Report RO-2014-102: High-speed roll-over, empty passenger Train 5153,
Westfield, South Auckland, 2 March 2014

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Final Report

Rail inquiry RO-2014-102,
high-speed roll-over,
empty passenger Train 5153,
Westfield, South Auckland
2 March 2014

Approved for publication: February 2015

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (Commission) is an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

Commissioners

Chief Commissioner	John Marshall, QC
Deputy Chief Commissioner	Helen Cull, QC
Commissioner	Jane Meares

Key Commission personnel

Chief Executive	Lois Hutchinson
Chief Investigator of Accidents	Captain Tim Burfoot
General Counsel	Cathryn Bridge
Investigator in Charge	Vernon Hoey

Email	inquiries@taic.org.nz
Web	www.taic.org.nz
Telephone	+ 64 4 473 3112 (24 hours) or 0800 188 926
Fax	+ 64 4 499 1510
Address	Level 16, 80 The Terrace, PO Box 10 323, Wellington 6143, New Zealand

Important notes

Nature of the final report

This final report has not been prepared for the purpose of supporting any criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this final report inadmissible as evidence in any proceedings with the exception of a Coroner's inquest.

Ownership of report

Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1980 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in this final report are provided by, and owned by, the Commission.

The roll-over site

Contents

Figures

Abbreviations

Commission	Transport Accident Investigation Commission
km	kilometre(s)
SPAD	signal passed at danger (stop)

Glossary

Crossover	a track that provides a connection, using two sets of points, between two parallel tracks
North Auckland Line	a track system that runs from the 0.00 kilometre (km) site at Westfield to the 280.76 km site at Otiria in Northland
route indicator	an additional feature on a signal that provides supplementary information to a train driver of the path set beyond the signal concerned (see Figure 1)

Figure 1
A route indicator

train control	KiwiRail's national train control centre located in Wellington. Train control is responsible for authorising and tracking train movements on the network
Transdev	Transdev Auckland Limited, the contracted operator of the rail passenger business in Auckland

Westfield Crossover — the No.1570A and No.1570B crossover points at the north end of Westfield used to divert trains between the Down and Up Main lines (see Figure 2)

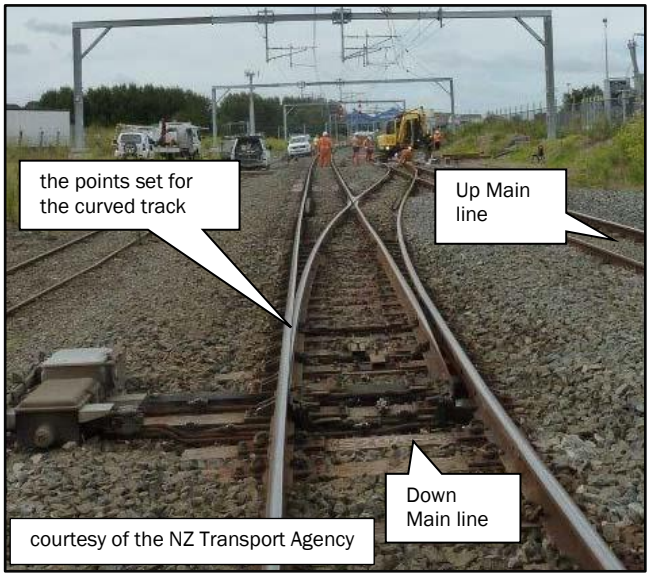
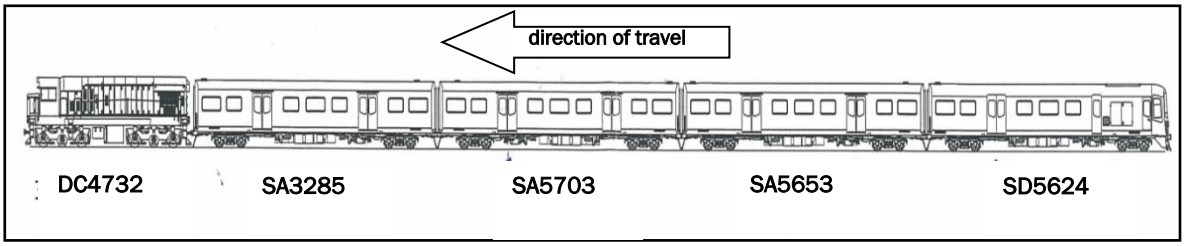


Figure 2
The Westfield crossover points

Data summary

Vehicle particulars:

Train type and number	push-pull Train 5153 scheduled to not convey passengers
Train origin/destination	Waitakere-Otahuhu, a distance of 38.2 kilometres (km)
Train consist	a DC class diesel-electric locomotive hauling four passenger carriages as shown below. The train was 96.6 metres long and weighed 210 tonnes



