Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY INVESTIGATION REPORT
Rail Occurrence Investigation Report – 2005/004
Final

Level Crossing Collision

Edith Street, Horsham, Victoria
11 August 2005

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Postal address: PO Box 967, Civic Square ACT 2608
Office location: 15 Mort Street, Canberra City, Australian Capital Territory
Telephone: 1800 621 372; from overseas + 61 2 6274 6440
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6274 6474; from overseas + 61 2 6274 6474
E-mail: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

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CONTENTS

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Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608 Australia
www.atsb.gov.au

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Abstract

At approximately 1213 Eastern Standard Time on 11 August 2005, a small motor vehicle drove into the path of a Pacific National locomotive, G535, on the Edith Street level crossing at Horsham in Victoria. The crossing is protected by flashing lights a bell, approach warning signs and road markings. The driver of the motor vehicle was fatally injured as a result of the collision.

The investigation found that the driver of the motor vehicle did not to give way to the train as prescribed in 'Road Rules – Victoria'. Based on available evidence it is believed that the driver of the motor vehicle was distracted by the intersection immediately ahead, Dooen Road, and/or personal issues and was apparently unaware of the train's presence, even though the level crossing warning devices were operating at the time of the accident.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations. Accordingly, the ATSB also conducts investigations and studies of the transport system to identify underlying factors and trends that have the potential to adversely affect safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements. The object of a safety investigation is to determine the circumstances to prevent other similar events. The results of these determinations form the basis for safety action, including recommendations where necessary. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations.

It is not the object of an investigation to determine blame or liability. However, it should be recognised that an investigation report must include factual material of sufficient weight to support the analysis and findings. That material will at times contain information reflecting on the performance of individuals and organisations, and how their actions may have contributed to the outcomes of the matter under investigation. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. While the Bureau issues recommendations to regulatory authorities, industry, or other agencies in order to address safety issues, its preference is for organisations to make safety enhancements during the course of an investigation. The Bureau is pleased to report positive safety action in its final reports rather than make formal recommendations. Recommendations may be issued in conjunction with the ATSB reports or independently. A safety issue may lead to a number of similar recommendations, each issued to a different agency.

The ATSB does not have the resources to carry out a full cost-benefit analysis of each safety recommendation. The cost of a recommendation must be balanced against its benefits to safety, and transport safety involves the whole community. Such analysis is a matter for the body to which the recommendation is addressed (for example, the relevant regulatory authority in aviation, marine or rail in consultation with the industry).

EXECUTIVE SUMMARY

At approximately 1213 Eastern Standard Time[1] (EST) on 11 August 2005, a motor vehicle drove into the path of a Pacific National locomotive, G535, on the Edith Street level crossing at Horsham in Victoria. The crossing is protected by flashing lights a bell, approach warning signs and road markings.

After the initial collision, the locomotive continued under emergency brake application for approximately 220 metres, while pushing the motor vehicle along the track. The vehicle became dislodged from the front of the locomotive when it collided with a points-machine at the eastern end of the Horsham station yard. Damage to the points-machine subsequently caused the locomotive to derail.

The driver of the motor vehicle was fatally injured during the collision. There were no direct injuries to the crew of the locomotive; however, they were treated for shock.

The motor vehicle was destroyed by the collision. The locomotive sustained minor damage. Damage to fixed infrastructure included approximately 50 metres of track beyond the points-machine, the destruction of the points-machine and some minor damage to a pedestrian crossing located at the southern side of the Edith Street level crossing.

The major safety issues identified in this report relate to the actions of the driver of the motor vehicle. The response by the train crew and integrity of the level crossing warning equipment were not considered to be factors in the collision. Witnesses who endeavoured to assist the driver of the motor vehicle should be commended for their actions. Emergency services personnel responded effectively and efficiently.

As a result of its investigation, the ATSB finds that the conditions that increased safety risk and contributed to the accident at Edith Street level crossing were:

- The collision occurred because the driver of the motor vehicle did not stop and give way to the locomotive as required by 'Road Rules – Victoria'. The motor vehicle entered the level crossing while the active level crossing protection system was operating.
- The driver of the car was not alerted by the crossing protection system to the train's presence and was probably distracted by internal and/or external factors.

  Internal factors may have included:

  - the expectation that a train would not be present,
  - familiarity with the crossing, and
  - the possible existence of personal issues as a result of changes to family circumstances.

  Potential external factors may have included the presence of an intersection immediately after the crossing.

1 All times throughout this report is Eastern Standard Time (EST) and expressed in a 24 hour clock format (hhmm:ss).

The ATSB[2] makes the following recommendations with the intention of enhancing future rail/road safety at level crossings:

- The ATSB recommends that the Victorian Department of Infrastructure, through the Victorian Railway Crossing Safety Steering Committee, re-examine the Edith Street level crossing, including the use of the ALCAM[3], to determine whether an upgrade of this site is warranted.
- The ATSB recommends that Public Transport Safety Victoria (PTSV) through the Victorian Railway Crossing Safety Steering Committee liaises with the ARTC and rail operators in Victoria regarding opportunities to formulate community education/awareness programs regarding level crossing safety and risk[4].
- The ATSB recommends that the Australian Rail Track Corporation improve communication with the Horsham Rural City Council in relation to the inspection and maintenance of level crossings, including the development of a formal 'Level Crossing Interface Agreement'.
- The ATSB recommends that the Horsham Rural City Council liaise with the Victorian Railway Crossing Safety Steering Committee regarding opportunities to formulate local community education/awareness programs for level crossings.
- The ATSB recommends that the Horsham Rural City Council develop a program for the regular inspection of all level crossings in the shire to ensure that road markings and signage conform with Australian Standard AS1742.7:1993, Manual of Uniform Traffic Control Devices, Part 7: Railway Crossings.

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2 SAFETY AT RAILWAY LEVEL CROSSINGS

At an Australian Transport Council (ATC) meeting on 2 June 2006, the Australian Government and State and Territory Transport Ministers agreed to commence innovative work on implementing a national level crossing behavioural strategy. The behavioural strategy forms part of the ATC's National Railway Level Crossing Safety Strategy and builds on the work of the National Road Safety Strategy. The Behavioural Strategy will work towards the national development and delivery of programs though each jurisdiction aimed at modifying road user behaviour to improve railway level crossing safety.

3 ALCAM - Australian Level Crossing Assessment Model. A mathematical model developed by Australian railway owners/operators for the determination of risk ratings for individual level crossings and thereby allowing those agencies to prioritise level crossing upgrading works.

4 It is further recommended that the PTSV liaise with members of the 'Rail Safety Regulators Panel' regarding the opportunity to develop a nationally consistent approach targeted at community education/awareness programs regarding level crossing safety and risk. The Railway Level Crossing Behavioural Coordination Group (initiated by the Australasian Railway Association) should also consider this matter.

1 INTRODUCTION

At approximately 1213 Eastern Standard Time (EST) on 11 August 2005, a motor vehicle drove into the path of Pacific National locomotive, G535, on the Edith Street level crossing at Horsham in Victoria. The crossing is protected by flashing lights a bell, approach warning signs and road markings.

The driver of the motor vehicle was fatally injured during the collision.

As a result of the collision, the Executive Director of the Australian Transport Safety Bureau (ATSB) authorised an independent investigation into the accident with a view of enhancing future rail/road safety.

The ATSB conducted a comprehensive on-site investigation, including an examination of the motor vehicle, railway rollingstock, track, signalling and associated infrastructure. Subsequent analysis by the ATSB has included an examination of available electronic data, safety management systems, records, personnel and organisational issues as considered appropriate.

This report is the result of the investigation into the occurrence.

2 FACTUAL INFORMATION

2.1 Narrative

At approximately 1213 EST on 11 August 2005, a small motor vehicle drove into the path of a Pacific National locomotive at the protected level crossing of Edith Street on the Melbourne to Adelaide section of the standard gauge Defined Interstate Rail Network (DIRN) at Horsham in Victoria. The locomotive was crewed by two senior drivers and an instructor.

The driver of the motor vehicle was fatally injured as a result of the collision.

Witnesses and available evidence indicate that the level crossing warning devices were operating at the time of the collision. The sighting[5] of the warning equipment, associated signage and road markings were in compliance with AS 1742.7-1993, the Australian Standard 'Manual of uniform traffic control devices Part 7: Railway crossings'.

2.2 Site information

Horsham is located approximately 300 km north west of Melbourne and 450 km south east of Adelaide.

Figure 1: Location of Horsham, Victoria (Railways of Australia)

The Edith Street level crossing is 326.048 track kilometres from a zero/reference kilometre mark near Melbourne's Southern Cross railway terminus. The level

5 Sighting – Refers to the physical positioning/location of the flashing lights and/or warning signs/markings along the road as prescribed by AS 1742.7-1993, the Australian Standard 'Manual of uniform traffic control devices Part 7: Railway crossings.

crossing is situated to the north-eastern side of the Horsham Township at the eastern end of the Horsham railway station. Edith Street is classified by the Horsham Rural City Council (HRCC) as an 'Urban Link' (highest-level urban road). It provides a strategic link between arterial roads, suburbs, commercial areas, major housing areas and/or a defined destination.

The level crossing comprises a single rail line with a speed limit of 115 km/h, crossed at right angles by the roadway which has a speed limit of 50 km/h. Edith Street also intersects Palm Avenue to the north western side of the level crossing and terminates in Dooen Road immediately on the south east side of the crossing. The distance from the centre of the track to the centre of Dooen Road is 24.8 m. Edith Street, immediately before passing over the crossing is straight for approximately 55 m, further back there is sweeping right hand curve.

The level crossing is protected with active flashing lights and a bell. In addition to the primary flashing lights, the crossing is equipped with supplementary flashing lights and associated signage to warn road traffic approaching the crossing from Palm Avenue and Dooen Road. Road surface markings and roadside signage is provided as prescribed by the AS 1742.7-1993, Part 7.

The Australian Rail Track Corporation (ARTC) manages the railway infrastructure. The roadway and approach signage is managed by the HRCC.

Figure 2: Aerial photograph - Edith Street Level Crossing, Horsham (S36°42.364' E142° 12.743')

2.3 Legislative context

The Victorian 'Road Safety Act 1986' incorporating the 'Road Rules – Victoria' at Part 10, Section 123 stipulates:

> 123. Entering a level crossing when a train or tram is approaching etc.
>
> A driver must not enter a level crossing if –

(a) warning lights (for example, twin red lights or rotating red lights) are operating or warning bells are ringing; or

(b) a gate, boom or barrier at the crossing is closed or is opening or closing; or

(c) a train or tram is on or entering the crossing; or

(d) a train or tram approaching the crossing can be seen from the crossing, or is sounding a warning, and there would be a danger of a collision with the train or tram if the driver entered the crossing; or

(e) the driver cannot drive through the crossing because the crossing, or a road beyond the crossing, is blocked.

Examples for paragraph (e)

The crossing, or a road beyond the crossing, may be blocked by congested traffic, a disabled vehicle, a collision between vehicles or between a vehicle and a pedestrian, or by stock on the road.

2.4 Organisation(s)

Australian Rail Track Corporation (ARTC)

The ARTC is the accredited rail organisation responsible for access to, and maintenance of, approximately 5,860 kilometres of standard gauge interstate track in South Australia, Victoria, Western Australia and New South Wales. This includes the section of DIRN between Melbourne and Adelaide over which locomotive G535 was travelling.

Horsham Rural City Council (HRCC)

The HRCC serves a municipality of approximately 19,000 people and is centred on the city of Horsham, with a population of over 13,000 people. Horsham sits at the junction of three major highways in the Wimmera Region of northwest Victoria.

Pacific National (PN)

Pacific National is the largest accredited and privately owned rail operator in Australia. Pacific National is/was a joint venture company owned by Toll Holdings and Patrick Corporation, and is now 100% owned by Toll Holdings; it is an Australian listed Company. Its primary business is transportation of rail freight; however, Pacific National also provides locomotives and crews to other organisations including passenger rail. Pacific National was the owner and operator of locomotive G535 at the time of the accident.

