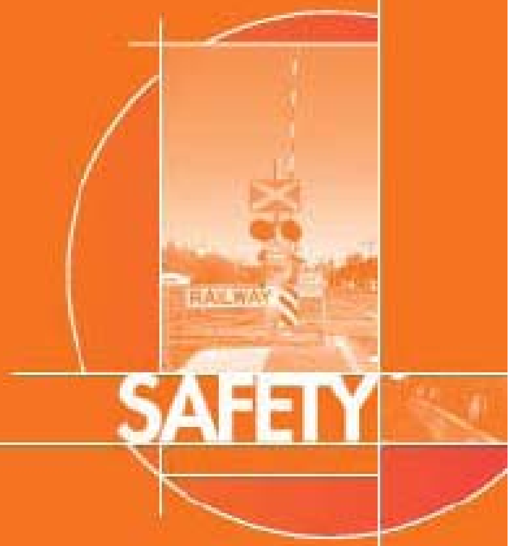
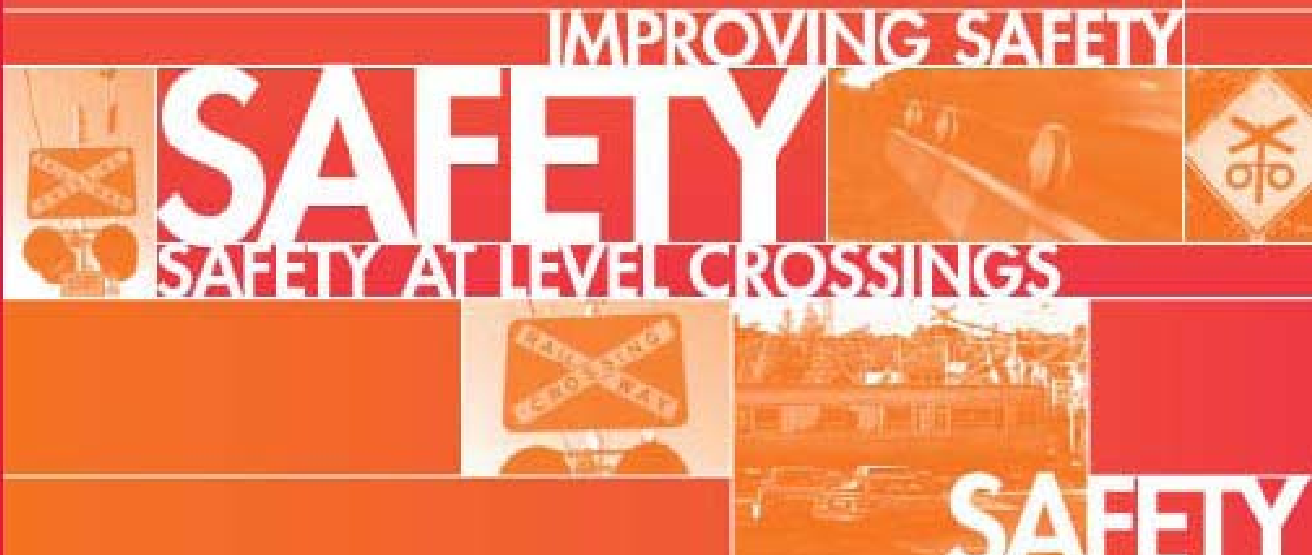


ROAD SAFETY COMMITTEE

INQUIRY INTO IMPROVING SAFETY AT LEVEL CROSSINGS

DECEMBER 2008



PARLIAMENT OF VICTORIA

ROAD SAFETY COMMITTEE **INQUIRY INTO SAFETY AT LEVEL CROSSINGS** DECEMBER 2008

Road Safety Committee

Inquiry into Improving Safety at Level Crossings

December 2008

Date of adoption 11 December 2008

Inquiry into Improving Safety at Level Crossings

Report of the Road Safety Committee on the Inquiry into Improving Safety at Level Crossings

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Committee Members

This Inquiry was conducted during the term of the 56th Parliament.

Committee Members

Mr John Eren, MP	Chair
Mr David Koch, MLC	Deputy Chair
Mr Craig Langdon, MP	
Mr Shaun Leane, MLC	
Mr Terry Mulder, MP	
Mr Ian Trezise, MP	
Mr Paul Weller, MP	

Secretariat

Ms Alexandra Douglas	Executive Officer
Mr Lawrie Groom	Principal Research Officer
Mr David Baker	Research Officer until 20 August 2008
Ms Georgia Ng	Office Manager until 30 November 2007
Ms Kate Woodland	Office Manager from 17 December 2007

The Road Safety Committee

The Victorian Road Safety Committee is constituted under the *Parliamentary Committees Act* 2003, as amended.

The Committee comprises seven Members of Parliament drawn from both houses and all parties. The Chair is elected by Members of the Committee.

Section 15 of the *Parliamentary Committees Act* 2003, describes the functions of the Committee as:

> The functions of the Road Safety Committee are, if so required or permitted under this Act, to inquire into, consider and report to the Parliament on any proposal, matter or thing concerned with –
>
> (a) road trauma;
>
> (b) safety on roads and related matters.

Committee Address

Address:	Parliament House Spring Street East Melbourne Victoria 3002
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Terms of Reference

By resolution of the Legislative Council on 18 July 2007 that the Road Safety Committee undertake the following inquiry –

That this House requires the Road Safety Committee to inquire into and report by 29 February 2008 on existing, new and developing technologies for implementation to improve safety at level crossings.

The Reporting date was extended to 31 December 2008 by resolution of the Legislative Council on 9 October 2008.

Chair's Foreword

This Inquiry was undertaken while the community was still trying to come to terms with and comprehend the level crossing tragedy that occurred near Kerang, in June 2007.

After many months of investigations conducted by the Road Safety Committee, we present this report on improving safety at level crossings. The recommendations are made with the sole objective of reducing fatalities and injury at level crossings.

Having said that I should also state that safety at level crossings is a shared responsibility and no amount of safety technologies implemented at level crossings is going to prevent crashes unless we collectively take care and pay attention while driving. Importantly we need to respect and take trains seriously and never underestimate their speed and weight.

Nevertheless we are human, and humans are prone to make mistakes, and as governments we should try as much as practicable to make level crossings as safe as we can. The Committee also understands that of the total fatalities that occur on our roads, less than one per cent of the fatalities occur as a result of level crossing crashes.

Victoria has 1,872 road and 843 pedestrian public level crossings, and more public crossings than any other State or Territory in Australia. There are also many crossings over railway tracks into private land.

Despite Government action to increase penalties for infringements, upgrade safety and reduce speed limits at some crossings, a comprehensive package of safety measures needs to be planned, funded and implemented in an energetic manner. Unless this is done and new measures implemented, it will be many decades before safety at crossings is improved.

The large cost of highly specified flashing lights, bells and boom barriers, and the even greater cost of constructing bridges or tunnels, means that it is very unlikely that the State will ever be able to afford the cost of upgrading every level crossing to these standards. This strongly points to the need for leadership in a new direction.

A new direction that includes using lower cost warning systems and Intelligent Transport Systems, and a strategy that brings all the measures together.

New measures that should be implemented include removing obstacles for the use of lower cost technology and Intelligent Transport Systems. This is not a new issue but is now urgent, deserving high level action by the Government.

Technologies, including those using Global Positioning Systems (GPS), should also be trialled and introduced to support the enforcement of road rules at crossings.

Work is also necessary at the national level to ensure that actions, especially those involving new and developing technologies at the rail/road interface, are uniform throughout Australia. Clearly Victoria has much to offer and a substantial amount to gain in safety by being energetic in the national forum.

Road speed limits should be reduced to 80 km/h at the approach to level crossings on all roads with a 100 or 110 km/h posted speed limit, and the safety of crossings on B-double and B-triple routes should be reassessed.

A consultative regional level crossing closing program to identify and close surplus crossings needs to be undertaken. This action would help to reduce the number of crossings and thus the scale of the problem facing the community.

The State Government has identified over 20,000 safety issues at crossings in a survey completed in 2007. The Department of Transport should prepare, with all the rail and road stakeholders, an overall cost estimate of the works required to address the issues identified in the survey. The Department should then prepare a funded, three-year program to implement the required safety measures.

The Committee heard evidence from the Victorian Railway Crossing Safety Steering Committee and considers that the value of this consultative body would be enhanced if it was more transparent and produced an annual progress report on its work, together with that of its sub-committees.

Government responses to recommendations made on level crossing crashes by the Chief Investigator, Transport and Marine Investigations, the State Coroner, and the Australian Transport Safety Bureau should also be published.

These and the other measures recommended by the Committee should be brought together by the Department of Transport in a level crossing safety strategy.

Finally, I thank my Parliamentary colleagues on this Committee for their sincere commitment and bi-partisan approach, which is in the true tradition of this very important Committee. Also, of course, I thank the dedicated staff of the Committee for their hard work; namely our Executive Officer Ms Alexandra Douglas, Research Officer Mr Lawrie Groom and Office Manager Ms Kate Woodland.

John Eren, MLA
Chair

Executive Summary

Victoria has more level crossings than any other State or Territory in Australia. Of particular concern to the Committee are the 1,087 crossings in regional and rural Victoria which do not provide any warnings to drivers and pedestrians of approaching trains. These crossings, known as passive crossings, only have static Give Way or Stop signs, and safety relies on the ability of users to be able to see a train in time to give way or stop.

This is one reason why Victoria's safety record at level crossings does not compare well with the rest of Australia, and must and can be improved.

During the six months prior to the commencement of this Inquiry, from January to June 2007, there were 11 crashes between a train and a vehicle or pedestrian at level crossings, which resulted in 13 fatalities. Two of these fatalities were pedestrians. In addition, rail operators reported 135 near-misses with vehicles or pedestrians. V/Line Passenger operations alone reported an average of approximately one near-miss each week on their country lines. Clearly, each near-miss is a potential crash and injury, or worse, a fatality.

Crashes and fatalities at crossings are caused, in the main, by the failure of drivers and pedestrians to detect approaching trains, or if the train is detected, to ignore or not to comprehend the risk of a crash. If there is no safety technology at these crossings to warn users of approaching trains, or if the crossings are poorly designed or maintained, the task of the driver or pedestrian to make a judgement about whether it is safe to cross, can be very difficult.

Ideally, all crossings should either be grade separated with a bridge or underpass, or designed and maintained to recognised standards, and equipped with flashing lights and boom barriers. However, due to the high cost of engineering works and highly specified warning systems, it is not feasible, especially in rural areas where crossing use is low, for the Government to allocate funds for a total system upgrade.

One measure to improve safety at crossings is to introduce lower-cost new and developing technologies that could potentially increase safety at crossings. However, to date, consideration of these measures has been rejected by the Government and the rail operators, as they are not considered to be 'fail-safe'. A system is 'fail-safe' if, when it fails, it fails in a safe, predictable or specified manner, and in a way that alerts users to the failure.

The Committee considers that technologies which would improve safety at level crossings should not automatically be discounted. This view is shared by Public Transport Safety Victoria. The Government and the rail operators have a duty of care to protect the community.

The Committee considers that lower-costing warning technology should be used as a supplement to existing controls, particularly at passive crossings. Lower-costing warning systems should not be used as a replacement or substitute for highly specified, fail-safe level crossing controls. Accordingly, a priority of the Government should be to facilitate the implementation of reliable lower-costing systems, including Intelligent Transport Systems, that can warn drivers of approaching trains and assist them to comply with the road rules when approaching and using a crossing. Reliability performance criteria will need to be developed and legislation may be required to support the introduction of this technology.

The other priority of the Government should be to foreshadow the introduction of technology that supports enforcement of the road rules at level crossings. For the longer term, the Committee considers that the Government should facilitate the introduction of technologies that can actively control trains and vehicles as they approach crossings.

Two measures which do not require technology but could nevertheless be introduced immediately is a program, funded by the Government, to close surplus level crossings and reducing the road speed limit at the approaches of crossings.

The Government has been preparing a level crossing safety strategy to guide decision making and the allocation of resources. The strategy should foreshadow a significant increase in funding for the State’s level crossing upgrade program. Additional funds will be necessary if the Government is to address, within a reasonable timeframe, the many safety issues identified in a survey of level crossings completed by the Department of Transport in 2007. There may also be value in examining more cost-effective ways of upgrading level crossings.

Unless a number of surplus level crossings are closed, or new, lower-cost technological measures are implemented, the Committee considers it will be many decades before safety at crossings can be improved.

Recommendations

Chapter 1 - Introduction

1. **That the Victorian Railway Crossing Safety Steering Committee annually produces a progress report on its work, together with the work of all of its sub-committees.**

2. **That the Auditor-General undertakes a review of the cost-efficiency of the Level Crossing Upgrade Program.**

Chapter 2 - The Problem

3. **That the Department of Transport consolidates Victorian level crossing reportable data and regularly publishes up-to-date statistics that would assist rail and road authorities to gain a greater understanding of level crossing vehicle and pedestrian crashes to enable appropriate countermeasures.**

4. **That the Department of Transport finalises and releases the Level Crossing Safety Strategy by 30 June 2009.**

Chapter 3 - Overview of Current Safety Measures

5. **That the Department of Transport investigates and reports on the reasons for the failure of warning systems at active level crossings, and takes action to reduce the frequency of failure.**

6. **That the Department of Transport requests that the Minister for Public Transport seeks uniformity of Standards at the Australian Transport Council by advocating the adoption of national standards.**

7. **That the Department of Transport adopts policy guidelines which set minimum safety standards for different types of level crossings.**

8. **That the Department of Transport publishes an analysis of the results of the Australian Level Crossing Assessment Model survey, including an overview of the works required, and whose responsibility it is to resolve the issues identified in the survey.**

9. **That the Department of Transport, together with the level crossing stakeholders, prepare a funded, three-year program to implement the safety issues identified in the**

Australian Level Crossing Assessment Model surveys. The program should be regularly monitored and the results published annually.

10. **That the Department of Transport and VicRoads trial:**

    a) **The introduction of 'railway crossing zones', and, if successful, the application of the zones across the State to all level crossings, and**

    b) **Solar powered variable speed limit signs on approach roads to crossings with safety issues.**

11. **That VicRoads reduces road speed limits to 80 km/h at the approach to level crossings on all roads with a 100 or 110 km/h posted speed limit.**

12. **That VicRoads assess public understanding of yellow box pavement markings and accompanying signs, and if required, use the research to inform a community awareness campaign.**

13. **That VicRoads determines the optimum extent of hatching that would encourage drivers to adhere to the requirement to keep clear and not stop on the tracks, and if necessary seeks an amendment to the Australian Standard.**

14. **That the Department of Transport monitors action being taken by Local Government to address safety issues at level crossings and writes to those Councils with outstanding issues to remind them of the responsibility they share for level crossing safety.**

15. **That the Department of Transport requests from Standards Australia to revise the sight distance provisions in Australian Standard, AS 1742.7-2007, to reflect more accurately the stopping and sight distances requirements for heavy vehicles.**

16. **That the Department of Transport reviews stopping and sight distances set for Australian Level Crossing Assessment Model against the research published by the Australian Transport Safety Bureau, and reassesses all level crossings on approved B-double and B-triple routes.**

17. That the Department of Transport:

a) Undertakes a consultative regional surplus level crossing closing program with the rail operators, road authorities and road users;

b) Develops criteria to assist in the identification of surplus level crossings that could be closed;

c) Accepts responsibility for the full cost of the surplus level crossing closing program, and

d) Plans and undertakes the upgrade of nearby crossings in conjunction with one or more of the crossings that are planned to be closed.

18. That the Department of Transport publishes the results of the road safety camera trials, and if the trials are successful, implements a program to roll-out the installation of safety cameras at level crossings to detect and enforce level crossing offences.

19. That the Department of Transport evaluates the effectiveness of level crossing safety education programs, and designs a safety education program that is linked to a campaign of effective enforcement.

20. That the Department of Transport investigates improved lighting systems for trains, and undertakes, within 12 months, a trial of low-profile strobe lights on trains. The Department of Transport should publish the results of the investigation and trial.

21. That the Department of Transport enforces the use and condition of reflectors on trains, to ensure that rail providers maintain the rolling stock to the appropriate Standard. Penalties should apply if the rail providers disregard the Standard.

22. That the Department of Transport ensures that the livery of trains is in mandatory, high visibility contrasting colours.

23. That the Department of Transport regularly inspects the livery of trains to ensure that they are painted in high visibility contrasting colours, are well maintained and kept clean. Penalties should be applied if trains are not painted in high visibility contrasting colours, or are not well maintained and kept clean.

24. **That VicRoads investigates and trials the use of perceptual countermeasures, such as line markings, with the aim of slowing the speed of vehicles approaching level crossings. If the trials prove successful, these measures should be adopted.**

25. **That once the evaluation of rumble strips is completed, VicRoads determines whether additional rumble strips should be installed.**

26. **That VicRoads investigates the use of tactile stimuli, including speed bumps, coloured raised pavement markers and changes to the texture of approach roads to level crossings.**

Chapter 4 - New and Developing Technologies

27. **That the use of low-cost warning technology be used as a supplement, or enhancement, to existing controls at level crossings, particularly at passive crossings.**

28. **That the Department of Transport:**

    a) **Consults with Accredited Rail Operators and Public Transport Safety Victoria and develops reliability performance criteria that non fail-safe technology should satisfy;**

    b) **Initiates the inclusion of low-cost warning technology into railway safety standards;**

    c) **Investigates whether legislation is required to introduce non fail-safe technology as a means of improving safety at level crossings; and**

    d) **Trials and publishes the results of low-cost systems which would be suitable for use as a supplement to existing controls at passive level crossings. The results of these trials should be published.**

29. **That the Department of Transport investigates the use of axel or wheel counters to detect trains approaching level crossings.**

30. **That the Department of Transport, in collaboration with VicRoads, investigates the use of solar powered lights to improve the conspicuity of passive level crossings.**

31. That the Department of Transport requests the Minister for Public Transport to pursue, through the Australian Transport Council, national adoption of new and developing technologies, including Intelligent Transport Systems, that would improve safety at level crossings.

32. That the Victorian Government co-ordinates, with ITS Australia, the financial and technical support required to develop, trial and adopt Intelligent Transport Systems infrastructure for Victoria, as a matter of urgency.

33. That the Department of Transport actively trials, promotes and encourages the use of Intelligent Transport Systems at the rail/road interface.

34. That VicRoads maps the location and types of level crossings for use in Global Positioning Systems by the end of 2009.

35. That the Department of Transport, in consultation with the rail authorities, commence a selection process and trial Intelligent Transport Systems, which can provide active warnings to drivers of approaching trains at level crossings.

36. That VicRoads maps the speed zones of Victoria's road system by the end of 2009.

37. That the Department of Transport, together with VicRoads and the Transport Accident Commission, investigates and trials the use and application of Intelligent Speed Adaptation technology on the approach roads to level crossings.

38. That the Department of Transport and VicRoads monitors and reports on the Western Australian investigation into Intelligent Speed Adaptation technology at level crossings. If the trial proves successful, the technology should be made available in Victoria.

39. That the Department of Transport monitors and reports on the development of Advanced Train Management Systems.

40. That, if the evaluation of the trial into train-activated advance warning signs is successful, VicRoads should implement advance active warning signs at crossings with sight distance issues within three years.

41. That the Department of Transport investigates the use of intelligent road studs as a supplement to other active devices at level crossings for pedestrians.

42. That the Department of Transport implements the pedestrian crossing measures that are demonstrated in the trial to be effective. These measures should be introduced at high-risk active crossings.

43. That the Department of Transport investigates:

a) The feasibility of incorporating the monitoring, and later the enforcement of, driver behaviour at level crossings into the Intelligent Access Program;

b) A scheme to subsidise the phased introduction of Intelligent Transport Systems technology into heavy vehicles and buses, especially heavy vehicles and buses owned or operated by smaller Victorian transport companies and farmers, and

c) A scheme to fund the technology subsidy through the introduction of a fixed-term crossing safety levy on the railway industry.

44. That the Department of Transport:

a) Publishes the Government's responses to the recommendations in the report of the Chief Investigator, Transport and Marine Investigations into the fatal level crossing crash near Kerang, in June 2007, and

b) Publishes the Government's responses to recommendations made on all level crossing crashes by the Chief Investigator, Transport and Marine Investigations, the State Coroner and the Australian Transport Safety Bureau.

Abbreviations and Definitions

Accredited Rail Operator

A rail infrastructure manager or rolling stock operator accredited by Public Transport Safety Victoria under the Rail Safety Act 2006.

Active Advance Warning Signs

Train activated warning signs with yellow flashing lights located on the roadside about 250m in advance of level crossings.

Active Crossing

A level crossing with train activated warning devices such as flashing lights or bells and boom barriers which warn drivers and pedestrians of approaching trains.

ALCAM

Australian Level Crossing Assessment Model, an assessment tool used to assist in the prioritisation of level crossings according to comparative safety risk.

ARA

Australasian Railway Association, the railway industry peak body.

ARTC

Australian Rail Track Corporation Ltd, a Commonwealth owned company which is the accredited rail infrastructure manager of Victorian interstate standard gauge railway tracks.

Arterial Roads

Designated freeways and major roads which carry through traffic and link suburbs, major activity centres, major towns and regions. VicRoads is responsible for the management of these roads.

ATA

Australian Trucking Association.

ATC

Australian Transport Council, a ministerial forum for Commonwealth, State and Territory consultations. The Council provides advice to governments on the co-ordination and integration of transport and road policy issues at a national level.

ATSB

Australian Transport Safety Bureau, an independent body within the Commonwealth Department of Infrastructure, Transport, Regional Development and Local Government, the bureau investigates crashes and serious incidents on the Defined Interstate Rail

Network. The ATSB may also investigate intrastate rail crashes and serious incidents.

Axel or Wheel Counters

Train detection technology used in signalling systems.

Chief Investigator, Transport and Marine Safety Investigation

A statutory position, the Chief Investigator investigates public transport and marine safety matters, including level crossing crashes.

Connex Melbourne Pty Ltd

An accredited rolling stock operator of trains, and the rail infrastructure manager of the electrified Melbourne metropolitan suburban network.

Dedicated Short Range Communications (DSRC)

Short range radio technology which can broadcast data from infrastructure to vehicles or from vehicle to vehicle.

Defined Interstate Rail Network (DIRN)

The standard gauge interstate main rail line linking the capital cities and certain regional centres.

Department of Infrastructure

a former Government department. On 30 April 2008, the Department of Infrastructure was restructured and renamed the Department of Transport.

Department of Transport

A department of the Government of Victoria which was created on 30 April 2008. The Department co-ordinates Victoria's public transport network.

Fail-safe

A system is considered to be ‘fail-safe’ if, when it fails, it fails in a safe, predictable or specified mode, and in a way that alerts users of the failure.

GPS

Global Positioning System which uses satellites that transmit signals to determine the location of the receivers.

Grade Separation

Infrastructure, such as a railway bridge, underpass or tunnel, which separates roads and pedestrian paths from railway tracks.

ISA

Intelligent Speed Adaptation is intelligent transport system technology which can actively control the speed of vehicles.

ITS

Intelligent Transport Systems. These systems can control the operation of trains and vehicles, and can transfer information between trains, vehicles and their associated infrastructure about location, speed of travel, direction of movement, up-coming features and hazards, and estimated times of arrival.

LCLCWD

Low Cost Level Crossing Warning Devices, level crossing warning devices which are intended to provide treatment for low volume roads to augment passive controls at a lower-cost than providing active protection.

Level Crossing

Is where a road crosses railway tracks at substantially the same level.

Local Roads

Roads which are not arterial roads, most of which are the responsibility of Local Government.

NTC

National Transport Commission, a Commonwealth statutory authority which develops reforms for transport Ministers on the Australian Transport Council. The Commission also plays a role co-ordinating and monitoring implementation of transport reforms.

Occupation Crossing

A level crossing providing access to private land.

Passive Crossing

A level crossing where the control of vehicle or pedestrian traffic is by signs and pavement markings. There are no train activated flashing lights, bells or boom barriers to warn users of approaching trains.

Pedestrian Level Crossing

A level crossing designed for use by pedestrians.

PTSV

Public Transport Safety Victoria, an independent statutory office, the Director PTSV regulates the safety of train operations in Victoria by accrediting train operators and monitoring their safety performance.

Queuing

A safety issue at a level crossings which occurs when a vehicle entering a level crossing is trapped on the railway tracks because there is insufficient space on the exit side of the crossing to accommodate the vehicle.

Rail Industry Safety and Standards Board

Owned by the ARA, the Board develops national rail industry standards, rules and codes of practice.

Rail Infrastructure Manager

A person or body which controls rail infrastructure.

Railway Crossing Project Delivery Group

A sub-committee of the Victorian Railway Crossing Safety Steering Committee which consists of stakeholders responsible for Victoria's railway crossing upgrade program.

Railway Crossing Technical Group

a sub-committee of the Victorian Railway Crossing Safety Steering Committee responsible for advising that Committee on technical and engineering matters relating to level crossing safety in Victoria.

Rolling Stock

A vehicle that operates on or uses a railway track, and includes the locomotive, carriage and wagon.

Rolling Stock Operator

A person or body which operates rolling stock on a railway.

Short Stacking

A safety issue at a level crossing which occurs when a vehicle, especially a long road vehicle, which has passed through a level crossing is prevented by other vehicles on an adjacent intersection or by traffic controls (such as traffic lights) from safely clearing the railway tracks.

TAC

Transport Accident Commission, a Government organisation, the TAC administers compensation for Victorians who are injured or die as a result of a transport crash, including a crash at a level crossing.

V/Line Passenger Pty Ltd

Owned by the Government, V/Line Passenger is the accredited rolling stock operator of trains and the rail infrastructure manager of the Victorian intrastate regional network.

VicRoads

The registered business name of the Roads Corporation, VicRoads is a statutory corporation of the Victorian Government which manages arterial roads, implements road safety strategies and programs and provides driver licences and vehicle registration services.

Victorian Rail Industry Operators Group

Prepares Victorian railway standards. The Group includes representatives of the Public Transport Division of the Department of Transport, VicTrack, Pacific National, VicTrack, V/Line Passenger, Connex Melbourne, Yarra Trams, and the Australian Rail Track Corporation.

Victorian Railway Crossing Safety Steering Committee

A consultative Committee which advises the Minister for Public Transport on level crossing safety. Membership comprises representatives of the Department of Transport, VicTrack, VicRoads, Municipal Association of Victoria, Chief Commissioner of Police and V/Line. Public Transport Safety Victoria has observer status.

VicTrack

A statutory corporation which is responsible for implementation of Victoria's level crossing upgrade program.