Train owner	Auckland Transport, a council-controlled organisation of the Auckland Council established under section 38 of the Local Government (Auckland Council) Act 2009
Licensed train operator	Transdev Auckland Limited (Transdev)
Maximum authorised train speed	90 km per hour
Passenger capacity	217 seated 295 fully laden (seated and standing)

Roll-over details:

Date and time	2 March 2014 at 0147 (New Zealand daylight saving time)
Location	0.35 km site, North Auckland Line, Westfield in South Auckland
Maximum authorised line speed	80 km per hour
Persons involved	a train driver in locomotive DC4732 and a train manager in carriage SD5624 at the rear of the train
Injuries	minor
Damage	major to train and rail infrastructure

1. Executive summary

1.1. In the early hours of 2 March 2014, a diesel-hauled, four-carriage passenger train had completed passenger operations for the night and was returning empty from Waitakere for overnight stabling in the yard in Otahuhu, near Westfield. There were the train driver and one train manager on board.

1.2. At 0142 a train controller in KiwiRail's national train control centre located in Wellington selected a path at the Westfield points ahead of the train to cross it from the Down Main line on which it was travelling to the adjacent Up Main line. He did this in order to co-ordinate several other empty passenger trains that were also returning to the Otahuhu yard for overnight stabling.

1.3. At the time the path was selected, the train was still about three kilometres from the first of three trackside signals and one route indicator, which indicated that the train was to be routed through a slow-speed crossover[1]. However, the train driver did not slow his train in compliance with the signals and route indicator.

1.4. The locomotive derailed and rolled on to its side as it travelled through the crossover at 71 kilometres per hour, 46 kilometres per hour faster than the maximum allowable speed. The leading two passenger carriages derailed but remained upright. The trailing two passenger carriages remained on the track. The train driver and train manager received minor injuries.

1.5. The Transport Accident Investigation Commission (Commission) found that the train driver's performance was possibly affected by his being tired at the end of a nine-hour shift in the early hours of the morning, but fatigue was unlikely to have been a factor.

1.6. The Commission identified two safety issues:

- there was no defence in the system to prevent an accident if a train driver did not react correctly to signals and route indicators
- KiwiRail's current policy and procedures regarding information that train controllers should give to train drivers about the routes set for their trains and other factors that are likely to affect the trains' progress are unclear and not consistent with protocols for good communication and crew resource management.

1.7. The Commission has an open recommendation to the Chief Executive of the NZ Transport Agency to develop a national standard for rail participants that deals with the protocols for good communication and crew resource management. The Commission is recommending that KiwiRail provide guidance to train controllers on the practice of passing to train drivers additional information about route setting or any other unusual factors that are likely to affect the progress of or the manner in which they drive their trains.

1.8. The key lesson learnt from the inquiry into this occurrence was that:

- train drivers should always remain vigilant and comply with the trackside signals. They should always be aware that the paths set for their trains can be altered unexpectedly and may not follow the usual paths.

[1] A track that provides a connection, using two sets of points, between two parallel tracks.

2. Conduct of the inquiry

2.1. On 2 March 2014 KiwiRail notified the Transport Accident Investigation Commission (Commission) of the accident under section 13(4) of the Railways Act 2005. The Commission opened an inquiry that same day under section 13(1) of the Transport Accident Investigation Commission Act 1990 to determine the circumstances and causes of the accident.

2.2. An investigator travelled to the site on 3 March 2014. He conducted a site investigation and obtained information from KiwiRail's signalling system. The investigator interviewed the Transdev train driver and the train manager the next day. He also travelled in the cab of a southbound passenger train from Britomart to Westfield via Penrose in daylight conditions to familiarise himself with the various trackside signals preceding the accident site.

2.3. The train event recorder was downloaded and the data used for the inquiry.

2.4. The Commission also obtained and reviewed a number of records and documents from Transdev and KiwiRail, including:

- training and personnel records for the train driver from when he was recruited by KiwiRail in January 2012 until his transfer to Transdev on 1 January 2014
- the train driver's personnel records, and his recent rosters and hours worked while working for Transdev until the date of the accident
- recent mechanical examinations of, and faults reported on, the locomotive
- train control signalling and voice recording systems
- the rail industry policies and procedures relating to the training, monitoring and assessment of the route knowledge of train drivers
- records of any sighting issues or faults reported for the three signals and one route indicator between Penrose and Westfield
- historic track geometry information and train movement information for the area.

2.5. On 6 May 2014, and after the track and signalling system had been restored to normal working order, the investigator travelled in the cab of an empty southbound passenger train from Britomart to Westfield via Penrose at night, with the path signalled as it was on the morning of the accident. He did this to familiarise himself with the aspects of three signals and one route indicator in night-time conditions.

2.6. On 10 December 2014 the Commission approved a draft final report for distribution to interested persons for comment.

2.7. On 25 February 2015 the Commission considered submissions received from Auckland Transport, Transdev, the NZ Transport Agency and KiwiRail and made changes to the report where appropriate. The Commission approved the final report for publication on the same day.