Works Infrastructure (WI)

Works Infrastructure (WI) is a division of Downer EDI Limited. It is an Australian listed company which provides comprehensive engineering and infrastructure management services to the public and private rail, road, power, telecommunications, mining and resource sectors in Australia, New Zealand, South East Asia and Hong Kong.

2.4.1 Level crossing - ownership and oversight

The rail infrastructure at the Edith Street level crossing is managed by the ARTC with maintenance at the site performed under contract by Works Infrastructure. Road markings and approach warning signs are the responsibility of the HRCC. The ARTC and the HRCC do not have an 'Interface Agreement'[6] covering their respective maintenance responsibilities (see ATSB report, Aloomba, Queensland, May 2003). However, the two organisations understand their key responsibilities as was evidenced in having the appropriate provision of level crossing warning signage, road markings and protection equipment.

2.5 Accreditation and standards

Department of Infrastructure (DoI)

The Victorian Rail system operates on the principle of 'co-regulation'. The state regulatory body, Public Transport Safety Victoria (PTSV), a separate statutory office within the Department of Infrastructure (DoI), accredits all rail owners/operators in Victoria, subject to satisfying the accreditation criteria set out in the Transport Act 1983.

Both the ARTC and PN are accredited in Victoria by the PTSV and are regularly audited. The PTSV has no authority over the HRCC with respect to mandating the provision of level crossing signage and road markings.

Australian Standard Manual of uniform traffic control devices Part 7: Railway crossings (AS 1742.7-1993)

AS 1742.7-1993 is one in a series of 13 standards prepared by the 'Standards Australia Committee on Road Signs and Traffic Signals'. Part 7 specifically deals with signs and markings associated with railway level crossings. It covers the way in which these signs and markings are used to warn road users of the presence of rail traffic and also includes advance warning signs and minimum treatment requirements.

The standard does not cover level crossing hardware such as the flashing lights and/or boom barriers or electrical circuit design.

The ARTC and the HRCC provide signage in accordance with AS 1742.7-1993.

2.6 The collision

At approximately 0730 on 11 August 2005, the crew of locomotive G535 booked on duty at Portland, Victoria. They had just completed two days of re-familiarisation training between Maroona and Portland on the Ararat to Portland branch line. The locomotive, running as train number 0783, was on its return journey to Dimboola. The journey from Portland to Murtoa Loop was reported as

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6 'Interface Agreements' - An interface agreement defines the maintenance responsibilities of parties who have a common interest in a piece of fixed infrastructure. Interface agreements are currently fairly uncommon throughout the rail industry.

uneventful with locomotive G535 passing through Murtoa Loop at approximately 1138. It then travelled to Horsham.

The weather conditions were fine and dry with good visibility. As the locomotive approached Horsham, the train driver sounded the train whistle, firstly for the Rasmussen Road and then the Edith Street level crossings. The train headlight and 'ditch' lights were on. The locomotive speed was reducing towards a target of 100 km/h beyond the level crossing and was less than the 115 km/h speed limit. At 1211:30 the locomotive activated the flashing lights and bell for the Edith Street level crossing. The locomotive was 638 m from the crossing at this time.

At about this time, the driver of the motor vehicle involved in the accident, was reversing out from her driveway[7] and on to Edith Street. She then drove in an easterly direction towards the Edith Street level crossing, a distance of approximately 90 m. The motor vehicle passed through the sweeping right hand bend on Edith Street, and then crossed Palm Avenue before entering the crossing. It is estimated that the speed of the vehicle during the entire journey did not exceed 30 km/h to 40 km/h. As the train driver approached the Edith Street crossing he allowed the locomotive to decelerate for an upcoming 100 km/h track speed restriction. Trees on the right hand (north western) side of the track restrict the train driver's view of road traffic coming from the west, until the train is at a distance of about 200 - 250 m from the crossing.

The locomotive continued towards the Edith Street level crossing. At a distance of approximately 200 m, the crew became aware of a small motor vehicle approaching the crossing. The motor vehicle continued at a steady pace. When it became apparent that the vehicle may not stop, the train driver placed the automatic brake controller in the emergency position, applied the locomotive independent brake and again sounded the whistle.

At 1211:50 both the motor vehicle and locomotive entered the crossing. The motor vehicle continued across the crossing and reached a point slightly past the centre line of the track when it was struck by the locomotive, now travelling at an estimated speed of 98 km/h. The rear half of the motor vehicle was hit by the left-hand side front of the locomotive and probably became caught on the locomotive's coupler. The front half of the motor vehicle was wrapped around the left hand side of the locomotive.

The motor vehicle was now jammed against the front of the locomotive and being pushed at speed along the track. The vehicle continued to be pushed along the track striking the pedestrian maze, just south of the Edith Street crossing. After travelling a further 220 m, the motor vehicle then struck a points-machine, situated on the left hand rail of the track approaching the Horsham station. By this time the locomotive had slowed to approximately 83 km/h under emergency braking.

7 The driver's place of residence was located on Edith Street.

Figure 3: Tyre marks indicate the position of the motor vehicle at the moment of impact. There was no evidence of vehicle braking or skidding in the approach to the crossing.

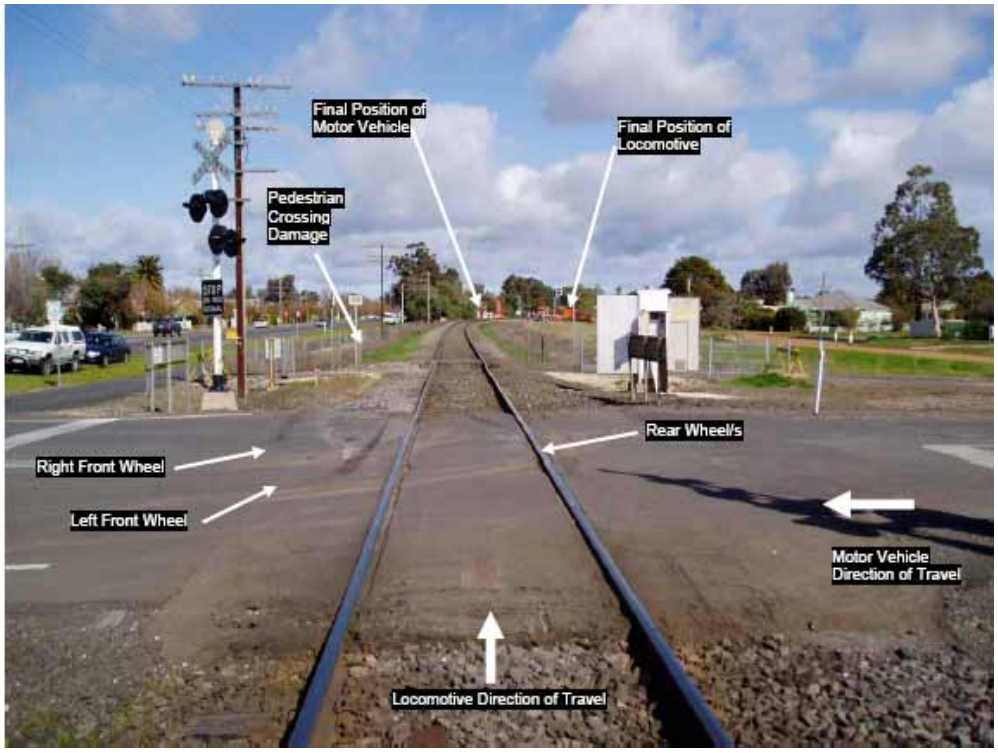


Figure 4: Damage caused by the motor vehicle colliding with the near-by pedestrian crossing. (Photograph, courtesy of Victoria Police).

When the motor vehicle collided with the points-machine it was dislodged from the front of the locomotive before being rolled onto its side and thrown down a small embankment before coming to rest against the right-of-way fence. The points-machine was destroyed in the collision and thus the turnout blades for the points were no longer locked in position. This in turn allowed the blades to move under the locomotive with the lead bogie travelling along the main line and the trailing bogie being diverted onto the crossing loop. The locomotive rapidly decelerated as it derailed and came to a rest leaning to the right, a distance of approximately 330 m past the level crossing.

Figure 5: Damage to the points-machine, caused the locomotive to derail. Part of the motor vehicle remained wedged in the locomotive coupler. (Photograph, courtesy of Victoria Police).

The train driver immediately made radio contact with the Adelaide based ARTC train controller to report the accident and requested the attendance of emergency services.

The accident was witnessed by a number of people travelling along Dooen Road and from nearby houses. Two witnesses, one a nurse, went to the accident scene and attempted to give the motorist first aid. Ambulance and other emergency services personnel were soon in attendance.

Figure 6: The motor vehicle was pushed 220 m along the track before colliding with the points-machine. (Photograph, courtesy of Victoria Police).

2.7 Injuries and fatalities

As a result of the collision between the motor vehicle and the locomotive, the driver of the motor vehicle was fatally injured.

The crew on board the locomotive were not physically injured but did suffer post-incident stress.

There were no reports of injuries or post-incident stress from witnesses, emergency personnel or onlookers.

2.8 Loss and damage

2.8.1 Locomotive

The locomotive was derailed as an indirect result of the collision, when the points-machine was destroyed and consequently failed to provide any holding of the points turnout blades. The train sustained minor damage, mainly the loss of the left-hand side leading sand box and a bent left hand side step. A small leak also developed on the right hand side fuel sight glass.

The locomotive was re-railed and moved to Horsham Station yard where the bogies were replaced and other repairs effected.

2.8.2 Motor vehicle

The motor vehicle was struck on the rear left hand side before being pushed along the track for approximately 220 m. Pieces of the vehicle were broken off and scattered along the length of the track. The motor vehicle was destroyed as a result of the collision.

2.8.3 Track infrastructure

There was no damage to the Edith Street level crossing; however the nearby pedestrian crossing was damaged.

The points-machine was destroyed and about 50 m of track were damaged just past the turnout where the train derailed.

2.8.4 Train operations

As a result of the accident, the line between Murtoa and Horsham was closed which in turn affected all movements over the Adelaide to Melbourne section of the DIRN. The line was re-opened following the completion of track restoration works, at approximately 0336 on Friday 12 August 2005.

2.9 Emergency response

The emergency services response was effective and efficient. The total time that elapsed from when the locomotive driver first called the ARTC train controller, (1215) to the first arrival of the emergency services was eight minutes.

2.10 Site recovery

The section of line over which the accident occurred is part of the DIRN and is an essential corridor for the running of interstate rail traffic. It was therefore important that restoration works were carried out quickly and efficiently; however, it was also important to collect any perishable evidence before restoration work started. To facilitate this process and minimise recovery delays, the ATSB called on the Victoria Police (based in Horsham) and investigators from the DoI Victoria, to assist with the gathering and preservation of evidence.

Much of this work was completed before the arrival of two cranes, about 2300. The two cranes were used to lift the locomotive back onto the track; this task was completed early Friday morning, 12 August 2005, with the line being open for normal services by 0336. G535 was moved into the crossing loop at Horsham for minor repairs before returning to Dimboola.

2.11 Personnel involved

2.11.1 Crew of locomotive G535

At the time of the accident the train crew comprised a driver, co-driver and an instructor driver.

All crew members had extensive experience commencing with the Victorian Railways (VR), before starting with PN in 2004. All crew members had been trained/re-trained to PN requirements.

Medical and toxicology

Pacific National use the National Transport Commission (NTC) National Standard for Health Assessment of Rail Safety Workers hereinafter referred to as the National Health Standard as a basis for health assessment of its 'Safety Critical Workers'.

The investigation established that all crew members were medically examined at Dimboola in late December 2004 and/or early February 2005. Records indicate that all were 'Fit for Duty – Meets all relevant medical criteria' as prescribed by the National Health Standard.

The train crew were breath tested by the police and returned negative results.

Fatigue and rostering

An examination of rosters worked by the crew of G535 established that train crew fatigue is unlikely to have been a factor in the accident.

