
Consequence	6%	0%	0%	94%	0%
Total ALCAM risk score	**6%**	**12%**	**29%**	**18%**	**35%**

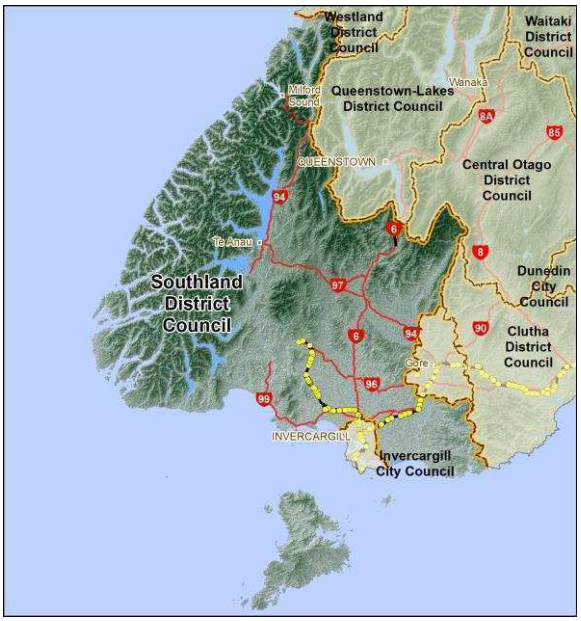
Comments

Roading Authority - Southland District Council

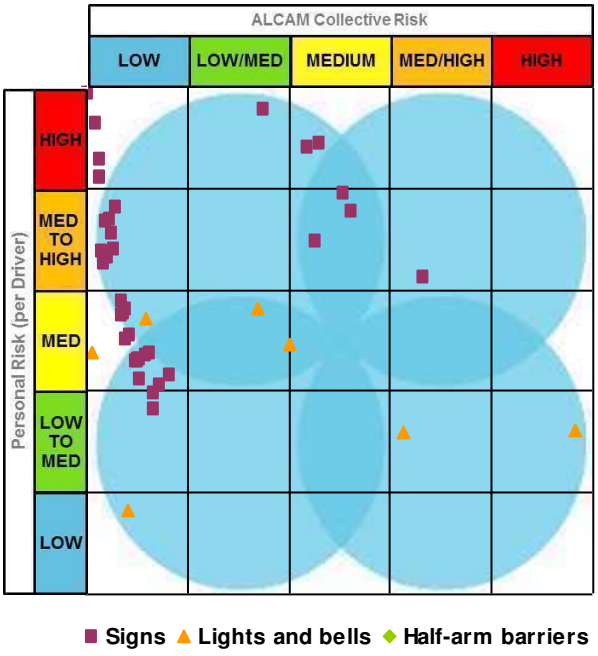
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	37	7	0
• percentage	84%	16%	0%
• in urban areas	0	0	0
• with unsealed road surface	18	0	0
• with stacking distance < 25m	10	2	0
• with a hump or dip	16	0	0
Vehicles per day (mean)	168	753	0
Vehicles per day (maximum)	600	2,100	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	2 - 6	2 - 6	0
Total trains per day	2 - 6	2 - 6	0



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	44	1268	3%
Collisions per 10 years	3.5	147	2%
Fatalities per 10 years	0.6	44	1%



Key collision factors	Authority	NZ
Visibility of trains	28%	23%
Queuing or stacking	11%	15%
Train operations	18%	13%
Vehicle operations	9%	12%
Condition of warning devices	7%	12%
Condition of crossing	16%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	16%	18%	30%	30%	7%
Exposure	34%	27%	23%	14%	2%
Consequence	73%	2%	0%	25%	0%
Total ALCAM risk score	**75%**	**5%**	**14%**	**5%**	**2%**

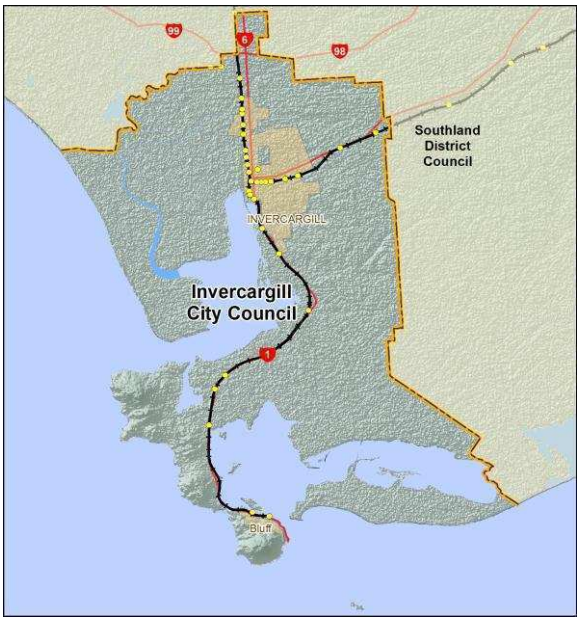
Comments

Roading Authority - Invercargill City Council

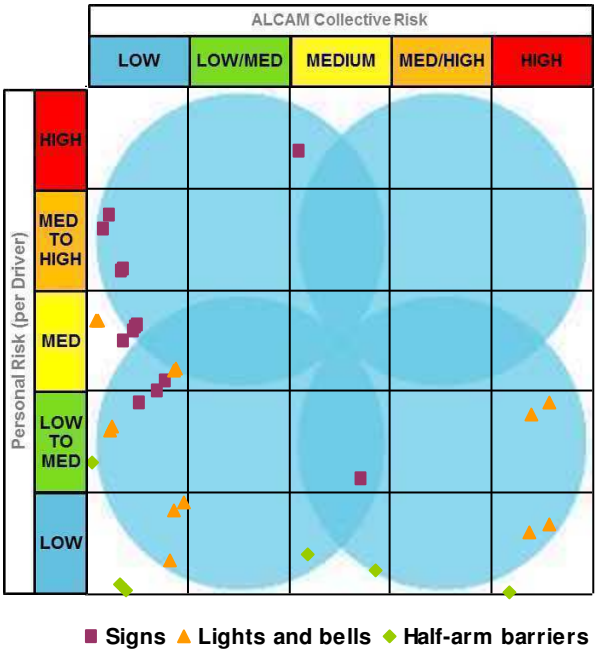
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	13	14	6
• percentage	39%	42%	18%
• in urban areas	2	9	6
• with unsealed road surface	3	0	0
• with stacking distance < 25m	6	5	0
• with a hump or dip	5	0	0
Vehicles per day (mean)	664	1,907	6,250
Vehicles per day (maximum)	6,000	6,000	15,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	2 - 6	2 - 6	3 - 6
Total trains per day	2 - 6	2 - 6	3 - 6



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	33	1268	3%
Collisions per 10 years	3.7	147	3%
Fatalities per 10 years	0.6	44	1%



Key collision factors	Authority	NZ
Visibility of trains	19%	23%
Queuing or stacking	22%	15%
Train operations	14%	13%
Vehicle operations	12%	12%
Condition of warning devices	11%	12%
Condition of crossing	10%	14%
Other	13%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	27%	24%	12%	21%	15%
Exposure	15%	21%	27%	21%	15%
Consequence	70%	6%	0%	24%	0%
Total ALCAM risk score	**73%**	**0%**	**12%**	**0%**	**15%**

Comments

Regional Council Management Areas

- Northland
- Waikato
- Bay of Plenty
- Hawkes Bay
- Taranaki
- Manawatu - Wanganui
- Nelson – Marlborough
- Canterbury
- West Coast
- Otago
- Southland

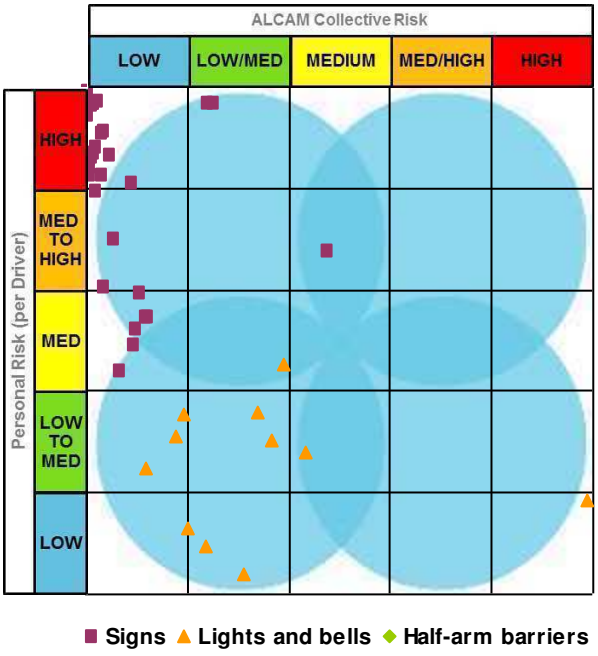
Regional Council - Northland Regional Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	31	11	0
• percentage	74%	26%	0%
• in urban areas	1	4	0
• with unsealed road surface	20	0	0
• with stacking distance < 25m	6	2	0
• with a hump or dip	23	1	0
Vehicles per day (mean)	61	4,077	0
Vehicles per day (maximum)	267	18,780	0

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0
Freight trains per day	1 - 3	3 - 5	0
Total trains per day	1 - 3	3 - 5	0

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	42	1268	3%
Collisions per 10 years	3.6	147	2%
Fatalities per 10 years	0.5	44	1%



Key collision factors	Authority	NZ
Visibility of trains	21%	23%
Queuing or stacking	9%	15%
Train operations	15%	13%
Vehicle operations	8%	12%
Condition of warning devices	11%	12%
Condition of crossing	26%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	14%	12%	19%	40%	14%
Exposure	55%	12%	17%	7%	10%
Consequence	76%	19%	5%	0%	0%
Total ALCAM risk score	**76%**	**17%**	**5%**	**0%**	**2%**

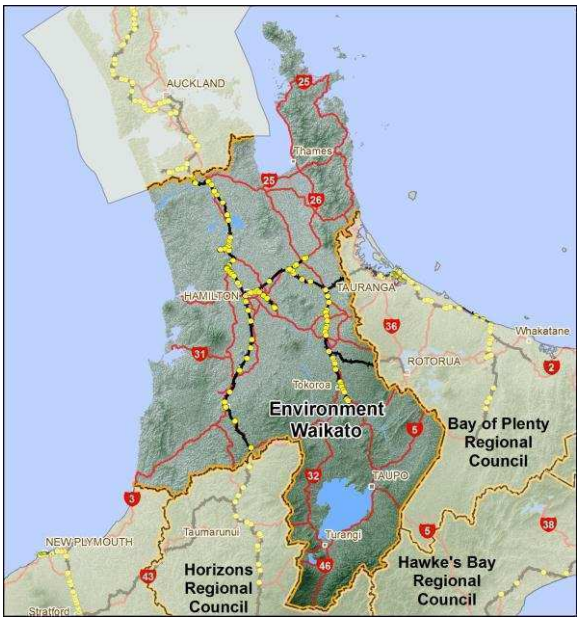
Comments

Regional Council - Environment Waikato

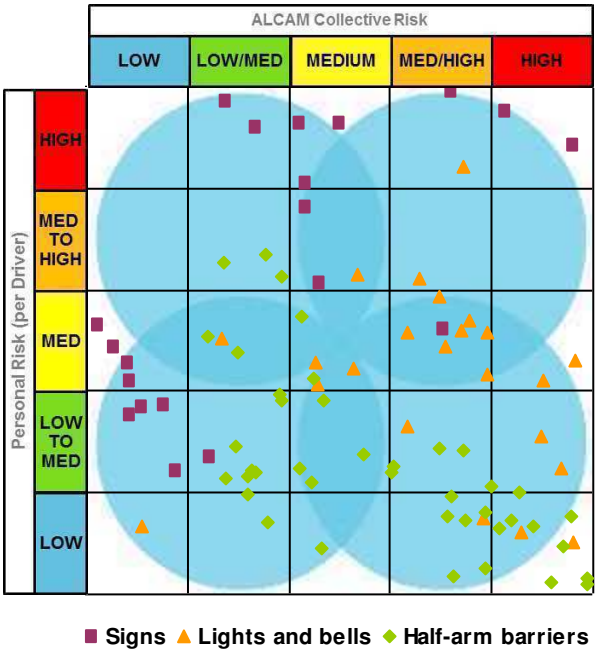
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	20	23	41
• percentage	24%	27%	49%
• in urban areas	0	3	15
• with unsealed road surface	5	0	2
• with stacking distance < 25m	6	5	10
• with a hump or dip	6	4	3
Vehicles per day (mean)	373	1,300	2,949
Vehicles per day (maximum)	2,409	10,125	21,920

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 29	0 - 29	0 - 29
Freight trains per day	1 - 26	2 - 26	7 - 26
Total trains per day	1 - 55	2 - 55	7 - 55



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	84	1268	7%
Collisions per 10 years	8.3	147	6%
Fatalities per 10 years	3.2	44	7%