Chapter

1

Introduction

Background

The Committee recognises that even though level crossing safety is an issue of great concern to the community and industry, the road toll at crossings is less than one per cent of the national road toll.[1]

However, Australia's safety record at level crossings could be improved. A 2004 United Kingdom study by the Rail Safety and Standards Board, *Road Vehicle Level Crossings Special Topic Report*, noted that Australia has a higher average number of fatalities, per crossing per year, than Japan, the United States and Great Britain.[2]

Within Australia, Victoria's safety record at level crossings does not compare well, and in the four years from 2001-02 to 2005-06, Victoria had the highest number of crossing-related serious injuries, and the second highest number of rail-related fatalities.[3]

The Australian Transport Safety Bureau (ATSB), in its submission to the Inquiry, compared Victoria's safety record at level crossings. The ATSB noted that:

> A breakdown of level crossing collisions over the last six years by state and territory shows that Victoria had the highest number of both car-train collisions and pedestrian-train collisions for each year. Victoria accounts for around one-third of train-car collisions and one-half of all train-person collisions. When normalised by the number of train-kilometres, Victoria's figures are closer to, but still well above the average.[4]

During the six month period prior to the commencement of this Inquiry, from January to June 2007, there were 11 crashes between a train and a vehicle or pedestrian at level crossings in Victoria that resulted in 13 fatalities. Two of these fatalities were pedestrians. In addition, rail operators reported 135 near-misses with vehicles or pedestrians.[5] V/Line Passenger operations alone reported an average of approximately one near-miss each week on their country lines.[6] Clearly, each near-miss is a potential crash and injury, or worse, a fatality.

By far the worst crash in living memory in Victoria was the event near Kerang, on 5 June 2007, when a heavy vehicle crashed into a V/Line passenger train which resulted in 11 fatalities. What distinguishes that crash from most level crossing incidents is that all the fatalities were train passengers.

With the increase of both train and heavy vehicle traffic, and the large number of crossings in this State, the potential for another such catastrophic event is of great concern and was the precursor to this Inquiry.

The Inquiry

Terms of Reference

On 18 July 2007, the Road Safety Committee was issued with a reference by the Legislative Council to inquire into and report on existing, new and developing technologies for implementation to improve safety at level crossings.

The Terms of Reference are quite explicit and restrict the Committee to report on existing technology in use at public level crossings, new technology that is being trialled or planned to be trialled or is worth investigating and trialling in Victoria, and finally, the types of developing technologies that should be monitored for future application.

The challenge for the Committee was to consider and recommend the feasibility of introducing lower-cost technologies so that some form of warning can be provided to drivers and pedestrians of approaching trains at the many crossings in regional and rural Victoria that rely on Stop or Give Way signs.

Submissions and Hearings

In August 2007, the Committee wrote and invited submissions from government departments, scientists, consultants, professional and industrial organisations throughout Australia, including those involved in the investigation of crashes, and the regulation and provision of transport services, rail and road infrastructure and technology.

Advertisements were placed in *The Age, Herald Sun, The Australian* and major Victorian regional newspapers, advising the public of the Terms of Reference and inviting submissions.

Fifty submissions were received from government departments, rail operators and regulators, road safety organisations, associations, research bodies, developers of technologies and members of the public. See Appendix A for a list of submissions received by the Committee.

Public hearings were conducted between March and May 2008. The Committee heard evidence from representatives of government departments, rail and road transport industries, as well as specialists in rail and road safety, Intelligent Transport Systems and developers of technologies. The Committee also heard evidence from Dr Eric Wigglesworth, Honorary, Senior Research Fellow, Monash University Accident Research Centre, who has specialised in rail research for many decades. See Appendix B for a list of the public hearings.

The submissions and evidence referred to existing, new and developing technologies, as well as other measures that could be taken to improve safety, including how driver behaviour could be improved through better warnings and improvements at crossings, driver education and enforcement.

Submissions identified the need for improved data, greater research into understanding driver and pedestrian behaviour, more investigation into technologies and the validation of technologies through trials.

Inspections

In February 2008, the Committee undertook an inspection of ten active and passive level crossings, including some crash sites, with officers of the then Department of Infrastructure, now Department of Transport, in the City of Ballarat and the Shires of Colac-Otway, Corangamite, Hepburn, Moorabool, Pyrenees and Surf Coast.

During the inspections the Committee noted the failure of some drivers to obey Stop signs at crossings, and where the sighting of a train would be difficult due to the geometry of the rail and road intersection, and overgrown rail and roadside vegetation.

The inspection also included viewing numerous crossings from the train driver’s cabin of a V/Line operated VLocity train travelling from Ballarat to Southern Cross station. This experience assisted the Committee to appreciate the number of crossings on this line, the speed at which they are approached by the train, the difficulty the train would have stopping or even slowing to reduce the impact of a crash, and the problems train drivers have sighting some crossings due to bends in the track, and the growth of vegetation along the track and at intersecting roads.

Forum

In addition to the public hearings, the Committee conducted a two day Forum on 21 and 22 July 2008, during which presentations of new and developing technologies were made, and discussions on the operation and potential of various devices and systems were held with the Committee.

The first day focused on new and developing technologies that may have the potential to improve safety at level crossings. See Appendix C for a list of the presentations.

On day two of the Forum, the Committee heard from experts who presented views on the merits of 'fail-safe'

There are several impediments to the implementation of a number of the new and developing technologies, and on the second day of the Forum the Committee concentrated on examining a significant issue, the rejection of technologies or systems that are considered not to be 'fail-safe', and whether it is possible to improve safety at crossings by supplementing existing measures with cost-effective but reliable systems.

A system is 'fail-safe' if, when it fails, it fails in a safe, predictable or specified mode, and in a way that alerts users to the failure. The failure could be in the warning or train detection devices, the communication system between the detectors and warning devices, or in the power supply. Therefore, if there were a failure at an active level crossing the barriers would close the road. Of course, fail-safe systems do occasionally fail. This issue is discussed in detail in Chapter 4.

The presentations were then followed by a facilitated discussion with the invited attendees. See Appendix D for a list of people who attended day two of the Forum.

Level Crossings

A railway level crossing, where a road intersects with railway tracks, is considered to be a high risk area, even though trains have right of way over road and pedestrian traffic. The reason for the high risk is that trains cannot stop as quickly as vehicles – mainly to the long breaking distances required – nor can a train driver divert a train.

The risk at a level crossing is a low frequency, high consequence risk. That is, while there are relatively few crashes, the consequences of serious injury or fatality are extremely high, particularly if a pedestrian is struck by a train, or there is a crash between a passenger train and a heavy vehicle.

Types of Crossings

There are 1,872 road level crossings in Victoria, and the two main types are defined as either passive or active.[7] The important distinction between the two crossing types is that passive crossings do not alert the road user to the approaching, or presence, of a train.

Active Crossings

Active crossings provide a higher level of safety as this system informs the driver or pedestrian that a train is approaching and that they must stop. Vehicle and pedestrian traffic control is supplemented by devices such as flashing signals, bells, gates or boom barriers, or a combination of these. These devices are activated prior to and during the passage of a train through the crossing.[8] There are 770 active crossings in Victoria.[9]

Passive Crossings

Drivers and pedestrians at passive crossings are not warned of an approaching train, rather they are warned of the crossing ahead by a Give Way or Stop sign and other static signs, to indicate that they need to take defensive action by giving way or stopping to check whether a train is approaching. There are 1,088 passive crossings in Victoria.[10]

All passive crossings are located in regional and rural Victoria, there are none within 80 kilometres of densely populated Melbourne.[11] There are however, passive pedestrian crossings in the Melbourne metropolitan area.[12]

Pedestrian Level Crossings

Adjacent to, or near many level crossings are pedestrian crossings, which can also be either active or passive. Passive crossings are protected by safety signs and fences designed as an enclosure or maze.

Active pedestrian crossings are also protected by signs and enclosures but with the added safety of train-activated devices, such as, mini-booms, gates or barriers, flashing lights and audible warnings.[13]

There are 843 pedestrian rail crossings.[14]

Private and Occupation Crossings

As well as crossings found on public roads, there are numerous level crossings on private roads and within private property, railway yards, sidings and terminals. There are approximately 1,450 of these crossings.[15]

In this report, the Committee will focus on crossings on public roads.

Safety Concerns at Level Crossings

In 2007, the National Transport Commission (NTC) identified level crossings as 'the priority' for rail safety reform nationally and 'the most significant source of latent risk' both from a public safety and commercial perspective. The NTC cited as examples, the potential for a crash between a train and a heavy vehicle, and the crippling impact a crash between a heavy vehicle and a freight train has on inter-state freight services.[16]

At a public hearing, 3 March 2008, Mr Alan Osborne, Director, Public Transport Safety Victoria (PTSV), informed the Committee of the increasing volumes of road traffic, the increasing mass of heavy vehicles, number of train services and increasing speed of rail services.[17] The Committee considers that the State's relatively dense population, and the large number of crossings would also be a factor. Indeed, there are more public level crossings in Victoria than in any other State in Australia.[18]

A particular concern is the number of passive crossings in rural Victoria which do not provide any warning to a driver or pedestrian of an approaching train, and the increasing number of heavy vehicles and trains which use these crossings.

As stated earlier, trains are unable to stop as quickly as vehicles. This is explained in an ATSB 2008 publication, *Railway Level Crossing Safety Bulletin*, which notes that:

> Interstate freight trains can be in excess of 1,500 m long and weigh upwards of 5,000 tonnes. Locomotive-hauled passenger trains can weigh 2,000 tonnes or more. Trains of this size are, by necessity, driven 'many kilometres in advance'. In routine operations, brakes are often applied kilometres beforehand to slow or stop a train. A train can also take many kilometres to accelerate to track speed.
>
> When a road vehicle enters a level crossing in the path of the train, the only action that a train driver can take is to try to alert the driver with the train horn and apply emergency braking. If the collision is imminent, even under emergency braking, the train will not slow significantly, if at all, before the collision occurs.[19]

With the increasing number and size of heavy vehicles, the probability of a crash between a train and a heavy vehicle increases. Fatalities are not the only concern. The crash near Kerang, mentioned earlier, also resulted in 14 passengers including the heavy vehicle driver being injured.[20]

As well as causing loss of life and serious injury, the financial cost of these crashes can be substantial. There are medical and hospital expenses, the repair of tracks, trains, roads and vehicles, as well as the economic disruption to business and trade. As an example, the crash near Lismore in 2006, resulting in the fatality of the heavy vehicle driver and the closure of the Adelaide to Melbourne interstate line for six days, was reported to have cost the rail and road operators, approximately $30 million.[21]

Level Crossing Rail Safety Measures

The Committee reviewed the statutory framework for safety at level crossings and found a complex array of legislation, regulations, international, national and State Standards, as well as many railway rules and codes of practice.

In Victoria alone, there a number of Acts of Parliament including: the *Rail Safety Act 2006; Road Management Act 2004; Road Safety Act 1986;* and the *Transport Act 1983*.

Since 2006 the following level crossing safety measures that have been adopted in Victoria. These include the:

- Implementation of railway safety management systems under the *Rail Safety Act 2006*;
- In 2006 the establishment of the offices of Public Transport Safety Victoria, and the Chief Investigator; and
- Completion of an audit of public level crossings by the Department of Transport.

The *Rail Safety Act 2006*, provides that risks to safety have to be eliminated by the rail operators so far as is reasonably practicable, or if they cannot be eliminated, then reduced so far as is reasonably practicable. In determining what is reasonably practicable, regard can be had to the available ways to eliminate or reduce the risk, and the cost of doing so.[22] The Committee found that the issue of 'reasonably practicable' was crucial to this Inquiry.

A number of technologies, both new and emerging that the Committee considers worth investigating, may never be implemented due to concerns about their appropriateness at level crossings. This issue is discussed in detail in Chapter 4.

Existing safety infrastructure used at level crossings in Victoria is similar to railway level crossing warning systems in use throughout the world.[23] Traffic control devices at level crossings must satisfy the applicable Standard at the time of installation.[24] These Standards include, Australian Standard AS 1742.7-2007, *Manual of Uniform Traffic Control Devices Part 7: Railway Crossings*, which is used through Australasia.

Responsibility for Level Crossings

The Committee found that a major impediment to improving safety at crossings is the lack of clarity and the shared responsibility for safety by the different rail and road stakeholders.

VicTrack, a Government authority, owns the land and infrastructure associated with level crossings on the railway side of the line. VicTrack leases the land and infrastructure to the Director of Public Transport, who in turn, sub-leases it to the rail operators. The operators responsible for the maintenance of railway crossings are:

- Connex Melbourne for the metropolitan area;
- V/Line Passenger for the regional and rural intrastate network; and
- Australian Rail Track Corporation (ARTC) for interstate railway lines.

The infrastructure leases with the rail operators provide that the operators are responsible for the maintenance of level crossing signs and equipment to ensure they are in a safe condition.

VicRoads and Local Government are responsible for the maintenance of the roads leading up to the crossings except for that part of the road approximately two metres either side of the railway tracks.

The Department of Transport is responsible for funding and upgrading crossings in liaison with the rail operators.[25]

In some instances VicTrack can also share responsibility for pedestrian crossings with the rail operators.[26]

While there are a finite number of crossings, the responsibility for each crossing is shared by a number of public and private organisations. The table below shows how the responsibilities for safety at the 1,872 level crossings in Victoria are shared.

Table 1.1 Number of Organisations Involved with Level Crossings

	Organisation	Responsible for Number of Crossings	Total
Road	Local Government Councils*	1, 744	
	VicRoads	574	2, 318
Rail	V/Line	1, 462	
	Australian Rail Track Corporation	325	
	Connex Melbourne	357	
	Other organisations	86	2, 230

Source: Department of Transport, Correspondence 23 September 2008, p. 2.

*NB: This includes crossings on railway lines which originate in Victoria and enter New South Wales

Often responsibility is shared by more than one body at the same time. For example, VicRoads is the responsible road authority at 245 crossings but it also has an interest in approximately 329 other crossings on local municipal roads. This is mainly as a result of these crossings being a short distance from an arterial road, and VicRoads may need to take remedial action on the arterial road.[27] More than one rail operator can also be involved if a road crosses more than one set of tracks, for example, parallel metropolitan and country lines.

The difficulty of the shared responsibility is illustrated in the 2008 report, *Pedestrian Fatality V/Line Train 8136 Ardeer 6 March 2008*, by the Chief Investigator, Transport and Marine Safety Investigations. The investigation report of the crash at Ardeer, concluded that, despite responsibility for the management of operational risks in the rail corridor resting with V/Line, the pedestrian crossing was outside the primary track infrastructure lease agreement and was maintained by VicTrack. The Chief Investigator found that there was no co-ordination mechanism in place to address responsibility issues.[28]

In a joint submission to the Inquiry by then Department of Infrastructure, now Department of Transport, VicRoads, in association with the Victorian Railway Crossing Safety Steering Committee (Joint Submission), the Committee were advised that it is aware of the ‘considerable confusion’ regarding railway crossing safety responsibilities between the various stakeholders.[29]

However, at a public hearing, 3 March 2008, Mr Tom Sargant, Chair, Victorian Railway Crossing Safety Steering Committee (VRCSSC), addressed the issue of who is responsible for level crossings. Mr Sargant informed Committee that:

> It is the road authority and the rail authority, depending on the crossing. In the metropolitan area it would be Connex, and either the local council or VicRoads, depending on which road the crossing existed in, and when you talk about crossing safety, it is not just at the crossing itself, the approaches as well. In the country it would be either V/Line or ARTC and the local council or VicRoads.[30]

The then Secretary of the Department of Infrastructure, Mr Howard Ronaldson, at the same hearing, stated he was unaware of any conflict as to who had ultimate responsibility. He concluded that:

> The Road Management Act makes it quite clear who is responsible for what road. The *Road Safety Act* and other acts makes it very clear within the confines of the rail corridor who is responsible for conduct in that corridor. We have not run across a situation where there has been a significant difference of opinion as to how a particular crossing is to be treated.[31]

Despite Mr Ronaldson's assurance, no one body or authority has ultimate responsibility for level crossings, either as a total system or a single entity. At a public hearing, 3 March 2008, Mr Alan Osborne, Director, PTSV, described the situation as one where:

> There is some sorting out at the moment around different roles …[32]

Rail Committees in Victoria

In an effort to develop an agreed approach and work program to improve safety at crossings, several committees have been formed.

The Department of Transport chairs the VRCSSC, which is a consultative committee.[33] In the Joint Submission, this committee was described as the peak body that:

> … advise and make recommendations to the Minister for Public Transport on the policy directions, management and standards, for the protection and safety of the public and reduction of risk at all railway road level crossings and railway pedestrian level crossings in the State of Victoria.[34]

Membership of the committee comprises of Chief Executives or General Managers from the: Department of Transport, Public Transport Division; VicTrack; VicRoads; Municipal Association of Victoria; Chief Commissioner of Police, and V/Line Passenger. The Office of the Director of Public Transport Safety Victoria attends as an observer.[35]

The committee has the following sub-committees:

- The Railway Crossing Project Delivery Group which consists of key stakeholders responsible for the State railway crossing upgrade program;

- The Railway Crossing Safety Awareness Group, which is responsible for advising the committee on a range of public education awareness programs; and

- The Railway Crossing Technical Group, which is responsible for providing advice to the Steering Committee on all technical and engineering matters relating to railway crossing safety in Victoria.[36]

Further, the technical group has the Research and Development Engineering sub-committee.[37]

In addition, there is also a Grade Separation Steering Committee.[38]

The Committee was unable to ascertain any public reporting emanating from the Victorian consultative committees, making it extremely difficult to ascertain their value. At the very least they should produce information annually on their work and achievements.

Recommendation:

1. That the Victorian Railway Crossing Safety Steering Committee annually produces a progress report on its work, together with the work of all of its sub-committees.

Commonwealth Rail Committees

The Commonwealth Government, also has many committees examining safety at level crossings, including the:

- Standing Committee on Transport. This committee has two sub-committees, a rail modal group and a strategy implementation group;

- Transport Agencies Chief Executives Committee;

- Railway Level Crossing Behavioural Co-ordination Group; and

- National Australian Level Crossing Assessment Model Committee.[39]

Work undertaken at the national level includes setting standards, data collection and research by the Australian Transport Council, NTC, ATSB, Rail Safety Regulators' Panel, Rail Industry Safety and Standards Board, and the Co-operative Research Centre (CRC) for Rail Innovation.

At the public hearing, Mr Sargant, Victorian Railway Crossing Safety Steering Committee (VRCSSC), discussed recent attempts to rationalise the national structure. He commented that:

> There are strong attempts to rationalise the national structure so there will be a single body responsible for national railway crossing safety that reports to the rail and road modal groups. It is important to understand that a national approach for railway crossing safety in Australia is essential. … the objective of the national strategy is to reduce the number, cost and trauma of crashes between trains and any road user by the most cost-effective means.[40]

The Committee is pleased with these events, but notes that there is no discussion of rationalising the Victorian structure, nor is there any evidence that a single national body will produce the necessary leadership required to enact changes in Victoria.

Amendment to the Rail Safety Act 2006

A measure is being implemented that may improve co-ordination and clarify responsibility issues.

In July 2007, the NTC prepared model legislation which was adopted by Parliament after the Kerang incident to amend the *Rail Safety Act 2006.* These new provisions require rail infrastructure and road managers to identify and assess safety risks at level crossings and enter into agreements, known as interface agreements. The parties must reach agreement by 1 July 2010, on how the risks at level crossings are to be managed.

If the parties are unable to reach agreement, the Director PTSV, will determine the actions required and direct implementation by a specified date. Penalties will apply if a party does not comply with the Director's instructions.[41]

The Committee supports the introduction of these safety interface agreements, though their ultimate success, in many instances, will depend on the willingness of the Government to provide funds for the upgrades that will be necessary at some crossings.

Issues Outside the Terms of Reference

As stated above, the Terms of Reference for this Inquiry are quite explicit in requesting the Committee to focus on technologies. Aside from the issues raised, the Committee heard a number of recurring themes during the course of its investigations which it considers are major impediments to improving safety at level crossings. As they are outside the Terms of Reference, the Committee does not address these issues in this report, but considers they are important. Issues include:

- Grade separation. The only secure and safe way for vehicle or pedestrian to cross railway tracks is via an underpass or a bridge. The Department of Transport has established a Grade Separation Steering Committee to review and rank the top 50 locations where level crossings could be considered for grade separation.[42] The Committee considers that the Government should then undertake a program to upgrade level crossings, particularly those that intersect on highways and arterial roads.

- National approach. By encouraging the adoption of a national approach to setting standards, data collection and research. Victoria could also adopt a leadership position by advocating a national approach, and undertake the trials of low-cost technologies, and the integration of Intelligent Transport Systems.

The Committee acknowledges that some of these issues are now being addressed. The Department of Transport is working with Local Government on level crossing closures, and during the course of the Inquiry the Committee noticed a distinct change in attitude to the use of new, including lower-cost technologies.

At the national level, important work has commenced on understanding driver behaviour at level crossings, including how it could be improved.

Significantly, the VRCSSC is developing a level crossing safety strategy to target level crossing risk. The Committee considers that this strategy should be completed and published as soon as possible.[43]

Other Cost Reduction Measures

The United Kingdom Rail and Safety Standards Board, benchmarked international level crossings in order to find more cost-effective means of upgrading level crossings.

The 2006 report, *The Cost of Level Crossings – An International Benchmarking Exercise*, sets out the costs of upgrading level crossings and the factors which determine these costs. The report suggests ways of improving the control of financial costs. Findings included that:

- There is a significant difference in the cost of constructing level crossings between different countries, due mainly to the variation of the technical scope and complexity;

- There is no such thing as a ‘standard’ level crossing upgrade; and

- The cost of non-materials, design, installation, overheads, testing, commissioning and project management is between 70 to 80 per cent of the total cost.[44]

The study was unable to find evidence that showed higher technical standards and additional functionality for a given level crossing type justified the higher costs. In other words, it was not clear the extent to which higher costs represented good value for money in terms of improved safety performance.[45]

A 2002, Austroads report prepared by ARRB, *Reducing Collisions at Passive Railway Level Crossings in Australia,* referred to the experience reported in Tasmania of the considerable savings made by upgrading 44 level crossings to active status under a single contract. The report states:

> If new active control technology is to be adopted, then it seems likely that the community would get better value for money from a small number of large installation programs rather than on-going programs only involving small numbers of crossings each year.[46]

In correspondence to the Committee, 29 April 2008, Mr Osborne advised that despite research and development in various countries trying to reduce the cost of level crossing safety measures with new technology, Germany is the only country that appears to have a significant program delivering reduced cost, rather than low-cost, active level crossing protection.[47]

In Germany, low-cost technologies are being used at level crossings on the regional railway network.

The railway system in Germany is divided into two classifications depending on rail traffic and standard of infrastructure. Category one covers the long distance, high speed and urban network lines, while category two is the regional network. In a paper presented by Mr Detlef Schwarz, at the 2006 Montreal, *9th International Level Crossing Symposium,* 'German Railways Strategy and Activities to Improve Safety at Level Crossings', low-cost measures used on the regional network include the replacement of flashing lights at crossings with yellow and red light traffic signals and boom barriers. Other measures include: the installation of beacons on both sides of the road, 240, 160 and 80 metres before the crossing; road and rail speed restrictions; and switching the horn on for a longer period of time. Some crossings are monitored with cameras or radar scanners. What is also notable is the program to close 100 level crossings each year.[48]

There may well be benefits in examining whether it is possible to improve the delivery of the State's level crossing upgrade program.

Indeed, the Committee heard a number of suggestions as to how the program could be improved.[49] As this is outside the Committee's terms of reference these issues were not pursued, however, the Committee considers that the Department of Transport should analyse the findings of the report by the United Kingdom Rail and Safety Standards Board.

Clearly there would be safety benefits to the State if it were found that the level crossing upgrade program could be delivered in a more efficient and cost-effective manner resulting in the upgrading of more crossings.

Recommendation:

2. **That the Auditor-General undertakes a review of the cost-efficiency of the Level Crossing Upgrade Program.**

Summary of Findings

- Victoria's safety record at level crossings does not compare well with the other States and could be improved.
- As well as causing loss of life and serious injury, the financial impact of crashes can be substantial. For example, one crash in Victoria cost rail and road operators approximately $30 million.
- The relatively high occurrence of crashes at crossings appears to be due to the high and increasing use of rail and road transport, the State's relatively dense population, and the large number of crossings. There are more public level crossings in Victoria than in any other State in Australia.
- A particular concern is the many passive crossings in rural Victoria which do not provide any warning to drivers or pedestrians of approaching trains.
- An impediment to improving safety at crossings is the shared responsibility for safety at individual crossings, by rail and road, private and public bodies.
- The level crossing upgrade program should be reviewed to find more cost-effective means of upgrading crossings.

Recommendations

1. **That the Victorian Railway Crossing Safety Steering Committee annually produces a progress report on its work, together with the work of all of its sub-committees.**

2. **That the Auditor-General undertakes a review of the cost-efficiency of the Level Crossing Upgrade Program.**

Endnotes

[1] Department of Infrastructure, now Department of Transport, VicRoads, in association with the Victorian Railway Crossing Safety Steering Committee (Joint Submission), Submission to the Inquiry, October 2007, p. 14.

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[12] Department of Transport, *List of Victorian Railway Crossings by Type at 'Active' Rail Lines as at 22 October 2008*, Melbourne, 2008, p. 2.

[13] Victorian Rail Industry Operators Group Standards, *Criteria for Infrastructure at Railway Level Crossings – Pedestrian Crossings*, VRIOGS 003.2-2006, Director of Public Transport, Melbourne, 2006, pp. 15, 24.

[14] Department of Transport, *List of Victorian Railway Crossings by Type at 'Active' Rail Lines as at 22 October 2008*, p. 1.

[15] Mr H Ronaldson, Department of Infrastructure, Correspondence, 30 April 2008, p. 2.

[16] National Transport Commission (NTC), *Discussion Paper on NTC Strategic Directions 2008/9 – 2010/11 For Comment*, Melbourne, August 2007, p. 22.

[17] Mr A Osborne, PTSV, Minutes of Evidence, Melbourne, 3 March 2008, p. 30

[18] Department of Transport, *Level Crossing Safety, Environmental Scan – March 2008*, Melbourne, 2008.

[19] ATSB, *Railway Level Crossing Safety Bulletin*, Canberra, April 2008, p. 2.

[20] Office of the Chief Investigator, Transport and Marine Safety Investigations, *Level Crossing Collision, V/Line Passenger Train 8042 and a Truck near Kerang, Victoria, 5 June 2007*, Rail Safety Investigation, Report No. 2007/09, Melbourne, 2008, p. 9.

[21] ATSB, *Collision Between Rigid Tipper Truck/Quad Axle Trailer and Freight Train 4AM3, Lismore, Victoria, 25 May 2006,* Rail Occurrence Investigation No. 2006/004 Final, Canberra, 2007, p. xi; ATSB, *Railway Level Crossing Safety Bulletin*, p. 1.

[22] *Rail Safety Act 2006* (Vic) s19.

[23] Joint Submission, p. 5.

[24] Standards Australia, p. 7.

[25] Joint Submission, Attachment 18, p. 8

[26] Mr J Betts, Department of Transport, Correspondence, 23 September 2008, p. 2.

[27] Mr J Betts, Correspondence, p. 2.