3. Factual information

3.1. Narrative

3.1.1. On 2 March 2014 at 0147, the locomotive of an empty Transdev[2] passenger train (the train) derailed and rolled on to its side while travelling at a speed in excess of that authorised for the crossover points at Westfield (the Westfield crossover points shown in Figure 2).

3.1.2. The train had completed passenger operations for the night at Waitakere station (west Auckland) and was scheduled to depart Waitakere at 0122 as an empty train to Otahuhu (south Auckland), where it was to be stabled for the night. The train consisted of a diesel locomotive hauling four passenger carriages. A train driver was in the locomotive and a train manager was riding in the rear carriage. There were no passengers on board. The train left Waitakere station early at 0111.

3.1.3. Trains on the Auckland rail network are controlled by train controllers working in the national train control centre (train control) in Wellington.

3.1.4. At 0139 the train passed through the crossover points at Newmarket at a speed less than the authorised 40 kilometres (km) per hour[3].

3.1.5. At 0142 the train controller selected a path ahead of the train to cross it from the Down Main line on which it was travelling to the adjacent Up Main line, then on to the Otahuhu train stabling area. The train was about 3 km from the first signal at Penrose when the signals were changed to indicate the path through the Westfield crossover points (see Figure 3). The controller made the change in order to co-ordinate several trains that were also returning to the Otahuhu train stabling area.

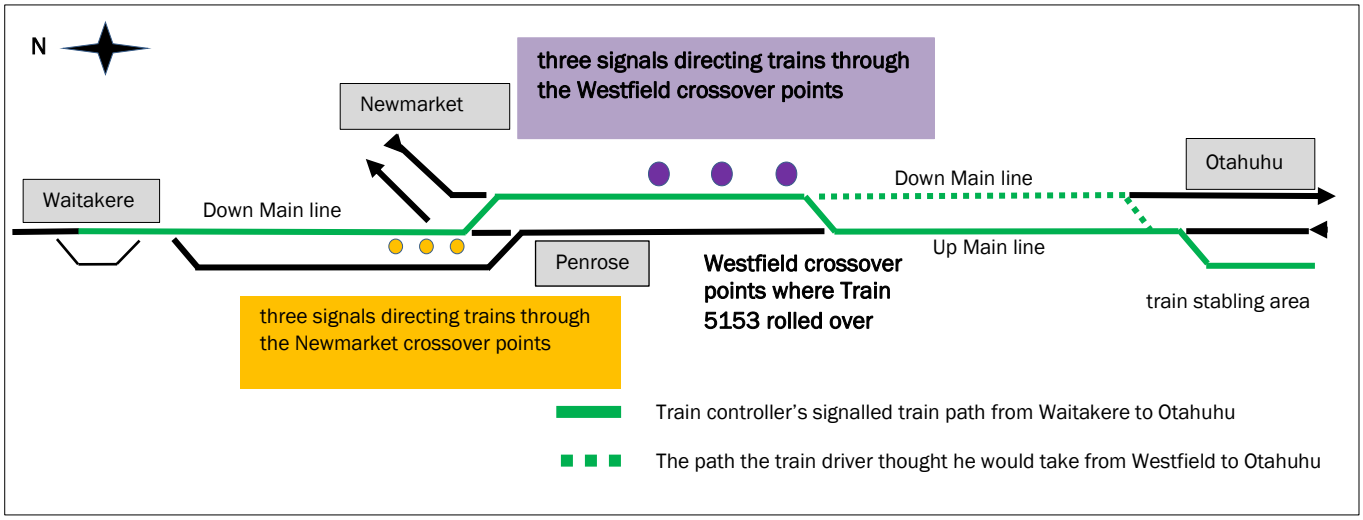


Figure 3
The path of Train 5153 from Waitakere to Otahuhu (not to scale)

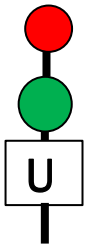
3.1.6. Principally, the "aspect" of trackside signals indicates to train drivers the speeds at which their trains are permitted to travel. Additionally, the signals can indicate diverging paths through sets of crossover points if they have been set for the trains. The signals are arranged in groupings of red/yellow/green lights in different display combinations, either vertically or slightly offset. The various aspects inform train drivers to proceed normally, proceed with caution, or stop. A green or yellow colour display in the bottom unit always indicates that the path ahead is set to diverge from the current track at a crossover.

[2] The contracted operator of the rail passenger business in Auckland.
[3] Information from the train event recorder was used to establish the timeline of events and the actions taken by the train driver.

3.1.7. The crossover points between the Down and Up main lines at Westfield had a permanent 25 km per hour speed restriction due to the tight radius curves that trains had to negotiate. The default setting for any crossover was 25 km per hour unless a higher speed was indicated at the final signal. When the train controller selected the new path, the aspects of the three signals preceding the Westfield crossover points changed to an increasing level of warning for the train driver that the path ahead was set to cross to another line. The sequence of aspects shown by all three signals approaching Westfield was identical to those with which the driver had complied when approaching Newmarket about eight minutes earlier.