Key collision factors	Authority	NZ
Visibility of trains	17%	23%
Queuing or stacking	25%	15%
Train operations	13%	13%
Vehicle operations	18%	12%
Condition of warning devices	5%	12%
Condition of crossing	12%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	30%	32%	10%	7%	21%
Exposure	29%	17%	20%	20%	14%
Consequence	12%	17%	2%	27%	42%
Total ALCAM risk score	**11%**	**21%**	**19%**	**29%**	**20%**

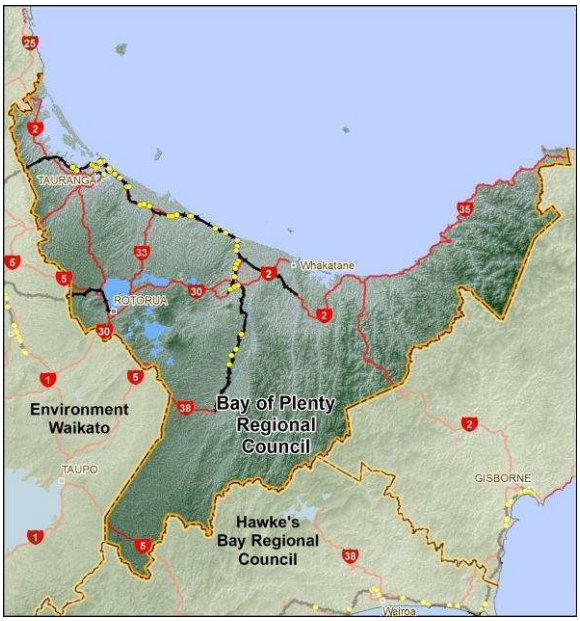
Comments

Regional Council - Bay of Plenty Regional Council

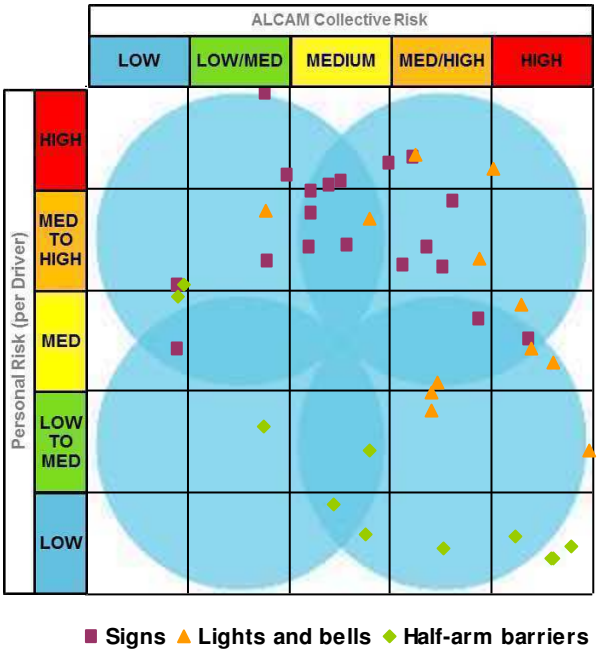
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	19	12	11
• percentage	45%	29%	26%
• in urban areas	0	1	6
• with unsealed road surface	6	1	0
• with stacking distance < 25m	5	6	4
• with a hump or dip	8	1	0
Vehicles per day (mean)	130	690	4,157
Vehicles per day (maximum)	452	4,677	10,800

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	6 - 16	11 - 26	11 - 26
Total trains per day	6 - 16	11 - 26	11 - 26



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	42	1268	3%
Collisions per 10 years	5.2	147	4%
Fatalities per 10 years	1.7	44	4%



Key collision factors	Authority	NZ
Visibility of trains	16%	23%
Queuing or stacking	24%	15%
Train operations	8%	13%
Vehicle operations	12%	12%
Condition of warning devices	15%	12%
Condition of crossing	14%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	19%	19%	14%	12%	36%
Exposure	10%	24%	21%	26%	19%
Consequence	5%	90%	5%	0%	0%
Total ALCAM risk score	**10%**	**12%**	**26%**	**29%**	**24%**

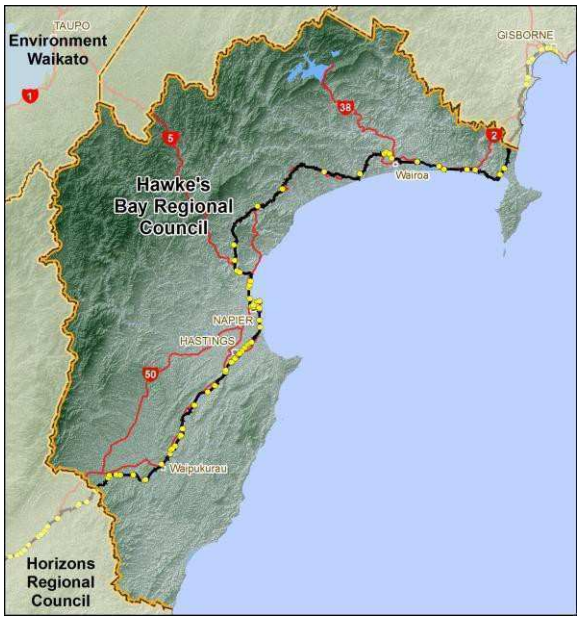
Comments

Regional Council - Hawke's Bay Regional Council

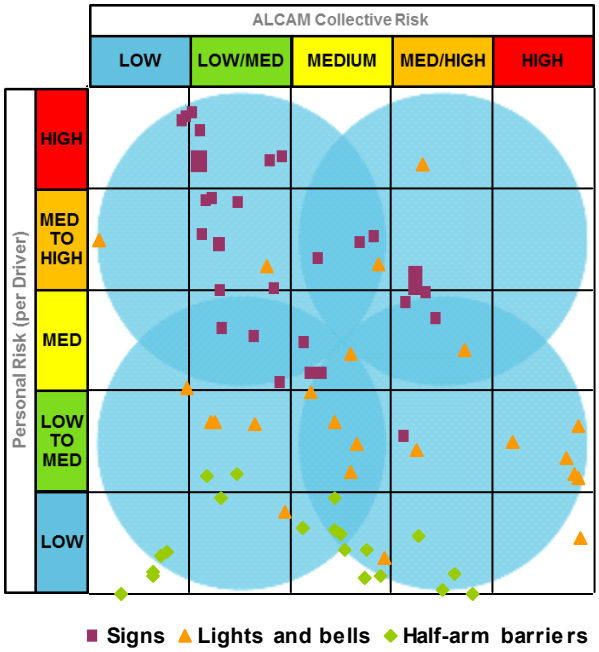
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	33	23	20
• percentage	43%	30%	26%
• in urban areas	1	8	9
• with unsealed road surface	9	1	0
• with stacking distance < 25m	6	8	7
• with a hump or dip	11	1	0
Vehicles per day (mean)	483	1,835	5,031
Vehicles per day (maximum)	11,559	10,000	15,500

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 4	1 - 10	1 - 10
Total trains per day	1 - 4	1 - 10	1 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	76	1268	6%
Collisions per 10 years	7.6	147	5%
Fatalities per 10 years	2.2	44	5%



Key collision factors	Authority	NZ
Visibility of trains	18%	23%
Queuing or stacking	19%	15%
Train operations	18%	13%
Vehicle operations	12%	12%
Condition of warning devices	13%	12%
Condition of crossing	10%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	14%	22%	21%	17%	25%
Exposure	34%	24%	16%	16%	11%
Consequence	14%	30%	3%	51%	1%
Total ALCAM risk score	**12%**	**34%**	**29%**	**17%**	**8%**

Comments

This summary includes data for the PNGL north of Napier. It should be noted that this section of the line was officially mothballed in October 2012 and there are no trains currently using it. The train volumes for this section of the PNGL were obtained prior to this date.

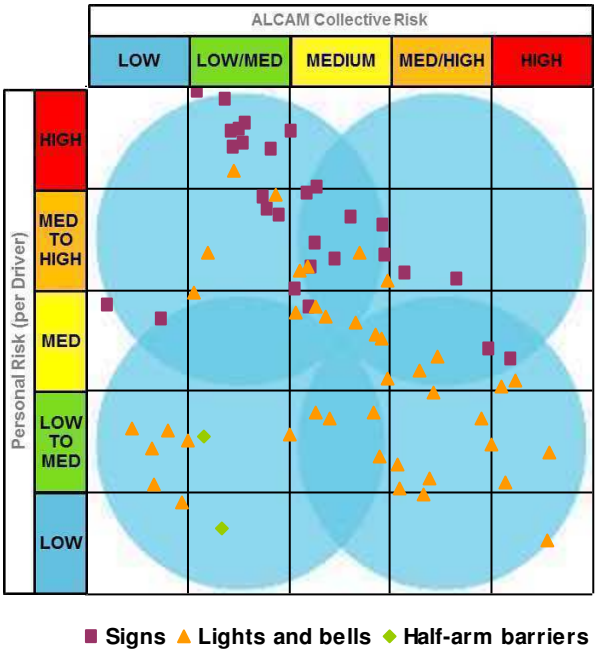
Regional Council - Taranaki Regional Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	28	40	2
• percentage	40%	57%	3%
• in urban areas	1	12	1
• with unsealed road surface	5	1	0
• with stacking distance < 25m	9	19	0
• with a hump or dip	5	0	0
Vehicles per day (mean)	100	908	932
Vehicles per day (maximum)	490	7,050	1,500

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	2 - 9	2 - 9	4 - 5
Total trains per day	2 - 9	2 - 9	4 - 5

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	70	1268	6%
Collisions per 10 years	6.6	147	4%
Fatalities per 10 years	2.0	44	5%



Key collision factors	Authority	NZ
Visibility of trains	22%	23%
Queuing or stacking	18%	15%
Train operations	15%	13%
Vehicle operations	14%	12%
Condition of warning devices	12%	12%
Condition of crossing	5%	14%
Other	13%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	27%	13%	19%	9%	33%
Exposure	23%	24%	23%	23%	7%
Consequence	9%	91%	0%	0%	0%
Total ALCAM risk score	**10%**	**27%**	**37%**	**17%**	**9%**

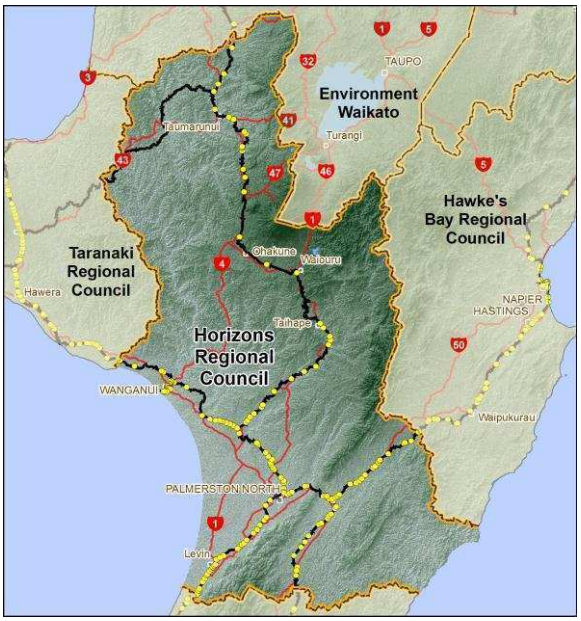
Comments

Regional Council - Horizons Regional Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

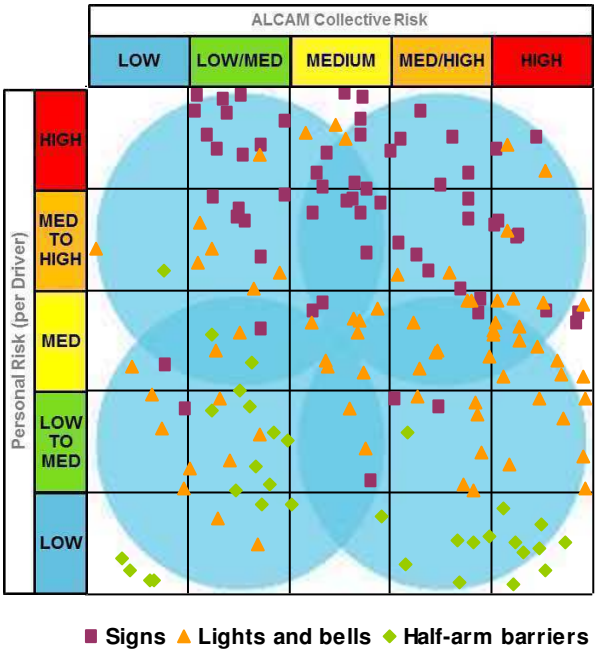
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	62	70	32
• percentage	38%	43%	20%
• in urban areas	4	19	17
• with unsealed road surface	22	3	1
• with stacking distance < 25m	13	19	10
• with a hump or dip	27	7	2
Vehicles per day (mean)	225	861	3,593
Vehicles per day (maximum)	6,261	12,000	12,200