Table 1: G535 - Crew Information

Details	Train Driver	Co-driver	Instructor Driver
Gender	Male	Male	Male
Qualifications	Qualified Driver	Qualified Driver	Qualified Instructor Driver
Experience	Extensive – 44 years.	Extensive – 27 years.	Extensive – 43 years.
Trained/Re-trained	To PN requirements	To PN requirements	To PN requirements
Medical Status	Fit to National Standards – In date at 30 Dec 04.	Fit to National Standards – In date at 01 Feb 05.	Fit to National Standards – In date at 28 Dec 04.
Medical Restrictions	None – 'Fit for Duty – Meets all relevant medical criteria'	None – 'Fit for Duty – Meets all relevant medical criteria'	None – 'Fit for Duty – Meets all relevant medical criteria'
Tests (Drug/Alcohol)	Negative	Negative	Negative
Fatigue/Rosters	No issues identified	No issues identified	No issues identified

2.11.2 Driver of motor vehicle

The driver of the motor vehicle was a female aged 65. She had moved from Warrnambool, Victoria to Horsham and had lived near the Edith Street level crossing for approximately 18 months.

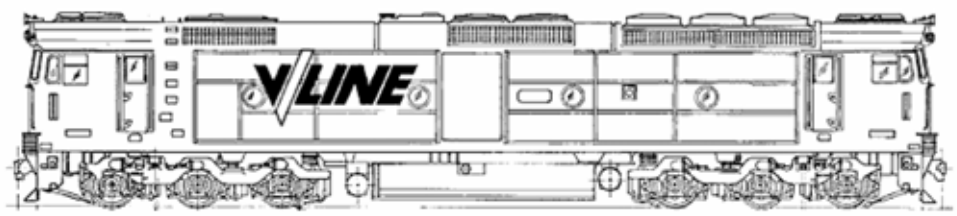
Based on police records, during the time she had lived in Horsham there had been no driving violations reported and anecdotal evidence suggests that she had not been involved in any major road accidents or incidents before moving to Horsham.

She was assessed as being of relatively good health, with no known problems that would have precluded her from driving a motor vehicle. A post mortem examination did not reveal any medical conditions that may have contributed to the accident. There was no evidence of any substance(s) that may have impaired her driving performance.

2.12 Train information

The G Class locomotives entered service between November 1984 and December 1988. A total of 31 units are currently is service, two locomotives (G517 and G518) were severely damaged in a collision at Ararat in late 1999 and are no longer in service.

Figure 7: G-Class Locomotive G526 to G543.



G-Class Locomotive, Specification

Introduced:	1984
Builder:	Clyde Engineering, Rosewater and Somerton
Model:	JT26C-2SS
Length:	19.82 m
Gauge:	1600mm, 1435mm
Axle load:	21.2 tonnes (approximately)
Weight:	127 tonnes
Axles:	Co-Co
Engine:	EMD 645E3B
Power:	2237kW
Max. speed:	114kph
Number in Class:	33 (G511 to G543)
Number in service:	31
Fleet Number:	511 to 543

Figure 8: Locomotive G535

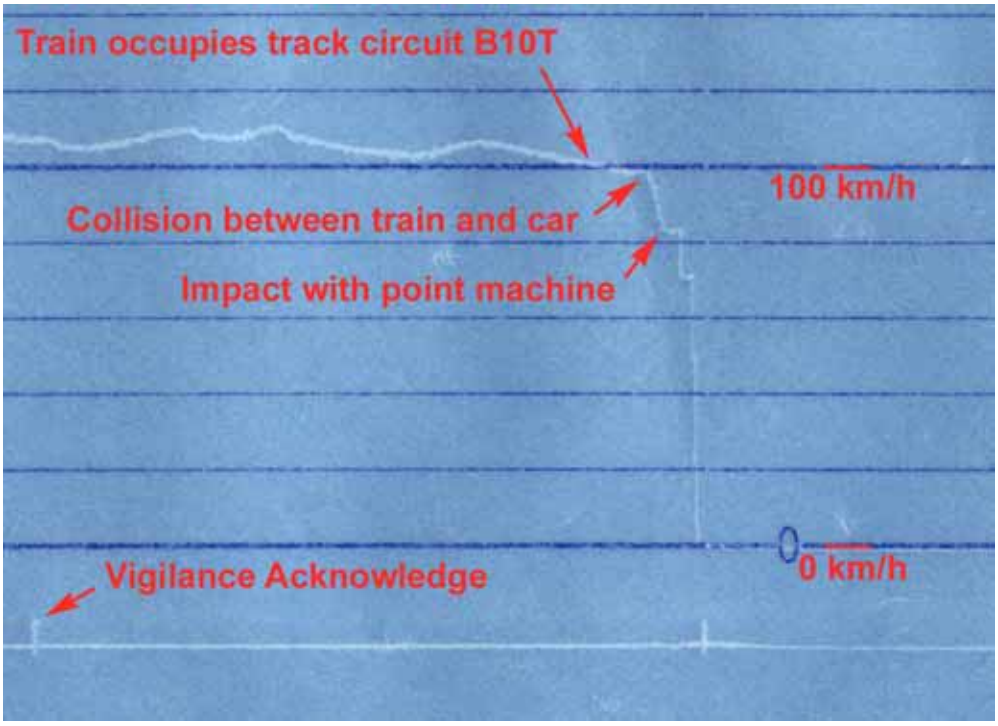
2.13 Train handling

Any train driver approaching a level crossing needs to anticipate what the driver of a motor vehicle may do and react accordingly. Typically a motor vehicle when travelling at 40 km/h requires less than 40 m to come to a standstill. Therefore it is only in the last 40 m or so that a train driver can reasonably anticipate whether the motor vehicle will stop. The braking distance for trains, even at relatively low speeds, is significantly greater than 40 m. It is therefore generally impossible for the driver of a train to take any avoiding action that will prevent a collision, particularly if a motor vehicle enters a crossing when a train is close. It is for this reason that active level crossing protection (at-grade road/rail interface) is desirable for areas with significant traffic volumes and it is essential that road users obey the law and respond by stopping when warning devices are active.

2.13.1 Hasler data logger

Locomotive G535 is fitted with a Hasler data logger. This is an electro-mechanical strip chart recorder used for recording train speed and vigilance activation information on locomotive G535. An examination of the data log was used in reconstructing the sequence of events leading up to this accident. A review of the data log (Fig. 9) shows that G535 had been driven at speeds consistent with the posted limits and started emergency braking shortly before passing over the Edith Street level crossing.

Figure 9: Locomotive G535 Hasler data logger tape



From the data extracted from the Hasler log and knowing the length of the Edith Street level crossing activation point, it is possible to calculate the warning time provided by the crossing equipment. This was calculated as 23 seconds, which is consistent with data downloaded from the Centralised Train Control (CTC) data logger and the level crossing Remote Terminal Unit (RTU) data logger.

Based on the data extracted from the locomotive, the train's braking performance is not considered to be a factor which contributed to the accident.

2.14 Road vehicle information

HYUNDAI GETZ – General Specification for 3dr XL

Engine: 1.4 litre transverse front-mounted, front wheel drive.

Transmission: Auto 4 speed.

Suspension: Front Independent MacPherson strut. Rear Semi-independent torsion axle with coil springs.

Steering: Power assisted rack and pinion.

Wheels/Tyres: 5.0J x 14 steel, tyres 175 / 65 R14.

Brakes: Dual-diagonal, split circuit, power assisted braking. Front Disc/Rear Drum (ABS provided on 1.6 litre models only).

Figure 10: Hyundai Getz (2 door)

An examination of the motor vehicle by the Victoria Police concluded that it was in a roadworthy condition prior to the accident. An inspection of the vehicle did not reveal any mechanical fault that would have contributed to the collision.

2.15 Train control

The ARTC network incorporates wayside signalling controlled remotely from a CTC centre located in Adelaide. Voice communications between trains and train control is achieved using UHF radio.

The section of track between Murtoa and Horsham including the crossing loops is remotely controlled by the ARTC controller working the Victorian North West CTC Board. Signal, points, track and train movement data for this section is recorded by an event logger and can be replayed after an incident or accident.

2.16 Track and other infrastructure

The section of track from Ararat through to Dimboola substantially comprises standard gauge single line with crossing loops to facilitate the passing of trains. There is a crossing loop at Murtoa (304.814 km) and one at Horsham (327.293 km). The track between the two crossing loops is relatively flat with some curves linked by straight sections. Speeds of up to 115 km/h are permitted with restrictions in place as appropriate.

The track at the location of the accident consists of 60-kg/m continuous welded rail (CWR), which is fastened to timber sleepers by Pandrol clips and lock spikes on Pandrol Plates. Nominal sleeper spacing is 685 mm. The section of track approaching Edith Street level crossing has a line speed limit of 115 km/h reducing to 100km/h just past the level crossing. Shortly after traversing the level crossing, the track curves to the right before leading into a set of facing points that provide access to the main line or crossing loop depending on the lie of the points.

The track infrastructure has not been examined as part of this investigation as it was not considered a contributing factor.

2.17 Signalling and communications

2.17.1 Signalling - general

The ARTC signalling system used on the DIRN between Ararat and Dimboola substantially comprises contemporary three-aspect speed signalling, using track circuits to detect trains. The track circuits also trigger any active level crossing protection. The station at Horsham comprises a main line and crossing loop for the passing of trains. There are signals located at the extremities of the station that protect train movements and control access into and out of the station yard. The ARTC employs a centralised train control system, located in Adelaide, to provide real time monitoring and control of field hardware, such as signals, points, track circuits, level crossings and the associated management of train movements.

Train protection comprises running signals, the train driver observing these signals, an onboard vigilance system, and a co-driver.

There are seven active level crossings located between Horsham and Murtoa (see Table 2).

Table 2: Details of active level Crossings between Murtoa and Horsham

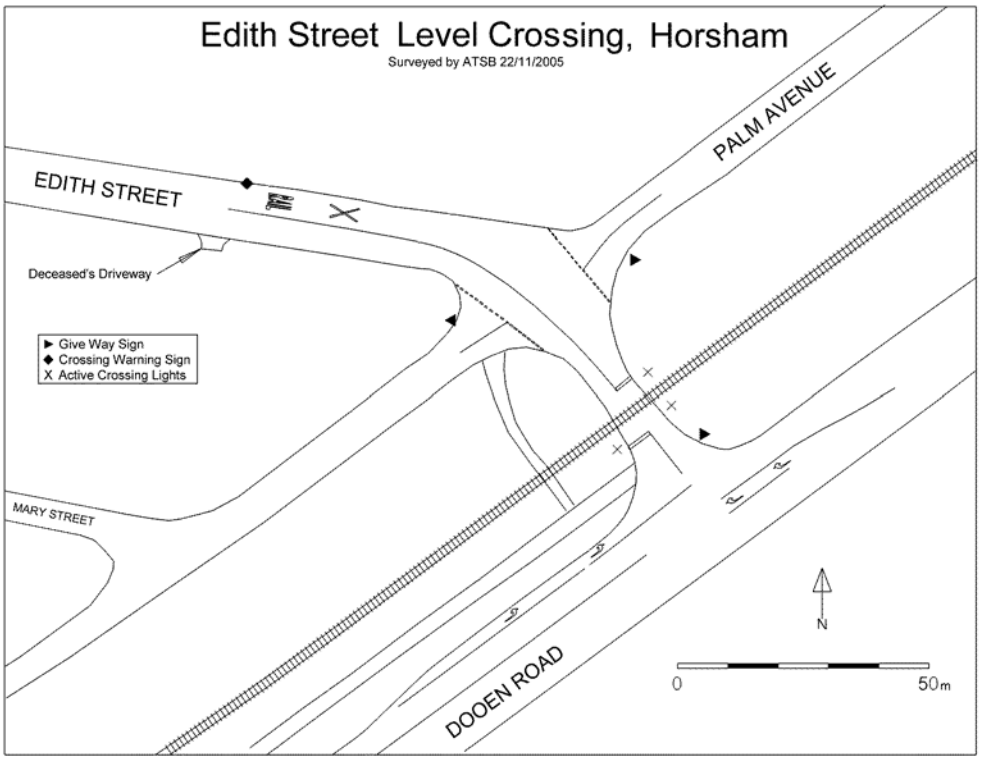
Line Segment	Level Crossing	Distance[8]	Type
Murtoa	Wimmera Highway	297.574	Auto gates
	Minyip Road	299.009	Flashing lights
Jung	North Jung Road	308.771	Flashing lights
	Wimmera Highway	314.072	Flashing lights
Dooen	Henty Highway	319.284	Auto gates
Horsham	Rasmussen Road	322.934	Flashing lights
	Edith Street	326.048	Flashing lights

2.17.2 Level crossing – warning signs and road markings

The Edith Street level crossing (Fig. 11) consists of one standard gauge track crossed at right angles by the roadway.