3.1.8. Table 1 shows the signal aspects before the Westfield crossover, and the time and at what speed they were passed as the train approached (data sourced from the signalling system and the train event recorder).

Table 1: Signal displays and the time and at what speed they were passed as the train approached the Westfield crossover

Time	Recorded signal display and rule definition	Signal meaning	Maximum allowable speed	Recorded speed at time of passing signal
0145:11	First signal at Penrose  Flashing yellow over green providing an "advanced caution to medium speed" warning	First alert of the crossover path 2,100 metres ahead	80 km per hour	47 km per hour
0146:10	Second signal between Penrose and Westfield  Steady yellow over green providing a "reduce to medium speed" warning	Second alert of the crossover path 1,200 metres ahead	80 km per hour	69 km per hour
0146:59	Third signal/route indicator at Westfield  Red over green with route indicator displaying U for Up Main providing a "medium speed 25 km per hour speed" warning	Absolute alert that the path was set to cross over to the Up Main line 260 metres ahead	25 km per hour	71 km per hour

3.1.9. The train driver made a full service brake application moments after passing the third signal, but it was too late to slow the train before reaching the Westfield points. The driver commented that he made this brake application to slow the train to 40 km per hour to comply with a permanent speed restriction over the Westfield Junction points ahead.

3.1.10. At 0147:07, eight seconds after passing the third signal, the train entered the curved track at the crossover at a speed of 71 km per hour. The locomotive rolled over on to its right-hand side and slid on its side for 94 metres (refer the figure on page iv). The first two carriages derailed but remained upright. The two rear carriages remained upright and on the track.

3.1.11. The train driver braced himself when he realised that the locomotive was going to roll over. After the train had come to rest he extracted himself from the cab and walked to the rear of the train to check on the train manager. The train driver and train manager both suffered minor injuries.

3.1.12. The airbrake couplings pulled apart, which released all the air pressure from the train's brake system when the locomotive rolled over. An alert is automatically sent to train control when this happens. The train controller also received a radio call from the train driver reporting the accident. The train controller called the emergency services. The train driver and train manager were taken by ambulance to a nearby hospital where they were examined, treated and discharged.

3.2. Personnel information

3.2.1. KiwiRail recruited the train driver in January 2012. He underwent about five months' initial theory and practical training and began his prescribed practical training period on the push-pull passenger trains in July 2012. KiwiRail approved the train driver for solo operations on 17 October 2013[4].

3.2.2. The train driver transferred from KiwiRail to Transdev on 1 January 2014 as part of a reorganisation that saw the management responsibility for all Auckland metro train drivers move to Transdev on that date.

3.2.3. On 7 January 2014 the train driver had an operating irregularity where he passed a signal at stop (signal passed at danger, or "SPAD") after he was distracted by a group of intoxicated persons on a station platform as his train was departing.

3.2.4. The train driver underwent eleven safety assessments between 16 January and 28 February 2014. No major issues with his driving standard were reported.

3.2.5. While in hospital after the accident the train driver underwent drug and alcohol testing in accordance with Transdev's policy and procedures. The test results were negative for all performance-impairing substances.

[4] The train driver was off work for 11 weeks during this period as a result of a workplace accident.

4. Analysis

4.1. Introduction

4.1.1. According to KiwiRail records, during the week leading up to this accident five passenger trains were directed through the Westfield crossover. One of these was another empty passenger train only seven minutes ahead of the train involved in this accident. The drivers of those five trains responded correctly to the same signal aspects, but the driver of the accident train did not. The accident caused significant damage to the train and track, and had potential to cause serious injuries.

4.1.2. Tests carried out by KiwiRail signalling engineers showed that the integrated signalling and points system at Westfield was working correctly prior to the accident. The signalling system for the Auckland rail network had been substantially redesigned as part of the electrification project. The signals preceding the Westfield crossover had been in place and operating for 31 months before the accident. Records revealed no reported instances of mechanical failure with the signalling system in the area and no reported SPAD incidents. There were also no reports from train drivers of signal sighting issues.

4.1.3. Servicing and maintenance records showed that the train's braking system was compliant with KiwiRail's mechanical code conditions at the time of the accident. The train driver reported no issues with the performance of his train.

4.1.4. There was accordingly no evidence or suggestion that issues with the train or the rail infrastructure contributed to the accident.

4.1.5. The following analysis discusses possible reasons for the train driver not complying with the signals that indicated his train was being directed through the Westfield crossover. It also discusses the lack of system defences against an accident occurring if a train driver makes an error in interpreting trackside signals.