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 4	0 - 4	0 - 4
Freight trains per day	2 - 20	2 - 20	4 - 20
Total trains per day	2 - 22	2 - 22	4 - 22



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	164	1268	13%
Collisions per 10 years	18.0	147	12%
Fatalities per 10 years	6.1	44	14%

Key collision factors	Authority	NZ
Visibility of trains	19%	23%
Queuing or stacking	15%	15%
Train operations	14%	13%
Vehicle operations	13%	12%
Condition of warning devices	14%	12%
Condition of crossing	14%	14%
Other	11%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	18%	23%	18%	18%	24%
Exposure	21%	16%	24%	23%	15%
Consequence	10%	26%	21%	21%	23%
Total ALCAM risk score	**7%**	**26%**	**20%**	**23%**	**24%**

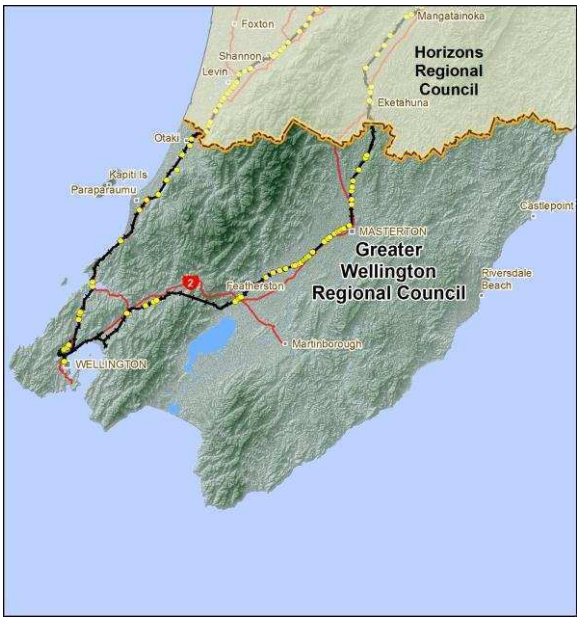
Comments

Regional Council - Greater Wellington Regional Council

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

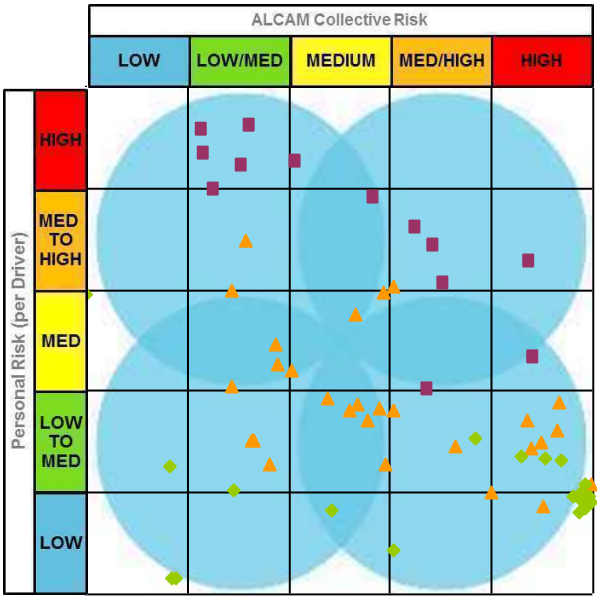
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	13	28	20
• percentage	21%	46%	33%
• in urban areas	0	10	15
• with unsealed road surface	1	0	0
• with stacking distance < 25m	1	4	5
• with a hump or dip	1	1	1
Vehicles per day (mean)	139	960	4,994
Vehicles per day (maximum)	527	5,300	10,014

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 8	0 - 8	0 - 88
Freight trains per day	2 - 15	2 - 9	0 - 10
Total trains per day	2 - 19	2 - 13	10 - 111



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	61	1268	5%
Collisions per 10 years	9.1	147	6%
Fatalities per 10 years	3.2	44	7%

Key collision factors	Authority	NZ
Visibility of trains	20%	23%
Queuing or stacking	16%	15%
Train operations	13%	13%
Vehicle operations	19%	12%
Condition of warning devices	15%	12%
Condition of crossing	5%	14%
Other	12%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	39%	23%	23%	5%	10%
Exposure	8%	13%	15%	25%	39%
Consequence	7%	18%	51%	13%	11%
Total ALCAM risk score	**7%**	**23%**	**20%**	**16%**	**34%**

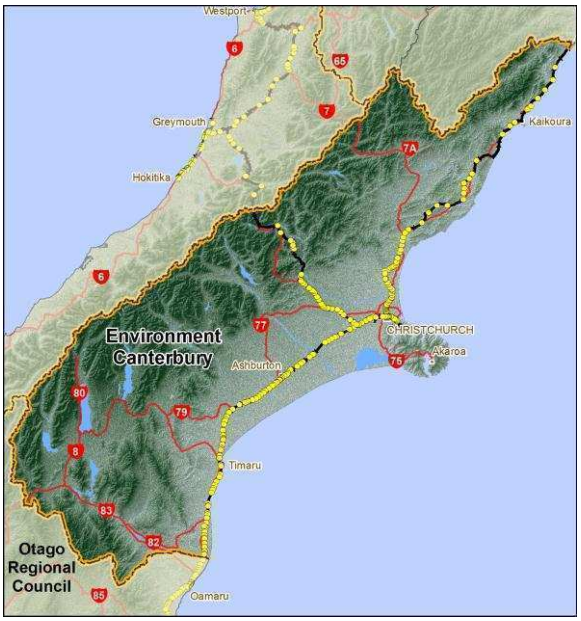
Comments

Regional Council - Environment Canterbury

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

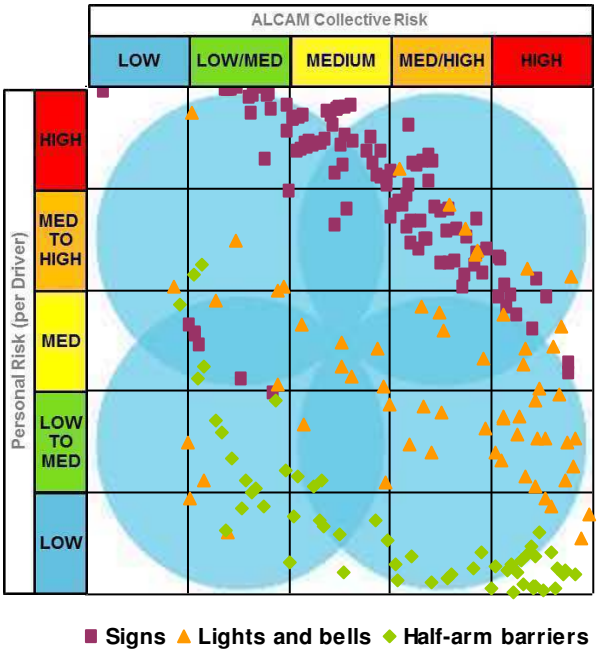
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	111	62	57
• percentage	48%	27%	25%
• in urban areas	3	16	36
• with unsealed road surface	44	3	3
• with stacking distance < 25m	33	16	9
• with a hump or dip	47	5	2
Vehicles per day (mean)	123	1,551	6,955
Vehicles per day (maximum)	1,550	16,200	24,100

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	0 - 2
Freight trains per day	7 - 13	7 - 13	6 - 21
Total trains per day	9 - 15	8 - 15	6 - 23



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	230	1268	18%
Collisions per 10 years	27.6	147	19%
Fatalities per 10 years	9.0	44	20%

Key collision factors	Authority	NZ
Visibility of trains	26%	23%
Queuing or stacking	16%	15%
Train operations	10%	13%
Vehicle operations	11%	12%
Condition of warning devices	12%	12%
Condition of crossing	14%	14%
Other	11%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	14%	17%	24%	27%	17%
Exposure	17%	20%	22%	16%	26%
Consequence	4%	10%	28%	56%	2%
Total ALCAM risk score	**1%**	**21%**	**25%**	**27%**	**27%**

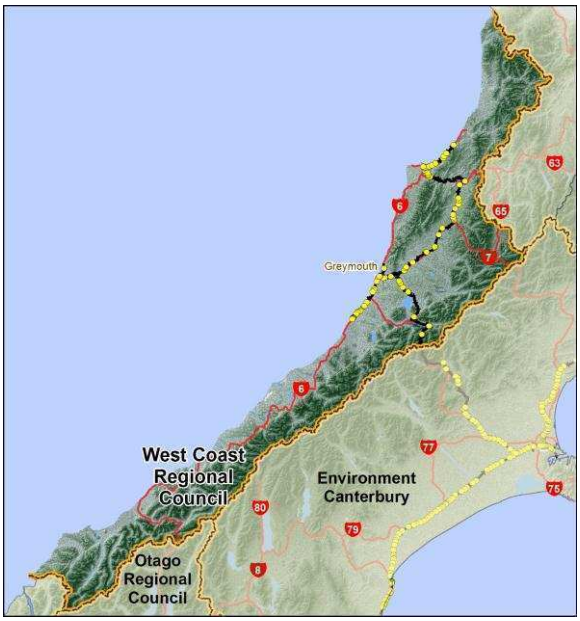
Comments

Regional Council - West Coast Regional Council

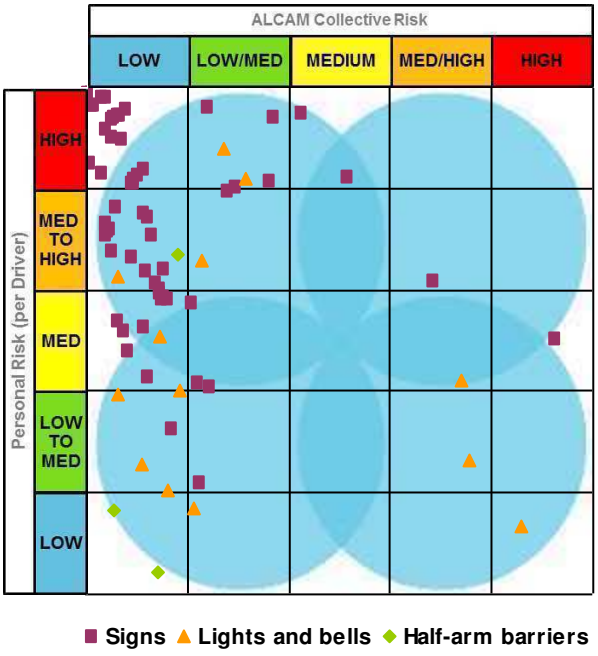
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	58	13	3
• percentage	78%	18%	4%
• in urban areas	9	7	2
• with unsealed road surface	18	0	0
• with stacking distance < 25m	13	6	1
• with a hump or dip	23	2	0
Vehicles per day (mean)	187	1,335	2,784
Vehicles per day (maximum)	2,925	6,454	6,821

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	0 - 2
Freight trains per day	2 - 13	2 - 13	5 - 13
Total trains per day	2 - 15	2 - 15	7 - 15



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	74	1268	6%
Collisions per 10 years	7.2	147	5%
Fatalities per 10 years	0.8	44	2%



Key collision factors	Authority	NZ
Visibility of trains	25%	23%
Queuing or stacking	12%	15%
Train operations	13%	13%
Vehicle operations	10%	12%
Condition of warning devices	13%	12%
Condition of crossing	16%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	9%	26%	18%	26%	22%
Exposure	30%	26%	16%	18%	11%
Consequence	77%	19%	0%	4%	0%
Total ALCAM risk score	**73%**	**18%**	**3%**	**4%**	**3%**

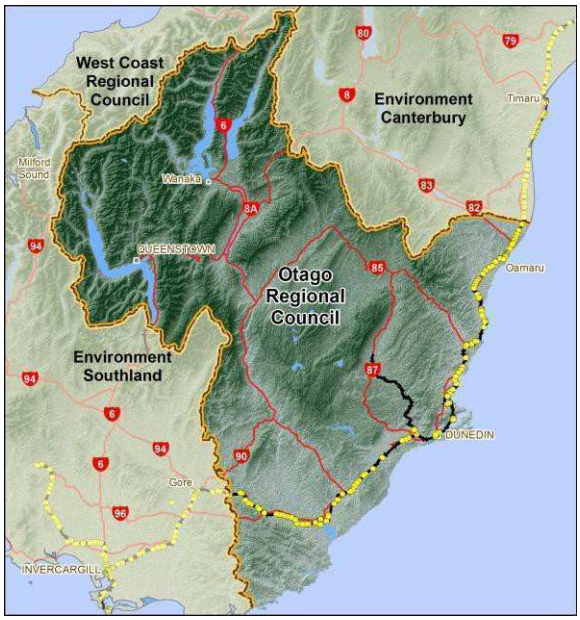
Comments

Regional Council - Otago Regional Council

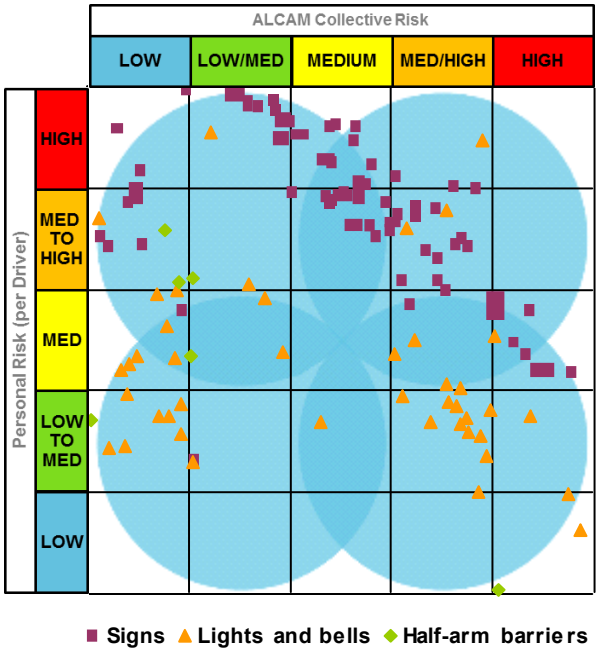
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	81	43	6
• percentage	62%	33%	5%
• in urban areas	9	7	2
• with unsealed road surface	36	1	0
• with stacking distance < 25m	11	4	1
• with a hump or dip	42	7	0
Vehicles per day (mean)	131	869	2,556
Vehicles per day (maximum)	2,038	10,280	14,852