8 Distance - Track kilometres from a zero/reference kilometre mark near Melbourne's Southern Cross railway terminus.

Figure 11: Site Survey Edith Street level Crossing



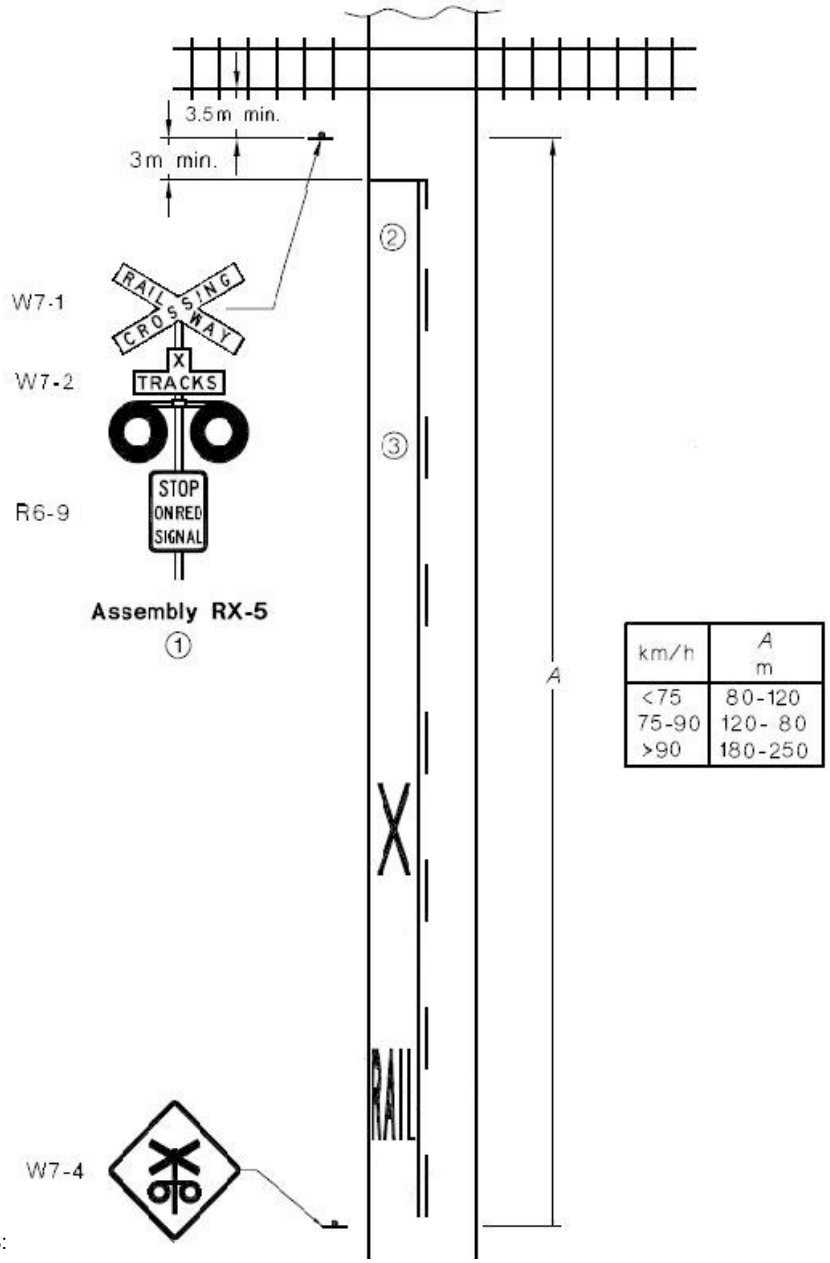
Edith Street intersects Palm Avenue on the north western side of the level crossing before terminating on the south east side of the crossing at Dooen Road.

Flashing lights, a bell, approach warning signs and road markings protect the Edith Street level crossing. In addition to the main flashing lights, the crossing is equipped with supplementary flashing lights and associated signs to warn road traffic approaching the crossing from Palm Avenue and Dooen Road. The Australian Standard AS 1742.7-1993 'Manual of uniform traffic control devices Part 7: Railway crossings' (Fig 12) prescribes the standard for road markings and signage to be used in conjunction with active warning protection used throughout Australia.

2.17.3 Level crossing – approach sighting

Flashing lights were installed at the Edith Street level crossing on 26 February 1975. They consist of a combination of main-lights, backlights and supplementary lights that have been set-up/aligned to provide coverage in accordance with the 'Horsham Edith Street – Focusing and Apparatus Diagram' (Fig. 13).

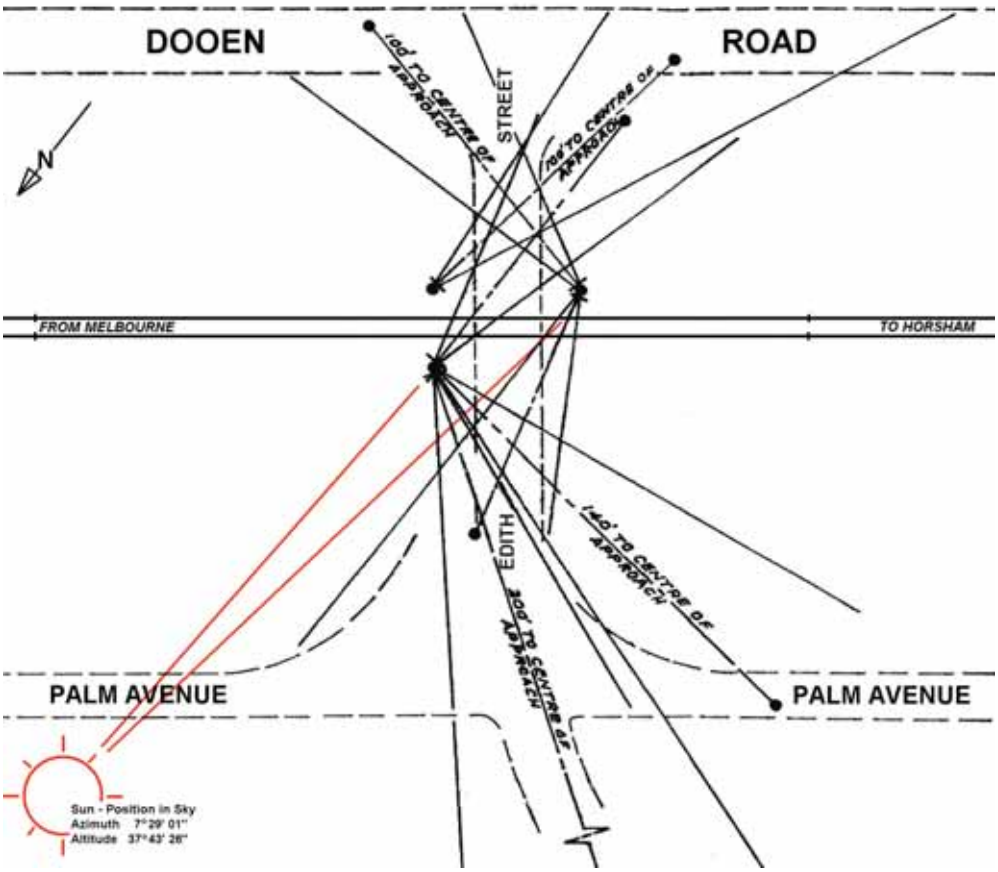
Figure 12: AS 1742.7 – 1993, Standard signage and road marking layout for 'crossing controlled by flashing lights'



NOTES:

1 If more than one track, the TRACK sign W7-2 is added below W7-1
2 Stop lines (see Clause 7.3) are required on sealed roads at level crossings controlled by flashing lights.
3 The barrier line (see Clause 7.5) should extend at least to the W7-4 sign.
4 The W7-4 sign may need to be repeated on the right-hand side of the carriageway (see Clause 6.3.3)

Figure 13: Focusing Diagram



2.17.4 Level crossing – hardware, typical arrangement

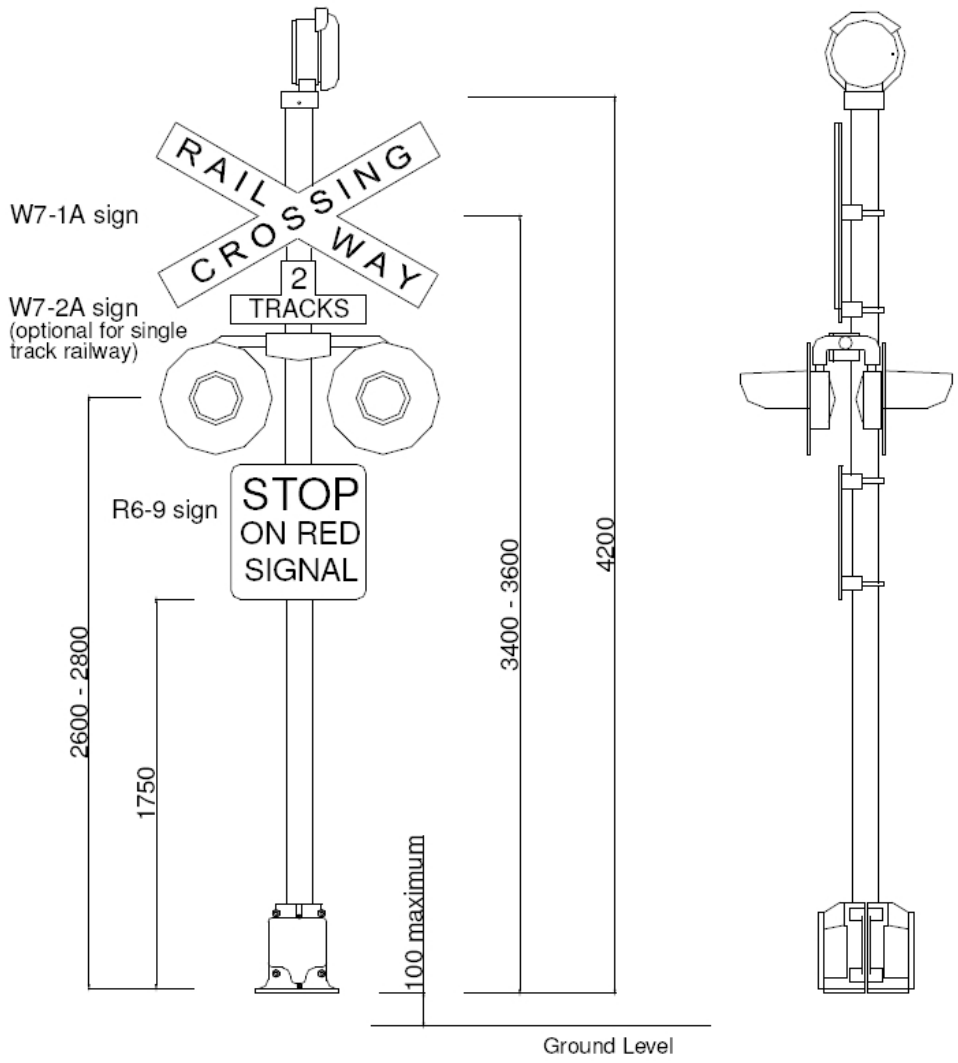
Visual Devices

Visual devices remain the primary method used to warn motorists of an approaching train. This may include passive signage or a combination of passive signage and active devices such as flashing lights and boom barriers.