[28] Office of the Chief Investigator, Transport and Marine Safety Investigations, *Brief Report, Pedestrian Fatality, V/Line Train 8136, Ardeer, 6 March 2008*, Rail Safety Investigation, Report No. 2008/03, Melbourne, 2008, p. 9.

[29] Joint Submission, Attachment 18, p. 4

[30] Mr T Sargant, Victorian Railway Crossing Safety Steering Committee, Minutes of Evidence, Melbourne, 3 March 2008, p. 15.

[31] Mr H Ronaldson, Department of Infrastructure, Minutes of Evidence, Melbourne, 3 March 2008, p. 15.

[32] Mr A Osborne, Evidence, p. 39.

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[34] Joint Submission, p. 4.

[35] Joint Submission, pp. 12-13.

[36] Joint Submission, p. 13.

[37] Department of Infrastructure, now Department of Transport, VicRoads in association with the Victorian Railway Crossing Safety Steering Committee (Joint Presentation), Melbourne, 3 March 2008, Presentation slide 12.

[38] Joint Submission, p. 34

[39] Joint Presentation, Presentation slide 12.

[40] Mr T Sargant, Evidence, p. 4.

[41] *Rail Safety Act 2006* (Vic) s34j, amended by *Transport Legislation Amendment Act 2007* (Vic) s61.

[42] Joint Submission, p. 34.

[43] PTSV, *Rail Safety News*, Issue 1, March 2008, p. 4.

[44] Rail Safety and Standards Board, *The Cost of Level Crossings: International Benchmarking Exercise*, Cambridge, 2006, p. 4.

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Chapter

2

The Problem

Introduction

Since the 1960s, there has been a significant reduction in fatalities at level crossing crashes. In a joint submission to the Inquiry by then Department of Infrastructure, now Department of Transport, VicRoads, in association with the Victorian Railway Crossing Safety Steering Committee (Joint Submission), the Committee were advised that these reductions are attributed to improvements in road safety measures, emergency medical response, rationalisation of railway lines and the Government's upgrade programs.[1]

However, more recently, fatalities have increased, from 25 fatalities between 1997–2002 to 39 in the five-year period, 2002–2006. The majority of the increased fatalities are due to train passenger and heavy vehicle drivers, while pedestrians continue to take risks.[2]

The Government's 2008 road safety strategy, *Victoria's Road Safety Strategy: Arrive Alive 2008–2017,* acknowledges that while level crossing crashes are small in number, their affect can be great. The strategy states that crashes at level crossings are:

> … generally very severe in terms of deaths and injuries and can have devastating effects on communities.[3]

In the 20 years from 1988 to 2007 there have been 177 fatalities due to train crashes with vehicles and pedestrians at level crossings in Victoria. Ninety-three were drivers and passengers of vehicles and trains, 84 were pedestrians.[4]

Twenty-one of these fatalities are deemed by the Coroner to be 'open cases', that is, it has not been determined whether the incident involved an intentional act. The Committee did not inquire into self harm and the fatalities determined by the Coroner to be the result of intentional self harm are not included in the data presented in this report.

There were 15 fatalities in 2007. During the first six months of 2008, there were five fatalities, all occupants of vehicles.[5]

Of the 249 seriously injured Australia-wide from 2001–02 to 2005–06, more than half, 129 were injured in Victoria.[6]

Number of Level Crossings in Victoria

Victoria has the largest number of crossings in Australia.[7] Of the 1,872 public level crossings, there are:

- 937 crossings controlled by Give Way signs;
- 151 crossings controlled by Stop signs;
- 400 active crossings controlled by train-activated flashing lights and warning bells;
- 370 active crossings controlled by train-activated flashing lights, warning bells and boom barriers; and
- 6 crossings with another form of protection such as hand-gates, traffic lights, and interlocked gates.[8]

There are also eight crossings with no controls whatsoever.[9]

All passive crossings are located in country Victoria; all are outside 80 kilometres of densely populated Melbourne.[10]

In addition, there are 843 pedestrian railway crossings and approximately 1,450 occupation and private road railway crossings.[11]

Data Issues

The Committee was not provided with comprehensive statistics to enable analysis of level crossings crashes, or to ascertain long-term trends.

The Department of Transport, the authority that has traditionally been responsible for level crossing policy and fund allocation, did not provide long-term historical data.[12]

The data provided was not disaggregated into the actual number of crashes and near-misses, type of vehicle, time of day, weather, or road condition. Nor was information on the types of crashes with pedestrians provided.

In Victoria, road statistics are collated by VicRoads, the Transport Accident Commission (TAC) and the Coroner who obtain all their information from police records. Since 2003, Public Transport Safety Victoria (PTSV) has obtained level crossing crash and near-miss data from the rail providers.[13]

In its submission to the Inquiry, the TAC raised a number of concerns about the collection of the data. The main concern for the Committee is that pedestrians are not included in the analysis of the crashes provided by the TAC. The submission clarifies that:

> Under the Australian guidelines that defines which events are 'reportable road crashes', crashes involving trains striking pedestrians are excluded as trains are not classified as 'vehicles'.[14]

As the responsible organisation, the Committee finds that the Department of Transport should ensure it collates all relevant and reportable data to enable a more thorough analysis of level crossing crashes.

Recommendation:

3. That the Department of Transport consolidates Victorian level crossing reportable data and regularly publishes up-to-date statistics that would assist rail and road authorities to gain a greater understanding of level crossing vehicle and pedestrian crashes to enable appropriate countermeasures.

National Statistics

Given how few crashes occur, it is important that statistics are collected nationally to ascertain appropriate trends. The Australian Transport Safety Bureau (ATSB) co-ordinates and publishes national rail occurrence data. This data is received from the rail safety regulators in each State, including from PTSV. Under the Victorian *Rail Safety Regulations 2006*, the rail operators must report all rail safety crashes, incidents and notifiable circumstances to PTSV.[15]

Since 1999, the ATSB has had a goal to obtain quality rail safety data. However, in their report, *Annual Review 2006*, the ATSB expressed disappointment that even very basic data provided by the regulators had not been accurate or comparable. In an effort to rectify this situation, $80,000 was provided to rail regulators to resolve data issues.[16]

The Committee found that the paucity of rail safety data has been recognised by safety specialists for some years.[17]

The ATSB in its submission acknowledged the issue, stating:

> Comparisons between jurisdictions do raise important questions, but limitations in the current data sets preclude further interpretation. Specifically, the number

> and type of level crossings, and their (road and rail) traffic flow, are important determinants of the combined risk of level crossing operation within a given jurisdiction. This breakdown of data is not presently available.[18]

Consequently, the Committee considers that data that does exist does not assist policy makers to identify issues except in the broadest of terms. This issue has been recognised by the National Transport Commission (NTC), which in 2007, released the draft, *National Strategy for Rail Safety Data,* for public comment. The draft notes that:

> The examination of the needs for relevant, valid and reliable rail safety data has identified deficiencies in the existing data (some key needs are not met; inconsistencies; more attention needed to meet regulatory good practice principles; shortcomings in existing classification tools; problems of data comparability; delays at national level; and some nationally collected data of limited or no value). There is presently no strategic framework to provide a mechanism for identifying and focusing on the needs of key stakeholders, for aligning the levels at which data is used so that unnecessary regulatory burdens are avoided, and to facilitate improvements in the quality and timeliness of data.
>
> Accordingly, a strategic approach should be taken to give greater attention both to the actual needs of the key stakeholders and to how well they are met, particularly by improving the quality and consistency of the data. In this respect, stakeholders at all levels should be able to have a better understanding of the causes of incidents and consequently to be in a better position to manage, from their differing positions, rail safety hazards and risks.[19]

The PTSV is piloting a Data Collection Quality Project to improve the reporting culture within rail organisations. The aim of the project is to improve the quality and coverage of rail safety incident data by improving reporting and increasing the type of data collected. This may impact on rail safety incident data by increasing the number of incidents reported.[20]

Circumstances Surrounding Vehicle Level Crossing Crashes

Types of Crashes

At the active crossings the following types of casualty crashes occurred in Victoria from 2002 to 2006:

- 21% of vehicles drove though crossings with flashing lights;
- 17.5% of vehicles drove through boom barriers;
- 11% of vehicles stopped on the railway track; and

- 7% of vehicles drove around boom barriers.[21]

At passive crossings, the following circumstances occurred:

- 40% of vehicles did not stop at the crossing or give way to the approaching train; and
- 4% of vehicles stopped on the railway track.[22]

Speed Limits

Approximately 52 per cent of casualty crashes at crossings in Victoria between 2002 to 2006 occurred on roads with a speed limit of less than 75 km/h.

Crashes at active crossings occurred at roads with the following speed limits:

- 40% on roads with a posted speed limit of less than 75 km/h; and
- 16% on roads with a posted speed limit greater than 75 km/h.[23]

At passive crossings, the crashes were found to be:

- 32% on roads with a speed limit greater than 75 km/h; and
- 12% on roads with a speed limit of less than 75 km/h.[24]

Given that most of the passive crossings are outside urban areas where the speed limits are higher, it is not surprising that there is greater percentage of crashes on high speed roads.

Other Contributory Factors

In 2003, the Australian Transport Council (ATC) published the strategy, *National Railway Level Crossing Safety Strategy*. In an effort to present the major factors of fatal crashes, the ATC concluded that it is difficult to determine contributory causes and factors, as generally there is more than one for any crash.[25] Nevertheless, they considered the factors involved in level crossing crashes are:

- 46% unintended vehicle driver error;
- 13% adverse weather or road conditions;
- 9% alcohol/drug taking by the vehicle driver;
- 7% excessive speed by the vehicle driver;

- 3% driver fatigue; and
- 3% other risk taking by the driver.[26]

Further, 70 per cent of crashes in Australia occur in the daytime and 'most' where the driver had a local understanding of the crossing.[27]

Where Crashes Occur

In the five years from 2002 to 2006, there were 57 casualty crashes at level crossings in Victoria which resulted in 37 fatalities.[28]

In the Joint Submission, the Committee were advised that crashes occurred at the following types of crossings:

- 56% were at active crossings, where the main protection included a combination of train-activated flashing lights, bells or boom barriers; and
- 44% were at passive crossings, where the main protection was a Stop or Give Way sign. [29]

In an analysis of casualty crashes between January 2007 and April 2008, once road and rail traffic volumes were statistically controlled, the PTSV found that passive crossings, in particular those with Stop signs, were shown to have 16 times more casualties than active crossings with boom barrier crossings.[30]

Serious Injuries

Statistics published by the Australian Institute of Health and Welfare on serious injuries at level crossings found that nationally:

- 43% were car occupants;
- 32% were pedestrians;
- 15% were passengers or riders of other vehicles, including trucks, vans, buses and motorcycles;
- Almost two-thirds (65%) were male;
- Serious injury rates were highest among young adults 20–24 years; and
- 84% were of aged between 15–64 years.[31]

Driver Behaviour

Level crossing crashes are caused, in the main, by the failure of the driver to detect an approaching train, or if the train is detected, to ignore or not comprehend the risk involved. While there are many underlying factors in a level crossing crash, the ATSB, in a 2008 bulletin, *Railway Level Crossing Safety Bulletin*, reported that almost every time the primary factor was:

> … the failure of the motorist to abide by the traffic control measures at the crossing. Given the operational limitations of trains, the onus to avoid a collision is primarily on the motorist. It is imperative that motorists remain alert, drive to the prevailing conditions and obey the road rules.[32]

The ATSB's report is consistent with a finding of a survey of level crossing crashes from 2000 to 2005 in 11 European countries by the European project SELCAT (Safer European Level Crossing Appraisal and Technology). The survey reported a 'strong dominance' of human causes on the road side of level crossings, in other words, intentional and non-intentional vehicle driver errors.[33]

Perceptions of Level Crossings

In 2006, the Australasian Railway Association (ARA) commissioned Roy Morgan Research to undertake qualitative and quantitative research into Australians' perceptions of level crossings. Part of the research was a survey of people, 18 years or older, who held a driver's licence and who had crossed a level crossing within the previous six months. The key findings of the research were:

- One in four reported having engaged in risky behaviour at level crossings. Not all respondents however identified behaviour such as crossing a level crossing when a train is approaching, as risky;
- Respondents identified the 16–25 year old age group as being the drivers most at risk;
- While 18–25 year olds were aware that they were an 'at risk' group, older drivers – who were highly familiar with level crossings – were less self-aware of their own risk;
- Driver inattentiveness and impatience were identified as the greatest factors seen to contribute to increased risk;
- A majority of those surveyed were aware of flashing lights and boom gates as level crossing features. Fewer spontaneously recalled warning signs at level crossings;

- Twenty-four per cent of respondents reported illegally using a level crossing at some point;
- One in five people reported that they had crossed a level crossing and not known it until after the event;
- One in five were not aware of any type of penalties for breaking the rules at level crossings; and
- Two thirds felt that they were less likely to be penalised for an infringement at a level crossing, than for speeding on the road.[34]

Driver behaviour is also a major issue at road intersections. Forty-four per cent of road fatalities and 60 per cent of serious injuries occur at intersections in middle and inner Melbourne, while more than half a million ‘running a red light’ infringements occur in Victoria each year.[35] This suggests to the Committee that driver behaviour may be a wider issue than that attributed to at level crossing crashes.

Reasons for Unsafe Driver Behaviour

The ATSB’s 2008 bulletin, *Railway Level Crossing Safety Bulletin,* identified a number of underlying factors that influenced the failure of a driver to stop and give way to a train. These factors include one or more of the following behavioural issues:

- Failing to drive according to the road and prevailing environmental conditions, including taking risks and driving at a speed that does not allow sufficient time for the driver to make a safe decision;
- Familiarity with the crossing and the train timetable and not expecting a train at the crossing at that time;
- Impatience with having to wait for crossing devices to indicate that it is safe to proceed;
- Misjudging train speed and expecting that the train will either not arrive at the crossing at the same time as the vehicle, or that it will be able to slow down to avoid a crash;
- Distraction, both inside and outside the vehicle, including operation of mobile telephones, checking paperwork, tuning a radio, selecting a music track, conducting a conversation with a passenger in the vehicle, or boredom;
- Operational aspects of heavy road vehicles, including the time required for a heavy vehicle to pass over a level crossing after it has stopped at a Stop sign; and

- Impairment by fatigue, alcohol and/or drugs, medical issues such as illness and hearing loss. Some medications can exacerbate the effects of fatigue, reduce the ability to concentrate and impair the ability to judge distances and speed.[36]

There does not appear to be safety issues at crossings due to train driver error such as failing to stop or speeding. Similarly, the failure of train-activated crossing signals has not emerged as an issue.

Heavy Vehicle Crashes at Level Crossings

Data provided by the PTSV show an average of five crashes a year between a train and heavy vehicle from 2001 to 2007.[37]

There are an increasing number of heavy vehicles in Australia. Between 1991 to 2001, the number of articulated heavy vehicles increased by 18 per cent and the distances travelled by these vehicles increased by 34 per cent.[38]

In Victoria, while freight and passenger train activity marginally increased from 37 million kilometres travelled in 2001 to 37.5 million kilometres in 2007, the number of regional rail services increased by 14.5 per cent in 2006–07, to 73,528 services per year.[39]

Regional rail patronage rose 32 per cent during the financial year 2006–07, reaching 9.4 million passenger trips.[40]

Dr Peter Cairney, Principal Research Scientist, Transport Management and Safety, ARRB, advised the Committee of the increasing number of both heavy vehicles and trains and the consequent increased likelihood of a crash. Dr Cairney stated that:

> … the predicted increases in oil prices are likely to drive more freight onto rail ... the rail industry can cope with longer trains, but there is a definite limit as to how far they can manage in that way.
>
> The likelihood is that we will be getting a lot more trains at some stage in the future. You increase the number of trains, you increase the exposure of railway level crossings coupled with the higher speeds and perhaps with more very large vehicles, and I think we will be faced with a big problem.[41]

Neither trains nor heavy vehicles travelling at high speed are able to swerve and stop in an emergency. Accordingly, increased activity on rail and road and consequentially at level crossing, can only lead to increased risk.

The Increasing Risk to Train Passengers and Crew

Train passenger and crew fatalities and injuries arising from heavy vehicle crashes is a safety issue of growing concern.

At a public hearing, 3 March 2008, Mr Alan Osborne, Director, PTSV, advised the Committee that the risk to train passengers at level crossings, unless mitigated, would increase as a result of the increased volume of road traffic, the increased mass of heavy vehicles, the increased number of train services, and the increased speed of rail services.[42]

The ATSB, in their 2008 bulletin, 2008, *Railway Level Crossing Safety Bulletin,* similarly raised concern about the increasing risk to rail passengers. The ATSB stated that:

> Heavy road vehicles such as road-trains and larger freight trains have become the norm in Australia for the good reason that they are an efficient way to transport goods over long distances between our metropolitan and regional centres. However, with the increased size comes an increased consequence in the event of a level crossing collision. It used to be somewhat rare to hear of a train derailing or of significant casualties on board the train as a result of a collision with a road vehicle. This is not the case today.[43]

Since 2002, there have been multiple fatality crashes between passenger trains and heavy vehicles at level crossings in Victoria. They are:

- Benalla, in 2002 the train driver, fireman and one passenger were fatally injured, and another passenger was injured.[44]
- Trawalla, in 2006 the locomotive driver and a passenger were fatally injured, two passengers were critically injured, and 17 other passengers were injured.[45]
- Near Kerang at the Fairley crossing, in 2007 eleven passenger fatalities and 14 passengers and the heavy vehicle driver were injured.[46]

The crashes at Benalla and Trawalla were at passive crossings protected by Give Way or Stop signs. The crash near Kerang was at an active crossing protected by train-activated flashing lights and warning bells.

Pedestrian Level Crossing Crashes

The Committee considers that pedestrian safety at level crossings and railway pedestrian crossings or where pedestrians illegally cross or trespass over a railway track, is of concern. In the past ten years, from 1998 to 2007, the proportion of pedestrian fatalities increased to 51%.[47]

Nationally that figure is over 60 per cent.[48]

The PTSV provided data on pedestrian fatalities from train crashes from 1 January 1999 to 31 December 2007 at road or pedestrian crossings. Of the 29 fatalities, 27 were in the metropolitan area and 25 of these were at active crossings.[49]

Dr Brenda Lobb, Department of Psychology, University of Auckland, in a 2006 paper, 'Trespassing on the Tracks: A Review of Railway Pedestrian Safety Research', in *Journal of Safety Research*, stated that there appeared to be very little published research investigating train-pedestrian crashes. Dr Lobb reported that these crashes:

- Cause more fatalities than any other form of train related crash;
- Are more likely to result in a fatality or irreparable damage, such as amputation or paralysis;
- Are most likely to involve trespassers; and
- Occur in or near railway stations in urban areas.[50]

Pedestrian Behaviour

The PTSV March 2008 newsletter, *Rail Safety News,* reported a study from 2006 which found that 30 per cent of pedestrians stated they had crossed railway tracks when a train was coming.[51]

Ms Anne Silla of the Technical Research Centre of Finland, in a paper presented at the *10th World Level Crossing Symposium, Safety and Trespass Prevention*, in Paris, June 2008, 'Why do People Trespass? Finnish Experiences' suggested that the main reason for trespassing is to take a short cut. Ms Silla reported that the interviewees:

> … indicated that the route across the railway tracks is the shortest and the fastest alternative. Many of them have used the route for years, and according to them it is easy to use because there are already clear paths across the railway tracks.[52]

A 2008 report by the United States Federal Railroad Administration, *Compilation of Pedestrian Safety Devices in Use at Grade Crossings,* commented that:

> It has been widely observed that pedestrians often tend to determine for themselves the shortest distance between where they are and where they want to go, and then proceed along that line, sometimes irrespective of paved pathways, sidewalks, or trails.
>
> In light of this, a guiding principle in the design and development of pedestrian crossing facilities should be to cause as little deviation as is practical from a direct pathway.[53]

The report noted that 66 per cent of train crashes with pedestrians were likely to have been caused by pedestrians disregarding or ignoring warning devices that indicated that a train was approaching. Significantly, many of the crossings reviewed were equipped with pedestrian gates. The report found that the warning devices, including pedestrian gates, were commonly ignored and easy to circumvent.[54]

Dr Lobb, in her paper stated that there is no clear picture on the causes of train-pedestrian crashes but by far the 'strongest finding' to emerge concerns the role of alcohol, concluding that:

> All but one of the studies that measured blood alcohol levels in those killed or injured in these accidents have found that a high proportion of victims were intoxicated.[55]

Dr Lobb stated that unsafe behaviour may be due to: unintentional error; an error of perception, knowledge or judgement, or a deliberate violation.[56]

Dr Lobb in her paper states that more research is required to understand the factors that cause these crashes, including the collection of improved data. She also states:

> Research on interventions to reduce train-pedestrian accidents is very limited indeed.[57]

High Cost of Increasing Levels of Safety

In its submission to the Inquiry, ARRB noted that unless new ways of managing the interaction between trains and vehicles at level crossings are found, the prospect of increasing train speeds are likely to present:

> … unacceptable risks, to the detriment of the Australian land transport system and the economy.[58]

In the Joint Submission, the Committee were informed that level crossing crashes are among the most costly economically.[59]

In April 2008, the ATSB reported that the damage bill for 15 level crossing crashes that occurred in Australia between April 2006 and December 2007 was estimated at well over $100 million.[60]

Clearly the human and financial benefit of eliminating crashes at level crossing is considerable. The benefit Australia-wide has been estimated by the NTC to be approximately $40 million per annum.[61]

Despite this, the high cost of constructing bridges or underpasses, installing boom barriers, bells and flashing lights, or changing the layout of railway lines and roads to improve safety can be very difficult to justify, particularly on low volume road and railway lines in rural areas.

At the public hearing, 5 May 2008, Dr Cairney, ARRB, advised the Committee that:

> The conventional flashing lights are really much too expensive. I make the point, particularly if they are competing for other scarce road safety funds, the safety benefits are actually so low that there are many other things that road authorities would probably spend the money on, … [62]

In the Joint Submission, it was noted that the capital cost to upgrade a crossing and provide fail-safe train-activated flashing lights can be between $250,000 and $350,000. Installation of train-activated full boom barriers can cost between $350,000 and $450,000, depending on the width of the crossing road and number of railway tracks.[63]

In 2007, the Department of Transport completed a survey of level crossings in Victoria. The Committee notes that the 200 crossings identified as the most risky already have active protection and are equipped with train-activated boom barriers and flashing lights. The high risk score of these crossings is due to the volume of road traffic using the crossings.[64] The Committee considers that this suggests the need for the implementation of other measures at these crossings, including the highest level of safety, grade separation.

At the hearing, Dr Cairney commented that where there is a volume of traffic to justify the expenditure, the solution lay in constructing grade separations.[65] This however, is the most expensive treatment where costs vary from $20 million to more than $80 million, depending on the complexity, including the number of rail tracks and vehicle traffic lanes.[66]

A Grade Separation Steering Committee has been established within the Department of Transport to review and rank the top 50 locations where crossings could be considered for grade separation. The Department advised the Committee that it expected that at least one grade separation will be constructed each year.[67]

Need for a Strategy

The Committee considers that a strategy comprising the priority, funding, timing and conduct of research into the various level crossing safety options should be set out in a Government strategy. Such a strategy should address each of the measures, such as various options to improve safety at level crossings, that is, eliminating crossings, upgrading them, including with technology, improving their maintenance and enforcing traffic regulations,

In the Joint Submission the Committee were advised of the 'need for a strategy to review the relative safety of existing level crossings and progressively implement any necessary improvements'.[68]

In the March 2008 edition of *Rail Safety News,* PTSV state that the Victorian Railway Crossing Safety Steering Committee is developing a level crossing safety strategy.[69] However, at the time of this report, the Government had yet to release the strategy.

Mr Alan Osborne, Director, PTSV, at a public hearing, 3 March 2008, referred to the task of allocating funds and the work being done in the Department of Transport to prepare a strategy. Mr Osborne stated that:

> I also think that the new level crossing strategy that Public Transport Division are bringing together as well, have also a lot to offer in terms of this whole agenda.[70]

The Committee strongly supports the finalisation and publication of a strategy and considers that it should be finalised as soon as possible.

Recommendation:

4. That the Department of Transport finalises and releases the Level Crossing Safety Strategy by 30 June 2009.

Summary of Findings

- In the 20 years from 1988 to 2007 there have been 177 fatalities from train crashes with vehicles and pedestrians at level crossings in Victoria. Ninety-three were drivers and passengers of vehicles and trains, and 84 were pedestrians. In addition, there were many serious injuries arising from crashes at crossings.

- Train passenger and crew fatalities arising from heavy vehicle crashes at crossings is a growing concern.
- Over one thousand public road level crossings in Victoria are controlled by Give Way or Stop signs.
- There is a paucity of rail safety data, a situation which does not assist policy makers to identify issues, and make informed decisions.
- Level crossing crashes are caused, in the main, by the failure of the driver or pedestrian to detect an approaching train, or if the train is detected, to ignore or not to comprehend the risk of a crash.
- There does not appear to be safety problems at crossings due to train driver error or the failure of train-activated crossing signals.
- The high cost of improving safety at crossings can be very difficult to justify, particularly on low volume road and railway lines in rural areas.
- There is a need for the Government to finalise their level crossing safety strategy.

Recommendations

3. **That the Department of Transport consolidates Victorian level crossing reportable data and regularly publishes up-to-date statistics that would assist rail and road authorities to gain a greater understanding of level crossing vehicle and pedestrian crashes to enable appropriate countermeasures.**

4. **That the Department of Transport finalises and releases the Level Crossing Safety Strategy by 30 June 2009.**

Endnotes

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Chapter

3

Overview of Current Safety Measures

Introduction

Passive crossing presents the greatest challenge to both the user and Government. For the driver or pedestrian, approaching these crossings, their safety relies on being able to see a train in time to give way or stop. The Government is faced with the problem of managing over one thousand of these crossings in Victoria. Unless large numbers of passive crossings are closed, or new technological safety measures implemented, it will be many decades before they can all be improved.

Active crossings also have safety issues, despite the sophistication of the technology that warns users of approaching trains. Some of these crossings can be upgraded with boom barriers and improvements to the layout of railway tracks and roads. Others may need to be replaced with bridges or underpasses. The safety of active crossings would also benefit from the introduction of new technologies.

Apart from these challenges, considerable attention is required to improve basic maintenance at crossings. Sight-lines must be clear, paths, fences and gates must be built and kept in good order so that pedestrians have no choice but to use the authorised paths and to move in a direction that assists them to see a train.

This Chapter describes existing measures that could be used to improve safety at level crossings.

Though many of the safety measures described in this Chapter do not utilise technology, the Committee considered it important to describe both these and the electrical and mechanical devices and systems that are used to warn of an upcoming crossing and approaching train.

Measures at Level Crossings

Passive Crossings

A passive crossing is where vehicle and pedestrian traffic is controlled by static signs such as Stop or Give Way signs that are not activated during the approach or passage of a train.