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 10	1 - 10	6 - 10
Total trains per day	1 - 10	1 - 10	6 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	130	1268	10%
Collisions per 10 years	12.6	147	9%
Fatalities per 10 years	3.8	44	9%



Key collision factors	Authority	NZ
Visibility of trains	28%	23%
Queuing or stacking	8%	15%
Train operations	11%	13%
Vehicle operations	9%	12%
Condition of warning devices	14%	12%
Condition of crossing	19%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	14%	13%	26%	32%	15%
Exposure	19%	29%	23%	19%	9%
Consequence	22%	9%	2%	67%	0%
Total ALCAM risk score	**24%**	**15%**	**23%**	**28%**	**10%**

Comments

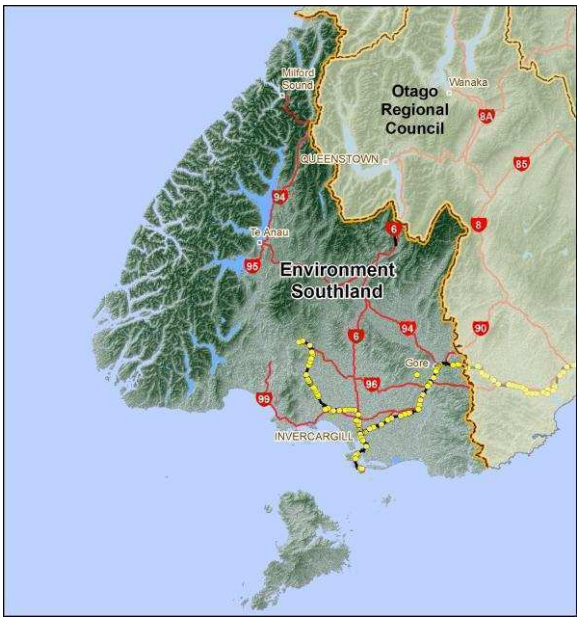
Summary excludes passenger trains operated as part of the Taieri Gorge Railway.

Regional Council - Environment Southland

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

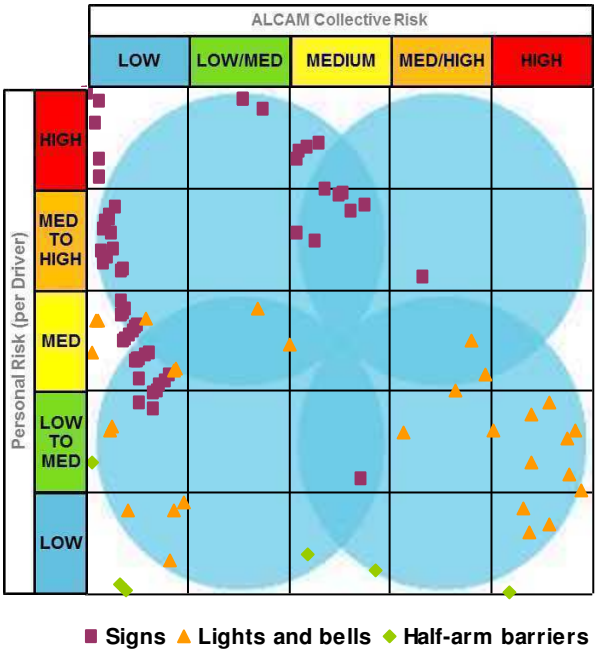
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	58	30	6
• percentage	62%	32%	6%
• in urban areas	2	14	6
• with unsealed road surface	24	0	0
• with stacking distance < 25m	20	12	0
• with a hump or dip	27	0	0
Vehicles per day (mean)	261	1,647	6,250
Vehicles per day (maximum)	6,000	6,000	15,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	2 - 6	2 - 6	3 - 6
Total trains per day	2 - 6	2 - 6	3 - 6



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	94	1268	7%
Collisions per 10 years	9.3	147	6%
Fatalities per 10 years	1.9	44	4%

Key collision factors	Authority	NZ
Visibility of trains	23%	23%
Queuing or stacking	16%	15%
Train operations	16%	13%
Vehicle operations	11%	12%
Condition of warning devices	8%	12%
Condition of crossing	14%	14%
Other	11%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	19%	17%	21%	29%	14%
Exposure	24%	26%	23%	15%	12%
Consequence	60%	3%	0%	37%	0%
Total ALCAM risk score	**62%**	**4%**	**16%**	**5%**	**13%**

Comments

NZTA Management Zones

- Auckland *
- Waikato – Bay of Plenty *
- Central
- Southern

* Contains fewer than 20 level crossings, meaning that some of the risk data may be statistically insignificant.

NZTA Zone - Auckland

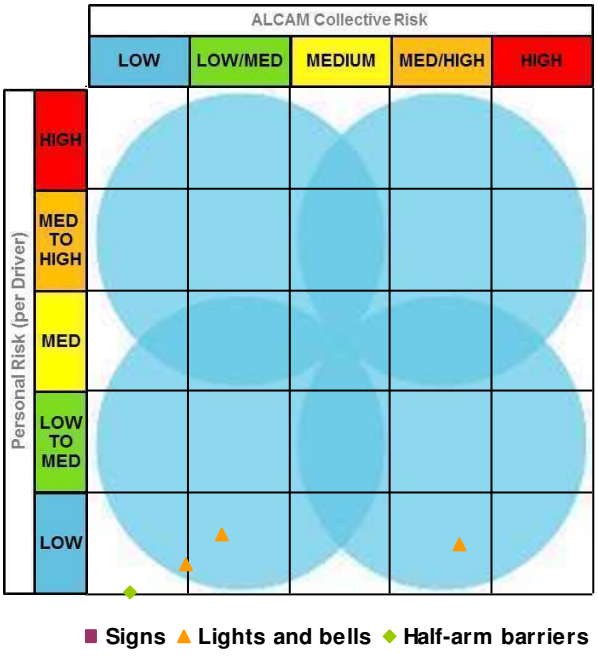
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	3	1
• percentage	0%	75%	25%
• in urban areas	0	0	1
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	1	0
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	7,030	9,668
Vehicles per day (maximum)	0	8,237	9,668

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0 - 0	0 - 0
Freight trains per day	0	3 - 3	3 - 3
Total trains per day	0	3 - 3	3 - 3

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	4	1268	0%
Collisions per 10 years	0.6	147	0%
Fatalities per 10 years	0.1	44	0%

Key collision factors	Authority	NZ
Visibility of trains	4%	23%
Queuing or stacking	22%	15%
Train operations	19%	13%
Vehicle operations	30%	12%
Condition of warning devices	12%	12%
Condition of crossing	0%	14%
Other	13%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	50%	25%	0%	0%	25%
Exposure	0%	0%	25%	0%	75%
Consequence	75%	25%	0%	0%	0%
Total ALCAM risk score	**50%**	**25%**	**0%**	**25%**	**0%**

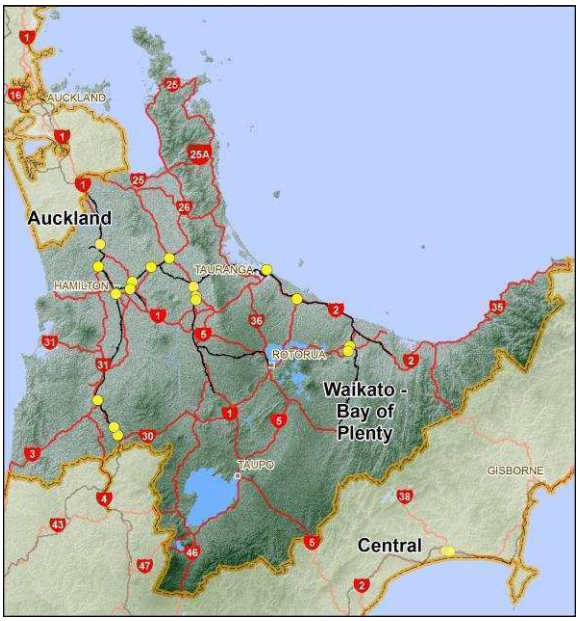
Comments

NZTA Zone - Waikato - Bay of Plenty

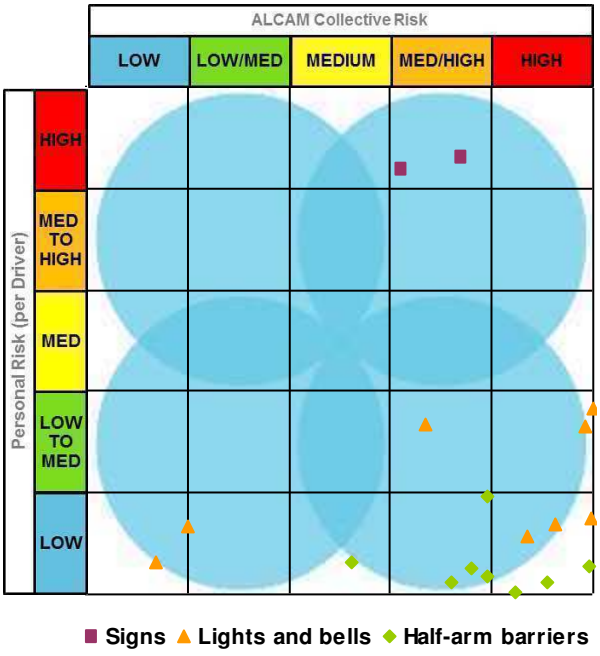
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	2	8	8
• percentage	11%	44%	44%
• in urban areas	1	1	3
• with unsealed road surface	1	1	1
• with stacking distance < 25m	1	2	1
• with a hump or dip	2	0	0
Vehicles per day (mean)	52	4,555	10,910
Vehicles per day (maximum)	54	8,595	23,548

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	0 - 2	0 - 2
Freight trains per day	9 - 9	1 - 16	7 - 26
Total trains per day	11 - 11	1 - 16	7 - 26



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	18	1268	1%
Collisions per 10 years	3.4	147	2%
Fatalities per 10 years	1.3	44	3%



Key collision factors	Authority	NZ
Visibility of trains	11%	23%
Queuing or stacking	36%	15%
Train operations	9%	13%
Vehicle operations	17%	12%
Condition of warning devices	5%	12%
Condition of crossing	11%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	39%	11%	11%	11%	28%
Exposure	0%	0%	22%	28%	50%
Consequence	11%	22%	17%	28%	22%
Total ALCAM risk score	**11%**	**0%**	**6%**	**39%**	**44%**