Train driver actions

4.1.6. The train driver had received his initial training during a 21-month period. All his practical training was conducted on the Auckland metro network and only on the push-pull train type. His training record was unremarkable, and other than one operating irregularity (SPAD), his performance up until the time of the accident was also unremarkable. He was familiar with the various main lines around the Auckland rail network, and was aware that the Up and Down Main lines were bi-directional[5], meaning that his train could be signalled along either line in either direction at any location where crossover points were installed.

4.1.7. The train driver said he braked the train in readiness for the approaching permanent speed restriction, and only five seconds before his train entered the crossover points. Transdev said that it was normal practice for train drivers to make such a brake application in this area because of the permanent 40 km per hour speed restriction that started about 450 metres ahead.

4.1.8. There are several reasons to consider for the train driver not responding to the three signals and one route indicator, of which distraction is an obvious one. However, he was adamant that he was not undertaking any other task and that there were no distracting influences at the time. Closed-circuit television footage of the train passing stations between Waitakere and Penrose showed that no-one else was in the locomotive cab with the train driver at those times. Cell phone records showed that the driver did not make or answer any calls, nor did he send or receive any text messages during this period.

4.1.9. The Commission considered whether fatigue was a factor. However, the train driver's hours of duty during the preceding four fortnights were unremarkable. He had five consecutive days off

[5] Used to allow trains to run in either direction over the same section of track subject to built-in safety systems that prevent collisions.

duty between 22 and 26 February 2014. He worked two evening shifts (1700 to 0130) on 27 and 28 February 2014, and was on his third evening shift when the accident occurred. He was due to finish at 0140. However, at the start of that shift he agreed to a request that he extend the shift to 0250. The train driver reported that he had been fresh and fit for duty at the beginning of that third evening shift. Based on the train driver's roster and his comments, it is unlikely that fatigue was a factor in the accident.

4.1.10. During the nine-hour shift the train driver spent six hours and 40 minutes driving trains, leaving him two hours and 20 minutes for breaks. The train driver said that this had allowed him ample time to eat and rest.

4.1.11. The end of the shift and the time of the accident occurred during a period when a person's natural circadian rhythm is at its lowest[6]. The train driver said that he was feeling tired at the end of the almost-nine-hour shift and was looking forward to getting home.

4.1.12. The locomotive's event recorder showed that throughout the 34-minute journey from Waitakere to Penrose the train did not exceed the maximum authorised speed. The train speed between Penrose and Westfield was maintained close to the maximum authorised, except when the train was slowed to a temporary limit of 40 km per hour for a short section of track under repair at Penrose.

4.1.13. A review of the locomotive's vigilance system[7] showed that the train driver's response times ranged between three and four seconds throughout the journey from Waitakere to Westfield. His slowest response was six seconds, which was less than that which would have caused the system to generate an audible alarm in the cab.

4.1.14. The train driver said that he had assumed that his train would be directed back to the Otahuhu yard via a path that he was used to, which was through the crossover farther along the Down Main line at Otahuhu. Although he acknowledged that using the Westfield crossover was a legitimate option available to the train controller, he had not been directed that way during the 20 months he had been driving.

4.1.15. It is likely that the train driver developed a mind-set that his train would be directed along the usual (to him) path and would take the crossover from the Down Main line at Otahuhu. As a consequence he either did not look at, or saw but did not comprehend the significance of, the three preceding signals and one route indicator that were telling him that his train was about to take the Westfield crossover instead. The accident occurred during early morning when human performance is typically at its lowest and when the driver was nearing the end of a nine-hour shift. These two factors are likely to have adversely affected the driver's performance.

4.1.16. Both Transdev and KiwiRail have embarked on separate projects to increase the awareness of signalling unusual movements for their train drivers (refer paragraphs 6.3.1 and 6.3.2 in the "Safety actions" section). The implementation of the bi-directional signalling system now means that trains can be signalled to the opposing track at any of the many crossover points on the Auckland metro network, without the need to impose manual wrong-line-running procedures.

[6] The time in the natural body clock when performance is at its lowest and the drive for sleep is at its highest.
[7] A system that monitors how often a driver manipulates the brake and throttle controls. If a period of inactivity is detected the system generates an alert in the cab that the driver must acknowledge. If they do not acknowledge the alarm in time, the train will automatically stop and train control will be alerted.

Findings

1. The locomotive derailed and rolled over because it entered the Westfield crossover points travelling at 46 km per hour over the maximum permitted speed.

2. The train driver did not slow his train to negotiate the Westfield crossover because he assumed that his train would be taking the usual route through the next crossover instead and did not therefore pay attention to the trackside signals that were warning him to slow his train.

3. The accident occurred during early morning when human performance is typically at its lowest and when the driver was nearing the end of a nine-hour shift. These two factors are likely to have adversely affected the driver's performance.

4.2. Single point of failure

Safety issue: ***There was no defence in the system to prevent an accident if a train driver did not react correctly to signals and route indicators.***

4.2.1. At the time of this accident the safe passage of the push-pull trains on the Auckland rail network relied totally on train drivers seeing, interpreting and responding accordingly to the various trackside signals.