The Australian Standard, AS 1742.7-2007, published in, *Manual of Uniform Traffic Control Devices, Part 7: Railway Crossings*, states that passive crossings: 'rely on the road user including pedestrians detecting the approach or presence of a train by direct observation'.[1]

The Standard provides for the use of signs and pavement markings at crossings controlled by either a Give Way or Stop sign. The absolute minimum treatment is a Give Way sign with the words 'railway crossing' against a red background, supplemented with a sign advising motorists of the number of tracks at the crossing.[2]

Pavement markings provided for in the Standard for sealed approaches to level crossings are:

- The RAIL X marking on all approaches where the speed limit exceeds 80 km/h;
- Stop or Give Way lines on all approaches;
- No-overtaking lines; and
- Box markings used to discourage traffic queuing on a crossing.[3]

Active Crossings

Active level crossings provide a higher level of safety because vehicle and pedestrian traffic is controlled by warning devices such as flashing signals, bells, boom barriers or gates, or a combination of these.

The devices at active crossings are triggered by a system which detects approaching trains.[4] The Australian Standard provides that the warning devices should commence activation at least 20 seconds prior to the arrival and during the passage of the train through the crossing.[5] In Victoria the time period is higher at approximately 25 seconds. The time period is designed to provide sufficient time for an approaching vehicle to either clear the tracks, or to stop safely before reaching the crossing.[6]

The technology at active crossings provided for in the Australian Standard and which can be used in different combinations include:

- Railway crossing red flashing lights and a railway crossing sign supplemented with a sign advising motorists of the number of tracks at the crossing;
- Overhead flashing signals used in conjunction with the above;
- Boom barrier with flashing signals;
- Pedestrian audible signals;
- Active advance warning yellow flashing lights; and
- Intersection type traffic signals, which can be incorporated into or used in lieu of the red flashing lights.[7]

The Australian Transport Safety Bureau (ATSB) advised the Committee that audible signals at crossings are probably less effective now than in the past because of vehicle sound proofing, air conditioning and entertainment systems. Helmet-wearing motor cyclists may also have difficulty hearing audible signals and train horns. They are, however, still effective for warning bicycle riders and pedestrians who are not using portable entertainment systems, such as iPods.[8]

On the railway side of active crossings, lights known as Healthy State Indicator Sidelights, advise train drivers that the level crossing devices are operating and that it is safe for the train to proceed.

The technological components of active crossings are designed to be fail-safe, that is, if the system fails, it fails in a safe, predictable or specified mode, and in a way that alerts users of the failure. Rail signal engineers who design devices and systems to achieve a fail-safe status, design the devices or systems to satisfy Safety Integrity Level 4 (SIL 4), as provided in international standard, IEC 61508.[9] The Standard is published by the Swiss based International Electrotechnical Commission, which is the lead organisation that prepares and publishes international standards for all electrical and related technologies.[10]

Measures Available to Improve Crossings

Safety at both passive and active crossings can be improved by eliminating crossings by closure, or constructing bridges or underpasses, up-grading the crossings with additional active safety devices, or depending on the nature of the issues, by installing:

- Additional warning signs and pavement markings;

- Tactile advance warnings;
- Lighting at crossings; and
- Up-to-date warning signs that comply with standards.

Other measures include:

- Reshaping railway cuttings to improve sighting;
- Improving the geometry or alignment of railway tracks and roads to improve sight-lines;
- Removing obstructions and overgrown vegetation to improve sight-lines along roads and railway tracks;
- Reducing the road speed limit close to crossings;
- Reducing train speed;
- Constructing vehicle escape or refuge areas to aid vehicles that may be trapped in a queue;
- Creating extra lanes over the crossing to address any queuing issues; and
- Adding measures to prevent vehicles driving around barriers, including dividing level crossing approach roads with mountable median islands, or frangible bollards or fencing.[11]

As well as the measures above, safety at active crossings can be further improved by:

- Adding boom barriers to crossings that are only equipped with flashing lights;
- Upgrading flashing lights with light-emitting diodes (LEDs);
- Adding additional warning signs, including train-activated advance warning signs;
- Installing traffic signals to support crossing signals; and
- Linking crossing signals with traffic signals.[12]

Some of these measures are discussed later in this Chapter.

In a joint submission to the Inquiry by then Department of Infrastructure, now Department of Transport, VicRoads, and in association with the Victorian Railway Crossing Safety Steering Committee (Joint Submission), the Committee were advised of other measures that are employed at active crossings. A safety measure used at active crossings in urban areas, where there is a risk of vehicles from a nearby intersection queuing through a crossing are the electronic Keep Tracks Clear signs. Box markings are also used to discourage traffic queuing on a crossing.[13]

Another measure in urban areas and regional roads with much traffic is to supplement the twin flashing lights with a boom barrier.

System Failures

In his submission to the Inquiry, Dr Charles Uber, an individual, suggested that an investigation was required into boom barrier failures and the means of reducing the frequency of failure.[14] Dr Uber stated that:

> Nearly every morning on the Melbourne radio drivetime shows there is a report of one or another level crossings being blocked by boom barriers in the down position. While this is the 'fail safe' condition for total safety, it does not inspire driver confidence in the reliability of the boom barrier system operation.[15]

The Committee notes that four of the level crossing crashes recorded for the period 2002–2006 involved motorists driving around lowered boom barriers.[16]

The Committee therefore shares the concern expressed by Dr Uber about the failure of devices at some active crossings and considers that the Department of Transport should investigate and report on the reasons for the failures, and take action to reduce their frequency.

Recommendation:

5. That the Department of Transport investigates and reports on the reasons for the failure of warning systems at active level crossings, and takes action to reduce the frequency of failure.

Monitoring Equipment

The Committee was advised that safety system monitoring equipment has been installed on all passenger lines and is being gradually deployed on freight-only lines that have active protection devices.[17] The equipment remotely monitors the operation of lights, bells, barriers and pedestrian gates at active crossings. If a fault arises at a crossing equipped with a remote monitoring system, central train control is alerted by an alarm and advises trains approaching the crossing to proceed cautiously. A maintenance crew is then dispatched to rectify the problem.

Railway Pedestrian Crossings

In addition to level crossings used by vehicles, there are 843 active and passive railway pedestrian crossings in Victoria. These crossings are located on one or both sides of a level crossing, or as a stand-alone crossing at one end of, or between railway stations.[18]

Australian Standard AS 1742.7-2007, *Manual of Uniform Traffic Control Devices Part 7: Railway Crossings,* sets out the minimum standards for the use of pedestrian crossings, including passive and active crossings used by pedestrians, people with disabilities and cyclists.[19]

The Victorian Rail Industry Operators Group Standard, *Criteria for Infrastructure at Railway Level Crossings – Pedestrian Crossings*, also applies.[20] This is because the Victorian standard for these crossings was published before the Australian Standard, and is intended to be used in conjunction with that standard.[21]

The Australian Standard provides that the minimum treatment for pedestrian crossings is a passive crossing comprising a footway, either by widening the roadway, or as a separately defined footpath. The standard sets out minimum surface conditions, warning signs, specification of the gap between the inner edge of a railway track and the crossing surface and on sealed or paved crossings, pavement markings and tactile surface indicators.[22]

The Australian Standard includes sight distance provisions for pedestrians at passive crossings and provides that if the sight distance is not available, then one or other of the followings actions is required:

- Removal of obstructions;
- Upgrading the passive crossing to active control;
- Closing or relocating the crossing;
- Reduced train speed, or
- Grade separating the crossing.[23]

Safety at pedestrian crossings can be improved by constructing bridges or underpasses, or up-grading the crossings by:

- Upgrading infrastructure, including signs, so that the crossing complies with the standards;
- Upgrading passive crossings with pedestrian mazes, sealed or paved footpath with tactile ground surface indicators;

- Upgrading passive crossings to active status with train activated visual and audible signals and signs;
- Upgrading active crossings with gated pedestrian enclosures, including escape gates for people caught on the crossing after the gates have been closed;
- Upgrading disability access and crossing surfaces, including for wheelchair safety; and
- Improving lighting.[24]

Pedestrian Crossing Taskforce

In 2001, the Minister for Transport established a taskforce to identify pedestrian rail level crossing issues for people with a disability. The report by the Taskforce, published in 2002, *Report to the Minister for Transport,* found that: 'there is a magnitude of issues relating to their accessibility and safety at pedestrian rail level crossings'.[25] The report states that:

> The initial investigations have revealed that there is a significant, inherent risk of further deaths or injury involving trains at pedestrian rail level crossings if the current issues and improved accessibility for people with a disability are not addressed. Of particular concern, is a basic incongruity of wheelchair wheels with pedestrian level crossing design, which affects the safety of people with a disability. The obvious solution is to replace all pedestrian rail level crossings with grade separation, a solution that can only be achieved in the longer term. However, in the interim there is a pressing need to ensure a range of short and medium term strategies are implemented.[26]

Implementation of the taskforce's recommendations is part of the Railway Pedestrian Crossing Protection Upgrade Program.[27]

Public Transport Safety Victoria (PTSV), in the March 2008 edition of its *Rail Safety News* reported that:

> The last five years has seen an improved standard of pedestrian crossings adopted especially for people with disabilities. There have been zero fatalities at pedestrian level crossings among wheelchair users in the last five years.[28]

The Committee considers that the Department of Transport should release a statement on the current position of the recommendations of the taskforce.

Standards and Policy Guidelines

The Committee found that there are no guidelines to inform the Department of Transport and the rail operators as to when crossings should be upgraded, that is, to progress from passive to active. The Committee also found that there are too many and inconsistent standards.

The Australian Standard AS 1742.7-2007, *Manual of Uniform Traffic Control Devices Part 7: Railway Crossings,* does not address all level crossing safety standards. For example, for pedestrian crossings, it is also necessary to consult the Victorian standards, the Victorian Rail Industry Operators Group Standard, *Criteria for Infrastructure at Railway Level Crossings – Pedestrian Crossings.* [29] There is also another State standard, the draft Victorian Rail Industry Operators Group Standard, *Criteria for Infrastructure at Railway Level Crossings – Occupation Crossings*.[30]

In 2008, the Chief Investigator, Transport and Marine Safety Investigations, published, *Brief Report: Pedestrian Fatality V/Line Train 8136 Ardeer, 6 March 2008,* on a pedestrian fatality at a pedestrian crossing at Ardeer. The report compared the Victorian with the Australian Standard with respect to pedestrian safety. The Chief Investigator found that while the standards between the manuals were generally consistent, there were some minor variations, in particular with signage.[31]

The Chief Investigator raised a second issue in the report, concerning the appropriate level of protection at crossings. Neither the Australian nor Victorian Standards prescribe the required level of protection or type of control at pedestrian crossings, although the Regional Fast Rail Project, Guideline No. 502: Pedestrian Crossing Protection, outlines the Project's policy position on the levels of crossing protection to be provided for this project.[32] According to the Ardeer report, this guideline:

> … required active protection for all crossings of two or more tracks with moderate or above pedestrian usage or where line speeds exceed 130 km/h irrespective of usage. The project guideline permitted passive protection at pedestrian crossings with two or more tracks in those instances where pedestrian usage was low (less than 15 pedestrians per hour, average peak) and the line speed was 130 km/h or lower.[33]

Further, the Chief Investigator, in his report, stated that:

> … the absence of guidelines on minimum treatments has the potential to lead to inconsistent levels of protection. Accordingly, there may be a case to expand the scope of current Victorian industry standards and specifically to introduce

> appropriate guidelines for the minimum levels of treatment to be provided at pedestrian crossings.[34]

The Chief Investigator recommended that the Victorian Railway Industry Operators Group should consider the development of guidelines to address the minimum levels of protection, such as types of control, to be provided at pedestrian crossings.[35]

The Committee notes that the absence of guidelines for minimum standards at railway level crossings could result in a two tiered system of crossings with differing levels of safety.

Differences in railway standards are raised in a 2008 issues paper, *Rail Productivity Review Issues Paper*, by the National Transport Commission (NTC), which stated that:

> Differences in standards, regulation and regulatory bodies across jurisdictions increase costs for industry and slow the flow of goods and information. Some harmonisation of standards has been occurring through the development of national model legislation for rail safety and the Rail Industry Safety and Standards Board (RISSB), however, further gains could be realised.[36]

The Committee notes that the Australian Standard, which addresses both road and pedestrian crossings, states that guidance on when a crossing should progress from passive to active is found in risk assessment models such as the Australian Level Crossing Assessment Model (ALCAM). The Standard provides no such guidance.[37]

The Committee considers that there is considerable merit in the adoption of policy guidelines to set minimum standards or targets for different types of crossings, such as those on high speed, high use lines, roads and pedestrian paths. This would be consistent with the approach taken on the regional fast rail project and should support field survey and risk modelling activities.

Recommendations:

6. **That the Department of Transport requests that the Minister for Public Transport seeks uniformity of Standards at the Australian Transport Council by advocating the adoption of national standards.**

7. **That the Department of Transport adopts policy guidelines which set minimum safety standards for different types of level crossings.**

Assessment of Level Crossings in Victoria

The Government has undertaken a survey of all road and pedestrian railway crossings in Victoria to help identify railway 'blackspots,' using the ALCAM method of risk assessment.[38] An interactive website database is managed by VicTrack, on behalf of the Victorian Railway Crossing Safety Steering Committee (VRCSSC) and the Department of Transport has responsibility to ensure that the responsible authority (of which there can be more than one), deals with the issues.[39] The results of the first survey were released May 2008.[40]

ALCAM is a comparative safety assessment tool that was adopted by the Australian Transport Council of Ministers (ATC) in 2003. The ATC and the Standing Committee of Transport have approved ALCAM as the national standard and the VRCSSC has adopted this tool.[41] It was designed to prioritise level crossing safety improvement works and to assist in determining the most effective treatments at these sites.

The Department of Transport has called tenders for ongoing ALCAM surveys of all public road and pedestrian crossings over a five-year period. The work will also include the identification and initial surveying, of occupation and private crossings, and the identification of illegal crossings.[42]

ALCAM is a complex mathematical tool which considers physical characteristics and controls in existence at both road and pedestrian level crossings. It considers these elements as well as the common driver/pedestrian behaviour at the site to provide a 'risk score' and 'total risk exposure score' for each level crossing. This enables the comparison of relative risk across all level crossings in Victoria.[43]

Users of ALCAM can also propose specific solutions to a crossing and consider the theoretical reduction in overall and specific risk. For example, where queuing has been identified as a risk factor, the introduction of active protection or boom barriers, although reducing the overall risk at the crossing, would not address the queuing risk. A more suitable solution may involve changes to the road infrastructure on the exit side of the crossing, or interfacing the crossing with adjacent road traffic signals. ALCAM also provides an analysis of the reduction in risk of a proposal compared with the estimated cost. This allows users of ALCAM to compare options in relation to their respective cost-benefits.[44]

The Department of Transport considers it now has an improved database of level crossings, and is in a position to re-prioritise the annual level crossing up-grade program on a risk assessment basis, rather than the previous crash history basis. [45]

The Committee requested the Department of Transport to provide it with an overview and analysis of the results of the ALCAM survey and assessment of level crossings. The Committee identified the following key points from the overview provided by the Secretary of the Department:

- The survey of 1,973 road and pedestrian level crossings identified 21,397 issues or potential hazards – 606 of these issues have been resolved;
- The results of the survey have been provided to rail operators and road authorities;
- The 200 crossings with the highest total risk exposure scores are mostly in metropolitan Melbourne – these crossings already have flashing lights and boom barriers and the existing treatment options are limited, and those treatments, such as grade separation, which will have a significant impact on risk, are expensive;
- The majority of the safety issues, 13,384, which require resolution are the responsibility of Local Government in their role as road authorities;
- V/Line is responsible for resolving 3,822 issues; and
- An interactive web site data base is being managed by VicTrack, on behalf of the VRCSSC, which is monitoring the stakeholders' activities.[46]

Table 3.1 shows who is responsible for each of the issues – each crossing usually has more than one responsible stakeholder, such as the rail operators and road authorities.

Table 3.1 Summary of Australian Level Crossing Assessment Model Issues

Stakeholder	No of Crossings for Which Responsible	No. of Issues for Which Responsible	
		Open	Closed
V/line	1,462	3,822	53
Australian Rail Track Corporation	325	904	40
Connex	357	604	8
Municipality*	1,744	13,384	481
VicRoads	547	1,889	24
Private	2	0	0
Heritage	69	157	0
Other Rail	15	31	0
Total		20,791	606

Source: Department of Transport, Correspondence 23 September 2008, p. 2.

*NB: This includes crossings on railway lines which originate in Victoria and enter New South Wales

VicRoads has undertaken a review of the ALCAM assessments and developed a preliminary program of works and ‘rough cost estimates’ to address issues raised in the survey.[47]

The Committee considers that one of the major benefits of ALCAM is its ability to identify safety issues and the role it will play to assist the Department of Transport to determine upgrade work priorities in an objective manner. The concern the Committee has relates to the lack of publicly available information on how the model assesses, weights and compares different safety risks and risk measures. The other issue concerns the lack of information provided to the public about safety issues that have been identified at particular crossings, including the organisation responsible for attending to the safety issues and the proposed timelines for attending to the required works.

The Committee considers that the community would have a greater understanding of the issues, and an appreciation of the nature and size of the problem, if the Department of Transport published a thorough analysis of the results of the ALCAM survey, together with an overview of the works required to resolve the issues identified in the survey. The information should identify in summary format, the responsible stakeholders, types of crossings and their location.

Recommendation:

8. **That the Department of Transport publishes an analysis of the results of the Australian Level Crossing Assessment Model survey, including an overview of the works required, and whose responsibility it is to resolve the issues identified in the survey.**

The Committee considers that if all the issues identified by ALCAM are to be addressed and funded within a reasonable timeframe, then the Government will need to significantly increase funding to the level crossing upgrade program.

Although the Committee notes that the current list of risk mitigation options does not include treatments such as Intelligent Transport Systems (ITS), the Committee considers that a three-year funded program should be prepared to accelerate safety works identified in the ALCAM survey. The funding of initiatives involving new and developing technologies should form part of a separate allocation.

The Committee considers that the Department of Transport should be actively engaging with VicRoads, Local Government and the rail operators to prepare an overall cost estimate of the works required to address the safety issues identified in the ALCAM survey. The Committee recognises that some Local Government Councils may find it difficult to meet their obligations due to drought and/or financial hardship in their municipalities. The Committee considers that this issue should be taken into consideration by the Department of Transport when funding responsibilities are negotiated with individual Councils.

A funded, three-year program should be prepared and the Department of Transport should monitor implementation of the risk mitigation activities. The program should be flexible as more urgent issues are addressed and others are identified in future ALCAM surveys. The program should be published, together with annual progress reports.

Recommendation:

9. **That the Department of Transport, together with the level crossing stakeholders, prepare a funded, three-year program to implement the safety issues identified in the Australian Level Crossing Assessment Model surveys. The program should be regularly monitored and the results published annually.**

Issues Identified by the Australian Level Crossing Assessment Model

VicRoads is the responsible road authority at 245 level crossings and has an interest in approximately 329 additional crossings a short distance from arterial roads.[48] In correspondence to the Committee, 23 September 2008, the Department of Transport advised that VicRoads has analysed the results of the ALCAM survey for the crossings they are responsible. Further, that VicRoads:

- Is assessing countermeasures for crossings on arterial roads;
- Advised that the majority of issues at crossings on arterial roads are non-conforming signs and pavement markings. However, these issues are considered by the Department of Transport to be relatively minor and deemed to have little impact in terms of risk;
- Has resolved 24 issues of the 1,889 issues to be resolved;
- Undertaken some signage and pavement marking improvements where existing maintenance budgets have allowed; and
- Given priority to the assessment of countermeasures to address sight distance deficiencies, queuing and short stacking problems.[49]

VicRoads is assessing funding requirements for further works identified by the survey. The Department of Transport advised the Committee that VicRoads' funding requirements are expected to be 'significant' and that they would be exploring funding options through the VRCSSC. However, the Department of Transport also stated that if no further funds were made available, works to address the deficiencies identified by ALCAM would be assessed against other competing projects, including road maintenance projects, across the State.[50]

Sight Distance Problems on Arterial Roads

One of the important safety issue identified by VicRoads from the ALCAM survey relates to sight distance deficiencies at level crossings on arterial roads. It is one issue that VicRoads is giving priority to, as treatment would 'significantly' reduce the risk at these sites. The sight distance issues reported in the ALCAM survey were mainly confined to passive crossings.[51]

In their submission, ATSB describe 'stopping sight distance' as the distance travelled by a vehicle between, when the driver first sights a requirement to stop, reacts accordingly, applies the brakes and brings the vehicle to a stop.[52]

The use of either a Give Way or Stop sign at passive crossings is determined by the sight distance available to the driver of an approaching train. The Australian Standard provides that for Give Way sign control there needs to be sufficient sight distance for the driver to see an approaching train in time to stop.[53]

Stop signs, on the other hand, should be used where there is sufficient sight distance for a driver stopped at a crossing to be able to start-off and clear the crossing before the arrival of a train.[54]

If the sight distance is less than that required for Stop sign control, the Standard states that passive control should not be used at the crossing. In other words, the crossing should be either closed or up-graded.[55]

If the crossing remains open, the Standard states that alternative measures are to be applied. These may include: restoration of the sight distance by re-establishing cuttings, clearing, geometric alteration of the crossing, or up-grading the crossing to active control.[56]

Another option that isn't included in the Standard is speed restrictions to trains or vehicles using the crossing. The application of speed restrictions could be a temporary measure until the sight distance had been restored, either through capital works, or by clearing vegetation from the sides of the railway track or roadway.

V/Line Passenger, in its submission to the Committee, supported speed reduction on roads but that with respect to slowing trains, stated:

> While, V/Line has reduced the speed of some trains at a few locations, we believe that it is more effective to reduce road speeds by at least 20 kilometres an hour (depending on conditions).
>
> Slowing down trains through level crossings and/or extending ring/boomgate activation periods, results in prolonged wait time for pedestrians and vehicle traffic at level crossings as well as substantially extending rail journey times.[57]

V/Line stated that the speed limit should be reduced to 80 km/h at crossings with active protection and lower at passive crossings:

> Reducing road speeds to maximum of 80 km/h locations with actively protected level crossings may drastically eliminate the likelihood of a collision as well as the level of potential damage if an accident does happen.

> We suggest the speed through passive level crossings, with Give Way signs be reduced to say 40 km/h or 60 km/h, depending on the characteristics of the area. [58]

The Committee notes that reducing either or both rail and road speeds are included as potential crossing controls in a case study example in the 2007 then Department of Infrastructure discussion paper, *Australian Level Crossing Assessment Model Discussion Paper.* The case study suggests that lower speeds could remain in place until a permanent option had been agreed to between the rail and road stakeholders.[59]

The Committee considers that the Department of Transport should request the inclusion in the Australian Standard of the options to apply a speed restriction as a temporary measure to trains and/or vehicles using a passive crossing with a sight distance problem, until the sight distance has been restored.

As well as reduced speed limits at passive crossings, V/Line also proposed the introduction of a ‘railway crossing zone’, similar to that of a ‘school zone’. The ‘railway crossing zone’ would be clearly identified with signs and road markings and have a reduced speed limit. V/Line suggested that the concept could be introduced as a pilot program.[60]

The Committee considers that ‘railway crossing zones’ have merit and should be made the subject of a trial and, if successful, applied across the State to all level crossings. Railway crossing zones, if clearly identified and with reduced speed limits, would provide drivers with additional time to react to changed conditions.

As a further safety measure, the Committee considers that VicRoads should trial solar powered variable speed limit signs on approach roads to crossings with safety issues. These signs could be used when there are sight distance and other safety issues at crossings, or if maintenance works were being undertaken.

The Committee supports the recent measure to reduce road speed limits to 80 km/h at 75 level crossings on high speed arterial rural roads, but considers that the measure should be extended to all high speed roads.[61] An 80 km/h road speed limit on all high speed roads, if applied uniformly across the State, would provide drivers with consistent information on speed limits at level crossings.

Recommendations:

10. That the Department of Transport and VicRoads trial:

a) The introduction of 'railway crossing zones', and, if successful, the application of the zones across the State to all level crossings, and

b) Solar powered variable speed limit signs on approach roads to crossings with safety issues.

11. That VicRoads reduces road speed limits to 80 km/h at the approach to level crossings on all roads with a 100 or 110 km/h posted speed limit.

Queuing and Short Stacking Problems on Arterial Roads

Another important safety issue identified by VicRoads from ALCAM relates to queuing and short stacking at crossings on arterial roads.[62]

Queuing

The issue known as queuing occurs when a vehicle enters a level crossing and is trapped on the railway track because there is insufficient space on the exit side of the crossing to accommodate the exiting vehicle.[63] The safety issue is created by a decision of the driver to enter a crossing where a traffic constriction at a nearby intersection on the exit side of the crossing prevents the queue of traffic from moving to unblock the crossing.

The Australian Standard provides that the following steps can be taken to eliminate the problem:

- Close, relocate or grade separate the crossing;
- If the intersection past the crossing is not signalised, change the priority of movement at the intersection, or install traffic lights and link them with the railway crossing signals; or
- If the intersection before or past the crossing is signalised, link the traffic signals to the railway crossing signals.[64]

In the Joint Submission to the Inquiry, the Committee were advised that supplementary traffic signals are currently used in a limited number of locations in urban areas where there is a history of vehicles queuing over crossings.[65]

However, if the problem cannot be guaranteed by the above steps, the Standard also provides for the installation of Keep Tracks Clear signs and painted yellow pavement box markings to discourage traffic from queuing on the crossing. The Standard also states that escape or refuge areas should be considered, where practicable.[66]

The yellow box markings are presently used at some active crossings in the metropolitan area and provincial centres to warn drivers not to enter and queue over the crossing, unless there is room to pass-over the railway tracks.[67] In 2007, PTSV released the discussion paper, *Yellow Box Markings at Railway Crossings Discussion Paper,* which concluded that further investigation should be undertaken to:

- Determine the optimum extent of hatching that would encourage drivers to adhere to the requirement to keep clear and not stop on the tracks; and
- Assess public understanding of these markings and accompanying signs. This research could be used to inform a community awareness campaign. [68]

The Committee found that while yellow box pavement markings are currently used in high risk areas, the appropriateness of their use should be evaluated, and if necessary, the Standards amended. In the meantime, the Committee considers that VicRoads should undertake a community awareness program to inform the public of the meaning of the signs.

Recommendations:

12. That VicRoads assess public understanding of yellow box pavement markings and accompanying signs, and if required, use the research to inform a community awareness campaign.

13. That VicRoads determines the optimum extent of hatching that would encourage drivers to adhere to the requirement to keep clear and not stop on the tracks, and if necessary seeks an amendment to the Australian Standard.