In Australia, active flashing light hardware, that is the mast, flashing lamp units and bell, generally complies with the Association of American Railroads (AAR) requisites for highway grade crossing signals.

The flashing lights at the Edith Street level crossing consist of 12 lamp units fitted within 210 mm diameter housings with 500 mm diameter background roundels. The lights are designed to display in one direction only and employ a highly efficient optical system for projecting a beam of light with a horizontal spread and downward deflection. Globes used within the lamp units typically range from 17 to 25 watts. The optical system in use at the Edith Street level crossing employs a parabolic reflector system providing a 30-degree horizontal spread and a 15-degree vertical deflection. The globes used were rated at 10 volts, 25 watts. All globes were functioning at the time of the accident. It is common practice to fit four-lamp units on each cross arm which is then mounted on a signal mast (Fig. 14).

Figure 14: Typical level crossing signal, complete with four lamp units, 'Rail Way Crossing' sign, '2 Track' sign and 'Stop on Red Signal' sign



Additional (supplementary) lamp units may be provided to cover the side roads, as is the case at Edith Street. A special window is located on each side of the lamp unit that allow train drivers to check whether the lamps are operating correctly.

The flashing rate of the lamps is typically 44 to 55 flashes per minute. The flashing rate for Edith Street was tested at 54 flashes per minute.

Audible Devices

Historically, audible devices have been considered an important sensory medium used to warn motorists of an approaching train. However, soundproofing, air conditioning and in-vehicle entertainment systems in modern vehicles raise questions regarding the effectiveness of level crossing bells and train whistles.

The high standard of sound proofing in modern motor vehicles, with closed windows, would require a significant sound pressure for it to be heard within the vehicle. Consequently, audible warning devices are more suited to bicycle riders and pedestrians. It is less likely that a driver of a vehicle would hear either a

warning bell or a train whistle and be alerted accordingly. Increasing the loudness of warning bells and train whistles is generally not considered to be a practical option, particularly for use in populated areas as the sound level would exceed reasonable environmental/community standards.

2.17.5 Level crossing – control circuits, test and maintenance data

Control circuits employed for active level crossing protection are in general very similar in design but do vary from location to location. This arises because of the unique topography associated with each individual signalling scheme, proximity of station stops, availability of commercial power, and a variety of other reasons.

Level crossing control circuits are designed to be fail-safe, that is, if a fault occurs the warning lights and bell are activated and operate continuously until the system is repaired. As a general rule most modern installations use cables to feed the flashing lights and associated field equipment with back-up power being available should the commercial supply fail.

On single line track, where trains operate in both directions, control circuits are required to stop the active warning devices as soon as a train has cleared the crossing. Additionally, where train signals control a movement into/out-of a station yard, as is the case at Horsham, it may be necessary to interlock the operation of the level crossing and train signals to prevent unnecessary operation of the level crossing warning devices.

Level crossing systems are complex pieces of safety equipment that require regular inspection and maintenance to ensure reliability of operation and guard against any unwanted operation. The Australian Standard 'Railway Safety Management' AS 4292.1-1995 Part 1 at section 6.4 prescribes that an organisation should have in place procedures for inspection and testing of safety-related engineering and operational systems. Maintenance documentation generally provides a detailed schedule of works, including the frequency of inspection and servicing that should be adhered to in providing for the safe operation of level crossing systems.

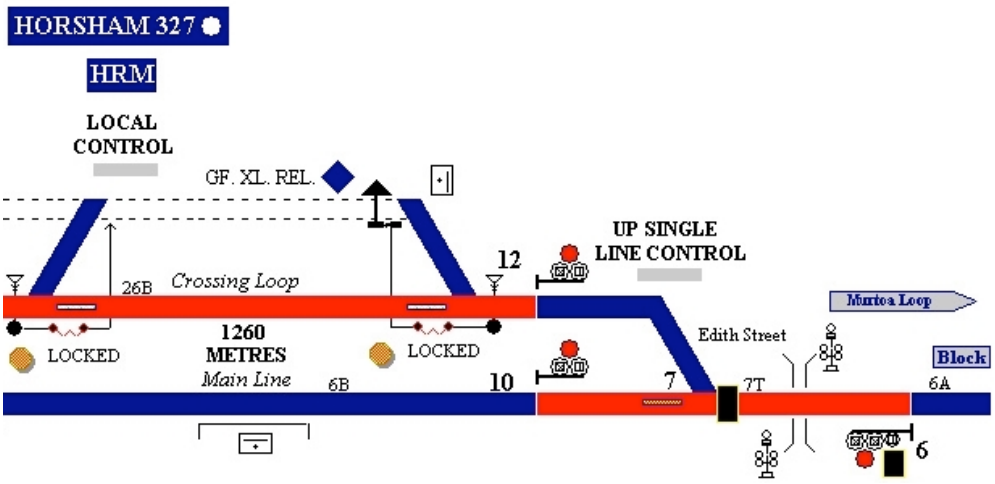
It is normal practice to fully validate the operation of level crossing control circuits and associated warning devices following any reported crossing incident/accident. This involves an examination of historic records, maintenance standards and a series of engineering tests, the outcomes of which are documented.

2.17.6 Level crossing – event and data logging

CTC event logging

At the time of the accident, G535 was under the direction of the ATRC Train Controller located in Adelaide, SA. The section of track between Murtoa and Horsham including the crossing loops are remotely controlled from the Victorian North West CTC Board (Fig. 15 - Graphics Overview). Signals, points, track and train movement data are recorded and can be replayed in the event of an incident/accident.

Figure 15: Horsham Yard (graphics overview) eastern end, as viewed on ARTC Victorian North West CTC Board Adelaide, SA



Remote Terminal Unit event logging

In addition to capturing events through the CTC system, the Edith Street level crossing also employs a Remote Terminal Unit (RTU) for capturing events locally.

The RTU is programmed to recognise specific alarm events and passes data to the ARTC Train Control Centre in Adelaide for an appropriate response. The system displays the alarm event at the respective train controller's workstation. The RTU also records the duration of operation of a level crossing for an approaching train, in the case of G535 this approach warning time was recorded as 25 seconds and is consistent with industry standards.

2.18 Environmental Factors

Maximum temperature for the day was 13 degrees Celsius. At the time of the accident the temperature was estimated to be 12 degrees Celsius with a wind speed of 25 km/h from the west. No rain had fallen since 0900 that morning.

Weather information for the Horsham area was sourced from the Horsham Airport and is as detailed at Table 3.

Table 3: Weather details for Horsham 11 August 2005 (Horsham Airport)

Local Time	Wind Direction (degrees from true north)	Wind Speed (km/h)	Cloud Cover	Temp. (degrees Celsius)	Cumulative Rainfall (mm) from 9am
0900	270	19	3/8	5.3	0.0
1500	270	30	Nil	9.5	0.0

2.19 Witness accounts

Witness accounts at the time of the accident indicated that the weather was fine with good visibility, the sky was partially overcast and no rain had fallen.

Observations from several witnesses established that the warning devices were operating as train G535 approached Edith Street level crossing, with the most relevant evidence coming from one witness who had traversed the level crossing shortly before the accident. The statement from this witness indicated that the crossing began operating as they crossed the rail line. The witness stated that they then continued over the crossing, heading in a westerly direction, before turning left into Palm Avenue. The motorist came to a stop just past Mary Street when she heard the sound of the collision. Based on an estimated speed of 20 – 30 km/h the motor vehicle would have taken approximately 20 to 30 seconds to travel from the crossing to Mary Street. This travelling time is consistent with the length of warning provided by the crossing equipment and as recorded by the data loggers.

In another witness account the motor vehicle involved in the accident was seen to be coming around the curved section of Edith Street when the lights and bell came on. The same witness reported that the train headlight was illuminated and that the train was observed to be some distance from the crossing.

2.20 Previous incident/accident history

A review of previous accidents/incidents was undertaken for the Edith Street level crossing. Based on available information, there were three incidents recorded by the ARTC since October 2001. Following the accident a fourth incident was brought to the attention of the investigation team by a member of the public. The incident had not been reported to the ARTC.

The incidents include:

- 12 October 2001, continuous operation of the level crossing due to vandalism.
- 15 January 2002, a low speed collision between a motor vehicle and train. The car drove into the side of the train. No injuries were reported.
- 10 October 2002, a car failed to stop at the crossing and passed in front of a train. No collision occurred.
- 14 June 2005, two members of the public assert that the Edith Street level crossing activated then stopped. When they began to drive over the crossing a track-mounted, road-rail vehicle[9] traversed the crossing in front of them. This incident was not reported to the ARTC when it reportedly occurred and made verification difficult.

  Investigations found that on the day of the occurrence:

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9 'road-rail vehicle' – A vehicle that is capable of running on both road and rail. Often these are standard road vehicles that have a pair of flanged rail wheels on the front and rear. Generally the vehicle accesses the rail via a level crossing, lowers the rail wheels onto the rails which will guide the vehicle without the need to steer, and is propelled by the road wheels that are in contact with the rails. Road-rail equipment is fitted to inspection, personnel carrying vehicles and some track construction machines.

– the road-rail vehicle either incorrectly activated the level crossing protection equipment - possibly a fault on the road-rail vehicle, or

– the driver of the road-rail vehicle stopped to manually activate the level crossing equipment as part of mandated testing requirements. He then drove the road-rail vehicle over the crossing, in the deactivated mode, in accordance with railway operating rules.

Based on interviews with the driver of the road-rail vehicle, the second scenario is what the witnesses probably observed.

2.21 Level crossing - upgrade priority

There are 2274 road/rail level crossings and 722 railway pedestrian crossings in Victoria. The interface between road and rail at level crossings continues to represent a risk for both transport modes.

Although the maintenance of crossings is the responsibility of the railway infrastructure manager, in this case the ARTC, the DoI manages a capital works program for the upgrading of crossings in Victoria. In 2002, the DoI ranked the Edith Street level crossing as 85th in an upgrade program; it did not consider that Edith Street warranted train activated/automatic gates.

In recent times, the Victorian Government has identified a need for a more consistent approach in developing its level crossing upgrade program and has established the 'Victorian Railway Crossing Safety Steering Committee' (VRCSSC). The role of the VRCSSC (see Appendix) is to advise the Minister for Transport on issues of policy, management and standards for railway – road/pedestrian crossings in the State of Victoria.

The ARTC submit a 'Safety Management Plan' to the PTSV as part of their accreditation process. The plan makes specific reference to the risk of level crossing accidents. However, in its plan the ARTC only includes level crossings as a generic hazard identifying issues such as; vandalism, power failure and equipment malfunction, as areas of risk. The Edith Street level crossing has not been specifically identified as a high-risk crossing.

2.22 Level crossing – public education

As part of its 'Terms of Reference', the VRCSSC is required to develop:

> 'Awareness campaigns and communication strategies targeted to improving safety and best practice at pedestrian and road railway crossing interfaces'.

The inclusion of this requirement within the mandate of the VRCSSC recognises the importance of developing public education programs aimed at improving community awareness regarding the risk of accidents at pedestrian and road/railway crossing interfaces.

The development of appropriate strategies for communicating the risk of accidents at pedestrian and road/railway crossing interfaces is an area where opportunity exists to improve community awareness throughout Australia. In the United States and Canada they have developed very successful public awareness programs.

3 ANALYSIS

3.1 Introduction

Safe driving and proper observance of road rules by drivers of motor vehicles when traversing level crossings is essential to rail safety. 'Road Rules – Victoria' at Part 10, Section 123, Clause (a) stipulates:

> A driver must not enter a level crossing if –
>
> (a) warning lights (for example, twin red lights or rotating red lights) are operating or warning bells are ringing;

The road rules, together with effective motorist education, the design of level crossings, road alignment and the provision of flashing lights and/or boom barriers are all defences that help to prevent road and rail systems coming into conflict. However, prima facie, a driver of a motor vehicle errs if he/she enters a level crossing when the warning devices are operating and the approach-warning signage is fit for purpose.