4.2.2. Humans are prone to making errors. Accident statistics show that human error features in a high percentage of accidents in any mode of transport. Therefore a transport system that relies solely on a single person's performance to prevent accidents will be at considerable risk.

Positive train control

4.2.3. At the time of the accident, as part of the electrification and re-signalling of the Auckland metropolitan rail network, a form of automatic train protection was also being installed (known as the European Train Control System). With this system a train interacts with signals and trackside sensors that are passed. The train is automatically slowed to the correct speed or, if necessary, brought to a stop if the driver does not take the appropriate action for a signal.

4.2.4. The system is not intended to replace the driver's responsibility to observe and act on all trackside signals. It is purely a defence to mitigate the risk of human error.

4.2.5. The train protection system requires modifications to the trains and to the signalling system. New electric passenger trains currently being commissioned are fitted with the system, and modifications to the signalling system were completed after the accident. Had such a system been installed and operating on the diesel-operated push-pull train involved in this accident, and been fully commissioned to the signalling system in the Westfield area at the time, the train would have been automatically slowed to the appropriate speed before the crossover and the accident would have been prevented.

4.2.6. However, the push-pull trains have not been fitted with the system because they are due to be phased out by August 2015 with the introduction of the new electric trains. Transdev and Auckland Transport considered the estimated $11 million to retrofit the push-pull trains with the system equipment to be not cost effective. This was a reasonable decision.

4.3. Additional advice from train controllers

Safety issue: ***KiwiRail's current policy and procedures regarding information that train controllers should give to train drivers about the routes set for their trains and other factors that are likely to affect the trains' progress are unclear and not consistent with protocols for good communication and crew resource management.***

4.3.1. If the driver had had a mind-set that his train would cross over at Otahuhu, that mind-set could have been broken if the train controller had offered the information that he had selected the Westfield crossover.

4.3.2. The train driver said that he recalled an occasion weeks earlier when he had been told by a train controller that his path through Otahuhu station would be different from that normally taken. After the accident the driver asked why he had not received a similar radio call on this occasion.

4.3.3. The Commission had raised the matter of train controllers providing additional advice with Tranz Rail (a predecessor to KiwiRail) during its investigations of two high-speed roll-overs during 1993 and 1997. The two roll-overs had involved freight trains at the same set of crossover points in Te Kauwhata (north Waikato).

4.3.4. Tranz Rail had advised the Commission on 12 August 1997 that "any dilution of the signalling system by train drivers relying on prior radio calls from train controllers was not acceptable".

4.3.5. In response to this latest accident KiwiRail said that it had not changed that philosophy, and added that there was no written documentation that required train controllers to make such calls. KiwiRail acknowledged that such calls could be made with the best of intentions. Train controllers could make such calls, if time permitted, in sudden emergency situations.

4.3.6. The Commission had raised this subject again in its report on a wrong line running irregularity in 2011 (report 11-101). In that case the train controller's plan to hold one train at a location to give priority to another was relayed to the signallers involved, but no-one informed the respective train drivers because the KiwiRail rules did not require that. The report commented that only some of the six parties involved in the execution of the plan (the train controller, the two signallers, the person in charge of a work site and the drivers of the two trains) were informed of it.

4.3.7. The Commission recommended then that the Chief Executive of the NZ Transport Agency:

> *require the executive of the Rail System Standard to develop standards to ensure that all rail participants meet a consistently high level of crew resource management, and communication that includes the use of standard rail phraseology (recommendation 002/12).*

4.3.8. The Chief Executive of the NZ Transport Agency replied:

> *We intend to work closely with the National Rail System Standard (NRSS) Executive with an aim to implementing and closing out this recommendation as soon as practicable. The NZ Transport Agency sits on the NRSS Executive as an observer. We will consider a strategy for rail operators outside the NRSS coverage*.

4.3.9. The recommendation still has an open status. The circumstances of this latest accident provide further evidence that additional advice to train drivers about conditions that are likely to affect their trains can help to prevent accidents. Currently the KiwiRail policy on the issue is unclear. There are no procedures to guide train controllers on best practice, yet in its response to the Commission KiwiRail management said that there were times when such advice could be given "with the best of intentions" and that it "expects train controllers to make such calls, if time permitted, in a sudden emergency situation". The issue with that philosophy is that it is not necessarily the reason for a diversion that the train driver needs to know. The information will be useful to drivers regardless of the reason. It could prevent accidents such as this.

4.3.10. At the time of this accident there were a greater number of passenger trains operating on the Auckland network following a special entertainment event. One option that KiwiRail could have taken was to use the Daily Information Bulletin to warn all train drivers that their trains could take different paths from usual because of the greater number of trains on the network.