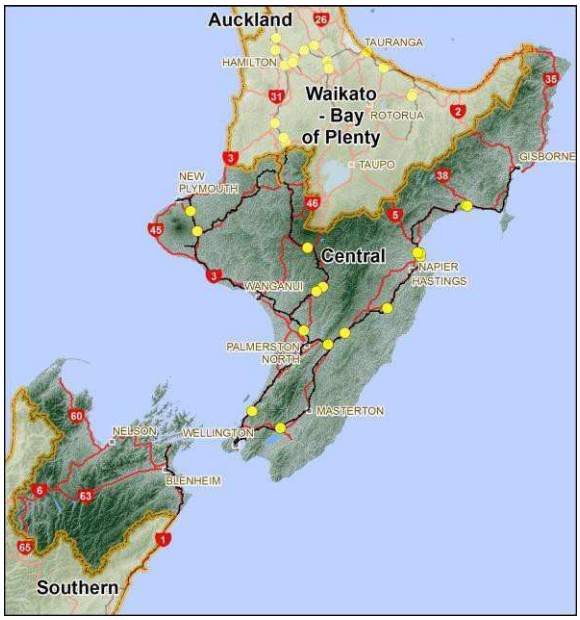
Comments

NZTA Zone - Central

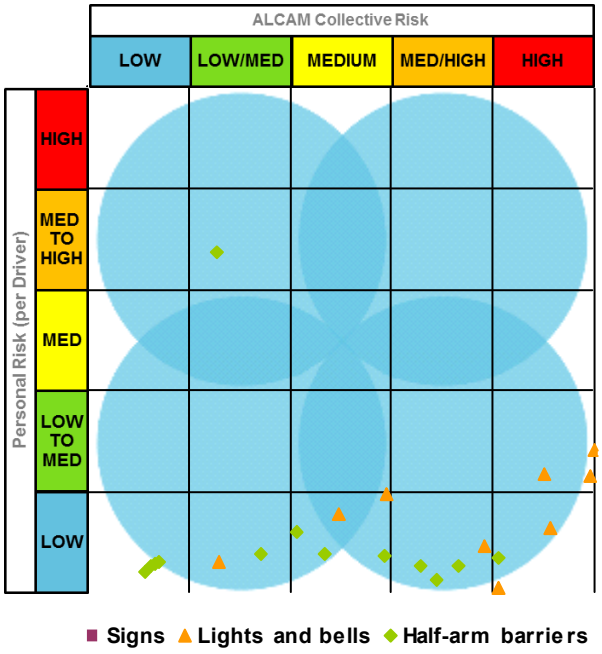
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	0	9	13
• percentage	0%	41%	59%
• in urban areas	0	2	8
• with unsealed road surface	0	2	0
• with stacking distance < 25m	0	1	1
• with a hump or dip	0	0	0
Vehicles per day (mean)	0	6,313	4,502
Vehicles per day (maximum)	0	14,551	8,000

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0	0 - 2	0 - 8
Freight trains per day	0	1 - 20	2 - 10
Total trains per day	0	1 - 22	4 - 88



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	22	1268	2%
Collisions per 10 years	3.6	147	2%
Fatalities per 10 years	1.3	44	3%



Key collision factors	Authority	NZ
Visibility of trains	5%	23%
Queuing or stacking	25%	15%
Train operations	13%	13%
Vehicle operations	23%	12%
Condition of warning devices	18%	12%
Condition of crossing	5%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	27%	41%	5%	14%	14%
Exposure	5%	14%	27%	23%	32%
Consequence	23%	23%	14%	23%	18%
Total ALCAM risk score	**18%**	**14%**	**23%**	**18%**	**27%**

Comments

This summary includes data for the PNGL north of Napier. It should be noted that this section of the line was officially mothballed in October 2012 and there are no trains currently using it. The train volumes for this section of the PNGL were obtained prior to this date.

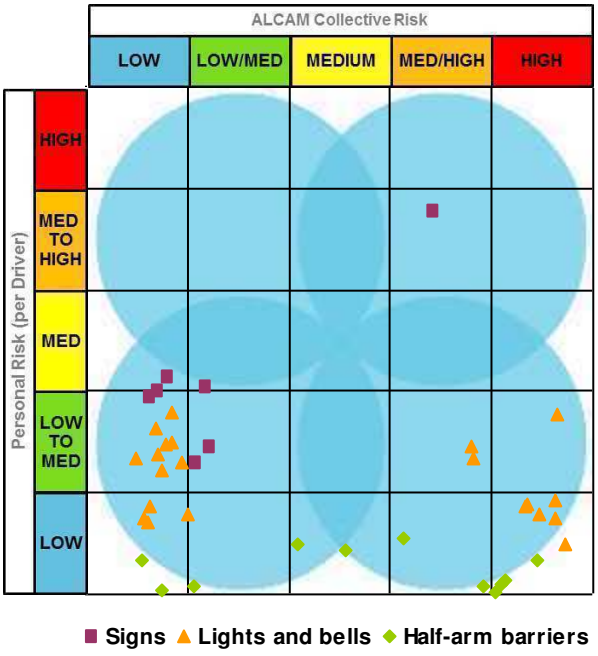
NZTA Zone - Southern

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	7	22	11
• percentage	18%	55%	28%
• in urban areas	1	1	6
• with unsealed road surface	0	0	0
• with stacking distance < 25m	2	1	1
• with a hump or dip	0	0	1
Vehicles per day (mean)	967	2,483	9,034
Vehicles per day (maximum)	2,130	8,753	16,900

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 2	0 - 2
Freight trains per day	2 - 10	2 - 13	6 - 21
Total trains per day	2 - 10	2 - 15	6 - 23

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	40	1268	3%
Collisions per 10 years	5.5	147	4%
Fatalities per 10 years	1.2	44	3%



Key collision factors	Authority	NZ
Visibility of trains	24%	23%
Queuing or stacking	12%	15%
Train operations	16%	13%
Vehicle operations	18%	12%
Condition of warning devices	13%	12%
Condition of crossing	5%	14%
Other	12%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	48%	25%	13%	10%	5%
Exposure	0%	3%	10%	38%	50%
Consequence	55%	5%	10%	30%	0%
Total ALCAM risk score	**43%**	**13%**	**5%**	**13%**	**28%**

Comments

KiwiRail Management Areas

- Auckland
- Hamilton East
- Hamilton South
- Palmerston North
- Napier
- Wellington
- Christchurch
- Greymouth
- Dunedin

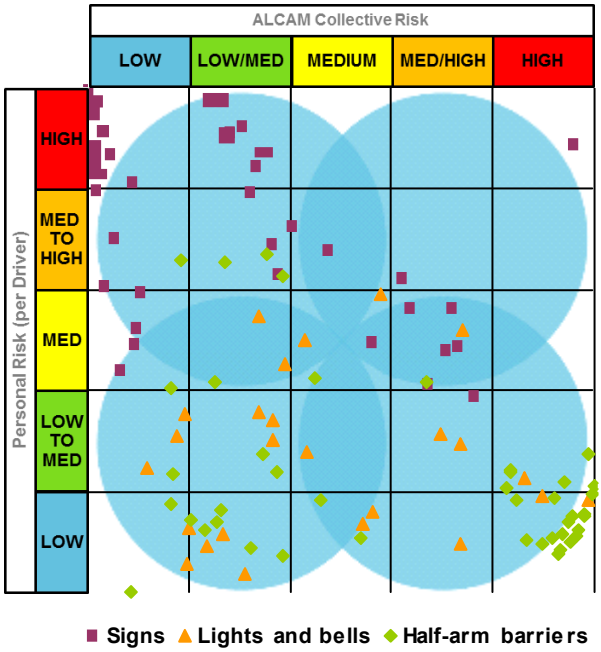
KiwiRail Area - Auckland

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	53	25	43
• percentage	44%	21%	36%
• in urban areas	2	4	32
• with unsealed road surface	31	0	1
• with stacking distance < 25m	13	4	4
• with a hump or dip	36	1	5
Vehicles per day (mean)	110	3,173	5,968
Vehicles per day (maximum)	750	18,780	14,469

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 29	0 - 29	0 - 82
Freight trains per day	1 - 26	3 - 26	0 - 26
Total trains per day	1 - 55	3 - 55	3 - 204

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	121	1268	10%
Collisions per 10 years	17.0	147	12%
Fatalities per 10 years	4.2	44	10%



Key collision factors	Authority	NZ
Visibility of trains	19%	23%
Queuing or stacking	14%	15%
Train operations	13%	13%
Vehicle operations	12%	12%
Condition of warning devices	11%	12%
Condition of crossing	22%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	21%	21%	18%	22%	17%
Exposure	31%	8%	11%	20%	30%
Consequence	30%	55%	4%	0%	12%
Total ALCAM risk score	**31%**	**27%**	**9%**	**11%**	**21%**

Comments

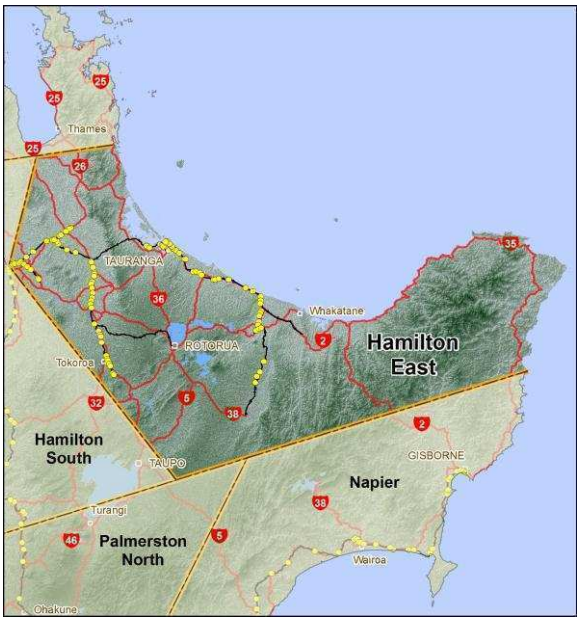
ALCAM surveys for the Onehunga Branch were taken prior to the level crossing upgrade work and the reopening of the line. There have also been a number of recent safety improvements carried out in Auckland that may change the overall risk profile of the area.

KiwiRail Area - Hamilton East

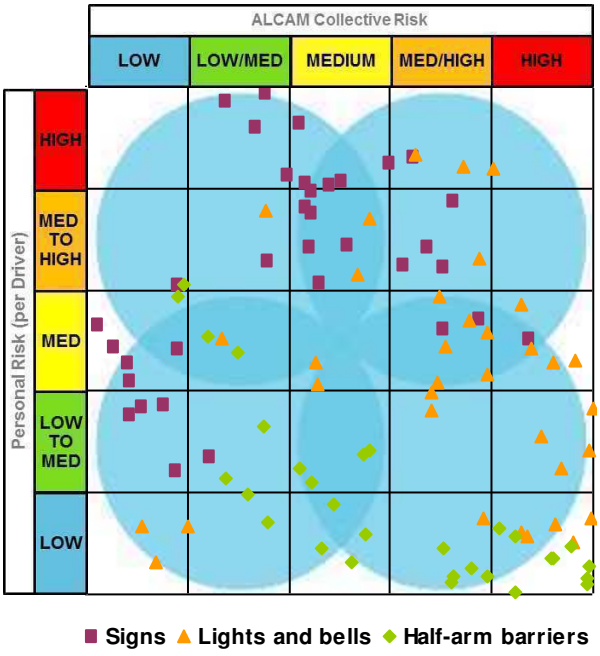
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	35	35	30
• percentage	35%	35%	30%
• in urban areas	0	4	14
• with unsealed road surface	7	2	2
• with stacking distance < 25m	10	12	9
• with a hump or dip	10	3	1
Vehicles per day (mean)	279	1,963	5,906
Vehicles per day (maximum)	2,409	10,125	23,548

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 16	1 - 26	7 - 26
Total trains per day	1 - 16	1 - 26	7 - 26



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	100	1268	8%
Collisions per 10 years	12.5	147	9%
Fatalities per 10 years	4.3	44	10%



Key collision factors	Authority	NZ
Visibility of trains	16%	23%
Queuing or stacking	27%	15%
Train operations	11%	13%
Vehicle operations	15%	12%
Condition of warning devices	10%	12%
Condition of crossing	10%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	32%	21%	12%	9%	26%
Exposure	16%	18%	19%	24%	23%
Consequence	14%	56%	3%	13%	14%
Total ALCAM risk score	**15%**	**14%**	**23%**	**24%**	**24%**

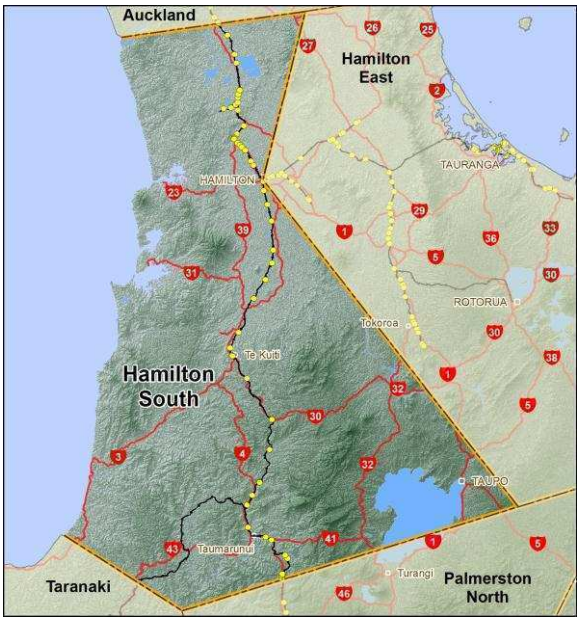
Comments

KiwiRail Area - Hamilton South

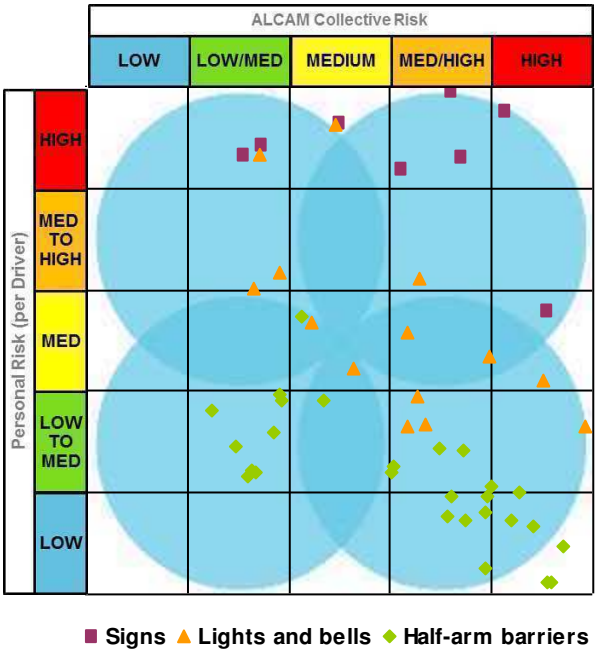
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	8	14	27
• percentage	16%	29%	55%
• in urban areas	1	1	9
• with unsealed road surface	7	3	1
• with stacking distance < 25m	2	2	5
• with a hump or dip	8	4	2
Vehicles per day (mean)	76	508	2,677
Vehicles per day (maximum)	358	2,784	15,258