The ATSB's investigation of the accident at Horsham on 11 August 2005 has identified that:

- there were no deficiencies that relate to the mechanical condition of the locomotive which contributed to the accident,
- there were no defects in the track that contributed to the accident,
- there were no factors identified that relate to the performance of the train crew in their handling of the train,
- the train crew were appropriately trained and qualified, medically fit and fatigue is not considered to have been a factor,
- breath testing of the train crew performed by the Victoria Police returned negative results, and,
- there were no deficiencies that relate to the mechanical condition of the motor vehicle which contributed to the accident.

This analysis therefore, focuses on the safety issues which may have been causal in the collision. These include the level crossing warning system and/or the actions of the driver of the motor vehicle.

3.2 Level crossing

Warning signs and road markings

All of the road markings and signage at the Edith Street level crossing were found to be in compliance with AS 1742.7 – 1993, 'crossing controlled by flashing lights' (Fig. 12) except for the 'Stop on Red Signal' sign (R6-9) which did not comply with the current standard. However, the sign did conform to an earlier standard – 'black background with white' lettering as compared with the newer standard 'white background with black' lettering. This issue is not considered important and

would probably not have contributed to the accident. Migration to the new standard has not been retrospective and therefore retention of existing signage is not uncommon.

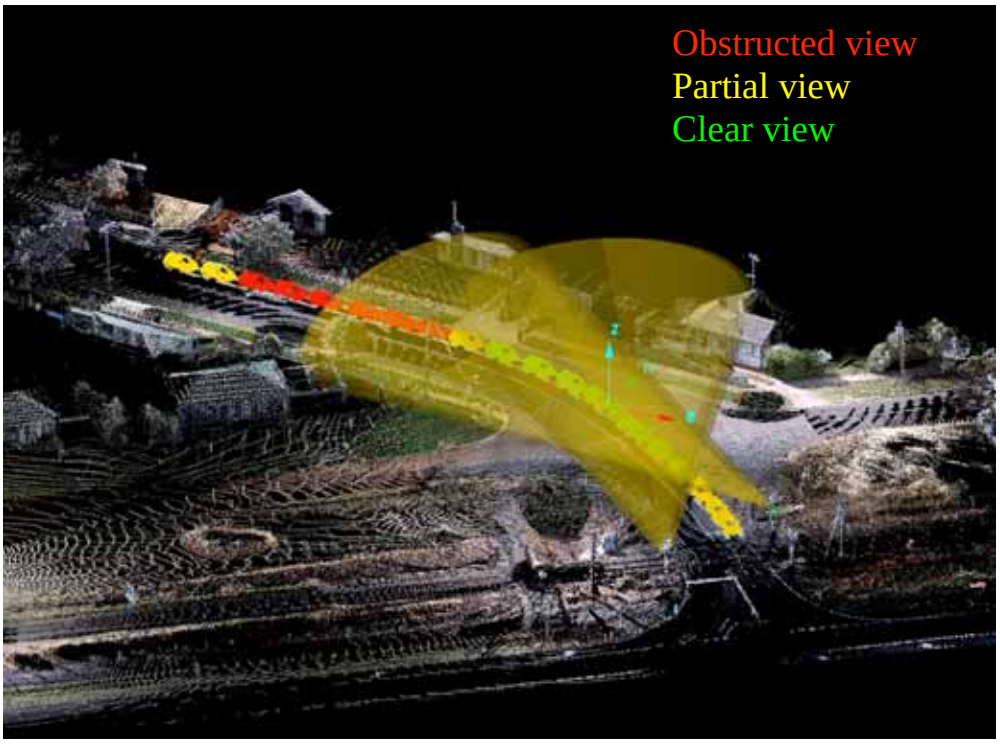
During the investigation it was noted that the W7-4 sign was correctly sited as prescribed by the standard. However, it was observed that the sign was almost directly opposite the motorist's place of residence and may not have been seen as she drove towards the Edith Street crossing. All road markings were visible even though the 'Rail' and 'X' (crossing) were faded and required repainting. The stop bar adjacent the flashing lights was clearly evident. The W7-4 sign, 'Rail' and 'X', is principally intended to warn motorists who are unfamiliar with the local topography and provides information regarding the presence of an upcoming protected level crossing. As the motorist was familiar with the local area and had traversed the Edith Street level crossing on many occasions, her need to be pre-warned regarding the proximity of the level crossing should not have been an issue.

It was evident that the HRCC did not have a system in place for regular inspection of level crossings in the shire. It is concluded that road markings and signage were not factors that would have contributed to the accident, however the HRCC should ensure that road markings and signage are regularly inspected and maintained

Approach sighting

A site inspection of the crossing established that the flashing lights generally provide good coverage of the approaches, which includes road traffic coming from the west along Edith Street. However, the curvature of Edith Street limits the sighting distances from the western approach to approximately 80 m (Fig. 16).

Figure 16: 'Visibility Diagram'. Unobstructed sighting available at a distance of approximately 80 metres from level crossing



Given the relatively low road speeds, 50 km/h, the 80 m sighting distance provides adequate braking distance for road traffic. At the time of day when the accident occurred, 1213, the sun was approximately 7 to 8 degrees east of true north and at an altitude of approximately 38 degrees. Reflection and ghosting off the flashing light lens surfaces was unlikely to have affected their visibility for an approaching motorist.

From the train driver's perspective, any improvement in the sighting distance by the removal of trees in the approach to this level crossing is unlikely to have been beneficial at least in terms of the train driver's ability to stop the train.

For the driver of locomotive G535, when approaching the Edith Street level crossing, sighting of east bound road traffic was only available at a distance of 200 - 250 m from the crossing. At this distance when travelling at a speed of 100 km/h, the train was just 9 seconds from the crossing. Allowing for the train driver's reaction time of approximately two seconds and the train braking dynamics, the locomotive would have been at or near the crossing just as the emergency braking came into effect. This conclusion is reinforced by the data extracted from the Hasler Log (locomotive data logger).

It is concluded that approach sighting was not a factor that contributed to the accident.

Hardware, control circuits, test and maintenance records

The hardware at Edith Street level crossing was consistent with the Association of American Railroads (AAR) requisites for highway grade crossing signals and is typical of that used throughout Australia. The lenses and parabolic reflectors were clean and provided a nominal optical spread of 30 degrees and vertical deflection of 15 degrees. All globes were functioning at the time of the accident and provided maximum illumination.

The Edith Street level crossing was regularly[10] tested by a track supervisor for correct operation in accordance with ARTC contract requirements. The last test before the accident was at 1348 on Wednesday 10 August 2005. Results of this test indicated that the crossing was operating correctly.

The level crossing was also regularly maintained in accordance with prescribed ARTC/WI contract/maintenance requirements. Maintenance was last performed on the 19 July 2006. No system anomalies were identified.

A physical inspection of the site established that there was no evidence of vandalism or graffiti that may have rendered any part of the warning system ineffective.

Tests undertaken following the accident established that the equipment was operating correctly; there was no evidence to suggest that there was any circuit design deficiency or system fault that would have resulted in the incorrect operation of the crossing.

10 The crossing was being tested approximately every three days.

CTC (Centralised Train Control) event logging

Centralised Train Control data covering the period 1034:24 through to 1259:59 on 11 August 2005 was made available to the ATSB for review and analysis.

The replay files pertinent to this accident were extracted with relevant information being analysed to identify whether there were any unusual occurrences in the lead-up to or during the accident. A review of this data established that No. 6 signal, which controls train movements into the Horsham yard was cleared for locomotive G535 at 1116:53, well in advance of the movement. No. 6 signal remained clear for the entire period that G535 approached the crossing and was correctly restored to stop by the train movement. The Murtoa to Horsham approach indicator became occupied at 1205:48, the Edith Street level crossing commenced operating at 1211:30 and correctly ceased operating at 1211:52 after locomotive G535 had cleared the crossing. During the period 1211:30 through to 1211:52 there was no recorded evidence that would suggest any abnormal operation of the crossing.

RTU (Remote Terminal Unit) event logging

The Edith Street level crossing RTU data was downloaded for the period 1000:00 through to 1917:58 and provided to the ATSB for analysis.

As part of the data capture process, the RTU measures the train's approach warning time based on when the flashing lights commence operation, through to the time when the train cleared the Edith Street crossing. At the time of the accident, the RTU recorded the level crossing as operating continuously from 1211:30 to 1211:54[11], the entire period G535 approached the level crossing.

Witness accounts

Several witnesses observed the level crossing to be operating correctly as the train and motor vehicle approached the Edith Street crossing.

From available witness statements it is concluded that the level crossing was operating at the time of the accident. This is corroborated by on site testing that found that the level crossing equipment was operating correctly and data available from the CTC and RTU event loggers.

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11 Subtle timing differences exist between the CTC and RTU data timings. This occurs as a result of slight differences in clock synchronisation, data source, eg lamp current compared to relay contact and recording of data remotely (CTC) compared to locally (RTU). The important observation is that the operation of the crossing was continuous from initial level crossing activation through to the flashing lights and bell switching off.

3.3 Driver of the motor vehicle

3.3.1 Response

The evidence is that the driver of the motor vehicle was familiar with the level crossing and often used it prior to the accident. The absence of tyre skid marks[12] on the pavement near the level crossing may indicate that the motorist did not make a brake application before entering or while traversing the crossing.

In the event that she did see the train, once she was on the level crossing and had time to react, that reaction may have been to accelerate in an attempt to move off the crossing and out of the path of the train. However, the short time between when the train driver saw the car enter the level crossing and impact would suggest there was limited time for the motorist to take such action.

The weight of the evidence, however, suggests that the most likely scenario is that the motorist did not perceive or did not respond to the activated level crossing lights and bell, or the train itself. This type of error is classified as a perceptual error or misjudgement. Perceptual errors occur when critical/important information was detectible but the motorist did not attend to or notice it because their mental resources were elsewhere (Green and Senders, 2004). Expectation and habit can potentially play a large role (Maurino, Reason, Johnston, and Lee, 1995). Evidence indicates that the level crossing lights were operating at the time of the accident and at the intensity and flash rate specified by the relevant standards. Similar findings were determined for the warning bell. The crossing lights were checked during normal daylight and found to be visible to a motorist for at least 80 metres before the crossing.

3.3.2 Expectation

Data relating to train movements the week before the accident were used to estimate the amount of rail traffic over the crossing. It was found that 101 trains had passed through the Edith Street crossing, that is, an average of 14.4 train movements per day indicating that there was a significant amount of rail traffic. Over a 24 hour period, calculations indicate that during the period 1000 – 1400 (the accident occurred at 1213) relatively fewer trains entered the crossing, approximately 7% of the daily average, compared with the four-hour period either side, 0600 – 1000 and 1400 – 1800, at 16% each. Locomotive G535 was not a timetabled train. It was being used for route re-familiarisation training. It is therefore possible that the motorist being familiar with the crossing activation pattern may have been less likely to expect a train in the middle of the day relative to other periods.

A factor which influences whether a road user actively looks for a train is their expectation of seeing one, as reported in an analysis by the National Transportation Safety Board (NTSB), of the United States. The NTSB (1998) interviewed 18 vehicle drivers involved in level crossing accidents and discovered that they

12 The absence of skid marks could be for various reasons, not being aware of the train, well controlled braking by the motorist and/or an anti-lock braking system (ABS). The Hyundai Getz involved in this collision did not have ABS.

underestimated the frequency of train crossings per day by a factor of two or three. For example one road user estimated that there were one to two trains per day when the actual number was 15. A low estimate indicates that motorists may not expect to see trains and consequently may not look for trains at a crossing. Although these findings relate to passive level crossings, a similar conclusion may be drawn for active crossings with flashing lights and bell. If the motorist does not expect to see the train they may not expect to see the flashing lights and hear the bell operate.