Findings

4. The rail system at the time of the accident had no defences in place to mitigate an accident occurring if a train driver did not react correctly to the trackside signals.

5. The train protection system that was being installed for the Auckland metropolitan rail network at the time of this accident will in future provide a defence against similar accidents involving all metropolitan passenger trains.

6. KiwiRail's current policy and procedures regarding information that train controllers should give to train drivers about paths and other factors that are likely to affect the trains' progress is unclear and not consistent with protocols for good communication and crew resource management.

5. Findings

5.1. The locomotive derailed and rolled over because it entered the Westfield crossover points travelling at 46 km per hour over the maximum permitted speed.

5.2. The train driver did not slow his train to negotiate the Westfield crossover because he assumed that his train would be taking the usual route through the next crossover instead and did not therefore pay attention to the trackside signals that were warning him to slow his train.

5.3. The accident occurred during early morning when human performance is typically at its lowest and when the driver was nearing the end of a nine-hour shift. These two factors are likely to have adversely affected the driver's performance.

5.4. The rail system at the time of the accident had no defences in place to mitigate an accident occurring if a train driver did not react correctly to the trackside signals.

5.5. The train protection system that was being installed for the Auckland metropolitan rail network at the time of this accident will in future provide a defence against similar accidents involving all metropolitan passenger trains.

5.6. KiwiRail's current policy and procedures regarding information that train controllers should give to train drivers about paths and other factors that are likely to affect the trains' progress is unclear and not consistent with protocols for good communication and crew resource management.

6. Safety actions

6.1. General

6.1.1. The Commission classifies safety actions by two types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation

(b) safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

6.2. Safety actions addressing safety issues identified during an inquiry

6.2.1. Transdev posted the following briefing to its operating staff soon after the accident:

SAFETY ALERT

EXPECT THE UNEXPECTED

Risk of incident due to unusual movements

An unusual movement is when normal scheduled train running has been altered potentially due to special events, major delays or other such unforeseen incidents on the network.

Resent history has shown that serious incidents such as SPAD's and derailments have occurred when there has been an unusual movement or a change in normal train running.

Understanding the risk

Failure to react correctly to a cautionary aspect, medium speed aspects or route indicators can result in such significant incidents.

Examples of errors leading to an incident when there has been a change in normal train running:

- Lack of detailed route knowledge when encountering infrequently made movements.
- Over reliance on past experience – not checking the route and assuming the correct signal has been cleared.
- Assuming that a signal will step up to a less restrictive aspect.
- Assuming that a route will set as it always been.
- Not taking positive action to reduce the train speed.
- Lack of concentration.

Minimising the risk

- ✓ Don't be misled by a proceed signal at a junction and start to relax, check the route indicator has been cleared and the indicator is the correct one for your route.
- ✓ Take positive action according to the operating conditions. This will involve planning ahead and may involve shutting off power, coasting or applying the brake.
- ✓ If you are unsure about the aspect you received in the previous signal or you become disorientated by fog, always apply the brakes and be prepared to stop at the next signal.
- ✓ Never 'chase' restrictive signal aspects. Hold back and allow the train in front to clear.
- ✓ Do not allow yourself to become distracted when receiving successive signals showing restrictive aspects.
- ✓ Concentrate on the job in hand – stopping at the red signal.
- ✓ If you are not sure whether the route is correct – check with the Train Controller or Signalperson first.

Remember, the best safe working system on a railway is an alert and cautious driver

transdev

6.3. Safety actions addressing other safety issues

6.3.1. On 18 June 2014 Transdev listed the following safety actions it had taken to address issues identified during its internal investigation:

- the development of a route risk assessment project that will include the following criteria:
    - characteristics of all routes on the Auckland metro network
    - specific and unusual activities that are likely to be encountered
    - general and specific route risks that will be encountered
    - locations where a higher level of situational awareness is required
- the introduction of non-technical skills training for train drivers and train managers by applying human factor and threat and error management principles in line with best practice that cover the following subjects:
    - error and violations
    - situation awareness
    - task prioritisation
    - risk triggered commentary driving
    - decision-making
    - teamwork
    - communication
    - self-management
    - risk management
    - emergency management
- a review of its professional train driver "A" observation procedures- train driver competence management system
- use the findings and lessons from the incident as a case study with a specific focus for train drivers on the need to stop and reassess when there has been a loss of or disconnect in their situational awareness.

6.3.2. On 30 January 2015 KiwiRail advised that it had taken the following safety actions:

- KiwiRail is presently working with a Driver Subject Matter Expert Group in an R&D project to help develop a Risk Triggered Commentary Driving procedure that is intended to include a stabilised approach procedure for non-ETCS trains. This work is based on international work in aviation and other rail domains (RSSB - UK), and is focused on providing an enhanced framework for improving LE [train driver] situational awareness and decision-making. Once this work has been trialled, it is intended to engage and consult with the wider rail industry.