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	2 - 2	2 - 2	2 - 2
Freight trains per day	9 - 26	9 - 12	9 - 26
Total trains per day	11 - 28	11 - 14	11 - 28



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	49	1268	4%
Collisions per 10 years	5.0	147	3%
Fatalities per 10 years	2.0	44	5%



Key collision factors	Authority	NZ
Visibility of trains	14%	23%
Queuing or stacking	21%	15%
Train operations	9%	13%
Vehicle operations	16%	12%
Condition of warning devices	8%	12%
Condition of crossing	23%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	16%	31%	6%	12%	35%
Exposure	24%	16%	29%	20%	10%
Consequence	0%	10%	18%	35%	37%
Total ALCAM risk score	**0%**	**27%**	**12%**	**41%**	**20%**

Comments

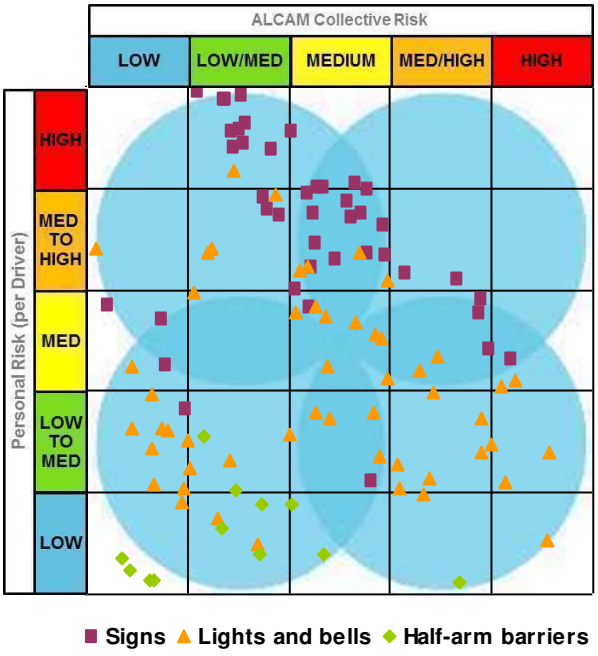
KiwiRail Area - Taranaki

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	42	52	12
• percentage	40%	49%	11%
• in urban areas	4	21	11
• with unsealed road surface	9	1	0
• with stacking distance < 25m	12	20	1
• with a hump or dip	9	0	0
Vehicles per day (mean)	271	1,261	3,844
Vehicles per day (maximum)	6,261	12,000	9,900

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	2 - 10	2 - 10	4 - 10
Total trains per day	2 - 10	2 - 10	4 - 10

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	106	1268	8%
Collisions per 10 years	10.9	147	7%
Fatalities per 10 years	2.7	44	6%



Key collision factors	Authority	NZ
Visibility of trains	20%	23%
Queuing or stacking	17%	15%
Train operations	16%	13%
Vehicle operations	14%	12%
Condition of warning devices	13%	12%
Condition of crossing	7%	14%
Other	13%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	24%	23%	19%	10%	25%
Exposure	20%	21%	25%	22%	12%
Consequence	21%	78%	1%	0%	0%
Total ALCAM risk score	**17%**	**27%**	**35%**	**15%**	**6%**

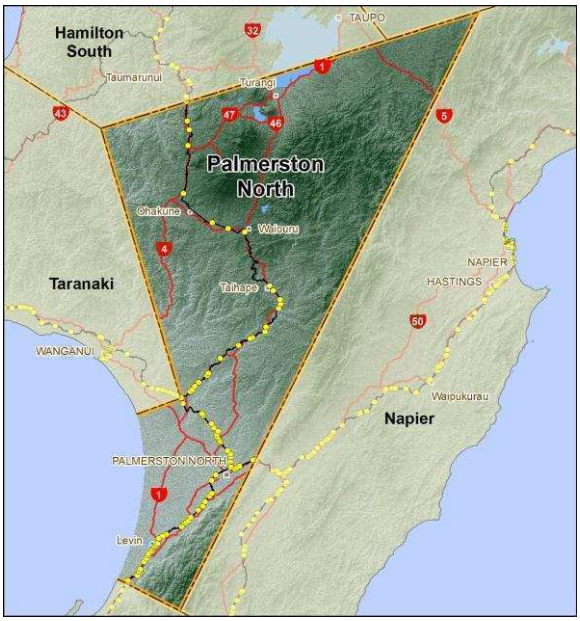
Comments

KiwiRail Area - Palmerston North

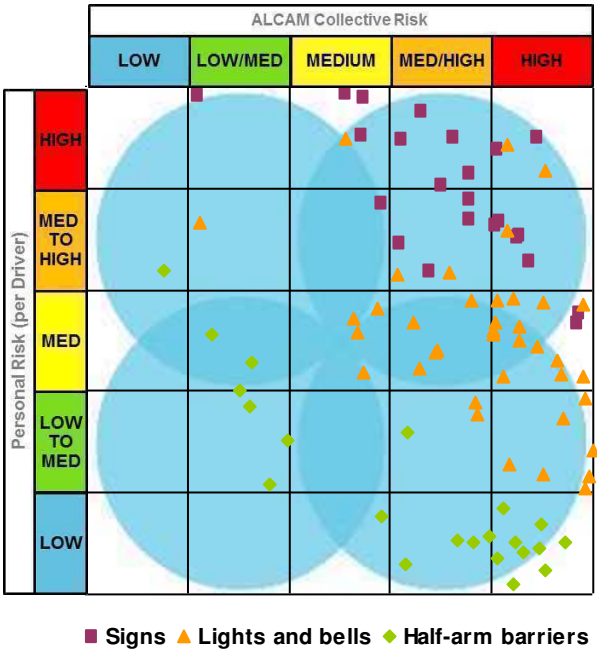
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	23	39	22
• percentage	27%	46%	26%
• in urban areas	0	5	8
• with unsealed road surface	10	1	1
• with stacking distance < 25m	8	15	8
• with a hump or dip	11	4	1
Vehicles per day (mean)	116	902	3,642
Vehicles per day (maximum)	635	10,000	12,200

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 4	0 - 4	0 - 4
Freight trains per day	9 - 20	9 - 20	9 - 20
Total trains per day	9 - 22	9 - 22	9 - 22



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	84	1268	7%
Collisions per 10 years	11.3	147	8%
Fatalities per 10 years	4.7	44	11%



Key collision factors	Authority	NZ
Visibility of trains	18%	23%
Queuing or stacking	20%	15%
Train operations	10%	13%
Vehicle operations	14%	12%
Condition of warning devices	15%	12%
Condition of crossing	13%	14%
Other	9%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	15%	21%	13%	20%	30%
Exposure	12%	12%	26%	27%	23%
Consequence	0%	4%	35%	13%	49%
Total ALCAM risk score	**1%**	**10%**	**12%**	**27%**	**50%**

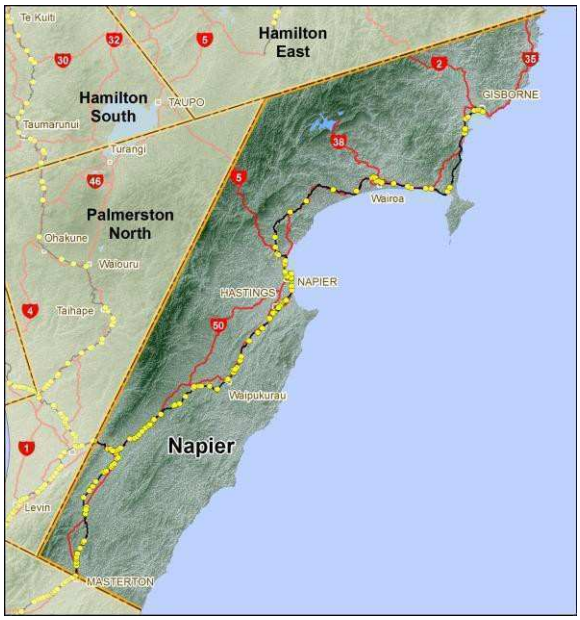
Comments

KiwiRail Area - Napier

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

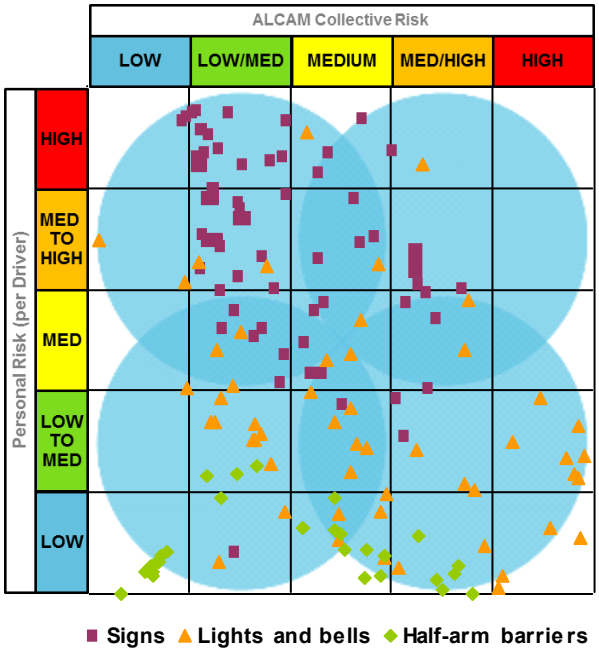
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	67	53	28
• percentage	45%	36%	19%
• in urban areas	2	16	14
• with unsealed road surface	17	2	0
• with stacking distance < 25m	9	11	9
• with a hump or dip	22	2	0
Vehicles per day (mean)	292	2,207	5,042
Vehicles per day (maximum)	11,559	14,551	15,500

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 8	1 - 10	1 - 10
Total trains per day	1 - 8	1 - 10	1 - 10



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	148	1268	12%
Collisions per 10 years	13.7	147	9%
Fatalities per 10 years	4.2	44	10%

Key collision factors	Authority	NZ
Visibility of trains	21%	23%
Queuing or stacking	14%	15%
Train operations	19%	13%
Vehicle operations	12%	12%
Condition of warning devices	13%	12%
Condition of crossing	10%	14%
Other	10%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	22%	22%	24%	14%	19%
Exposure	35%	23%	16%	16%	9%
Consequence	11%	41%	4%	43%	1%
Total ALCAM risk score	**9%**	**40%**	**26%**	**18%**	**7%**

Comments

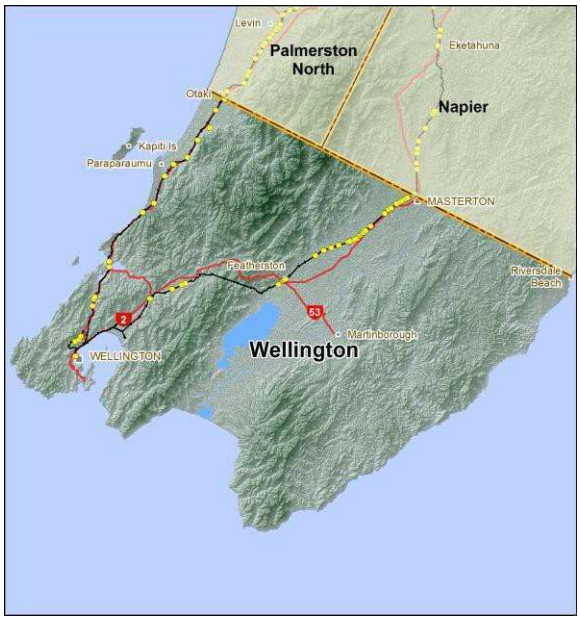
This summary includes data for the PNGL north of Napier. It should be noted that this section of the line was officially mothballed in October 2012 and there are no trains currently using it. The train volumes for this section of the PNGL were obtained prior to this date.