The road user's perception that a train is unlikely to be at the crossing is reinforced every time that road user traverses the crossing without seeing a train. Research has found that an individual's response to a possible hazard is influenced by both the perceived probability of the adverse event occurring and of that individual's understanding of the severity of the consequence of the event (Schoppert and Hoyt, 1968 cited in NTSB, 1998). A person's perception of the probability of a given event is strongly influenced by past experience (Schoppert and Hoyt, 1968 cited in NTSB, 1998), and the frequency with which they encounter a train at a level crossing that they use regularly will influence the likelihood of the motorist stopping (NTSB, 1998).

Although it is not known how frequently the motorist involved in this accident used the crossing, she played a very active role in the community volunteering her time to several community groups. One interviewee indicated that she had never seen the motorist travel on the only alternative route, which did not include traversing a level crossing. It is therefore likely that the motorist used the crossing regularly. Familiarity with a level crossing does not necessarily reduce an individual's risk of having an accident, especially if trains are infrequent on the crossing (Wigglesworth, 1979 cited in Caird, Creaser, Edwards, and Dewar, 2002). At passive level crossings Caird et al (2002), maintain that crossing familiarity combined with the expectation that a train won't be present has the potential to lull motorists into becoming complacent or developing poor looking habits. Although the research involved passive level crossings the same conclusion may be drawn for active level crossings, however the warning systems fitted to these crossings should reduce this effect by providing a clear indication that a train is present.

One of the key requirements of a warning system is that once activated it should draw an individual's attention towards it. There is therefore the expectation that the warning system would indicate the presence of a train (Tidwell and Humphreys, 1982; Richards and Heathington, 1988; Wigglesworth, 1990, cited in Wigglesworth, 1992). Based on her potential past experience of little rail traffic on the Edith Street crossing in the middle of the day, the motorist may not have expected to see a train and this may also have influenced her search for / interpretation of, the activated warning signals. For what ever reason, the signals did not draw the individual's attention to the presence of the train.

3.3.3 Presence of T-junction

Intersecting roads and other road traffic can distract a road user from looking for a train or indications of an oncoming train (e.g., flashing lights). Along roads where another intersects with the motorist's roadway just before or after a level crossing, may increase the number of decisions the motorist must make and distract the motorist from looking for a train (NTSB, 1998). Evidence suggests that a nearby highway/main road intersection may become a distraction to the motorist simply because the motorist is aware of it. If on the departure side of the level crossing a

highway/main road intersection is visible to an approaching motorist, the motorist's attention may be drawn towards that intersection and away from the crossing (NTSB, 1998).

The T-junction of Dooen Road and Edith Street was only 24.8 m (distance from the centre of track to the centre of Dooen Road) apart. As higher levels of attention are necessary to negotiate intersections, the car driver's attention may have been directed towards safely navigating the T-junction rather than on the level crossing. It is therefore possible that the close proximity of the intersection, Edith Street and Dooen Road may have been a factor in this accident.

3.3.4 Changes to family circumstances

Based on interviews, there is evidence to suggest that the motorist may have been preoccupied with personal issues at the time of the accident. Several days prior to the accident there had been significant changes in the family circumstances. Internal distraction, as defined by Wigglesworth (1979), is being distracted by internal cognitive processes, such as daydreaming, worrying, or being excited about an event in one's life (cited in Caird et al, 2002). Internal distractions are thought to draw an individual's attention away from the task environment in general. Distraction can have the effect of reducing an individual's attention towards their external environment. As attentional resources are engaged on the internal concern, there is less available for another task. It is therefore possible that the car driver was preoccupied with analysing the family issue, not on changes in her environment. One of the train drivers indicated that the car driver did not look left or right on approaching the crossing. This may provide additional support for the view that the car driver did not perceive that a hazard was present (i.e. flashing lights, hence a train), and unintentionally drove across the crossing. It is quite possible that the motorist's preoccupation with personal issues may have diverted her attention and was a factor in the accident.

3.3.5 Attention

Attention is a complex process which refers to the capacity of an individual to maintain some level of alertness during their activities. Failures of attention occur because unnecessary or distracting information intrudes on cognitive processing. Under these conditions an individual's attention may become narrowly focused on information unrelated to the driving task. Research by Garland Wise and Hopkin (1999) has found that stressors not only narrow an individual's attention, they reduce information intake and there is a reduction in working memory capacity. It has also been observed that there is an increased tendency to address dominant or probable sources of information in the task environment as cited by Broadbent (1971). The T-junction immediately after the level crossing may have drawn the driver's attention away from the level crossing, particularly given that traffic on the road ahead was more frequent than traffic along the railway line. Other research by Wachtel (1967) has found that under stress the scanning of information is scattered and poorly organised. If the driver was preoccupied with other matters she may not have been effectively scanning her environment and hence may not have perceived the activated level crossing warning devices or indeed the presence of the train.

The activated lights and bell at the Edith Street level crossing were insufficient to draw the motorist's attention to the imminent hazard. Research conducted by

Wigglesworth and Uber (1991) evaluated the effectiveness of upgrading level crossings in Victoria from flashing lights to boom barriers. Over a 19 year period (1971 to 1989) vehicle and train collisions were reduced from 61 (when only flashing lights protected the crossings) to two when boom barriers were installed. Similarly, mortality rates, as deaths per 100 crossing years, were reduced from 5.71 to 0.33. The research indicates that the installation of boom barriers had a significant impact on protecting the rail/road interface. The reason why boom gates at level crossings are more effective than lights alone is that they present a more salient signal that the train is imminent. Furthermore boom barriers present a physical obstacle that blocks the path of the vehicle and thus act as a deterrent to motorists who may have missed other warnings indicating the presence or imminent arrival of a train. As stated previously, however, approximately 10 per cent of level crossing accidents still occur at locations with boom gates (ATSB, Monograph 10, 2002).

Other research, for example as cited by Pickett & Grayson (1996) suggests that for drivers who have not been alerted by visual cues that a train is near (i.e. flashing lights), other measures may be available that are effective in raising driver attention.

3.4 Safety at level crossings

In a report tabled at the Australian Transport Council (ATC), 'National Railway Level Crossing Safety Strategy' dated August 2003, the ATC identified a series of 'Strategic Actions' (Appendix 7.2) aimed at the cost-effective improvement of level crossing safety. In its report, the ATC cited an ATSB report that identified 46% of fatalities at railway level crossings are as a result of 'Unintended driver error' and that 50% of accidents occur at 'Active controlled crossings'.

The level crossing accident at Horsham on 11 August 2006 involved a number of the issues identified in the ATC report; in particular car and truck driver responses; stakeholder education and information; site assessment, prioritisation and treatment; and coordination.

The Victorian Government established the VRCSSC to advise the Minister for Transport on issues regarding railway crossings so the committee has a clear role in considering issues arising from the Edith Street collision of 11 August 2005.

Car and Truck Driver Responses

The National Railway Level Crossing Safety Strategy's strategic action to address the issue of car and truck driver responses is:

> 'Ensure that drivers identify railway level crossing sites, and respond appropriately.'

Since the tabling of the ATC report, there have been a number of initiatives aimed at improving public awareness regarding level crossings safety. However, initiatives such as high level/electronic media campaigns may not have been recognised as relevant to individuals who live in close proximity to a level crossing. Local familiarity has been identified as a possible issue that can undermine an individual's perception of the dangers associated with level crossings. For this category of potentially higher risk users local initiatives may be more effective in raising awareness of the safety issues associated with level crossings.

Stakeholder Education and Information

The strategic action to address the issue of stakeholder education and information is:

> 'Develop awareness and understanding through participation amongst the public, engineers, the police and others to improve responses, engineering and enforcement (may be similar to U.S. "Operation Lifesaver")'

Australian state/territory transport authorities have been working with stakeholders to improve level crossing safety. For example, working with local government agencies to ensure compliance with approach signage and road markings as specified in AS1742.7-1993. In at least one state, an internet based database has been established to allow local government authorities to review level crossing protection and highlight deficiencies within their jurisdictions.

Site Assessment, Prioritisation and Treatment

The strategic action to address the issue of site assessment, prioritisation and treatment is:

> 'Develop uniform criteria for the establishment of the level of protection for road vehicle and pedestrian crossings.'

The ALCAM[13] model is used in some Australian states and the Northern Territory to analyse level crossings and consider the change in risk associated with differing measures of crossing protection. Train activated/automatic gates may have prevented the collision at this site by focusing the motorist's attention on a physical barrier of potentially greater significance than personal distractions and/or the T-junction immediately ahead. However, based on available information supplied by the DoI, there are many level crossings in Victoria that were considered of a higher upgrade priority than Edith Street.

Coordination

The strategic action to address the issue of coordination between jurisdictions is:

> 'Develop consistency in information, assessments, standards and practices between States.'

While not a safety issue on this occasion, the ATSB found that the ARTC and the HRCC did not have an 'Interface Agreement' covering their respective maintenance responsibilities for signage covering the Edith Street level crossings. The establishment of consistent standards/practices is necessary to ensure that all parties are aware of their responsibilities and accountabilities. For example approach warning signage is necessary and is generally provided by road authorities. However it has not always been clear who should fund and provide the signage. Therefore the lack of a formal agreement potentially exposes organisations to risk, particularly where items are not provided/maintained in accordance with industry

13 ALCAM - Australian Level Crossing Assessment Model. A mathematical model developed by Australian railway owners/operators for the determination of risk ratings for individual level crossings and thereby allowing those agencies to prioritise level crossing upgrading works.

standards because the responsibilities between the parties are unknown/ill-defined and therefore not being applied.

It is therefore highly desirable that the ARTC and HRCC should have an agreement in place that adequately addresses their specific responsibilities and it should be compliant with AS 4292.1[14] Section 7 – Interface management.

14 Australian Standard AS4292.1 Railway safety management – General requirements

4 CONCLUSIONS

The following findings are made with respect to the collision between a motor vehicle and locomotive G535 at Horsham Victoria on 11 August 2005. These findings identify the different factors that contributed to the accident and should not be read as apportioning blame or liability to any particular individual or organisation.

4.1 Contributing safety factors

These findings identify the various events and conditions that increased safety risk and contributed to the incident.

1. The collision occurred because the driver of the motor vehicle did not stop and give way to the locomotive as required by 'Road Rules – Victoria'. The motor vehicle entered the level crossing while the active level crossing protection system was operating.

2. It is likely that the driver of the car was not alerted by the crossing protection system to the train's presence as she was distracted by internal and/or external factors.

   Internal factors may have included:

   - the expectation that a train would not be present,
   - familiarity with the crossing, and
   - the possible existence of personal issues as a result of changes to family circumstances.

   Potential external factors may have included the presence of an intersection immediately after the crossing.

4.2 Other safety factors

These findings identify other events and conditions that increased the safety risk.

1. The Australian Rail Track Corporation and the Horsham Rural City Council do not have an 'Interface Agreement' covering their respective maintenance responsibilities for signage at level crossings in the shire. While this was not a factor in the accident, it could potentially expose the organisations to risk where items are not maintained because responsibilities have not been defined.

2. Horsham Rural City Council do not have a program for the regular inspection of level crossings in the shire.

3. At the time of the accident, the Department of Infrastructure ranked the Edith Street level crossing as 85th in their upgrade program. Train activated/automatic gates may have prevented the collision by focusing the motorist's attention on a physical barrier and hence the presence of an imminent hazard that required a timely response.

4.3 Other key findings

These are findings that are not defined as safety factors or may be positive events and conditions that reduced the risks associated with the incident.