7. Recommendations

7.1. General

7.1.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, one recommendation has been made to the Chief Executive of KiwiRail.

7.1.2. In the interest of transport safety it is important that this recommendation is implemented without delay to help prevent similar incidents or accidents occurring in the future.

7.2. Recommendation made during this inquiry

7.2.1. The train driver in this instance had several weeks earlier received a radio call about a divergent path to bypass a disabled passenger train at Otahuhu. However, on this occasion he did not receive a similar radio call warning him that his train was not going to follow the usual path.

The circumstances of this latest accident provide further evidence that additional advice to train drivers about conditions that are likely to affect their trains can help to prevent accidents.

Currently the KiwiRail policy on the issue is unclear, which can lead to uncertainty among train drivers and, as in this case, false expectations among drivers, causing them to not pay full attention to the trackside signals to which they should be driving.

*The Commission recommends that the **Chief Executive of KiwiRail** provide clear guidelines to train controllers on the practice of providing additional advice to train drivers on route setting or any other unusual factors that are likely to affect the progress of or the manner in which they drive their trains. (004/15)*

7.2.2. On 19 March 2015 KiwiRail replied in part as follows:

> KiwiRail's current safety system deals with the issue of train driver advice through prescribing by rule the occasions Train Control must advise train drivers about any changes to routes. The absence otherwise of a rule means advice is not intended to be provided.
>
> Advice to train drivers about a signalled route ahead is only intended to be given when there is a clear operational need (often not directly related to the signal itself) – such as a change in platform requiring a guard to operate different doors, or a locomotive engineer [train driver] crew change.
>
> KiwiRail's safety system only prescribes mandatory circumstances when Locomotive Engineers need to be advised of a change in signal. To reduce the chances of a false expectation of pre-emptive signal advice by Locomotive Engineers, the safety system will be amended (through training or other appropriate means) to state the circumstances for which advice is not intended to be given.

8. Key lesson

8.1. Train drivers should always remain vigilant and comply with the trackside signals. They should always be aware that the paths set for their trains can be altered unexpectedly and may not follow the usual paths.

9. References

GE Transportation Driver Manual for Auckland Transport dated 12 November 2013.

KiwiRail's pilot for Automatic Signalling Rules implemented on all lines north and east of Te Rapa on 8 May 2011.

KiwiRail's Rail Operating Code, Code Supplement CS 4.19, Operating Instructions for SA/SD Trains approved on 1 February 2014.

KiwiRail's Rail Operating Code, Section 4.0, Locomotive Engineer Training/Certification approved on 27 August 2012.

KiwiRail's Signal and Rail Operating rules approved on 26 July 2010.

KiwiRail's Signalling and Interlocking Arrangements diagram No.3110 for Westfield dated 28 February 2014, diagram No.3111 for Penrose dated 28 February 2014 and diagram No.3044 for Newmarket dated 4 May 2013.

Siemens Auckland EMU Drivers ETCS [European train control system] System Overview dated 25 January 2014.

Recent railway occurrence reports published by the Transport Accident Investigation Commission (most recent at top of list)

RO-2013-106	Track occupation irregularity, leading to near head-on collision, Otira-Arthur's Pass, 10 June 2013
RO-2012-102	Train control power failure, 26 April 2012
Interim Report RO-2014-103	Metropolitan passenger train, collision with stop block, Melling Station, Wellington, 27 May 2014
RO-2013-102	Passenger train travelled with doors open, Wingate - Taita, 28 March 2013
12-101	Load shift on Train 926D struck stationary, Train 845, Main South line, Rolleston, 6 April 2012
11-105	Freight Train 228 wrong-routed, into closed section of track Wiri Junction, South Auckland, 12 November 2011
RO-2013-108	Near collision between 2 metro passenger trains, Wellington, 9 September 2013
11-106	Hi-rail vehicle nearly struck by passenger train, Crown Road level crossing near Paerata, North Island Main Trunk, 28 November 2011
11-102	Track occupation irregularity, leading to near head-on collision, Staircase-Craigieburn, 13 April 2011
RO-2013-104	Urgent Recommendations: Derailment of metro passenger Train 8219, Wellington, 20 May 2013
11-103	Track workers nearly struck by passenger train, near Paekakariki, North Island Main Trunk, 25 August 2011
10-101	Wrong route setting, high-speed transit through turnout, near miss and SPAD (signal passed at danger), Tamaki, 13 August 2010
11-104	Freight Train 261 collision with bus, Beach Road level crossing, Paekakariki, 31 October 2011
10-102	Collision between 2 metro passenger trains, after one struck a landslide and derailed between Plimmerton and Pukerua Bay, North Island Main Trunk, 30 September 2010
07-102	(incorporating inquiry 07-111) freight train mainline derailments, various locations on the national network, from 6 March 2007 to 1 October 2009

Price $13.00

ISSN 1178-4164 (Print)
ISSN 1179-9102 (Online)