KiwiRail Area - Wellington

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

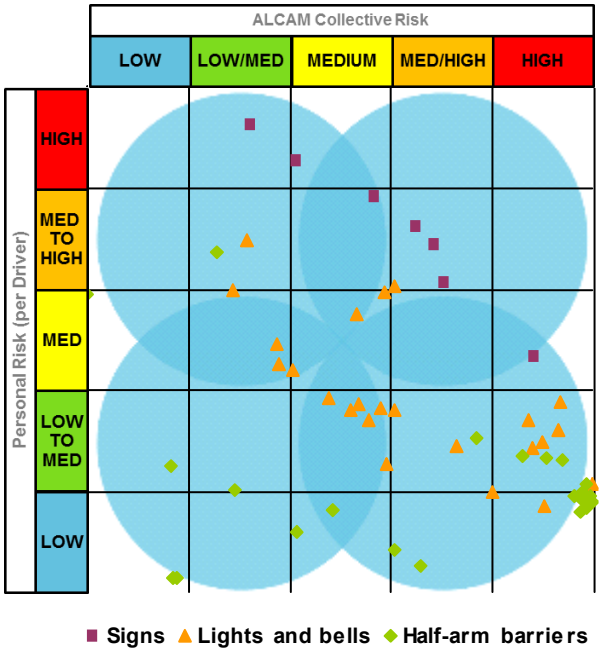
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	7	24	23
• percentage	13%	44%	43%
• in urban areas	0	10	17
• with unsealed road surface	0	0	0
• with stacking distance < 25m	0	4	5
• with a hump or dip	0	1	1
Vehicles per day (mean)	145	1,031	4,682
Vehicles per day (maximum)	527	5,300	10,014

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	8 - 8	4 - 8	0 - 88
Freight trains per day	2 - 2	2 - 9	0 - 10
Total trains per day	10 - 10	10 - 13	10 - 111



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	54	1268	4%
Collisions per 10 years	8.6	147	6%
Fatalities per 10 years	3.0	44	7%

Key collision factors	Authority	NZ
Visibility of trains	14%	23%
Queuing or stacking	20%	15%
Train operations	11%	13%
Vehicle operations	23%	12%
Condition of warning devices	17%	12%
Condition of crossing	4%	14%
Other	12%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	39%	26%	20%	6%	9%
Exposure	4%	11%	15%	28%	43%
Consequence	7%	4%	59%	17%	13%
Total ALCAM risk score	**7%**	**13%**	**24%**	**19%**	**37%**

Comments

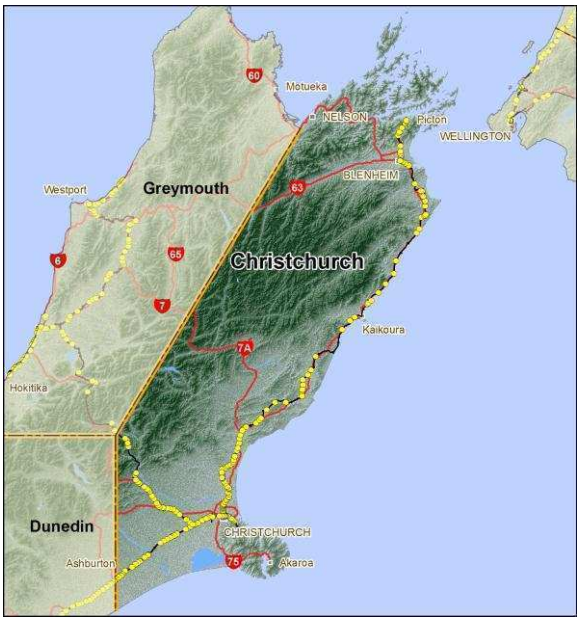
ALCAM surveys were carried out prior to the double-tracking and electrification on a 13 km section of the NIMT (MacKays Crossing to Waikanae). Some level crossings were upgraded as part of this work and the summary does not include all these changes.

KiwiRail Area - Christchurch

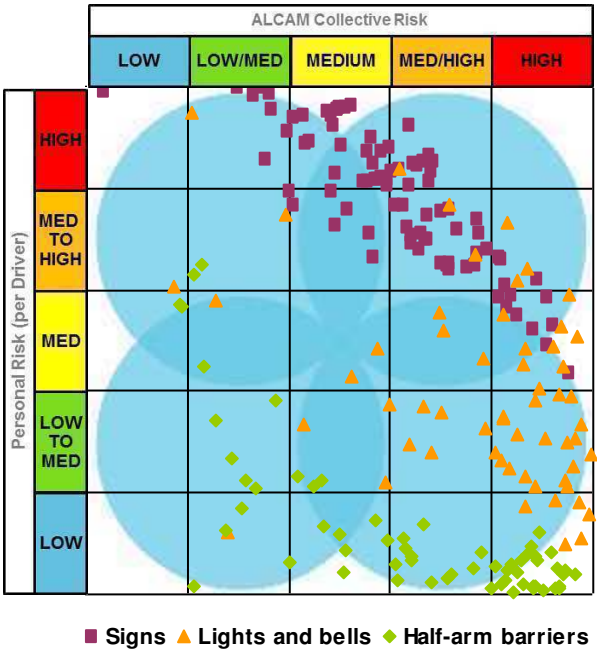
ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	89	58	62
• percentage	43%	28%	30%
• in urban areas	2	18	42
• with unsealed road surface	34	3	3
• with stacking distance < 25m	30	20	12
• with a hump or dip	42	7	2
Vehicles per day (mean)	100	1,986	7,965
Vehicles per day (maximum)	921	16,200	24,100

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	0 - 2
Freight trains per day	7 - 13	7 - 13	6 - 21
Total trains per day	9 - 15	8 - 15	6 - 23



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	209	1268	16%
Collisions per 10 years	27.7	147	19%
Fatalities per 10 years	9.5	44	22%



Key collision factors	Authority	NZ
Visibility of trains	23%	23%
Queuing or stacking	20%	15%
Train operations	9%	13%
Vehicle operations	11%	12%
Condition of warning devices	12%	12%
Condition of crossing	14%	14%
Other	10%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	13%	17%	22%	24%	24%
Exposure	11%	18%	22%	18%	30%
Consequence	2%	10%	49%	37%	2%
Total ALCAM risk score	**2%**	**11%**	**22%**	**28%**	**36%**

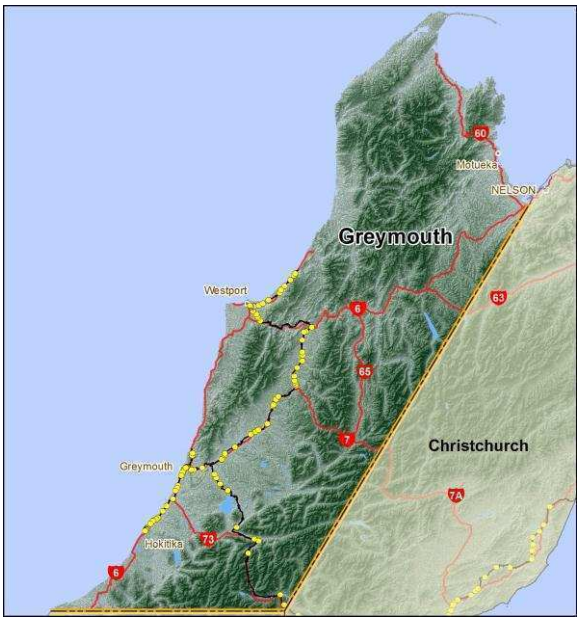
Comments

KiwiRail Area - Greymouth

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

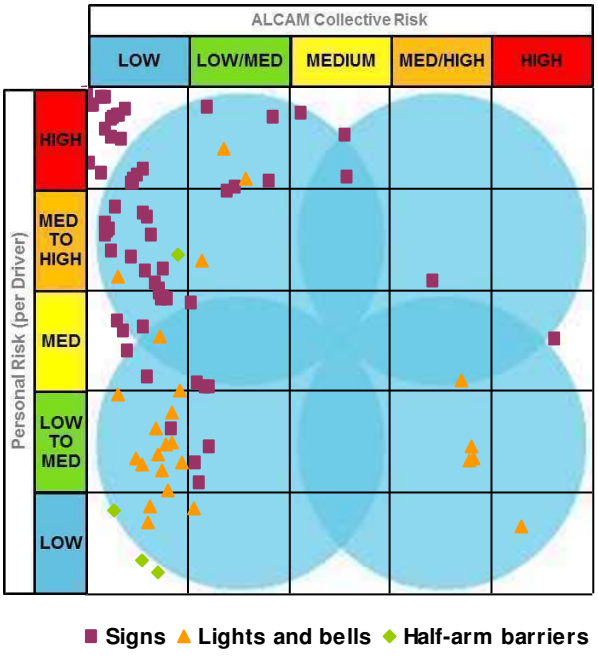
Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	62	26	4
• percentage	67%	28%	4%
• in urban areas	10	8	3
• with unsealed road surface	18	0	0
• with stacking distance < 25m	13	6	1
• with a hump or dip	23	2	0
Vehicles per day (mean)	259	1,409	3,202
Vehicles per day (maximum)	2,925	6,454	6,821

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 2	0 - 2	0 - 2
Freight trains per day	2 - 13	2 - 13	5 - 13
Total trains per day	2 - 15	2 - 15	7 - 15



ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	92	1268	7%
Collisions per 10 years	9.5	147	6%
Fatalities per 10 years	1.1	44	3%

Key collision factors	Authority	NZ
Visibility of trains	26%	23%
Queuing or stacking	11%	15%
Train operations	13%	13%
Vehicle operations	10%	12%
Condition of warning devices	13%	12%
Condition of crossing	15%	14%
Other	12%	11%



Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	18%	24%	18%	22%	17%
Exposure	24%	22%	14%	24%	16%
Consequence	78%	16%	0%	5%	0%
Total ALCAM risk score	**72%**	**17%**	**3%**	**5%**	**2%**

Comments

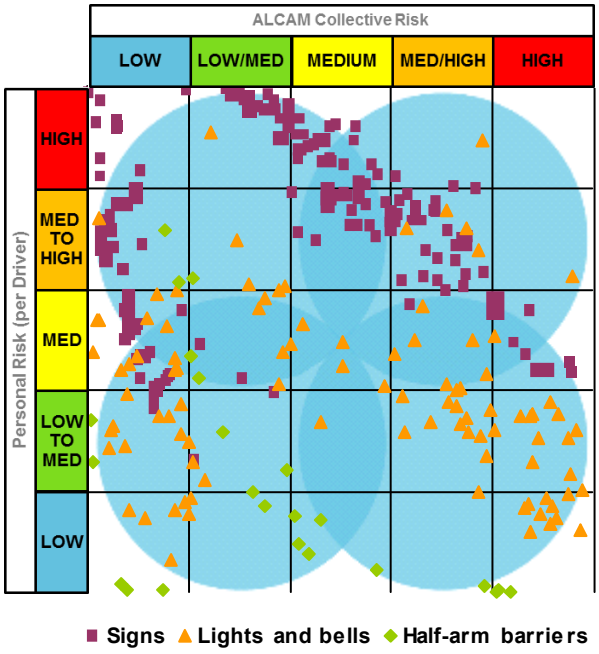
KiwiRail Area - Dunedin

ALCAM LEVEL CROSSING STATISTICAL SUMMARY

Road	Signs	Lights and bells	Half-arm barriers
Number of road level crossings	184	98	23
• percentage	60%	32%	8%
• in urban areas	13	24	12
• with unsealed road surface	73	1	0
• with stacking distance < 25m	40	20	1
• with a hump or dip	81	8	1
Vehicles per day (mean)	187	1,280	4,414
Vehicles per day (maximum)	6,000	10,280	16,093

Rail	Signs	Lights and bells	Half-arm barriers
Passenger trains per day	0 - 0	0 - 0	0 - 0
Freight trains per day	1 - 10	1 - 10	3 - 10
Total trains per day	1 - 10	1 - 10	3 - 10

ALCAM modelled outputs	Authority	NZ	Percentage
Total level crossings	305	1268	24%
Collisions per 10 years	30.7	147	21%
Fatalities per 10 years	8.2	44	19%



Key collision factors	Authority	NZ
Visibility of trains	27%	23%
Queuing or stacking	11%	15%
Train operations	13%	13%
Vehicle operations	10%	12%
Condition of warning devices	11%	12%
Condition of crossing	16%	14%
Other	11%	11%

Risk Distribution	Low	Low-Medium	Medium	Medium-High	High
Infrastructure	18%	16%	24%	30%	12%
Exposure	21%	27%	22%	17%	14%
Consequence	31%	6%	1%	61%	0%
Total ALCAM risk score	**31%**	**17%**	**21%**	**19%**	**12%**

Comments

Summary excludes passenger trains operated as part of the Taieri Gorge Railway.

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Appendix B: Installation and maintenance responsibilities around level crossings

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This section has been directly extracted from Appendix E of the NZ Transport Agency's *Traffic control devices manual part 9 – level crossings* (edition 2, 2012).