Short Stacking

The issue known as short stacking applies to long vehicles which enter a level crossing where the road infrastructure is insufficient to permit the rear of the vehicle to clear the crossing.[69]

Short stacking occurs where there is a short distance between the railway tracks and where a short distance exists between the rail line and nearby road intersection. This can result in the rear part of a vehicle remaining over or ‘fouling’ the tracks while it is waiting at the adjacent road intersection to give way to other traffic.[70]

The Australian Standard provides that if the distance between the level crossing and a downstream crossing or other constriction is not long enough to accommodate a long vehicle stopped at the intersection without fouling the tracks, one or other of the following actions should apply:

- Establish and sign-post a detour for long vehicles; or
- Provide appropriate escape or refuge areas.[71]

Non-Compliant Road Signs

As a result of the ALCAM survey, Local Government has 13,384 issues to resolve. As at September 2008, 481 issues had been resolved.[72]

In the Joint Submission, the Committee were advised that they offered to pay Councils for the costs of replacing any non-compliant road warning signs, provided that the council pays for the installation.[73] The Committee supports this cost sharing measure and considers that the Department should write and remind councils of the funding program.

Given the large number of unresolved level crossing safety issues facing Local Government, the Committee considers that the Department should continually monitor the resolution of safety issues at crossings and work with Councils to ensure that they are aware of their responsibilities and the types of actions they could implement to improve safety at level crossings.

Recommendation:

14. That the Department of Transport monitors action being taken by Local Government to address safety issues at level crossings and writes to those Councils with outstanding issues to remind them of the responsibility they share for level crossing safety.

Safety Issues on Heavy Vehicle Routes

In correspondence to the Committee the Department of Transport advised that the safety issues identified in the ALCAM survey on routes used by heavy vehicles are similar to those identified generally, that is sight distance, short stacking, signage and line marking deficiencies. However, sight distance and short stacking issues are usually more significant for heavy vehicles as a result of longer stopping distances required, and due of the length of these vehicles.[74]

The Department of Transport stated that the operating characteristics, that is, acceleration and braking of B-doubles, are equal or superior to other heavy vehicles. Accordingly, the risk of B-doubles over other heavy vehicles, are not necessarily greater.[75]

The Committee, however, considers that the additional length and weight of a B-double adds to its risk at some crossings. This is mainly due to the extra space required if there is a nearby intersection at which a B-double is required to give way to other traffic, compounding the short stacking issue. The Committee also notes the advent of B-triples in this State.

The ALCAM survey identified level crossings where there is, or may be, a short stacking or a sight distance issue. Those on arterial roads are being prioritised for treatment by VicRoads, and Councils are being encouraged to address these issues where they have been identified on local roads.[76]

As noted above, the speed limit on high speed arterial roads is in the process of being reduced to 80 km/h at 75 locations. Active advance signs warning of a crossing ahead are also being introduced at 53 active crossing locations, mostly on regional arterial roads.[77] The Committee notes there are also some opportunities for new and developing technologies to assist in this area. This is discussed in Chapter 4.

In correspondence from the Department of Transport, the Committee was informed that VicRoads is undertaking an investigation, which is expected to be completed by the end of 2008, of the risks associated with heavy vehicles at level crossings, including the identification of potential treatments, including new technology, their practicality and cost effectiveness.[78]

Appropriateness of B-Double Routes

The Committee considers another option is to re-examine the suitability of approved B-double routes. The ATSB has on two occasions in the past two years recommended that authorities in this State review B-double approved routes.

Following a fatal crash between an historic steam locomotive and a B-double at a passive crossing in Benalla in 2002, the Australian Transport Safety Bureau (ATSB), in a 2006 report, *Level Crossing Collision Between Steam Passenger Train 8382 and Loaded B-double Truck, Benalla, Victoria, 13 October 2002,* recommended that VicRoads reviews all existing level crossing protection treatment levels on B-double approved routes, including line markings and signage.[79]

The report noted that VicRoads advised it had begun a review of B-double routes at passive crossings and was satisfied that the Benalla crossing was appropriate for a B-double route.[80]

The ATSB also recommended that Benalla Rural City Council review all existing railway level crossing protection treatment levels on B-double approved routes, including line markings and signage.[81]

The ATSB found, amongst other matters, that the sighting distance on the approach road, based on a speed of 80 km/h, provided minimal time for a heavy vehicle to cross the rail corridor. They also found that the design of a B-double cabin inhibits sighting distances to the left, across the cabin, to crossings.[82]

In 2007, the ATSB, following its investigation into another fatal crash, at a passive crossing at Lismore between a freight train and a heavy vehicle in 2006, recommended that the then Department of Infrastructure ensures that road and rail authorities jointly assess the risks associated with B-double/higher mass limit vehicles using level crossings. The report, *Collision Between Rigid Tipper Truck/Quad Axle Trailer and Freight Train 4AM3, Lismore, Victoria, 25 May 2006,* found that there was no evidence of joint consideration between road and rail authorities of the risks associated with B-double/higher mass vehicles using level crossings.[83]

The ATSB in its submission to the Inquiry, raised an important associated issue, that there is no national guide that defines the stopping distance provisions for active crossings. The current Australian Standard only describes the process for calculating sight distance provisions at passive crossings. The ATSB stated that this implies that the provisions are not mandatory for active crossings, even though the provision for stopping sight distance could be considered appropriate for both types of crossing control.[84]

A further concern raised by the ATSB was that the guidance in the Standard for calculating sight distance provisions at passive crossings may be inadequate for some heavy vehicle configurations.[85]

The Committee considers that VicRoads and the Department of Transport should take action to have these matters rectified, as soon as possible. The Department should not wait for the Standard to be amended but should review sight distances set for ALCAM, and reassess all level crossings on approved B-double routes.

In 2007, the Department of Transport requested road authorities to ‘reconsider’ B-double routes at crossings which do not comply with the Australian Standard because of queuing or short stacking issues, if it was not practical to mitigate those risks by other means.[86] The Committee notes that preventing B-double and B-triple use on some level crossings should be considered.

Recommendations:

15. That the Department of Transport requests from Standards Australia to revise the sight distance provisions in Australian Standard, AS 1742.7-2007, to reflect more accurately the stopping and sight distances requirements for heavy vehicles.

16. That the Department of Transport reviews stopping and sight distances set for Australian Level Crossing Assessment Model against the research published by the Australian Transport Safety Bureau, and reassesses all level crossings on approved B-double and B-triple routes.

Closing Surplus Crossings

The Committee considers that closing surplus level crossings is one crucial means of reducing the scale of the problem in Victoria.

Several submissions to the Committee stressed the importance of closing unnecessary, or as the Committee considers them, surplus level crossings.[87]

In his submission to the Inquiry, Dr Eric Wigglesworth, Honorary Senior Research Fellow, Monash University Accident Research Centre (MUARC), advised the Committee that the first recommendation of the *Seventh International Symposium on Railroad-Highway Grade Crossing Research and Safety*, held at Monash University, 2002, was for the development of a level crossing closure program modelled on the United States Department of Transportation Federal Railroad Administration document, *Guidance on Traffic Control Devices at Highway-Rail Grade Crossings*.[88]

Dr Wigglesworth advised that the document suggests a maximum of not more than one crossing per mile (1.6 km) in rural areas and four per mile in urban areas.[89] The United States report noted that:

> Eliminating redundant and unneeded crossings should be a high priority. Barring highway or railroad system requirements that require crossing elimination, the decision to close or consolidate crossings requires balancing public necessity, convenience and safety. The crossing closure decision should be based on economics; comparing the cost of retaining the crossing (maintenance, accidents, and cost to improve the crossing to an acceptable level if it would remain, etc.) against the cost (if any) of providing alternate access and any adverse travel costs incurred by users having to cross at some other location. Because this can be a local political and emotional issue, the economics of the situation cannot be ignored.[90]

In his submission, Dr Wigglesworth stated that:

> Only a minority of crossings can be closed, but perhaps an initial step would be to identify a list of (say) 100 crossings to be closed within the next 5 years.[91]

Dr Wigglesworth referred to a report he submitted to the Government in 1976 where he identified two crossings in Tatura only 157 metres apart and 48 crossings in 66 kilometres on the Toolamba-Echuca line.[92] The Committee notes that there are still 45 crossings on this line, 33 of which are passive and 12 active.[93]

The Committee noted that the Department of Transport had encouraged Local Government Councils to close level crossings. At a public hearing on 3 March 2008, Mr Tom Sargant, Chair, Victorian Railway Crossing Safety Steering Committee (VRCSSC), advised the Committee of a grant or incentive, which sought to encourage Local Government to nominate crossings that should be closed. Mr Sargant advised the Committee that none of the Councils had taken up the offer.[94] He stated that:

> There have been none yet but there are a number that we are talking to at the moment.
>
> …
>
> Councils have probably said on the one hand they would like to see them closed but on the other there is a reluctance as well. We need to make sure that their needs are accommodated as well.[95]

The Committee considers that the Department of Transport should review the basis of the Department's scheme and ascertain the reasons why the approach to Councils has not been successful.

However, the Committee considers that encouraging Councils to close level crossings has merit.

V/Line Passenger, in its submission, proposed that crossings should be investigated for possible closure in a strategic planning process with stakeholders on a regional network level.[96] The Committee supports the approach suggested by V/Line.

The Committee considers that the Department of Transport should undertake a regional level crossing closing program with rail operators and road authorities, in particular Local Government. The program would identify surplus level crossings that could be closed through a consultative process with level crossing stakeholders, including users of crossings. The Committee considers a consultative approach involving road users, Councils, VicRoads and the rail operators, in a geographically defined area, such as along a railway line, is preferable to requesting individual Councils to nominate crossings that could be closed.

An initial step in this consultative approach would be to develop with stakeholders and road users, agreed criteria to assist in the identification of surplus crossings that could be closed. The criteria should address existing and projected rail, vehicle, emergency and pedestrian use, the availability of other level crossings, and the social and economic impact of closure, including impacts on other traffic routes. This work could address the question of what is a surplus or unnecessary crossing by considering whether distance between crossings might be included as a criterion.

The Committee considers that the Department of Transport should bear all the costs of the surplus crossing closing program, which would include transport studies, the consultative process with stakeholders and road users, legal fees, as well as the engineering works involved in diverting traffic and closing the road and crossing. There may be a benefit in planning and undertaking the upgrade of one or more nearby crossings in conjunction with crossing closures. The total cost of the associated upgrades should not be born by Local Government.

Recommendation:

17. That the Department of Transport:

a) Undertakes a consultative regional surplus level crossing closing program with the rail operators, road authorities and road users;

b) Develops criteria to assist in the identification of surplus level crossings that could be closed;

c) Accepts responsibility for the full cost of the surplus level crossing closing program, and

d) Plans and undertakes the upgrade of nearby crossings in conjunction with one or more of the crossings that are planned to be closed.

Behaviour Change Countermeasures

Behaviour change measures, supported by penalties and enforcement are another countermeasure for improving safety at level crossings.

As part of the Government's response to the crash at Fairley near Kerang in 2007, new level crossing offences were introduced for speeding to beat a train, crossing tracks when lights and bells are operating, and weaving between boom barriers. In 2008, traffic fines for level crossing offences were increased.[97]

In 2005, the Government ran a $1 million, *Don't Risk It,* level crossing advertising campaign, with subsequent phases in 2006 and 2007 costing $1.4 million. In June 2008, $2 million was allocated to update the campaign through television, radio and print media to educate drivers of new safety measures, offences and penalties. A CD Rom of educational material was also distributed to all primary schools. A localised print campaign was also been developed for the Mildura Freight Upgrade project and the State Level Crossing Upgrade Program.[98]

The Committee received numerous submissions both supporting and expressing reservations about the value of driver education campaigns.[99] While education and media campaigns are outside the terms of reference of this Inquiry, in a previous report the Committee has expressed the view that:

> While media campaigns help to put important road safety issues on the public agenda, the evidence provided to the Committee suggests that mass media campaigns have a limited impact on behaviour in the absence of other factors such as enforcement.
>
> The Committee found that mass media campaigns can be effective when associated with enforcement campaigns.[100]

This was supported by research undertaken by Dr Brenda Lobb, Department of Psychology, University of Auckland. In a 2006 paper, 'Trespassing on the Tracks: A Review of Railway Pedestrian Safety Research' published in *Journal of Safety Research* on railway pedestrian safety, Dr Lobb commented that:

> … education about the severe consequences of a collision does not have very much effect on unsafe behaviour. [101]

Dr Brenda Lobb doubts the value of educational and awareness-raising interventions and warning signs, suggesting instead, the use and study of law enforcement measures.[102]

The Committee considers that the effectiveness of level crossing safety education programs should be evaluated. This should be followed by work to design a safety education program that is linked to a campaign of effective enforcement. This campaign could be assisted by some of the technology suggested by the Committee in Chapter 4 of this report.

Infringements

The purpose of technology which reports infringements is to support the evidence gathering activities of enforcement bodies.

Public Transport Safety Victoria (PTSV), in their submission to the Inquiry, advised the Committee that recent research has suggested that the introduction of photo/video enforcement together with boom barriers could potentially reduce level crossing crashes by up to 75%.[103]

The Committee considered submissions suggesting how technology could be used to report infringements to enforcement bodies, such as exceeding the road speed and failing to stop at a Stop sign. This technology could support the work of Victoria Police and importantly, should lead to behaviour modification of drivers. The suggestions included:

- Installing red light cameras at all urban level crossings with standard traffic signals linked into existing level crossing system.[104]
- Using high speed laser scanning with digital photographic documentation for vehicle scanning, tracking and enforcement.[105]
- Using the Intelligent Access Program developed by Transport Certification Australia, which is described in Chapter 4.

A 2006 report by Sinclair Knight Merz, *Level Crossing Obstacle Detection,* on obstacle detection systems stated that:

> In California, photo enforcement has been installed along the Los Angeles Metro Blue Line light rail system. The system uses inductive loop detectors to trigger high resolution cameras after the boom gates are down. Results at the trial sites varied between 78% and 92% reduction in violations. Similar results in Florida and Michigan yielded violation reductions of 60% and 50% respectively.[106]

The Department of Justice is trialling the use of road safety cameras at level crossings at Springvale Road, Nunawading, and Bagshot, near Bendigo. The aim of the trial is to test existing camera technologies in the demanding rail crossing environment with its potential electromagnetic interference and severe vibrations, and also test emerging technologies such as radar imaging. The trial will also test the detection and prosecution of level crossing offences, including speeding, red light offences, and stopping and queuing on the railway tracks.[107]

In September 2008, Mr Brendan Facey, Acting Director, Infringement Management & Enforcement Services, Department of Justice, in a paper delivered to the *Saferoads 2008* conference held in Melbourne, reported that at Nunawading, almost no speeding offences was detected, however, each day there were 200 red light and 75 queuing offences. At Bagshot there were almost no red light or queuing offences, however, 23 per cent of drivers were caught over the speed limit, of which ten per cent were more than 10 km/h over the limit.[108]

Mr Facey stated that:

> The trial proved that safety cameras can be effectively used at railway level crossings to detect, record and enforce speed and red light offences.
>
> Queuing offences are more complex and require the use of video evidence to enable successful prosecution in Court.[109]

With respect to the use of videos to enforce queuing offences, Mr Facey stated that it would be a complex and long-term project, including significant changes to legislation. He stated that the Government has supported a three-year project to implement the video evidence-based enforcement of queuing offences.[110] The Committee would support a trial.

The Committee supports the trials currently underway and the project to progress the use of video cameras to detect and enforce queuing offences. The Committee considers that if the trials are successful, road safety cameras should be installed at level crossings to detect and enforce level crossing offences.

Recommendations:

18. That the Department of Transport publishes the results of the road safety camera trials, and if the trials are successful, implements a program to roll-out the installation of safety cameras at level crossings to detect and enforce level crossing offences.

19. That the Department of Transport evaluates the effectiveness of level crossing safety education programs, and designs a safety education program that is linked to a campaign of effective enforcement.

Improvements to Train Conspicuity

The Committee considers that every opportunity should be taken to ensure trains are visible as a means to improve safety at level crossings. Using trains to carry safety measures would be far more cost effective than installing expensive equipment at level crossings. This is due to fewer locomotives (approximately 1,800) than level crossings (over 9,000 public crossings) in Australia.[111] Further, trains are regularly inspected and maintained, and carry their own source of power. This has great application to Intelligent Transport Systems, as discussed in Chapter 4 and train control systems which constantly monitor the position of trains on the rail networks.

In his submission to the Inquiry, Dr Charles Uber, an individual, advised that the question of visibility of locomotives and rolling stock is a problem Australia-wide.[112]

A 2003 ARRB report, *Prospects for Improving the Conspicuity of Trains at Passive Railway Crossings,* prepared for the ATSB stated that it is not possible to say what effect increasing the conspicuity of trains would have in reducing collisions.[113]

Nevertheless, the Committee considered train conspicuity issues raised in submissions, worth further attention. These include improved uses of lighting on trains, use of highly visible paint and reflective strips, and the sounding of train horns.[114]

Rotating Beacons, Oscillating or Strobe Lights on Trains

Thirty per cent of crashes at level crossings occur at night.[115] The Australian Standards on train lighting and visibility do not require trains to install flashing beacons on freight or passenger trains. Amber or orange flashing beacons are however required to be fitted to self-propelled railway maintenance vehicle.[116]

Several submissions advocated the installation of rotating beacons, oscillating or strobe lights on locomotives.[117]

The Australasian Railway Association, on the other hand, did not support the installation of additional lights on trains arguing that research from overseas and by ARRB indicate that:

> … additional lights such as strobe lights have no significant effect on detection distance, or identification of a safe distance for proceeding across level crossings. … strobe lights do not improve the conspicuity of locomotives achieved by standard headlights.[118]

In his submission, Dr Uber stated that VicRoads and V/Line had conducted trials into rotating or strobe lights on locomotives. He advised the Committee that the trials were successful, however, the required height clearance from the roof of the locomotive to the roofs of tunnels and bridges was not adequate, therefore the lights could not be fitted. Dr Uber suggested the low-profile flashing lights used on police vehicles may be a satisfactory alternative.[119]

In their submission, United Group Rail supported the installation of signals on the front of trains, such as a lighting pattern or flashing red and blue lights, which could be incorporated into a GPS based train vigilance system and activated when a train is approaching a crossing. The company suggested that the rail network could be plotted onto a virtual map in the train's vigilance control unit, and using GPS, train-borne warning systems, such as warning and ditch lights which could be automatically activated before each crossing was reached. [120]

In his submission to the Inquiry, Dr Eric Wigglesworth, Honorary Senior Research Fellow, MUARC, supported research into the fitting of flashing lights on locomotives to increase the conspicuity of trains. He suggested that high intensity, short duration flashing lights should be operated in conjunction with the locomotive horn as the train approaches a crossing.[121]

Dr Wigglesworth cited the 2004, House of Representatives Standing Committee on Transport and Regional Services report, *Train Illumination,* following an inquiry into measures proposed to improve train visibility and reduce crashes at level crossings. The House of Representatives Committee took the view that although additional lighting would not lead to a significant reduction in crashes during daylight hours or at active crossings, it may be worth considering the potential benefit to be gained at passive crossings between dusk and dawn. The Committee recommended that the Australian Government take steps to require all locomotives to be fitted with rotating beacons lights.[122]

In December 2005, the Minister for Transport and Regional Services responded, stating that the Government would not support the recommendation, 'without evidence that this would be worth the significant costs involved'.[123]

In their submission, ARRB advised that there is evidence to suggest that compared to the use of locomotive headlights alone, all auxiliary lighting treatments are effective and increase detectability or improve the capacity of a driver to estimate the time of arrival of a train. Further studies have also shown that strobe lights can improve detection when added to locomotives previously equipped with headlights alone.[124]

However, a study conducted for the Western Australian Government Railways indicated that a single strobe light did not improve detection when added to locomotives already fitted with headlights and crossing lights.[125] Dr Wigglesworth suggested that a more scientific experiment was needed to determine the effectiveness of supplementary lighting, perhaps in a laboratory or in a university department of optometry, psychology or visual science.[126]

The Committee considers that the Western Australian trial was not sufficiently robust and concurs with Dr Wigglesworth's suggestion of a more scientific study.

ARRB suggested that if further research into improving conspicuity is undertaken it should commence with careful modelling of the photometric properties of the proposed conspicuity-enhancing properties.[127] This would provide a clear indication of whether a particular lighting treatment was likely to increase the probability of a train being noticed under a range of ambient lighting conditions.[128] In the 2003, *Prospects for Improving the Conspicuity of Trains at Passive Railway Crossings,* ARRB suggested this approach, as field trials are expensive, difficult to organise and should only proceed once a solid case has been established that a treatment has a high probability of succeeding.[129]

The Committee considers that an independent investigation should be undertaken to settle the value of additional lights on trains. The Committee supports further research into improving train conspicuity, including into low-profile and different coloured flashing strobe lights. The research should commence with an evaluation of the lighting systems currently used on trains.

Recommendation:

20. That the Department of Transport investigates improved lighting systems for trains, and undertakes, within 12 months, a trial of low-profile strobe lights on trains. The Department of Transport should publish the results of the investigation and trial.

Reflective Materials on Trains

The 2003 ARRB report, *Prospects for Improving the Conspicuity of Trains at Passive Railway Crossings,* presents research which shows that fifty per cent of night-time crashes in the United States are into the sides of trains. The report suggests that this may support the use of lights or at least reflective strips on the sides of the rolling stock.[130]

In his submission, Dr Uber stated that the United States is phasing-in the introduction of reflectors, pursuant to a 2005 Department of

Transportation final rule, Reflectorisation of Rail Freight Rolling Stock.[131]

The Australian Standard on train lighting and visibility provide that it is mandatory to fit reflectors on each side of locomotives, freight and passenger rolling stock.[132]

Rail operator, Asciano, informed the Committee in their submission that its locomotives and rolling stock have reflective signage and visibility material in accordance with the Australian Standard.[133]

Mr Patrick McKay, a former engineer with the Victorian Railways and Public Transport Corporation and currently a consultant with MainCo, in a supplementary submission, advised the Committee of the results of an inspection he had undertaken of rolling stock in North Melbourne in April 2008. He notes that while most wagons were fitted with reflective delineators provided for in the Australian Standard, virtually none were properly maintained. Reflective delineators were missing in part or whole on most wagons and: 'all were dirty enough to be virtually useless.'[134]

Clean and well maintained reflectors on trains are an important element of a safe rail system. The Committee considers that trains should be regularly inspected and action taken to ensure that reflectors are fitted on all trains and that they are kept in a clean, well maintained condition. Penalties should apply if the rail providers disregard the Standard.

Recommendation:

21. That the Department of Transport enforces the use and condition of reflectors on trains, to ensure that rail providers maintain the rolling stock to the appropriate Standard. Penalties should apply if the rail providers disregard the Standard.

Colours and Markings on Trains

The conspicuity of trains during daylight can be improved through the use of colour or livery schemes and markings.

In his submission, Dr Uber recommended that the front of locomotives should be painted in highly visible colours that contrast with the surrounding landscape.[135]

In the 2003 ARRB report, *Prospects for Improving the Conspicuity of Trains at Passive Railway Crossings,* reported that no single colour provides a consistent contrast against all backgrounds, and supported research findings which recommended the use of contrasting colour schemes using wide bands of light and dark colours, to ensure visibility of a block of colour at a distance of 300 metres. The report draws attention to the difficulty of selecting a livery for a train that may operate in a variety of landscapes.[136]

The Australian Standard on train lighting and visibility provides that it is mandatory for new and modified locomotives and passenger rolling stock to have a livery applied that: 'has areas of high visibility colour'.[137] The recommended colours for the high visibility areas are either a yellow, orange, orange-red or red, or white. It is mandatory for the forward facing area of colour to be not less than one square metre in area with a minimum continuous height or width of 0.6 metres. The standard recommends a minimum luminance factor for the yellow, orange, orange-red or red.[138]

Rail provider Asciano, informed the Committee that its locomotives have high visibility colours on their front face and that its locomotives and rolling stock have visibility material in accordance with the Australian Standard.[139]

At a public hearing, 7 April 2008, Mr Rob Barnett, Chief Executive Officer of V/Line Passenger, informed the Committee that V/Line is undergoing a change to its livery.[140]

The Committee considers that it should be mandatory for the livery, or colour scheme, of locomotive and passenger rolling stock to be in high visibility contrasting colours. Further, the Department of Transport should regularly inspect the livery of trains to ensure that they are painted in high visibility contrasting colours, are well maintained and kept clean. Penalties should be applied if trains are not painted in high visibility contrasting colours, or are not well maintained and kept clean.

Recommendations:

22. That the Department of Transport ensures that the livery of trains is in mandatory, high visibility contrasting colours.

23. That the Department of Transport regularly inspects the livery of trains to ensure that they are painted in high visibility contrasting colours, are well maintained and kept clean. Penalties should be applied if trains are not painted in high visibility contrasting colours, or are not well maintained and kept clean.

Other Measures

Perceptual Countermeasures

Dr Wigglesworth, his submission, informed the Committee of countermeasures that could be used to slow vehicles as they approach crossings. A series of white lines could be painted across the approach road of a crossing at gradually decreasing distances to give the illusion of travelling gradually faster with time. A trial of this measure was conducted by the United Kingdom Road Research Laboratory at roundabouts. The perception of driving faster than legally allowed, results in drivers slowing down.[141]

In their submission to the Inquiry, the Railway Technical Society of Australasia, suggested several other measures which the Committee considers also may be worth trialling: zig-zag line markings and the use of cross-hatched markings at all surfaced crossings.[142] A joint study by ARRB Transport Research and MUARC of such low-cost treatments were discussed in a 2004 report for the ATSB, *On-Road Evaluation of Perceptual Countermeasures*. 'Herringbone' painted lines were applied to six intersections in Melbourne and Sydney. The study found that speed reductions were observed at a majority of these locations.[143]

The Committee considers that such treatments appear to be effective and should be examined and trialled in Victoria at level crossings.

Clearly, these pavement-based measures could not be employed at crossings on gravel roads, and as Dr Wigglesworth stated:

> At a passive railway crossing, there is a strong likelihood of there being no rail traffic approaching that intersection. This highlights the difficulty. If a passive crossing has low volumes of train movement (which most have) there is a negative expectation of train arrival which – in the long term – will over-ride any system of passive protection, be it lights, rumble strips or road markings. As it is the long-term effectiveness that determines the success of a particular countermeasure, this strategy cannot be examined in the simulator, but only in field studies which are both lengthy and expensive. [144]

The Committee considers the use of traffic calming measures to slow the speed of vehicles approaching level crossings, should be investigated, trialled, and if successful, implemented.

Recommendation:

24. That VicRoads investigates and trials the use of perceptual countermeasures, such as line markings, with the aim of slowing the speed of vehicles approaching level crossings. If the trials prove successful, these measures should be adopted.