1. From available evidence it was determined that the level crossing warning devices were operating at the time of the accident.
2. Edith Street level crossing was appropriately signed in accordance with AS1742.7-1993 (Manual of uniform traffic control devices Part 7: Railway crossings).
3. The flashing lights were found to provide good coverage/sighting for approaching road traffic.
4. There were no mechanical deficiencies with the locomotive that contributed to the accident. It would not have been possible for the train driver to stop the locomotive and prevent this collision.
5. There were no track deficiencies that contributed to the accident.
6. There were no identified performance issues with the train crew that contributed to the accident.
7. There were no mechanical deficiencies with the motor vehicle that contributed to the accident.
8. The speed at which the driver of the motor vehicle approached the level crossing was estimated to be 30 – 40 km/h and adequate level crossing sighting distance was available for the motorist to stop.
9. Enhanced public awareness/education is considered an effective strategy in raising public awareness regarding the danger of traversing level crossings.

5 SAFETY ACTIONS

As a result of its investigation, the ATSB makes the following recommendations with the intention of enhancing future rail/road safety. Rather than provide prescriptive solutions, these recommendations are designed to guide interested parties on the issues that need to be considered. Recommendations are directed to those agencies that should be best placed to action the safety enhancements intended by the recommendations, and are not necessarily reflective of deficiencies within those agencies.

RR20060043

The ATSB recommends that the Victorian Department of Infrastructure, through the Victorian Railway Crossing Safety Steering Committee, re-examine the Edith Street level crossing, including the use of the ALCAM, to determine whether an upgrade of this site is warranted.

RR20060044

The ATSB recommends that Public Transport Safety Victoria through the Victorian Railway Crossing Safety Steering Committee liaises with the ARTC and rail operators in Victoria regarding opportunities to formulate community education/awareness programs regarding level crossing safety and risk[15].

RR20060045

The ATSB recommends that the Australian Rail Track Corporation improve communication with the Horsham Rural City Council in relation to the inspection and maintenance of level crossings, including the development of a formal 'Level Crossing Interface Agreement'.

RR20060046

The ATSB recommends that the Horsham Rural City Council liaise with the Victorian Railway Crossing Safety Steering Committee regarding opportunities to formulate local community education/awareness programs for level crossings.

RR20060047

The ATSB recommends that the Horsham Rural City Council develop a program for the regular inspection of all level crossings in the shire to ensure that road markings and signage conform with Australian Standard AS1742.7:1993, Manual of Uniform Traffic Control Devices, Part 7: Railway Crossings.

15 It is further recommended that the PTSV liaise with members of the 'Rail Safety Regulators Panel' regarding the opportunity to develop a nationally consistent approach targeted at community education/awareness programs regarding level crossing safety and risk. The Railway Level Crossing Behavioural Coordination Group (initiated by the Australasian Railway Association) should also consider this matter.

6 SUBMISSIONS

Section 26, Division 2, and Part 4 of the Transport Safety Investigation Act 2003, requires that the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate, for the purposes of:

a) Allowing the person to make submissions to the Executive Director about the draft; or

b) Giving the person advance notice of the likely form of the published report.

The final draft of this report has been made available for comment to the following directly involved parties:

a) Australian Rail Track Corporation

b) Horsham Rural City Council

c) Pacific National

d) Department of Infrastructure (Victoria)

The Australian Rail Track Corporation, the Horsham Rural City Council, Pacific National and the Department of Infrastructure (Victoria) made a number of comments and observations on the draft report issued to directly involved parties. Comments and observations have been incorporated into this report where they are supported by valid evidence and agreed to by the investigation team.

Of note however, was a comment by the ARTC which is considered important and has been included hereunder in its entirety:

> However as a significant rail infrastructure owner in four States of Australia, where road motorist behaviour has significant effect on the safety of rail operations Australian Rail Track Corporation believes that national road vehicle driver awareness programs such as that currently being promoted by the Standing Committee on Transport (SCOT) has greater potential for increasing safety at level crossings than State based programs.
>
> Australian Rail Track Corporation would prefer to pursue a national approach rather than the State based approach as currently recommended in the report.

The ATSB believes that individuals, councils and the States must be involved in any awareness program aimed at improving level crossing safety.

7 APPENDIX

7.1 TERMS OF REFERENCE for the VICTORIAN RAILWAY CROSSING SAFETY STEERING COMMITTEE

ROLE

A Victorian Railway Crossing Safety Steering Committee (VRCSSC) will advise and make recommendations to the Minister for Transport on the policy directions, management and standards for railway level crossings and pedestrian railway crossings in the State of Victoria for the protection and safety of the public and reduction of risk.

COMPOSITION

The membership of VRCSSC will be at a CEO/General Manager level and will be represented by the following organisations/agencies.

- Director of Public Transport Safety, Department of Infrastructure – designated Chair
- Director of Public Transport, Department of Infrastructure
- Chief Executive Officer, Victorian Rail Track Corporation
- Chief Executive Officer, Victorian Road Corporation or nominee
- Chief Executive Officer, Municipal Association of Victoria or nominee

Where a need is identified, representation may be sought from other relevant organisation/s.

The secretariat for the committee will be provided by the Public Transport Safety Division, Department of Infrastructure.

The committee will be formed under the terms as laid out in the Transport Act 1983, Section 36; Consultative committees and regional advisory boards.

The committee will meet on a quarterly basis or more frequently if required.

Appointments will be for a term of three years.

TERMS OF REFERENCE

The VRCSSC will provide planning and policy advice to the Minister for Transport with respect to the application of Planning Scheme Amendment 18.01-2 of the State Planning Policy Framework "Design of transport routes must provide for grade separation at railway crossings except with the approval of the Minister for Transport."

The VRCSSC will advise and make recommendations to the Minister for Transport on the safety of railway crossings in Victoria with respect to:

- A Victorian Railway Level Crossing Safety Strategy which aligns with national priorities.
- Priorities for improvements and upgrades to at grade railway crossings and railway pedestrian crossings.
- Awareness campaigns and communication strategies targeted to improving safety and best practice at pedestrian and road railway crossing interfaces.
- The effectiveness of the Level Crossing Improvement Programme and the Pedestrian Crossing Protection Upgrade Programme.
- Review the adequacy of funds allocated to railway level crossing safety management in Victoria.
- Management of the Australian Level Crossing Assessment Model (ALCAM).
- Initiatives for research and monitoring of national and international level crossing safety developments and application of new technology in Victoria.
- The Australian Railway Crossing Safety Implementation Group (ARCSIG) and the Australian Level Crossing Assessment Model group (ALCAM)
- Other road/railway crossing and pedestrian/railway crossing issues that arise, as appropriate.
- Establishment of working groups as necessary to assist the committee with its work.

7.2 National Railway Level Crossing Safety Strategy

Strategic Response

Issue	Strategy
Train Conspicuity	Ensure that road users can see either an approaching train (locomotive or carriages), or a train that is already on the railway level crossing.
Car and Truck Driver Responses	Ensure that drivers identify railway level crossing sites, and respond appropriately.
Pedestrian Responses	Ensure that pedestrians identify railway level crossing sites, and respond appropriately. Ensure that people with disabilities are provided with appropriate information by way of site design and other initiatives.
Site Assessment, Prioritisation and Treatment	Ensure that railway level crossing sites, including pedestrian crossings separate to road crossings, are designed and constructed to an appropriate standard. Develop appropriate Australian design standards for railway level crossing protection equipment including the operation and timing of flashing lights, boom barriers, pedestrian signals and gates, and active advance warning signs. Develop uniform criteria for the establishment of the level of protection for road vehicle and pedestrian crossings. Ensure that designs are appropriate for people with disabilities and other vulnerable road users. Close level crossings where appropriate. Investigate low cost treatments including active warning signs, beacons, strobe lights and other alerting devices at railway level crossings.
Stakeholder Education and Information	Develop awareness and understanding through participation amongst the public, engineers, the police and others to improve responses, engineering and enforcement (may be similar to U.S. 'Operation Lifesaver').
Data Collection	Enable effective national data comparisons.
Funding	Seek additional funds for railway level crossing safety. Allocate funds for railway level crossing treatments within the context of broader transport infrastructure priorities.
Rail Industry Involvement	Industry involvement in engineering, education and enforcement programs. Ensure appropriate train standards and operation.
Legislation, Regulation and Enforcement	Ensure that laws and penalties are clear, understood, appropriate and enforced.
Coordination	Develop consistency in information, assessments, standards and practices between States. Implementation of the Strategy should be well managed, co-ordinated, monitored and reviewed.

8 REFERENCE INFORMATION

Australian Transport Safety Bureau (ATSB) Monograph 10 (2002). Level crossing accidents: fatal crashes at level crossings.

Australian Transport Safety Bureau. Report on the fatal collision between passenger train 3C37 and a Ford Falcon Station wagon at the Hesp Road/Bennett Road level crossing, Aloomba on 23 May 2003.

Australian Transport Council (2003). National railway level crossing safety strategy. August 2003.

Australian Transport Council (2006). National Railway Level Crossing Safety Strategy.

Caird, J.K., Creaser, J.I., Edwards, C.J., and Dewar, R.E. (2002). Highway-Railway grade crossing research: A human factors analysis of highway-railway grade crossing accidents in Canada. Transport Canada: TP 13938E.

Garland, D.J., Wise, J.A., Hopkin, V.D. (1999). Handbook of aviation human factors. Lawrence Erlbaum Associates, Ltd.

Green, M. (2004). Determining visibility. Visual expert human factors. http://www.visualexpert.

Green, M., & Senders, J. (2004). Human error in road accidents. Visual expert human factors. http://www.visual expert.com.

Leibowitz, H.W. (1985). Grade crossing accidents and human factors engineering. American Scientist, 73, 558-562.

Maurino, D., Reason, J., Johnston, N., and Lee, R. (2003). Beyond Aviation Human Factors: Safety in High Technology Systems. Aveburg Aviation: Aldreshot, England.

National Transportation Safety Board (1998). Safety at passive grade crossing. Volume 1: Analysis. Safety study NTSB/SS-98/02. Washington DC.

Commonwealth of Aust report on 'Train Illumination' (June 2004).

Pickett, M.W., & Grayson, G.B. (1996). Vehicle driver behaviour at level crossings. HSE contract research report No. 98/1996. Transport Research Laboratory: Berkshire.

Proctor, R., and Zandt, T. (1994). Human factors in simple and complex systems. Allyn and Bacon: Needham Heights, MA.

STAYSAFE Committee (2004). Report on the safety of railway level crossings – where roads and railway lines meet at substantially the same level. Parliament of New South Wales. Report No. 4/53.

Wachtel, P.L. (1967). Conceptions of broad and narrow attention. Psychological Bulletin, 68, 417-429.

Wigglesworth, E.C., & Uber, C.B. (1991). An evaluation of the railway level crossing boom barrier program in Victoria, Australia. Journal of Safety research, 22, 133-140.

Wigglesworth, E. (1992). Improving safety at railway level crossings. Railway level crossings: what's wrong with the present system? Conference proceedings: Injury Research Project.

9 MEDIA RELEASE

An ATSB investigation has found that the driver of a motor vehicle who was fatally injured on 11 August 2005 at the Edith Street level crossing in Horsham, Victoria, did not give way to the train as prescribed in 'Road Rules – Victoria'. The motorist drove into the path of the train even though the level crossing flashing lights and bell were operating correctly.

The ATSB's report concludes that it is likely that the driver of the car was distracted by internal and/or external factors. Internal factors may have included an expectation that a train would not be present, familiarity with the crossing and/or personal issues. External factors may have included the presence of an intersection immediately after the crossing.

The report further concludes that there was nothing the train crew could have done to prevent the accident.

In the interest of enhancing future road/rail safety the ATSB has made a series of recommendations which include opportunities for better public education regarding the dangers of level crossing, the improved inspection of warning signage associated with level crossings and a review of the upgrade priority assessed for the Edith Street level crossing.

Horsham is situated on the main Melbourne to Adelaide line and is approximately 300 km north-west of Melbourne, and 450 km south east of Adelaide. The level crossing comprises a single rail line crossed at right angles by the roadway and is protected by flashing lights a bell, approach warning signs and road markings.

Copies of the report can be downloaded from the ATSB's internet site at www.atsb.gov.au, or obtained from the ATSB by telephoning (02) 6274 6478 or 1800 020 616.