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This information is not controlled and users are referred to the NZ Transport Agency's website to obtain the latest version of the manual.

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The following table provides a basic guide to the general responsibilities for carrying out physical works and does not reflect responsibility for funding this work. Funding arrangements should be agreed in writing between the rail provider and the RCA.

While every effort has been made to describe the responsibilities correctly, there may also be formal maintenance agreements, deed of grants or legal interpretations applying to a specific location, or asset that differ from the details below.

Installation and maintenance on many of the assets require cooperation between rail and RCAs. Significant risk reductions and cost savings through can be reached though coordinating these upgrade or maintenance activities. Note that the table below only applies to level crossings on public roads. The responsibilities for private level crossings are specified in individual deed of grants, or in legislation.

For all work within the rail corridor, the RCA is required to contact KiwiRail and obtain an access permit. Likewise KiwiRail is required to obtain permits and traffic management plans for any work outside of the rail corridor. Both RCAs and KiwiRail are strongly encouraged to waive application fees where the work being undertaken is in the mutual interest of both parties.

Asset	Responsible for		Comments
	installation	maintenance and operation	
Rail			
Rail track and associated infrastructure	Rail	Rail	
Road			
Kerb and channel along road	Road	Road	Where this encroaches within 5m of the rail, all kerb and channel to be done by RCA
Pavement within 5m of rail centreline	Road/rail by agreement	Rail	Railways Act 2005, section 83(1)
Pavement more than 5m from rail centreline	Road	Road	Railways Act 2005, section 83(1)
Structures			
Road-over-rail bridges	Road	Road	Railways Act 2005, section 83(2)
Rail-over-road bridges	Rail	Rail	Railways Act 2005, section 83(3)
Rail-road share bridge	Road-rail by agreement	Road-rail by agreement	Railways Act 2005, section 83(4)
Pier protection and pier graffiti removal on rail-over-road bridges	Road	Road	

Asset	Responsible for		Comments
	installation	maintenance and operation	
Crash protection barriers			
Longitudinal crash protection barriers	Road	Road	Includes the approach to level crossing and at road-over rail bridges
Other forms of end crash protection	Road/rail by agreement	Road/rail by agreement	Includes crash cushions and bollards
Within rail corridor for protection of alarms	Rail	Rail	
Vegetation and fencing			
Fencing along the rail corridor	Landowner	Landowner	Rail operators are not required to build or maintain fences (Fencing Act 1978, section 3(1))
Clearing vegetation within rail corridor	Rail	Rail	To maintain sightlines for operational reasons
Clearing vegetation within road reserve	Road	Road	To maintain sightlines
Clearing vegetation on adjoining properties	Landowner	Landowner	To maintain sightlines. Clearing of vegetation may be done under the direction of rail
Traffic control devices			
Level crossing alarms and barriers	Road/rail by agreement	Rail	
Traffic signals linked to level crossing alarms	Road/rail by agreement	Road	Road responsibility is up to rail signal control box
Signs in advance of level crossing	Road	Road	As defined in section **Error! Reference source not found. Error! Reference source not found.**
Advance variable traffic signs activated by train	Rail-road by agreement	Rail-road by agreement	
Signs at the level crossing or within rail corridor	Rail	Rail	As defined in section **Error! Reference source not found. Error! Reference source not found.** RCA involvement is required to implement local traffic bylaw and change approach signs and road markings (Railways Act 2005, section 81(2))
Height clearance signs and devices on rail-over-road bridges	Road	Road	
Road and pavement markings	Road-rail by agreement	Road	As defined in section **Error! Reference source not found. Error! Reference source not found.**. Includes yellow box markings

Asset	Responsible for		Comments
	installation	maintenance and operation	
Alternative passive warning devices on approach to level crossings	Road/rail by agreement	Road	Includes rumble strips or other trial technology
Alternative active warning devices on approach or at level crossing	Road/rail by agreement	Road/rail by agreement	Includes actively controlled pavement markers, signs or other trial technology
At grade pedestrian level crossings and cycle facilities			
Active pedestrian alarms	Rail	Rail	
Footpath more than 5m from rail centreline	Road/rail by agreement	Road	
Footpath within 5m of rail centreline	Road/rail by agreement	Rail	Hold line may be used as boundary where agreed
Pedestrian signs	Rail	Rail	
Mazes and fencing at level crossing	Road/rail by agreement	Road	As defined in section **Error! Reference source not found. Error! Reference source not found.**
Street lighting or illumination at the level crossing	Road	Road	As defined in section **Error! Reference source not found. Error! Reference source not found.**
Pavement marking and tactile pavers	Road	Road	As defined in section **Error! Reference source not found. Error! Reference source not found.**
Street lighting			
Street lighting at the level crossing	Road	Road	
Services – utilities			
Aerial cabling over rail section of road reserve	Asset owner	Asset owner	Rail responsible for access licences and leases within rail corridor
Water, gas, electricity and petroleum	Asset owner	Asset owner	Rail responsible for access licenses and leases within rail corridor
Drainage gullies and open drains on rail corridor	Rail	Rail	
Pipeline or culvert under rail line where it forms part of a stormwater or sewerage drainage system	Road or drainage authority	Road or drainage authority	Railways Act 2005, section 74
Other drainage pipelines or culverts under rail line	Rail	Rail	

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Appendix C: Contact details for road controlling authorities and KiwiRail area offices

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North Island

Road controlling authority	RCA phone number	KiwiRail area	KiwiRail phone number	Line	Kilometerage
Far North District Council	09 401 5200	Auckland	09 270 5557	North Auckland Line	247–298km
Whangarei District Council	09 430 4200	Auckland	09 270 5557	North Auckland Line	173–247km
				Dargaville Branch	0–3km
Kaipara District Council	09 439 3123	Auckland	09 270 5557	Dargaville Branch	3–49km
				North Auckland Line	129–173km
Auckland Council	09 355 3553	Auckland	09 270 5557	Mission Bush Branch	
				North Auckland Line	0–129km
				North Island Main Trunk	625–673km
				Newmarket–Auckland Line	
				Onehunga Branch	
Waikato District Council		Hamilton East	07 848 0231	Cambridge Branch	0–12km
				East Coast Main Truck	7–20km
				Rotowaro Branch	
		Hamilton South	07 848 0222	North Island Main Trunk	551–625km
Hamilton City Council	07 838 6699	Hamilton East	07 848 0231	East Coast Main Truck	0–7km
		Hamilton South	07 848 0222	North Island Main Trunk	540–551km
Matamata-Piako District Council	07 884 0060	Hamilton East	07 848 0231	East Coast Main Truck	20–66km
				Kinleith Branch	0–18km
				Waitoa Branch	
South Waikato District Council	07 885 0340	Hamilton East	07 848 0231	Kinleith Branch	18–33km
Western Bay of Plenty District Council	07 571 8008	Hamilton East	07 848 0231	East Coast Main Truck	66–89, 111–146km
Tauranga City Council	07 577 7000	Hamilton East	07 848 0231	East Coast Main Truck	89–111km
				Mount Maunganui Branch	
Whakatane District Council	07 306 0500	Hamilton East	07 848 0231	East Coast Main Truck	146–180km
				Murupara Branch	
Waipa District Council	07 823 3800	Hamilton East	07 848 0231	Cambridge Branch	12–15km
		Hamilton South	07 848 0222	North Island Main Trunk	507–540km
Otorohanga District Council	07 873 4000	Hamilton South	07 848 0222	North Island Main Trunk	486–507km

Road controlling authority	RCA phone number	KiwiRail area	KiwiRail phone number	Line	Kilometerage
Waitomo District Council	07 878 0800	Hamilton South	07 848 0222	North Island Main Trunk	443–486km
Ruapehu District Council		Palmerston North	06 351 6827	North Island Main Trunk	278–443km
New Plymouth District Council	06 759 6060	Taranaki	06 834 2743 (Napier)	Marton–New Plymouth Line	173–213km
Stratford District Council	06 765 6099	Taranaki	06 834 2743 (Napier)	Marton–New Plymouth Line	154–173km
South Taranaki District Council	06 278 0555	Taranaki	06 834 2743 (Napier)	Kapuni Branch	
				Marton–New Plymouth Line	72–154km
Wanganui District Council	06 349 0000	Taranaki	06 834 2743 (Napier)	Castlecliff Line	
				Marton–New Plymouth Line	22–72km
				Wanganui Branch	
Rangitikei District Council	06 327 0099	Palmerston North	06 351 6827	North Island Main Trunk	171–278km
		Taranaki	06 834 2743 (Napier)	Marton–New Plymouth Line	0–22km
Manawatu District Council	06 323 0000	Palmerston North	06 351 6827	North Island Main Trunk	142–171km
Palmerston North City Council	06 356 8199	Palmerston North	06 351 6827	North Island Main Trunk	120–142km
				Palmerston North–Gisborne Line	0–16km
Gisborne District Council	06 867 2049	Napier	06 834 2743	Palmerston North–Gisborne Line	347–392km
Wairoa District Council	06 838 7309	Napier	06 834 2743	Palmerston North–Gisborne Line	242–347km
Hastings District Council	06 871 5000	Napier	06 834 2743	Palmerston North–Gisborne Line	131–171, 194–242km
Napier City Council	06 835 7579	Napier	06 834 2743	Napier Freight Branch	
				Palmerston North–Gisborne Line	171–194km
Central Hawke's Bay District Council	06 857 7179	Napier	06 834 2743	Palmerston North–Gisborne Line	80–131km
Tararua District Council	06 374 4080	Napier	06 834 2743	Palmerston North–Gisborne Line	16–80km
				Wairarapa Line	121–171km

Road controlling authority	RCA phone number	KiwiRail area	KiwiRail phone number	Line	Kilometerage
Horowhenua District Council	06 366 0999	Palmerston North	06 351 6827	North Island Main Trunk	77–120km
Kapiti Coast District Council		Wellington	04 498 3174	North Island Main Trunk	36–77km
Porirua City Council	04 237 5089	Wellington	04 498 3174	North Island Main Trunk	16–36km
Masterton District Council		Wellington	04 498 3174	Wairarapa Line	86–121km
Carterton District Council	06 379 4030	Wellington	04 498 3174	Wairarapa Line	66–86km
South Wairarapa District Council	06 306 9611	Wellington	04 498 3174	Wairarapa Line	46–66km
Upper Hutt City Council	04 527 2169	Wellington	04 498 3174	Wairarapa Line	26–46km
Hutt City Council	04 570 6666	Wellington	04 498 3174	Melling Branch	
				Wairarapa Line	9–26km
Wellington City Council	04 499 4444	Wellington	04 498 3174	Johnsonville Line	
				Wairarapa Line	0–9km
				North Island Main Trunk	0–16km

South Island

Road controlling authority	RCA phone number	KiwiRail area	KiwiRail phone number	Line	Kilometerage
Marlborough District Council	03 520 7400	Christchurch	03 339 3855	Main North Line	251–348km
Kaikoura District Council	03 319 5026	Christchurch	03 339 3855	Main North Line	162–251km
Hurunui District Council	03 314 8816	Christchurch	03 339 3855	Main North Line	44–162km
Waimakariri District Council	03 311 8900	Christchurch	03 339 3855	Main North Line	16–44km
Christchurch City Council	03 941 8999	Christchurch	03 339 3855	Main North Line	0–16km
				Main South Line	0–24km
Westland District Council	03 756 9045	Greymouth	03 769 8223	Hokitika Line	14–40km
				Midland Line	121–149km
Grey District Council	03 769 8600	Greymouth	03 769 8223	Hokitika Line	0–14km
				Midland Line	149–213km
				Rapahoe Branch	
				Stillwater–Ngakawau Line	0–33km
Buller District Council	03 788 9111	Greymouth	03 769 8223	Stillwater–Ngakawau Line	33–162km
Selwyn District Council	03 347 2800	Christchurch	03 339 3855	Midland Line	0–121km
				Main South Line	24–67km
Ashburton District Council	03 307 7700	Christchurch	03 339 3855	Main South Line	67–128km
Timaru District Council	03 687 7200	Dunedin	03 466 3155	Main South Line	128–184km
Waimate District Council	03 689 7771	Dunedin	03 466 3155	Main South Line	184–239km
Waitaki District Council	03 433 0300	Dunedin	03 466 3155	Main South Line	239–325km
Dunedin City Council	03 477 4000	Dunedin	03 466 3155	Main South Line	325–415km
				Port Chalmers Branch	
				Taieri Branch	
Clutha District Council	03 419 0200	Dunedin	03 466 3155	Finegand Branch	
				Main South Line	415–518km
Gore District Council	03 209 0330	Dunedin	03 466 3155	Main South Line	518–557km
Southland District Council	0800 732 732	Dunedin	03 466 3155	Main South Line	557–592km
				Ohai Line	10–80km
Invercargill City Council	03 211 1777	Dunedin	03 466 3155	Bluff Branch	
				Main South Line	592–602km
				Ohai Line	0–10km