Rumble Strips

Rumble strips are sets of strips of material about 300mm wide that are installed transversely across the width of the road approaching a crossing. Two sets of strips are located 100 metres apart at approximately 250 metres and 150 metres ahead of the crossing. Rumble strips cause increased noise to tyres when passed-over by a vehicle and are used to alert drivers of an up-coming hazard.[145]

They have been used successfully for many years on the side of the road to warn drivers that they are about to leave their laneway.[146]

In the Joint Submission to the Inquiry, the Committee were advised that ARRB had conducted a literature review and found that, while there are some conflicting results in the various studies, generally rumble strips had been found to be ineffective in reducing speed but effective in alerting drivers to hazards and usually effective in reducing the number of crashes.[147]

Shortly after the Kerang crash in June 2007, VicRoads began installing rumble strips on the approaches to more than 200 level crossings, mostly on high speed, sealed rural roads. The installation was completed by 30 June 2008.[148]

The initial installation was a trial of the material and construction methods only. The results led to a change to the construction of the strips.[149]

The rumble strips were installed at crossings where rail traffic volumes were low and, where therefore, drivers may be less vigilant about safety risks. ALCAM was used to identify the sites. The project cost approximately $11.7 million.[150]

The Committee received submissions supporting the use of rumble strips as a means of alerting drivers to an up-coming hazard.[151] Mr Charles Sinn, an individual, suggested the use of reflective rumble strips and that the strips should be installed at the angle at which the railway track intersects the road to alert the driver of the possibility that a train may be approaching the crossing from a direction behind the vehicle.[152]

A 2004 report by Main Roads Western Australia, *Effects of Rumble Strips on Driver Speed Behaviour at Approaches to Passively Controlled Railway Level Crossings,* concluded that the strips trialled in Western Australia had a significant beneficial effect on driver speed behaviour at the crossings with Stop signs, while the effect was negligible, if any, at crossings with Give Way signs.[153]

The report noted that the greater the number of rumble strip groups installed at the approach to crossings, the greater the beneficial effect is on driver speed behaviour. The report recommended that an additional trial be conducted with an increased number of rumble strip groups so as to determine the optimum number of rumble strips required at passive crossings with Give Way signs.[154]

The Australasian Railway Association, in its submission referred to the trial in Western Australia and stated that it supports the further study of rumble strips by the Victorian Government.[155]

VicRoads has engaged ARRB to conduct a before and after evaluation, validation, and compliance trials of rumble strips.[156] Dr Peter Cairney, Principal Research Scientist, ARRB, stated at a public hearing, 5 May 2008, that he could not advise the Committee on rumble strips as ARRB was still conducting the evaluation. The study involves crash analysis and driver behaviour, including whether drivers slow down, or if they drive around the strips.[157]

The Committee supports this evaluation as it is consistent with evidence-based road safety measures advocated by this Committee.

Once the evaluation is complete, the Committee considers VicRoads will need to act on whether additional rumble strips are installed, or whether it would be more cost effective to focus on other safety measures.

Recommendation:

25. That once the evaluation of rumble strips is completed, VicRoads determines whether additional rumble strips should be installed.

Other Tactile Stimuli

The Committee received a number of suggestions regarding tactile stimuli. These include:

Dr Wigglesworth recommended the following research be undertaken into the use of:

- Speed humps at passive crossings used by semi-trailers and B-doubles. The research should examine a design that would provide adequate tactile stimulus without resulting in the movement of the load and loss of control of the vehicle. Dr Wigglesworth suggested investigation of a double hump placed 0.5 seconds apart might prove to be a unique method of warning of a level crossing.[158]

- A bitumen strip on a gravel road with a Railway Crossing Ahead sign some distance before a crossing to provide a stimulus to alert a driver of a potential danger ahead.[159]

The Railway Technical Society of Australasia suggested speed bumps on minor roads, and speed dips on higher speed roads and coloured raised pavement markers.[160]

The CSIRO suggested that the texture of approach roads could be changed to warn drivers of a crossing. Their submission stated that this measure might help to address the lack of signal recognition when a driver is behind a heavy vehicle or is otherwise distracted.[161]

Dr Wigglesworth expressed concern over the lack of scientific evidence to underpin current and proposed countermeasures.[162] The Committee agrees with Dr Wigglesworth's call for research and considers that these measures should be investigated.

Recommendation:

26. That VicRoads investigates the use of tactile stimuli, including speed bumps, coloured raised pavement markers and changes to the texture of approach roads to level crossings.

Summary of Findings

- Unless a large surplus number of crossings are closed, or new technological safety measures implemented, it will be many decades before safety at level crossings can be improved.
- The Department of Transport should bear all the costs of a consultative regional program to close surplus crossings.
- Basic maintenance at level crossings should be a priority.
- An overall cost estimate of the works required to address safety issues identified by ALCAM, needs to be prepared.
- The Government will need to significantly increase funding to the level crossing upgrade program if the issues identified by ALCAM are to be addressed within a reasonable timeframe.

- The absence of guidelines on minimum treatments has the potential to lead to inconsistent levels of protection.
- Preventing B-double and B-triple use on some crossings should be considered, if there are insufficient funds to address safety issues in any other manner.
- The effectiveness of rumble strips should be evaluated.

Recommendations

5. **That the Department of Transport investigates and reports on the reasons for the failure of warning systems at active level crossings, and takes action to reduce the frequency of failure.**
6. **That the Department of Transport requests that the Minister for Public Transport seeks uniformity of Standards at the Australian Transport Council by advocating the adoption of national standards.**
7. **That the Department of Transport adopts policy guidelines which set minimum safety standards for different types of level crossings.**
8. **That the Department of Transport publishes an analysis of the results of the Australian Level Crossing Assessment Model survey, including an overview of the works required, and whose responsibility it is to resolve the issues identified in the survey.**
9. **That the Department of Transport, together with the level crossing stakeholders, prepare a funded, three-year program to implement the safety issues identified in the Australian Level Crossing Assessment Model surveys. The program should be regularly monitored and the results published annually.**
10. **That the Department of Transport and VicRoads trial:**
    - a) **The introduction of 'railway crossing zones', and, if successful, the application of the zones across the State to all level crossings, and**
    - b) **Solar powered variable speed limit signs on approach roads to crossings with safety issues.**
11. **That VicRoads reduces road speed limits to 80 km/h at the approach to level crossings on all roads with a 100 or 110 km/h posted speed limit.**

12. That VicRoads assess public understanding of yellow box pavement markings and accompanying signs, and if required, use the research to inform a community awareness campaign.

13. That VicRoads determines the optimum extent of hatching that would encourage drivers to adhere to the requirement to keep clear and not stop on the tracks, and if necessary seeks an amendment to the Australian Standard.

14. That the Department of Transport monitors action being taken by Local Government to address safety issues at level crossings and writes to those Councils with outstanding issues to remind them of the responsibility they share for level crossing safety.

15. That the Department of Transport requests from Standards Australia to revise the sight distance provisions in Australian Standard, AS 1742.7-2007, to reflect more accurately the stopping and sight distances requirements for heavy vehicles.

16. That the Department of Transport reviews stopping and sight distances set for Australian Level Crossing Assessment Model against the research published by the Australian Transport Safety Bureau, and reassesses all level crossings on approved B-double and B-triple routes.

17. That the Department of Transport:

a) Undertakes a consultative regional surplus level crossing closing program with the rail operators, road authorities and road users;

b) Develops criteria to assist in the identification of surplus level crossings that could be closed;

c) Accepts responsibility for the full cost of the surplus level crossing closing program, and

d) Plans and undertakes the upgrade of nearby crossings in conjunction with one or more of the crossings that are planned to be closed.

18. That the Department of Transport publishes the results of the road safety camera trials, and if the trials are successful, implements a program to roll-out the installation of safety cameras at level crossings to detect and enforce level crossing offences.

19. That the Department of Transport evaluates the effectiveness of level crossing safety education programs, and designs a safety education program that is linked to a campaign of effective enforcement.

20. That the Department of Transport investigates improved lighting systems for trains, and undertakes, within 12 months, a trial of low-profile strobe lights on trains. The Department of Transport should publish the results of the investigation and trial.

21. That the Department of Transport enforces the use and condition of reflectors on trains, to ensure that rail providers maintain the rolling stock to the appropriate Standard. Penalties should apply if the rail providers disregard the Standard.

22. That the Department of Transport ensures that the livery of trains is in mandatory, high visibility contrasting colours.

23. That the Department of Transport regularly inspects the livery of trains to ensure that they are painted in high visibility contrasting colours, are well maintained and kept clean. Penalties should be applied if trains are not painted in high visibility contrasting colours, or are not well maintained and kept clean.

24. That VicRoads investigates and trials the use of perceptual countermeasures, such as line markings, with the aim of slowing the speed of vehicles approaching level crossings. If the trials prove successful, these measures should be adopted.

25. That once the evaluation of rumble strips is completed, VicRoads determines whether additional rumble strips should be installed.

26. That VicRoads investigates the use of tactile stimuli, including speed bumps, coloured raised pavement markers and changes to the texture of approach roads to level crossings.

Endnotes

[1] Standards Australia, *Australian Standard, Manual of Uniform Traffic Control Devices, Part 7: Railway Crossings*, No. AS 1742.7 – 2007, 3rd edn, Sydney, 2007, p. 7.

[2] Standards Australia, p. 33.

[3] Standards Australia, p. 25-26.

[4] Standards Australia, p. 29.

[5] Standards Australia, p. 31.

[6] Department of Infrastructure (now Department of Transport), VicRoads, in association with the Victorian Railway Crossing Safety Steering Committee (Joint Submission), Submission to the Inquiry, October 2007, p. 24.

[7] Standards Australia, pp. 16-21, 31, 45.

[8] Australian Transport Safety Bureau (ATSB), Submission to the Inquiry, October 2007, p. 6.

[9] Mr A Osborne, Public Transport Safety Victoria (PTSV), Correspondence, 29 April 2008, p. 3.

[10] International Electrotechnical Commission, *Functional Safety and IEC 61508,* Geneva, 2005, pp. 3-5.

[11] Standards Australia, pp. 29-43.

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Chapter

4

New and Developing Technologies

Introduction

As discussed in previous chapters the safest way to cross a level crossing is either via an underpass or a bridge. Even active crossings could be improved.

A 2003 ARRB report, *Prospects for Improving the Conspicuity of Trains at Passive Railway Crossings*, prepared for the Australian Transport Safety Bureau (ATSB) suggests that upgrading passive crossings to active warning status would reduce crashes by more than 60 per cent.[1]

Crossings can, and are, being up-graded, depending on the priority of the crossing in the State's upgrade program and the availability of funds. However, as the average cost of flashing lights can cost approximately between $250,000-$350,000 per crossing, and boom barriers can be between $350,000-$450,000 to install, it can be prohibitively expensive.[2]

Obviously if new, preferably cheaper technology to warn road users of upcoming trains can be introduced at crossings, particularly at vulnerable passive crossings it would then increase safety.

At a public hearing, 5 May 2008, Dr Peter Cairney, Principal Research Scientist, ARRB, commented that:

> … we have really got to think about something radically different in terms of warning drivers that trains are on the way.[3]

During the course of this Inquiry, the challenge for the Committee was the feasibility of introducing new technologies that would be acceptable to the authorities and the public. This was an issue for the National Transport Commission (NTC), who identified in 2007, the potential for technology to provide warnings of on-coming trains at passive crossings as one of its priorities for consideration.[4]

The Committee found that, for the main part, both the Government and the rail providers have been reluctant to consider new warning technologies due to liability concerns.[5] That is, all technologies installed at crossings had to be fail-safe. However, at a public hearing 3 March 2008, Mr Chris McKeown, General Manager, Safety Systems, Public Transport Safety Victoria (PTSV), informed the Committee that, ultimately, there is no such thing as ‘a fail-safe system’. All systems have a small probability that there will be an unsafe failure.[6] Power supplies could fail, light systems, bells can all malfunction, and at the same time.[7]

In the context of this Inquiry, the Committee defines ‘new’ technology as a system or device that has been developed and is presently being trialled, or is available for trial in a rail environment.

‘Developing’ technology on the other hand, includes systems or devices in the design stage and which are not presently available for trial.

In the case of both new and developing technologies, the Committee found that a number of these technologies have either not been trialled, or are currently being trialled, therefore no evidence is available as to their efficacy.

Nevertheless, the Committee found a number of technologies worth investigating and trialling for future application in the rail environment. This includes Intelligent Transport Systems (ITS).

Applications for the Use of New and Developing Technologies

The Committee considered it useful to examine new and developing technologies from the point of view of their potential use at level crossings. Accordingly, technologies can be used for the following purposes. These include:

- To warn drivers of an up-coming level crossing;
- To warn drivers and pedestrians of trains approaching a crossing;
- To warn train drivers of obstructions on railway tracks;
- To warn drivers that their vehicle is exceeding the speed limit approaching the level crossing;
- To monitor the behaviour of drivers and pedestrians at crossings;
- To report infringements to enforcement bodies;
- To actively control vehicles and trains; and
- To improve the crashworthiness of trains.

Of these, the Committee considers that the greatest potential for improved safety at level crossings is by far technologies that can warn road users of approaching trains at passive crossings. Improvements to enforcement technology at crossings will greatly benefit safety. In the longer term, the Committee considers that technologies that actively control trains and vehicles will be beneficial.

Issues Surrounding New Technologies

All active level crossings around the world operate under a 'fail-safe' system covered by the international standard IEC 61508.[8] The Standard is published by the Swiss based body International Electrotechnical Commission, which is the lead organisation that prepares and publishes international standards for all electrical and related technologies.[9]

A fail-safe system means that, if a level crossing system fails, it fails in a safe, predictable or specified manner, and in a way that alerts users of the failure. If the level crossing fails in a fail-safe mode, the advance warning signs operate continuously.[10]

The high level of specification of active level crossings is a cost impediment to safety and a disincentive to the exploration and use of other technologies that could assist drivers to comply with Stop and Give Way signs at passive crossings.

Alternative technologies that are considered here do not operate in such a fail-safe manner and are often referred to as low-cost warning devices.

Low-Cost Warning Devices

Low-cost warning devices have been developed to address the need for warning equipment at crossings in locations where the use of high-cost, high-specification, fail-safe devices cannot be justified.

At a public hearing in Melbourne, 5 May 2008, Mr Brent Graham, Project Director, Rail Group, Sinclair Knight Merz, advised the Committee that the introduction of low-cost systems which could be quickly deployed offer the best solution to improved level crossing safety.[11] He stated that:

> Given a fixed budget, more crossings can be upgraded. By reducing the number of steps and the complexity of getting a level crossing upgraded, we can do more in the same amount of time, and if we just get more crossings upgraded, it will generally improve the overall safety of the system.[12]

A 2005 report by the United States Transportation Research Board, *An Analysis of Low-Cost Active Warning Devices for Highway-Rail Grade Crossings*, noted that the priority for the rail industry is to find a way to implement low-cost active warning systems at passive crossings.[13] The report states that:

> Finding out how to implement low-cost active warning systems for passively controlled highway-rail grade crossings, particularly in today's technology rich environment, should be among our highest safety priorities. …
>
> The incredible advances we have seen in technology over the past decade or so – from communications and the Internet to computer and sensor technology – suggest that there has to be a low-cost way to signalise some of the thousands of passive grade crossings that exist in our country.[14]

The Australian Transport Council (ATC) is a ministerial forum for Commonwealth, State and Territory consultations and provides advice to Governments on the co-ordination and integration of all transport and road policy issues at a national level.[15] Issues on the council's agenda include the formation of a single, national rail safety regulatory and investigation framework.[16]

The Committee notes that in May 2008, the ATC agreed to the development of a package of railway level crossing safety initiatives, including consideration of a major trial of low-cost level crossing treatments.[17]

The Victorian Experience with a Low-Cost Warning System

Several submissions referred to a low-cost level crossing warning device (LCLCWD) developed in Victoria which uses electromagnetic induction loop detectors to detect trains.[18] The Victorian device is now referred to as the Passive Crossing Warning System.[19]

Induction loop systems detect metal objects and their use to detect trains has been favourably trialled in Victoria, and used in the United States.[20] One or more loops of wire connected to an electrical power source and control box are placed under the railway tracks and when a train passes over the loop, its presence is detected.

This technology is similar to the technology used by road bodies in Australia to control traffic signals.[21]

The purpose of the Victorian system is to supplement Stop or Give Way signs at passive crossings. It is powered from solar panels and batteries, and instead of rail track circuits, uses existing technology, electromagnetic induction loop detectors to recognise trains and activate amber flashing warning lights. The system detects the speed of an approaching train and initiates a warning light when it is calculated that the train would take 25 seconds to reach the crossing. Should the system fail, faults are notified to road users through the warning light which changes to a slow flashing mode, while a mobile telephone notifies the VicRoads' control room.[22]

The then Road Safety Committee made reference to the Victorian system in the 2002 report, *Inquiry into Rural Road Safety and Infrastructure.* The Committee noted that:

> VicRoads and VicTrack have established a project to develop a cost-effective alternative to address the 1,500 or so crossings that are on low volume roads across Victoria and are still untreated. VicRoads state that:
>
> - The Railway Level Crossing Improvement program could be expanded in order to treat more sites and prevent the occurrence of catastrophic crashes; and
> - A research and development project is underway, in conjunction with VicTrack, to develop a cost-effective treatment costing between $25,000 and $30,000 suitable for most of the 1,500 low volume crossings that do not have active signal protection. This should be continued.[23]

At the 2006, Institution of Railway Signal Engineers Australasian Section Annual General Meeting, Mr Phillip Jordan, formerly Principal Road Safety Engineer, VicRoads, presented the paper, 'A Trial of a Low Cost Level Crossing Warning Device' in which he described the course the then Victorian Rail Level Crossing Committee followed in the early 1990s, and which led to a nine-year study and trial of the system. This included:

- An international literature search;
- Trialling five detection systems before settling on one for further testing on a track near Ballarat; and
- The final stage of the trial which resulted in installing a prototype at a passive crossing at Creswick in Western Victoria that was monitored under real traffic conditions.[24]

At the annual general meeting Mr Jordan stated that the outcome of the trial was very encouraging, noting that:

> VicRoads and VicTrack now have a low cost level crossing warning device just months away from being available for use on low volume roads in rural areas. Its final cost will be in the order of one fifth of the cost of the conventional active control.[25]

Mr Jordan further added that the final step was to evaluate the public reaction, and to monitor its usage at the trial site. Mr Jordan stated:

> Unless something terribly untoward takes place, it can be expected that the new device will soon become a[n] accepted treatment for passive crossings in remote areas across the state.[26]

The South Australian Department of Transport, Energy and Infrastructure has also undertaken a blind trial to test the system.[27]

Their 2005 report, *Low Cost Crossing Warning Device Comparative Field Trial,* concluded that the system performed to its designed detection and activation specifications. The report recommended that the system should be trialled at a passive crossing. They also recommended a national co-ordinated approach as to how and where the low-cost level crossing warning device technology can be applied and what warning systems should be in place to warn the road user.[28]

At a public hearing, 3 March 2008, Mr Alan Osborne, Director, PTSV informed the Committee that he believed the trial in South Australia performed to its design specification and detected a .02 failure rate out of 4,372 events.[29]

Status of the Victorian Passive Crossing Warning System

In a joint submission to the Inquiry by then Department of Infrastructure, now Department of Transport, VicRoads, in association with the Victorian Railway Crossing Safety Steering Committee (Joint Submission) the Committee were advised that VicTrack engaged a consultant in July 2006 to analyse the data collected from the field trial and that VicTrack had requested the consultant to complete a business case for a further trial and development program.[30]

At the public hearing, 3 March 2008, Mr Tom Sargant, Chair, Victorian Railway Crossing Safety Steering Committee (VRCSSC), informed the Committee that the system was still being trialled and that, despite early testing indicating a high degree of reliability, there were still issues that needed to be resolved.[31]

The Railway Crossing Technical Group is a sub-committee of the VRCSSC, whose responsibility it is to conduct research and develop initiatives to enhance the safety of crossings.[32] At a public hearing in Melbourne, 5 May 2008, Mr Geoff Walker, Chair, Railway Crossing Technical Group, informed the Committee that a consultant has been engaged to:

> … do worldwide research or a search of what technology is out there. We have been trialling a low-cost device for a period of time, but we wanted to see what else is around the world.[33]

The Committee notes that the trial at Creswick has been underway for at least nine years and there do not appear to be any published results. The Committee considers that if the trials are a success, and if the system is technologically sound and reliable, the Department of Transport should investigate the feasibility of implementing the system.

Significantly, the Australian Rail Track Corporation (ARTC), which leases the interstate track from the Government, supports the work undertaken in Victoria to develop a low-cost enhanced warning system for passive crossings.[34] The ARTC stated that the characteristics of such a system should be that: it is solar powered; has the same reliability level as road traffic signals; has a simple and reliable train detection system; and that if the system fails the underlying protection is relied on, that is, the Stop or Give Way sign remains effective. The ARTC added that such a system should be incorporated into the appropriate standard.[35]

In the Joint Submission, the Committee were advised of conditional support of the technology, stating that:

> It is considered that the simplicity and non-dependence on traditional signalling device methods (i.e. wheel rail contact) gives this LCLCWD [the passive crossing warning system] advantages over existing technology.[36]

However, they also noted that:

> The fundamental problem with this initiative is that unlike normal/traditional level crossing protection equipment, the LCLCWD does not fail safe.[37]

Legal Concerns for New Technologies

The Victorian Passive Crossing Warning System is an example of a new technology that requires clarification as to whether it would comply with current legislation and standards.

At the 2006, Institution of Railway Signal Engineers Australasian Section Annual General Meeting, Mr Jordan explained that VicRoads engaged Patent Attorneys to advise on the use of induction loop technology and further legal advice was sought on the question of legal liability if there was a crash after a system failure with this technology.[38] Mr Jordan commented that:

> The legal advice received before the trials was of the view that the technology used had to be well tested, subjected to rigorous risk assessments, and applied in a professional manner. If this was done, it was concluded that a Court of Law would most likely have little reason to find against the new device, all other matters being equal.[39]

At a public hearing, 3 March 2008, Mr Osborne, Director, PTSV, informed the Committee that from a regulator's perspective, he would accept the technology that has been trialled at Creswick. He noted that:

> … the view there was that there is a very real and practical option for using these, particularly at rural rail crossings. They are certainly cheaper and lower cost. Adoption: yes, there are some legal issues to be gotten through; probably also require a change to the current Australian standard 1742.7, and these legal issues will need hammering out, but I personally feel that that is not insurmountable. Certainly our position as a regulator would be to accept technology that was not deemed to be fail-safe and what you have to do is look at the benefits on the other side, as well as the fail-safe.[40]

At the public hearing, Mr Sargant, VRCSSC, stated that he was unsure if legislation would be required to support the introduction of non fail-safe devices.[41] Mr Sargant noted that work was being done to address liability concerns. He explained that if non fail-safe devices were used at crossings, a communication process would be required to:

> … make sure that everyone is absolutely aware that whilst the light might flash or the bells might go when a train is coming, there is the odd chance that it might not.[42]

In 2007, the VRCSSC sought the opinion from PTSV, on the use of low-cost warning devices and whether the adoption of this technology would be prohibited by the *Rail Safety Act 2006*.

A copy of the correspondence was provided to the Committee by the Department of Transport, in which the Director, Mr Osborne, wrote that:

> The Rail Safety Act 2006 (RSA) requires Accredited Rail Operators (ARO's) to eliminate risks and where this is not possible to reduce those risks to a standard of 'so far as is reasonably practicable'. The RSA cannot be used as a reason for non adoption of risk controls that will reduce risks at existing passive level crossings.
>
> Recognising the emerging opportunities for reduction in level crossing risk, PTSV encourages the VRCSSC and all duty holders to properly investigate the

> options that this new technology presents. If the technology being considered achieves risk to be eliminated or reduced so far as is reasonably practicable, then prima facie it could be utilised consistently with the RSA.
>
> In particular PTSV would be looking for the ARO to nominate the reliability performance that the equipment would meet and that this should be at least to the standard of similar road based signals.[43]

In correspondence to the Committee, Mr Osborne clarified the issue further, stating:

> From PTSV's point of view if a non fail-safe technology demonstrated that it met the test of reducing risk 'so far as is reasonably practicable' … and given that the system reliability was at least as effective as normal road traffic equipment, we would support its application to be installed at a level crossing that had low train and road vehicle volumes that were previously protected by passive signs.[44]

In July 2008, the Committee conducted a one day Forum to debate these very issues. At the Forum, Ms Jennifer Patterson, Manager, Regulatory Policy and Legal, PTSV offered the opinion that the perception of increased liability was overstated. Rather, Ms Patterson noted that there is potential for rail operators to be liable for refusing to adopt a new technology when it is available.[45] She explained that with the introduction of the *Rail Safety Act 2006,* the organisation/s who manage the risk at the rail crossing have a responsibility to do so. Ms Patterson elaborated by noting that:

> Part 3 of the Act also sets out the rail safety duties that rail operators are expected to comply with. The key to those is that there is a duty to ensure safety so far as is reasonably practicable. ... It begs the question: what does it mean? In terms of what the statute itself says, ... It is a balancing act between the likelihood of the hazard or the risk concerned eventuating, the degree of harm that would result if it did occur, what the person who is supposed to be managing the risk knows or ought to know about how to go about managing that risk, the availability and the suitability of ways to eliminate or reduce the risk, and the cost of eliminating or reducing the hazard or risk. … all these factors are … to be worked out on a case-by-case basis.[46]

The Committee consider that, although trains pose a dangerous risk to other road users, there is no reason why the reliability performance of the equipment could not be similar to other road based signals.

Findings on Low-Cost Warning Systems

The Committee has determined that low-cost warning systems are not, nor should they be, intended to be a replacement or substitute for fail-safe active level crossing controls. However, these types of technologies have the potential to provide a greater level of protection than currently available for the majority of drivers at passive crossings.

The Committee is disappointed with the amount of time it has taken to both investigate the Victorian system and to make a decision on whether to proceed with its implementation as a supplement or enhancement to existing controls at passive level crossings.

The Committee does not consider that the lack of fail-safety is sufficient reason to reject the use of low-cost warning devices. It does however consider that the following strategic issues need to be addressed:

- Under what conditions and where the devices should be used;
- Whether the devices would be used on the road system as a supplement to existing level crossing safety control signs;
- Whether the devices would operate independently of, and not be linked to, the railway signalling systems and therefore not compromise rail safety; and
- How human factors could be addressed.

The Committee considers that if additional technology is introduced, the devices or systems should satisfy a number of tests, including that it should have the capacity to operate:

- At all level crossings but in particular at passive crossings in rural Victoria;
- To positively assist a road user with their decision-making;
- In conjunction with, and as a supplement to, existing rail and road safety systems;
- In a manner consistent with existing level crossing systems, for example, providing a warning of an approaching train at least 25 seconds prior to the arrival and during the passage of the train through the crossing;
- In a manner which does not compromise the operation and safety of existing rail and road safety systems; and
- Reliably, and with automatic testing and remote monitoring systems.

In addition to the above, the Committee considers that they should be as reliable as existing road traffic signals, such as traffic lights.

The Committee considers these issues to be policy decisions, and separate to the establishment of technical requirements as to the reliability, trialling and development issues associated with low-cost warning systems.

The Department of Transport should allocate resources to support and contribute to the research, trialling and development of these types of systems.

The Committee considers that the Government ought to support the use of non fail-safe technology as a supplement or enhancement to existing controls at level crossings.

The Department of Transport should collaborate with Accredited Rail Operators and Public Transport Safety Victoria to develop reliability performance criteria that non fail-safe technology must satisfy.

Recommendations:

27. That the use of low-cost warning technology be used as a supplement, or enhancement, to existing controls at level crossings, particularly at passive crossings.

28. That the Department of Transport:

a) Consults with Accredited Rail Operators and Public Transport Safety Victoria and develops reliability performance criteria that non fail-safe technology should satisfy;

b) Initiates the inclusion of low-cost warning technology into railway safety standards;

c) Investigates whether legislation is required to introduce non fail-safe technology as a means of improving safety at level crossings; and

d) Trials and publishes the results of low-cost systems which would be suitable for use as a supplement to existing controls at passive level crossings. The results of these trials should be published.

Types of Low Cost Warning Devices

The Committee found a number of technologies, that applied alone or in combination, have the potential to detect the presence of an approaching train, calculate its approach speed and time of arrival at a level crossing, and are thus able to trigger a warning device.[47]

These technologies include systems that can detect a train visually or by the noise, weight, vibration, rail stress and energy emitted by the train. Other systems can transmit and receive waves of energy reflected from an approaching train. Systems can also transmit beams of energy to a receiver which passing trains interrupt or break as they travel through the detection area.[48]

While several papers describe new and developing technologies, it is difficult to evaluate their safety impact due to the few trials that have occurred and been reported.[49]

In correspondence to the Committee, 29 April 2008, Mr Osborne, PTSV stated that his office was not aware of any studies on the safety of non fail-safe technology. Mr Osborne noted that due to the low number of incidents that occur at level crossings it is generally difficult to evaluate safety improvements.[50]

The types of systems the Committee considers worth investigating are described below: they include radar systems; axel counting; and a number of lighting systems. GPS and short-range radio are also systems worth investigating and are dealt with under Intelligent Transport Systems.

Radar Systems

Radar is used in train detection systems in Norway, Venezuela and the United States, and for obstacle detection on railways in Italy, Germany and the Netherlands.[51]

In correspondence to the Committee, 29 April 2008, PTSV stated that Canada seems to be on the cusp of being able to deliver lower-cost technology utilising solar power, radio linking and lower-cost train detection.[52]

PTSV is monitoring the prototype development of a low-cost warning system in Canada, known as the advanced crossing signal system.[53] This system reliably alerts drivers of an approaching train, and alerts train drivers of obstructions at crossings that have been detected by radar and light detecting devices. It is solar powered and costs less than CAD $50,000. The warning at the crossing could include standard flashing lights and bells or simulated train horn, or a red, yellow and green traffic light. The system has been concept designed, and the next steps before it can be manufactured, include detailed design, laboratory and field testing.[54]

In correspondence to the Committee, 23 September 2008, the Department of Transport advised that the Victorian Railway Crossing Safety Steering Committee, in August 2008, endorsed a radar-based low-cost level crossing warning to be trialled at a level crossing at Mitiamo during 2008–09.[55]

The Committee supports the trial and considers that the use of radar to detect approaching trains at level crossings appears to hold promise and should be investigated.

Axel or Wheel Counting Systems

Axel or wheel counters use magnetic detection technology to identify the presence and speed of trains.[56]

Axel counters detect the presence of a train by counting the passage of wheels that have entered and left a particular track section. The technology is used on rail in Europe and the United States.[57]

In a submission to the Inquiry, the Railway Technical Society of Australasia, advised that the use of axel counters: 'may represent a step toward more cost efficient active level crossing protection.' Sinclair Knight Merz made a similar comment in their submission.[58]

At the Forum, 21 July 2008, the Committee were informed that the system is reliable for use on seasonal and low use railway lines and is in use on a lightly used section of the Portland line in Victoria.[59] Axel counters have also been introduced for signalling purposes in some Regional Fast Rail corridors and the Stony Point line, but not for level crossing purposes in Victoria. A solar powered version has been developed in Victoria which incorporates central monitoring via SMS. [60]

A 2005 report, *An Analysis of Low-Cost Active Warning Devices for Highway-Rail Grade Crossings*, prepared for the United States Transportation Research Board, identified problems historically associated with this technology but also stated that:

> … new or improved technologies have allowed wheel counter systems to re-emerge as candidates for serious consideration.

Further,

> Lighter, more resilient materials, greater detection distances, and improved computer processing all contribute to this potential rebirth as a viable approach to lower-cost active warning systems.[61]

Because of their cost advantage, the Committee considers that the use of axel counters at passive level crossings should be investigated.

Recommendation:

29. That the Department of Transport investigates the use of axel or wheel counters to detect trains approaching level crossings.

Solar Powered Lighting

Improved lighting would assist vehicle drivers, especially at crossings which experience frequent fogs or inclement weather, and might provide train drivers with a better opportunity to see vehicles that are encroaching onto a crossing. The measure would also benefit pedestrians.

The Committee examined several measures to improve the conspicuity of level crossings in rural Victoria. A number of submissions suggested the use of lighting, including solar powered lights.[62]

The Committee considers that the use of solar powered lighting to improve the visibility of passive crossings in rural Victoria should be investigated by the Department of Transport.

Recommendation:

30. That the Department of Transport, in collaboration with VicRoads, investigates the use of solar powered lights to improve the conspicuity of passive level crossings.

Intelligent Transport Systems

Intelligent Transport Systems (ITS) are technologically-based systems that can transfer information between trains, vehicles and their associated infrastructure. They currently play an important role in traffic management and include the provision of information such as: the position of the train or vehicle, travel speed, direction of movement, up-coming features and hazards, times of arrival, including at crossings and public transport co-ordination.

ITS include systems that can control the operation of the train or vehicle, and can even intervene to prevent or reduce the severity of a crash. In the event of a crash, these systems can notify emergency services of the location of the crash and provide some diagnostic data. Advances in ITS technology and the vehicle industry have led to communication between vehicles or between vehicles to roadside infrastructure. Applications can monitor driver behaviour and report infringements.

Mr Peter Bentley, President, ITS Australia stated at the *ITS for Railway Level Crossing Workshop*, in Melbourne, 29 February 2008, that achieving Vision Zero, that is, no injuries or fatalities to anyone travelling on any form of transport, will only be achieved through the implementation of intelligent infrastructure and intelligent vehicles.[63]

In August 2008, the Committee, in its report of the Inquiry into Vehicle Safety described how ITS communication systems could link vehicles to each other through a central transport centre which could revolutionise road safety. Significant development and trials have been undertaken overseas, with Japan planning to launch an active intelligent transport system in 2010.[64]

The Committee considers that these technologies improve the safety of the rail and road transport systems.

The 2004, United States Department of Transportation, action plan on level crossing and pedestrian safety, *Secretary's Action Plan for Highway-Rail Crossing Safety and Trespass Prevention,* promotes the use of ITS, including as an augmentation or supplement to existing controls. The action plan comments that:

> In the future, Intelligent Transportation Systems (ITS) will provide the ability to use an in-vehicle warning of danger at highway-rail crossings and, perhaps, even provide the means to intervene before a collision occurs. Railroad Positive Train Control (PTC) systems will provide information on the direction, speed, and routing of each train; and highway-side systems will utilise this information to communicate a warning to individual motor vehicles.[65]

In correspondence to the Committee, 23 September 2008, Mr Jim Betts, Secretary, Department of Transport, acknowledged that the current list of level crossing risk mitigation options does not include new or developing treatments such as ITS.[66]

Further, Mr Betts also noted that:

> However, all stakeholders support the development of these systems as they may be much more cost effective than traditional approaches and allow the reduction of risk levels at more sites across the State.[67]

At a public hearing in Melbourne, 14 April 2008, Mr Terry Warin, Executive Director of ITS Australia, which represents the Intelligent Transport Systems industry, advised the Committee of the workshop his organisation conducted, February 2008, in collaboration with the Australasian Railway Association (ARA) on ITS applications for railway crossings.[68]

At the hearing Mr Warin stated he was not aware of the implementation or trialling of ITS on rail systems, although he acknowledged that:

> We have not had a long relationship with the rail people, it has only really started. They also were quite surprised … at what came out of that event. They were amazed at what technology our members brought to the table. I think it has given them some good ideas too.[69]

One outcome of the workshop was that the ARA, ITS Australia and the Victorian Transport Association agreed to form a working party to pursue matters discussed at the workshop.[70] At the time of the hearing, Mr Warin noted that the working party had held one meeting and was seeking clear assistance and involvement from the Department of Transport.[71]

More recently, the Australian Transport Council (ATC) has requested Queensland Transport to lead the development of a work program for technology based solutions.[72]

In correspondence, Mr Betts further suggested that a joint road/rail taskforce be established through the ATC to identify and implement the most appropriate ITS technology.[73]

The Committee noted that the ATC meeting held in Canberra, 2 May 2008, agreed to: the development of best practice speed enforcement measures and a national best practice speed management strategy; as well as, in-vehicle and at-roadside technology, including an already approved pilot of digital tachograph technology and other potential solutions that use Global Positioning Systems.[74]

The Committee is encouraged by these recent developments and considers that the Department of Transport should take an active role to promote and encourage the use of ITS at the rail/road interface to improve safety at level crossings.

The Committee considers that Intelligent Transport Systems have the potential to provide great benefits for road and rail safety in the future. The 2008 Committee report, *Inquiry into Vehicle Safety,* reported that Australia is only commencing ITS development. Australia is years behind compared with other developed economies which, in some cases will soon implement ITS technology.[75] The Committee concluded that:

> The Government has a central role and key responsibility in establishing infrastructure that will facilitate the integration of vehicle based ITS components.[76]

The Committee recommended that the Government co-ordinates with ITS Australia, the financial and technical support required to develop, trial and adopt ITS infrastructure for Victoria, as a matter of urgency.[77] It reiterates that recommendation. Victoria must play a leading role in the identification and adoption of ITS.

However, with respect to level crossing safety where stakeholders include intra and interstate railway networks and operators, the Committee acknowledges that policy should be developed at a national level through the Australian Transport Council. Victoria, should play a leading role in the national adoption of new and developing technologies, including ITS, that would improve safety at level crossings.

Recommendations:

31. That the Department of Transport requests the Minister for Public Transport to pursue, through the Australian Transport Council, national adoption of new and developing technologies, including Intelligent Transport Systems, that would improve safety at level crossings.

32. That the Victorian Government co-ordinates, with ITS Australia, the financial and technical support required to develop, trial and adopt Intelligent Transport Systems infrastructure for Victoria, as a matter of urgency.

33. That the Department of Transport actively trials, promotes and encourages the use of Intelligent Transport Systems at the rail/road interface.

The Potential for Intelligent Transport Systems

In the vehicle safety report, the Committee described vehicle-to-infrastructure (V2I) technology as the most accessible starting point for implementing an ITS system in Victoria.[78] The report noted that:

> V2I technologies allow the direct communication of information from a central traffic management centre to passing vehicles via roadside transmitter beacons and visual displays. The data flow can also be two-way with data collected by a vehicle being transmitted back to the traffic management centre.[79]

At the *ITS for Railway Level Crossing Workshop*, Mr Bentley described the benefits of this technology as: enabling more efficient traffic flow; the ability to re-route traffic; speed warning; and dynamic signs to warn of hazards, such as rail crossings.[80]

In correspondence, 23 September 2008, Mr Betts, Department of Transport, advised that:

> Linking intelligent vehicles and roadside to move from an autonomous to a co-operative intelligent transport system provides the opportunity to improve safety and mobility.[81]

Types of Intelligent Transport Systems

At a public hearing in Melbourne, 14 April 2008, Mr Warin, Executive Director, ITS Australia, advised the Committee of the technologies discussed at the railway level crossing workshop, including:

- Radio transponders;
- Break-in radio;
- GPS;
- Digital mapping;
- Active advance warning signs;
- In-pavement lighting; and
- Adaptive cruise control.[82]

Some of these technologies are currently being considered by the Department of Transport, including GPS navigation technology and radio based collision warning devices.[83]

Global Positioning Systems

In the 2008 Committee report, *Inquiry into Vehicle Safety*, the Committee stated that an ITS enabled vehicle can receive Global Positioning System (GPS) information from a 300 metre radius.[84]

GPS technology is already being used to locate the position of trains and vehicles.[85] In their submission to the Inquiry, Public Transport Safety Victoria (PTSV) advised the Committee that GPS technologies should be further explored for use at level crossings, including those systems in development which can estimate the trajectories and locations of other vehicles in the vicinity, and warn of a possible crash.[86]

An example where GPS can be used as more than a navigation device was supplied by Mr Alan Osborne, Director, PTSV. Mr Osborne informed the Committee of a Victorian transport company that has installed a GPS system in its heavy vehicle fleet to alert drivers the presence of school buses. Mr Osborne stated that programs using similar technology may be able to be extended to notify vehicles of approaching trains at up-coming level crossings.[87]

The Committee considers that this is possible. In the course of the Vehicle Safety Inquiry the Committee were informed of vehicles' ability to inform another vehicle of their presence, either in a side street, or travelling around a corner, or of unseen traffic congestion ahead.[88]

At the *10th World Level Crossing Symposium, Safety and Trespass Prevention*, in Paris, June 2008, Mr Paul Bousquet, United States Volpe National Transportation Systems Centre, presented the paper, 'A Technology Comparison of Two In-Vehicle Warning Methods at Level Crossings with Human Factor Implications'. Mr Bousquet discussed the potential use of GPS location navigation systems to not only alert drivers of level crossings but also of an approaching train.[89] Mr Bousquet stated that:

> Since many, if not all, navigation systems allow for updates to their map database as well as provide for optional points of interest, it is suggested that the location of all or at a minimum all high risk level crossings could be added to the navigation systems databases.
>
> …
>
> Integrating an in-vehicle warning system with the railroad system may allow the implementation of providing advance messaging advising the motorist not only of the time of train arrival to the level crossing, but also if there will be an extended delay at the crossing. Integration of this advanced system with a mapping program could also provide alternative routing information to the operator thereby relieving congestion in the area.[90]

Mr Bousquet further noted that:

> The technology is commercially available and there are standards that already have been developed to address the interface between the highway and rail subsystems.[91]

Global Positioning Systems Availability in Victoria

As noted, Victoria is a long way behind ITS infrastructure developments and standards. However, commercial products exist that can provide information to drivers as to how to get to their destination as well as points of interest along the route, and other value-added information such as petrol stations.

The Committee examined GPS systems currently available that can send a warning message regarding speed limits and other information to drivers. A number of submissions advised that GPS could be extended to inform drivers of approaching crossings.[92]

Level crossings can be located on a digital map from information provided by the Government or mapped in field surveys by providers. Maps can be revised and downloaded weekly or more often, to a GPS system for a subscription fee, while other systems are constantly updated, including with real-time information on traffic hazards and congestion.[93]

The advantage of GPS systems is that they do not require roadside infrastructure, however maps must be accurate and kept up-to-date and the GPS system must be capable of correctly locating the vehicle.

Commercially available GPS devices track the vehicle's position and speed using a GPS system. When the vehicle comes close to a hazard, such as a school zone or accident black spot, or enters a speed restriction area, a computer generated voice provides a warning to the driver.[94]

The Government's 2008 road safety strategy action plan, *Victoria's Road Safety Strategy: First Action Plan 2008-2010*, identifies that they will:

> Develop a global positioning system (GPS) based speed and hazard zone mapping system to integrate with intelligent speed assist systems.[95]

The Committee considers that 'hazard zone mapping' must include the identification of level crossings.

In correspondence to the Committee, 23 September 2008, the Department of Transport announced it is undertaking a trial of GPS navigation technology that could warn vehicle drivers they are approaching a level crossing. The results of this trial are expected in December 2008.[96] The Committee considers that if the results are positive, information regarding level crossings should be included in GPS devices, either fitted to vehicles by the manufacturer or through after-market sales.

In the meantime, the Committee considers that the Department of Transport should collaborate with GPS navigation providers to ensure that they have reasonable access to accurate and up-to-date data on the location and types of level crossings.

Recommendation:

34. That VicRoads maps the location and types of level crossings for use in Global Positioning Systems by the end of 2009.

United States Trial of Global Positioning Systems Tracking of Trains Near Crossings

The Committee examined several systems that use GPS technology at crossings and all appear to show promise. For example, since 2002 in Minnesota, in the United States, on rural low volume crossings a GPS-based tracking device uses a digital map to co-ordinate the location of trains with crossing signals to warn drivers as they approach the crossing. There is also a warning device to alert the train driver to slow or stop the train in the case of a malfunction.[97]

In their submission to the Inquiry, Sinclair Knight Merz, referred to this system and advised the Committee that its potential benefit was its low-cost which may allow it to be implemented in locations which are not economical to upgrade with conventional technologies.[98]

The Department of Transport advised the Committee that the Victorian Railway Crossing Safety Steering Committee (VRCSSC) is ‘keeping a watching brief’ on the field trials of the Minnesota system.[99] In correspondence to the Committee, 29 April 2008, PTSV advised that the development companies involved in this project have refined the device, and in January 2007, presented a new system, known as the advanced crossing signal system, to Transport Canada.[100]

Australian Global Positioning Systems in Development for Train Application

At the Forum, 21 July 2008, the Committee were advised of a GPS that could be developed to define a geofence around an area, such as a level crossing. The application would use GPS technology and mobile data network geographic message services. Subscribers to the service would be warned of trains entering the defined area. The application could also be used to alert trains to obstructions on a railway line within the defined area. The system is being developed and has not been trialled at level crossings.[101]

There is a GPS based, solar powered system that is being installed on the Blue Mountains, Zig Zag tourist railway in New South Wales for marketing and demonstration purposes.[102] A locomotive-based terminal broadcasts the GPS determined location of the train to a wayside radio tower that in turn operates warning lights and bells at level crossings by radio frequency. An in-cabin alert system can also be provided to high risk vehicles, such as heavy vehicles, school buses and farm machinery. The system does not require track circuits.

The Committee considers that the Department of Transport should monitor the demonstration of the GPS system taking place in the Blue Mountains.

The Committee considers that the implementation of technology which provides an active warning to drivers of approaching trains at level crossings is a priority. It also considers that it is a natural extension to systems currently being introduced into vehicles. The Department of Transport should, in consultation with the rail authorities, commence a selection process and trial the best systems.

Recommendation:

35. That the Department of Transport, in consultation with the rail authorities, commence a selection process and trial Intelligent Transport Systems, which can provide active warnings to drivers of approaching trains at level crossings.

Dedicated Short-Range Radio Communication Systems

Electronic warnings of an up-coming level crossing, using radio frequencies, can be sent from a short-range transmitter placed on a crossing. The warnings can either be displayed or broadcast on the vehicle's sound system.

In the Joint Submission to the Inquiry, the Committee were advised that radio data systems operate in many European cities and are used in the CityLink tunnels.[103]

Mr Warin, ITS Australia, similarly advised the Committee of dedicated location-based traffic message channels in Europe and Japan that broadcast messages from roadside infrastructure to vehicle radios.[104]

At the *10th World Level Crossing Symposium, Safety and Trespass Prevention*, Paris, June 2008, Mr Paul Bousquet, United States Volpe National Transportation Systems Centre, presented the paper, 'A Technology Comparison of Two In-Vehicle Warning Methods at Level Crossings with Human Factor Implications'. One of the two concepts Mr Bousquet reviewed was dedicated short-range radio communication systems (DSRC).[105]

Mr Bousquet stated that this technology is in use for electronic toll collection, and in the United States for the trial program, Co-operative Intersection Collision Avoidance System (CICAS) and Vehicle Infrastructure Integration (VII). Mr Bousquet stated that:

> It is the planned implementation of this technology within the VII and CICAS programs that make the inclusion of in-vehicle warnings at level crossings seem a logical next step.

> Since vehicles will be equipped with DSRC receivers for purposes of collision avoidance and stop sign warnings, vehicles could also be adapted to receive 'Approaching Level Crossing' or 'Train Approaching' warnings. … Level crossings can be retrofitted with the necessary roadside DSRC equipment ...[106]

The Committee also identified the potential of DSRC in road safety and traffic management in its recent Inquiry into Vehicle Safety.[107] In correspondence to the Committee, 23 September 2008, Mr Betts, Department of Transport, informed the Committee of the recent discussions with Latrobe University, who are conducting research into DSRC and wireless access in vehicular environments (WAVE), regarding its applications at level crossings.[108]

Unfortunately, implementation of this technology is approximately three years away.[109]

The Committee was briefed on proposals to develop DSRC for adaptation to level crossing safety systems, including a system that operates in the Queensland's sugar cane privately owned and operated rail network.[110]

Systems under development propose the use of DSRC with break-in radio to receive warnings of up-coming crossings and approaching trains, even if the vehicle's sound system is switched off.[111]

In correspondence to the Committee, 23 September 2008, the Department of Transport advised that VicRoads will be undertaking a 'proof of concept' trial of three types of radio based Collision Warning Devices (CWD) at level crossings. A proof of concept examines the capacity and viability of a proposal to perform as designed and to be commercially produced. A project plan of the trial was being prepared.[112]

The Committee considers that dedicated short-range communication systems offer potential safety benefits to drivers approaching level crossings and supports VicRoads' investigation into the proof of concept.

Vehicle Control Systems

Speeding and inappropriate travel speeds are a primary factor in at least 30 per cent of road fatalities in Victoria each year.[113]

Technologies already exist that can improve warnings to a driver or can even slow the vehicle down if they are driving too fast at an approach to a level crossing.[114]

In its submission to the Inquiry, the Transport Accident Commission (TAC), stated:

> Technologies that help to moderate driver approach speeds, and that can provide ‘time critical’ warnings either at the road-side or within the vehicle cabin itself show significant promise and are worthy of further investigation and trialling.[115]

In the Committee’s 2008 report, *Inquiry into Vehicle Safety*, it noted the progress of research and trials of Intelligent Speed Adaptation (ISA) technology in France and the United Kingdom, as a means of affecting compliance with the speed limit. ISA moves beyond merely warning the driver they have exceeded the speed limit, rather this technology can autonomously limit the speed of the vehicle to ensure the speed limit is adhere to.[116]

The Joint Submission advised the Committee that intelligent speed adaptation could be utilised to provide in-vehicle alerts of hazards, such as level crossings.[117]

At the Forum, 21 July 2008, the Committee examined an intelligent traffic management system, using GPS, an on-board navigation system and ISA technology, which can warn drivers of up-coming crossings and actively control the speed of vehicles as they approach the crossing. This ISA system is being trialled, and if successful, vehicles equipped with the system could automatically slow down to a predetermined speed to be safe for the conditions.[118]

One company suggested to the Committee that the feasibility of automatically cancelling cruise control and audio systems on vehicles, especially heavy vehicles, 300 yards (274 metres) before level crossings should also be investigated.[119]

The ISA technology, including the feature that would alert drivers to approaching trains and slow vehicles as they approach a level crossing, is currently being investigated by Main Roads Western Australia. The investigation will include demonstrations on road and rail environments, with a view to undertaking a trial in Perth, possibly in 2009.[120] This investigation is separate to the ISA trials that are underway in that State.

The Committee supports the development of ISA technology and is encouraged by the initiative of Main Roads Western Australia. Further, the investigation should be supported by the rail industry, and monitored by the Department of Transport. If the trials prove the technology worthwhile, then the Department of Transport and VicRoads should ensure that it is introduced and made available in Victoria as soon as possible.

The Committee supported the introduction of this technology in its Inquiry into Vehicle Safety, and considered that it should be the responsibility of VicRoads to establish and maintain a road speed zone data map.[121] As discussed above, the Government has committed to mapping speed as well as hazard zones to integrate with intelligent speed warning systems. In the Vehicle Safety Report, the Committee recommended that this be completed by the end of 2009. It reiterates that recommendation here.

Recommendations:

36. That VicRoads maps the speed zones of Victoria's road system by the end of 2009.

37. That the Department of Transport, together with VicRoads and the Transport Accident Commission, investigates and trials the use and application of Intelligent Speed Adaptation technology on the approach roads to level crossings.

38. That the Department of Transport and VicRoads monitors and reports on the Western Australian investigation into Intelligent Speed Adaptation technology at level crossings. If the trial proves successful, the technology should be made available in Victoria.

Train Control Systems

At the Forum on 21 July 2008, the Committee was informed of the advanced developments of train vigilance systems. Vigilance systems protect a train by requiring the driver to perform tasks at the request of an on-board system. They have the potential to automatically switch on the train's warning lights, ascertain the status of up-coming crossings, or even, in the future, alert vehicles and activate level crossing warning systems. However, due to the speed trains travel, it is doubtful whether a train would be able to stop in time to prevent a crash with a vehicle or pedestrian.[122]

In June 2008, the ARTC announced a $90 million prototype trial of Advanced Train Management Systems (ATMS), commencing on the interstate line between Adelaide and Port Augusta. The plan is to replace 'on track' signals, with an ATMS system which would manage trains with computer, GPS and throttle-brake systems, which verify train positions, speeds and braking distances, and if necessary, applies the brakes to trains from a control centre.[123]

Clearly these advanced train management and ITS systems offer new ways of managing and controlling rail and road traffic within a unified transport system. The Committee considers that the Department of Transport should monitor and report on these developments, as well as the implications these systems will have on the management of Victoria's transport system.

Recommendation:

39. That the Department of Transport monitors and reports on the development of Advanced Train Management Systems.

Train-Activated Advance Warning Signs

The Joint Submission to the Inquiry advised the Committee that electronic warning signs had been installed on the Princes Highway at Warncoort. The signs are located approximately 250 metres in advance of active crossings to provide drivers with early warning that a train is approaching, as well as warning that the crossing ahead is closed.[124]

Similar systems have been installed elsewhere in Australia and overseas.[125]

In correspondence to the Committee, 30 April 2008, the then Department of Infrastructure, now Department of Transport, stated that a program has commenced to install these signs at another 52 crossings on State highways at a cost of $11.1 million between 2007 and 2009.[126] Three signs were scheduled to be installed at Talbot, Birchip and Tarnagulla in the 2007–08 financial year, with the balance to be completed by December 2009.[127]

On their website, the Department of Transport state that preference is to be given to locating signs at crossings on passenger lines, sites with a record of crashes or near misses and locations where a large numbers of heavy vehicles operate.[128] The Department noted that the signs are particularly useful where drivers do not have a clear line of sight of the crossing they are approaching.[129]

The Committee were advised that VicRoads had been requested to engage consultants to conduct a before and after evaluation, validation and compliance, and trials of these signs.[130]

The Australasian Railway Association (ARA), in its submission, strongly supports the installation of these signs. The Association also stated that:

> It is important that the effectiveness of this initiative be evaluated. The ARA is looking forward to the finding of the evaluation.[131]

The Committee supports the decision to evaluate the use of train-activated advance warning signs as it is consistent with evidence-based road safety measures advocated by this Committee. The Committee, however, is disappointed that the installation of these signs, are not identified on the Department of Transport's website as a trial.

Dr Eric Wigglesworth, Honorary Senior Research Fellow, Monash University Accident Research Centre (MUARC), in his submission to the Inquiry, raised questions regarding the research behind the decisions to install these signs.[132]

Dr Wigglesworth questioned the decision to locate these signs 250 metres before a crossing. The Committee considers that these questions should be referred to the consultants engaged by VicRoads to evaluate the trial, for consideration.[133]

Recommendation:

40. That, if the evaluation of the trial into train-activated advance warning signs is successful, VicRoads should implement advance active warning signs at crossings with sight distance issues within three years.

Intelligent Transport Systems for Disabled Pedestrians at Crossings

The Committee found that ITS may also have application at pedestrian crossings, subject to research and trials, including:

- Infrared devices that can detect the heat of a pedestrian which then activates a pre-recorded message – the device could also be used to activate warning signs;
- Transmitters which emit directional infrared beams to visually impaired pedestrians who wear small receivers – when the receiver intercepts the infrared beam it relays a message to the user through an earpiece or lapel speaker; and
- Radio messages which are broadcast to users with receivers or a mobile phone, a message such as 'train approaching'.[134]

The Committee was advised at the Forum, 21 July 2008, of a high accuracy Global Positioning System known as assisted-GPS. A geofence, discussed earlier, is defined around a station or level crossing and a message is sent to subscribers' mobile telephones on entering the defined area, providing them with information or safety warnings. The technology is developing and has not been trialled at level crossings.[135]

Obstacle Detection Systems

Technologies that can alert train drivers of obstructions or obstacles are important especially if they could provide the train driver with sufficient time to stop and prevent a crash, or at least to slow the train to reduce the severity of the crash.

Obstructions are caused by traffic queuing on the crossing, a stalled vehicle, a dislodged load from a vehicle, fallen trees, suicide attempts or unsafe behaviour by pedestrians and drivers.

The Committee considered the technology which could be used to improve warnings to a train driver of an obstruction on an up-coming level crossing. This includes:

- Metal detecting technology, including systems which transmits the information to the train's protection system;
- Inductive loops within the crossing to detect vehicles that have stalled, trapped or caught in a queue – a system has been trialled on an Amtrak line in Connecticut, and in New Hyde Park, New York, USA;
- Video cameras, microwaves and infrared – a system has been in operation in Pittsford, New York for over three years;
- Laser radar working in conjunction with a video camera – systems are operating in Sweden and Singapore; and
- CCTV which can send an alarm and video image to train control or the approaching locomotives – a system operates on the Pilbara iron ore railway network for Rio Tinto in Western Australia; a video monitoring system operating with a GPS train location system has been trialled in Florida, USA.[136]

In 2007, the United States Department of Transportation report, *State-of-the-Art Technologies for Intrusion and Obstacle Detection for Railroad Operations*, reviewed worldwide level crossing obstacle detection technologies. The report concluded that:

> Although no formal benefit/cost studies have been conducted to date, the least expensive options are locomotive-based equipment since these have the capability to monitor the whole rail network and need only to be mounted on railroad locomotives, which number about 21,000 and are far fewer than the number of crossings or number of railway miles. In addition, locomotive-based systems could be selectively used along higher risk routes or with higher risk shipments.[137]

Despite investigating numerous technologies, including laser, magnetic, radar, seismic and video systems, the report found that while most of the systems showed promise, their effectiveness had not been properly tested and evaluated.[138]

A 2006 report by the United Kingdom Rail and Safety Standards Board, *Research into Obstacle Detection at Level Crossings*, concluded that obstacle detection devices, unless provided at active crossing with full barriers, was potentially highly problematic, or at best would only provide very small safety benefits. The report stated:

> The main difficulties are the short time available to provide a warning to the approaching train, and the fact that without full-barriers, users may enter on to the crossing and cause significant disruption to rail services, even if there is no safety incident.[139]

The United Kingdom report concluded obstacle detection, unless applied at full-barrier crossings, could result in an increased overall risk due to heavy braking incidents.[140]

In Victoria, a 2006 report by Sinclair Knight Merz, *Level Crossing Obstacle Detection Systems*, on available technologies and systems capable of detecting obstacles at level crossings, found that:

> The greatest improvement to Level Crossing safety will be achieved through a co-ordinated approach to monitoring and response to incidents occurring on and near Level Crossings. For example, in the event that an accident causes queue lengths to extend beyond the Level Crossing then multiple responses may be triggered; traffic signals may be changed to clear congestion, emergency services can be alerted, and train control can be notified to inform the train driver of a possible hazard ahead.
>
> Level Crossing Obstacle Detection would form an integral component in an Intelligent Level Crossing Controller, a system which to date does not exist, although many of the components are currently available albeit in different forms and as part of other systems.[141]

Sinclair Knight Merz found that an obstacle detection system would require an integrated road/rail response in order to maximise safety while minimising impacts on rail operations. The consultants concluded that:

> The effectiveness of a Level Crossing Obstacle Detection system is presently limited by the capabilities of road and rail systems to respond appropriately to the threat of a collision. Until such time as road vehicles are equipped with advanced collision avoidance and VII communication systems and advanced train control systems … or cab signalling, an automated camera-based enforcement system coupled with ongoing education and awareness programs may be [the] most effective means of improving safety at Level Crossings.[142]

With respect to the specific technology, the consultants concluded that intelligent video monitoring should be pursued as the technology most likely to be the basis for a level crossing obstacle detection system in the near term. Intelligent video monitoring which uses high level programming language has the capacity to operate under predetermined rules so that it can be programmed to distinguish between obstacles and other visual effects.[143]

The Committee was advised that the Railway Crossing Technical Group is no longer investigating technology that could identify an obstruction on a railway line as, in most instances, the train would be travelling too fast to stop in time to prevent a crash.[144]

Technologies to Assist Pedestrian Crossings

Pedestrians will not use crossings that are not appropriately designed and located.

Intelligent Road Studs

Intelligent road studs are train-activated flashing LED lights that are installed in the pavement of a road or pedestrian path. These lights operate at level crossings in the United Kingdom, and are common at pedestrian crossings in North America.[145]

Intelligent road studs or in-pavements lights have also been used at pedestrian road crossings in Victoria.[146] At a level crossing the lights could be activated by an existing active crossing system or by other new or developing train detection devices.[147]

In the United States, BNSF railways is trialling their use at level crossings.[148] The Metropolitan Transit Authority of Harris County, (METRO) has installed red pavement lights at intersections which switch on with the traffic signal to give drivers additional warning as they approach a light rail crossing. An initial assessment by the Texas Transportation Institute found that traffic violations had decreased and that the lights increased driver awareness and behaviour.[149]

The Joint Submission to the Inquiry also noted that intelligent road studs were in use in Europe. They are generally used to support other forms of control.[150]

At a public hearing, 5 May 2008, a presentation was made to the Committee by the Railway Crossing Technical Group, which included information to the effect that they believed road studs would be very effective during adverse weather conditions and to supplement other forms of active control.[151] Further, that VicTrack, in conjunction with Sinclair Knight Mertz is reviewing the studs and how they could be adapted for use in active crossings with flashing lights:

> Ultimately a trial would be required with a detailed before and after study to determine if the studs have a positive impact on the amount of non-compliance (drivers proceeding through crossings when flashing lights are operating).[152]

The Committee considers that the use of intelligent road studs as a supplement to other active devices should be investigated by the Department of Transport.

Recommendation:

41. That the Department of Transport investigates the use of intelligent road studs as a supplement to other active devices at level crossings for pedestrians.

Pedestrian Crossing Surfaces

One issue that affects safety at both passive and active pedestrian crossings is the risk of small wheels on wheelchairs, bicycles, shopping carts and prams being caught in the gap between the crossing surface and the railway track, known as the flange gap.

The Committee was advised that VicTrack is planning to trial a concrete pedestrian crossing surface at Regent, as an alternative to rubber material. The concrete system is supported by the foot of the railway track, instead of resting on the sleepers, and provides an even, smooth and long lasting crossing surface with a consistent flange gap width.[153]

A device, known as a flange gap filler, used to occupy the flange gap so as to provide a completely even crossing surface is also being considered by VicTrack. The system is currently used in Germany.[154]

Trials of Pedestrian Level Crossings Technologies

Following a pedestrian fatality at a level crossing at the Bentleigh railway station, 2004, trials of safety measures commenced in 2006 at Bentleigh. The following devices and measures are being considered:

- Another Train Coming and Red Man warning signs – these provide visual warnings to pedestrians, together with a train-activated pedestrian gate. When more than one train is in the vicinity of the crossing the Another Train Coming sign provides additional warning;

- Emergency exit gate locks – these are designed to prevent entry across the railway tracks while at the same permitting safe exit by anyone who is trapped on the wrong side of the gate;

- Increases to fencing and gate height; and

- Upgrades to signage to reflect amendments to the Australian Standard.[155]

Other works occurred at Bentleigh to ensure compliance with disability discrimination legislation.[156]

At the public hearing in Melbourne, 3 March 2008, Mr Tom Sargant, Chair, VRCSSC, advised the Committee that the measures on trial cost over $1 million.[157]

The effectiveness of the measures is being determined by camera monitoring, before and after surveys, and industry and public feed-back. An evaluation of the trial is due in either late 2008 or early 2009, to determine the effectiveness of the measures and inform a decision about their possible future application throughout the network.[158]

The Committee supports this approach and considers that the Department of Transport should publish the report of the evaluation of the trial, and implement those measures that are demonstrated in the trials to be effective.

Recommendation:

42. That the Department of Transport implements the pedestrian crossing measures that are demonstrated in the trial to be effective. These measures should be introduced at high-risk active crossings.

Behaviour Monitoring Technologies

The purpose of technology that monitors the behaviour of road users and train drivers is to provide: evidence of an infringing behaviour to enforcement authorities; information about incidents to investigation bodies; data on the behaviour of crossing users to research organisations, and data on the operation of safety equipment.

The Committee considered submissions suggesting how technology could be used to report the behaviour of drivers as they approach an up-coming level crossing, such as heavy vehicles exceeding the speed limit or failing to stop at a Stop sign. Monitoring driver behaviour, especially if it was reported to employers or owners of vehicles could play a role in improving safety at level crossings.

The suggestions included the use of:

- Locomotive cabin-based digital video systems to record crashes, near-misses and other incidents – train-borne videos have been installed by GO-transit, Toronto and Burlington Northern Santa Fe Railroad.[159]

- Remote actuated video cameras on railway lines to provide data on pedestrian and vehicle driver behaviour.[160]

- GPS vehicle tracking system.[161]

At a public hearing in Melbourne, 7 April 2008, Mr Barry Hedley, General Manager Network Safety, Connex Melbourne, informed the Committee of 'smart' video systems that could be installed to monitor and improve traffic flow at urban level crossings.[162]

In the Joint Submission the Committee were informed of an active level crossing system that is linked to cameras which can record train and vehicle movement at crossings.[163]

Many transport companies have GPS tracking in their vehicles as a safety measure, and monitor vehicle speed over 100 km/h, fatigue breaks and vehicle location.[164]

Existing technology using air tubes and signal monitoring devices, are also used to record vehicle movement at intersections and level crossings, including speed and vehicle type.[165]

The Committee considered a submission and evidence from Transport Certification Australia Ltd (TCA) on the possible incorporation of level crossings as part of TCA's Intelligent Access Program (IAP).[166] The IAP, which is being established throughout Australia, facilitates the provision of improved road access for heavy vehicles to the road network granted by road authorities, such as VicRoads, in exchange for agreement that the vehicles are monitored by satellite on their compliance with the conditions of access. Road authorities are advised if the vehicle leaves the permitted route, travels over prohibited bridges or is en route at prohibited times.[167]

The TCA was established in 2005 by the Commonwealth, States and Territories to administer the program. The access program is governed by a national legal and policy framework, and in Victoria is authorised by an amendment to the *Road Safety Act 1986* made by the *Road Legislation (Projects and Road Safety) Act 2006*.[168]

The TCA suggested that an IAP-type solution to level crossing safety could be developed. The TCA proposed that the IAP could monitor a vehicle's location and in combination with in-locomotive and at-crossing devices, would generate an alert or warning for both the heavy vehicle driver and locomotive. The nature of alert or warning, timing and distance thresholds, and vehicle type would need to be determined in a trial.[169]

Dr Peter Cairney, Principal Research Scientist of the ARRB Group also drew the Committee's attention to the IAP. He stated at a hearing:

> It would seem to me to be a relatively simple matter if railway level crossings were included as part of the package of the intelligent access program that the Transport Certification Australia has now become. It could include, for example, that from the GPS record you would be able to identify whether or not drivers stopped at level crossings where a stop was required and you would be able to detect any speeding up at level crossings. It is not a complete answer because you cannot easily relate it with the presence of trains. But it would at least give some indication and would really establish it in drivers' minds that their behaviour at railway level crossings is something that is really audited and has to be taken seriously.[170]

The Committee considers there would be considerable merit incorporating the monitoring and later the enforcement of driver behaviour at level crossings into the IAP. It could be implemented by mandating that heavy vehicles were not permitted to travel on Victorian roads without being IAP compliant.

One impediment, to this and other ITS-type measures, is the cost to purchase and install devices into vehicles. The Committee considers that this issue could be overcome by introducing a Government subsidy for purchase and fitting of ITS technology into heavy vehicles and buses, especially heavy vehicles and buses owned or operated by smaller Victorian transport companies and farmers. The technology subsidy could be funded by the introduction of a fixed-term crossing safety levy on the railway industry.

Recommendation:

43. That the Department of Transport investigates:

a) The feasibility of incorporating the monitoring, and later the enforcement of, driver behaviour at level crossings into the Intelligent Access Program;

b) A scheme to subsidise the phased introduction of Intelligent Transport Systems technology into heavy vehicles and buses, especially heavy vehicles and buses owned or operated by smaller Victorian transport companies and farmers, and

c) **A scheme to fund the technology subsidy through the introduction of a fixed-term crossing safety levy on the railway industry.**

Improving Crashworthiness of Trains

Change to the design of trains could provide protection for train crew and passengers, as well as road users, against injury or loss of life in the event of a crash.

These types of technologies, or design changes have a similar purpose to passive technologies found in vehicles, such as seatbelts, air bags, and the vehicle crumple zone which compress and absorb energy in a crash.

In submissions to the Inquiry, Dr Wigglesworth and DVExperts International suggested that research be undertaken into energy attenuating systems, such as airbags on the front of locomotives to reduce the severity of a crash.[171]

The Railway Technical Society of Australasia suggested an investigation into locomotive shapes so that obstructing vehicles would be swept aside rather than crushed during a crash.[172]

The design of passenger rail cars is another safety issue. The Chief Investigator, Transport and Marine Safety Investigations in his report on the level crossing crash between a heavy vehicle and passenger train near Kerang in June 2007, stated that the rail cars were not built to any side impact crashworthiness requirements, and nor are there any side impact crashworthiness standards in Australia for rail vehicles.[173]

The Chief Investigator recommended that the Department of Transport reviews the adequacy of current crashworthiness standards applied to passenger-carrying rolling stock in Victoria, with particular focus on side impact loading.[174] The Committee supports the Chief Investigator's recommendations. The Government's response to this and the other recommendations of the Chief Investigator should be published.

Section 85 of the *Transport Act 1983*, provides that the Chief Investigator must provide the Minister for Public Transport with a report of the investigations into a public transport safety matter. However, the Act is silent on actions the Minister is to take on any recommendations that might be included in the report.[175]

The Committee also considers that the Government's responses to recommendations made on all level crossing crashes by the Chief Investigator, Transport and Marine Investigations, as well as by the State Coroner and the ATSB, should be published. Publication of the Government's responses, particularly those which respond to recommendations arising from a fatality, would provide assurance to the public that action was to be taken to improve safety at level crossings.

Recommendation:

44. That the Department of Transport:

a) Publishes the Government's responses to the recommendations in the report of the Chief Investigator, Transport and Marine Investigations into the fatal level crossing crash near Kerang, in June 2007, and

b) Publishes the Government's responses to recommendations made on all level crossing crashes by the Chief Investigator, Transport and Marine Investigations, the State Coroner and the Australian Transport Safety Bureau.

Summary of Findings

- A priority is to implement reliable low-cost systems and Intelligent Transport Systems that can warn drivers of approaching trains.
- Another priority is to introduce technology that can support enforcement of the road rules at crossings.
- For the longer term, the priority is to introduce technologies that can actively control trains and vehicles.
- Low cost warning technology should be used as a supplement to existing controls at crossings, particularly at passive crossings in rural areas.
- Reliability performance criteria will need to be developed for low-cost warning technology and legislation may be required to support the introduction of non fail-safe technology.
- Low cost warning systems are not, nor should they be intended as a replacement or substitute for highly specified, fail-safe level crossing controls.
- The Government does not but should publish its responses to recommendations made by rail crash investigators.

Recommendations

27. **That the use of low-cost warning technology be used as a supplement, or enhancement, to existing controls at level crossings, particularly at passive crossings.**

28. **That the Department of Transport:**

    a) **Consults with Accredited Rail Operators and Public Transport Safety Victoria and develops reliability performance criteria that non fail-safe technology should satisfy;**

    b) **Initiates the inclusion of low-cost warning technology into railway safety standards;**

    c) **Investigates whether legislation is required to introduce non fail-safe technology as a means of improving safety at level crossings; and**

    d) **Trials and publishes the results of low-cost systems which would be suitable for use as a supplement to existing controls at passive level crossings. The results of these trials should be published.**

29. **That the Department of Transport investigates the use of axel or wheel counters to detect trains approaching level crossings.**

30. **That the Department of Transport, in collaboration with VicRoads, investigates the use of solar powered lights to improve the conspicuity of passive level crossings.**

31. **That the Department of Transport requests the Minister for Public Transport to pursue, through the Australian Transport Council, national adoption of new and developing technologies, including Intelligent Transport Systems, that would improve safety at level crossings.**

32. **That the Victorian Government co-ordinates, with ITS Australia, the financial and technical support required to develop, trial and adopt Intelligent Transport Systems infrastructure for Victoria, as a matter of urgency.**

33. **That the Department of Transport actively trials, promotes and encourages the use of Intelligent Transport Systems at the rail/road interface.**

34. That VicRoads maps the location and types of level crossings for use in Global Positioning Systems by the end of 2009.

35. That the Department of Transport, in consultation with the rail authorities, commence a selection process and trial Intelligent Transport Systems, which can provide active warnings to drivers of approaching trains at level crossings.

36. That VicRoads maps the speed zones of Victoria's road system by the end of 2009.

37. That the Department of Transport, together with VicRoads and the Transport Accident Commission, investigates and trials the use and application of Intelligent Speed Adaptation technology on the approach roads to level crossings.

38. That the Department of Transport and VicRoads monitors and reports on the Western Australian investigation into Intelligent Speed Adaptation technology at level crossings. If the trial proves successful, the technology should be made available in Victoria.

39. That the Department of Transport monitors and reports on the development of Advanced Train Management Systems.

40. That, if the evaluation of the trial into train-activated advance warning signs is successful, VicRoads should implement advance active warning signs at crossings with sight distance issues within three years.

41. That the Department of Transport investigates the use of intelligent road studs as a supplement to other active devices at level crossings for pedestrians.

42. That the Department of Transport implements the pedestrian crossing measures that are demonstrated in the trial to be effective. These measures should be introduced at high-risk active crossings.

43. That the Department of Transport investigates:

a) The feasibility of incorporating the monitoring, and later the enforcement of, driver behaviour at level crossings into the Intelligent Access Program;

b) A scheme to subsidise the phased introduction of Intelligent Transport Systems technology into heavy vehicles and buses, especially heavy vehicles and

buses owned or operated by smaller Victorian transport companies and farmers, and

c) A scheme to fund the technology subsidy through the introduction of a fixed-term crossing safety levy on the railway industry.

44. That the Department of Transport:

a) Publishes the Government's responses to the recommendations in the report of the Chief Investigator, Transport and Marine Investigations into the fatal level crossing crash near Kerang, in June 2007, and

b) Publishes the Government's responses to recommendations made on all level crossing crashes by the Chief Investigator, Transport and Marine Investigations, the State Coroner and the Australian Transport Safety Bureau.

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Appendix A

List of Submissions

Government

Australian Transport Safety Bureau

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Department of Infrastructure (now Department of Transport)

Department of Justice

Department of Planning and Infrastructure, Northern Territory Government

Department of Transport, Energy and Infrastructure, Government of South Australia

Public Transport Safety Victoria

Queensland Transport

Transport Accident Commission

Victoria Police

Victoria State Emergency Service

Non Government

ARRB Group Ltd

Asciano Limited

Association of Professional Engineers, Scientists and Managers, Australia (APESMA)

Astucia (Aust) Pty Ltd

Australasian Railway Association Inc

Australian Rail Track Corporation Ltd

Australian Sugar Milling Council Pty Ltd

Australian Trucking Association

DVExperts International Pty Ltd

EV Alert Pty Ltd

GE Transportation Global Signalling, LLC

GHD Pty Ltd

Institute of Public Works Engineering Australia

Institution of Railway Signal Engineers Australasia Inc

Pathfinder Systems Australia Pty Ltd

Railway Technical Society of Australasia, Engineers Australia

Royal Australasian College of Surgeons

Safety Institute of Australia Inc

Saft Batteries Pty Ltd

SCT Logistics

Sinclair Knight Merz Pty Ltd

Speed Mate Pty Ltd

Transport Certification Australia Limited

Transport Workers' Union, Victoria/Tasmania Branch

United Group Rail (Ltd)

V/Line Passenger Pty Ltd

Victorian Transport Association Inc

VicTrack Access

Vitronic Machine Vision Australia Pty Ltd

Individuals

Name			**Suburb/Town**
Mr	N	Bennett	Stawell
Mr	W	Calaby	Sydney, New South Wales
Mr	M	Daff	Frankston
Mr	J	Erdmanis	Toorak
Mr	M	Plummer	Fitzroy
Mr	B	Sharp	Burnie, Tasmania
Mr	C	Sinn	Cobram
Dr	C	Uber	Churchill
Dr	E	Wigglesworth AM	Balwyn

Appendix B

List of Witnesses

Public Hearings

Melbourne 3 March 2008

Howard Ronaldson	Secretary **Department of Infrastructure**
Gary Liddle	Chief Executive **VicRoads**
Tom Sargant	Chair **Victorian Railway Crossing Safety Steering Committee**
Alan Osborne	Director
Chris McKeown	General Manager, Safety Systems **Public Transport Safety Victoria**
Peter Foley	Deputy Director, Surface Safety Investigation **Australian Transport Safety Bureau**

Melbourne 31 March 2008

Jeff Potter	Senior Manager, Safety
Jan Powning	Manager, Policy **National Transport Commission**
Bryan Nye	Chief Executive Officer **Australasian Railway Association Inc**

Melbourne 7 April 2008

Robert Barnett	Chief Executive Officer **V/Line Passenger Pty Ltd**
David Edwards	Group General Manager Safety, Health and Environment **Asciano/Pacific National Ltd**
Barry Hedley	General Manager, Network Safety **Connex Melbourne**
Tim Ryan	General Manager, Asset Management

	Australian Rail Track Corporation Ltd

Melbourne 14 April 2008

Terry Warin	Executive Director
	Intelligent Transport Systems Australia
Chris Koniditsiotis	Chief Executive Officer
Dr Charles Karl	Manager Major Projects
John Baring	Nation Manager – Government Relations
	Transport Certification Australia Ltd
Patrick McKay	Treasurer, Transport Division Committee
	Association of Professional Engineers, Scientists and Managers Australia (APESMA)
Gary Lawson-Smith	Chief Executive Officer
Dr Geoff Dell	National President and Dean College of Fellows
Dr George Rechnitzer	Fellow
	Safety Institute of Australia Inc

Melbourne 5 May 2008

Dr Peter Cairney	Principal Research Scientist
	ARRB Group Ltd
Dr Eric Wigglesworth	Honorary Senior Research Fellow
	Monash University Accident Research Centre
Stuart St Clair	Chief Executive
	Australian Trucking Association
Brent Graham	Project Director, Rail Group
	Sinclair Knight Merz Pty Ltd
Tom Sargant	Chair, Victoria Railway Crossing Safety Steering Committee
Geoff Walker	Chair, Railway Crossing Technical Group
	Victorian Railway Crossing Safety Steering Committee, Railway Crossing Technical Group

Appendix C

Forum Day One – New Technologies

Parliament House, Monday, 21 July 2008

Stephen Baker	Electro-Mechanical Technology, Sales Manager
Wayne McDonald	Manager, Technology & Training
	Westinghouse Rail Systems Australia
Sam Sozio	Director
Michael Maguire	Systems Manager
	Hi-Lux Technical Services Pty Ltd
Walter Schwalbe	Business Development Director, Industry and Public Sector Solutions
	Alcatel-Lucent
Dylan Reichelt	Business Development Manager
	STI-Global
Greg Blackwood	Managing Director
	EV Alert Pty Ltd
Pat Latter	Executive Director
Anthony Boscacci	Technical Director
	NFA Innovations Pty Ltd
Frank De Zilva	Business Development Manager, Railways
	SICE Australia Pty Ltd
Paul Dawson	Executive Director
Jason Ko	Manager Systems Development
	Automotion Control Systems Pty Ltd
Jim Watters	General Manager Technical Alliances and Product Development
Tim Buchanan	Project Engineer, Product Design
	United Group Rail Ltd

Bill Yeadon	Research Director
Dominic Luppino	Managing Director, Emergency Warning Systems
	National Safety Agency
Geoff Walker	Chair, Railway Crossing Technical Group
Matthew Kluga	Manager, Railway Crossings
	VicTrack

Appendix D

Forum Day Two – Failsafe

Parliament House, Tuesday, 22 July 2008

Ray Taylor	Facilitator
Welcome	
John Eren, MP	Chair Parliament of Victoria Road Safety Committee
Defining Fail-Safe and Non Fail-Safe Technologies	
Nick Thompson	Director, Rail Technology
Ian Worthington	Fellow, Australasian Section Institution of Railway Signal Engineers
The Case for Fail Safe Technology	
Tom Sargant	General Manager, Safety and Asset Management Department of Transport
The Case for Non-Fail Safe Technology	
Chris McKeown	General Manager, Safety Systems Public Transport Safety Victoria
Human Factors Issues Associated With Driving and Level Crossings	
Professor Ian Johnston	Professor Monash University Accident Research Centre
Legal Issues	
Jennifer Patterson	Manager, Regulatory Policy and Legal Public Transport Safety Victoria
Indemnity Issues	
Alan Woodroffe	Senior Manager, Policy, Service and Review Transport Accident Commission
National Perspective	
Tony Simes	Senior Transport Safety Investigator Australian Transport Safety Bureau

Railways' Perspective

Phil Sochon

Deputy Chief Executive, Manager Government Relations

Australasian Railway Association

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IMPROVING SAFETY

SAFETY

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