Report 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

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Final Report

Rail inquiry 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

Approved for publication: May 2012

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.

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Important notes

Nature of the final report

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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.

Source: mapsof.net

Location of accident

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Abbreviations

Ganz	Ganz Mavag
km	kilometre(s)
km/h	kilometre(s) per hour
m	metre(s)
mm	millimetre(s)
NIMT	North Island Main Trunk
regional council	Greater Wellington Regional Council
t	tonne(s)
UTC	universal co-ordinated time

Glossary

ganger	the person responsible for a group of track workers maintaining a defined section of track. The ganger carries out special inspections on their section of track under the direction of the area manager
essential feature	a structure or section of track that is considered to present a greater risk to operations than normal so is included on the "essential features list". The items listed are always checked when carrying out a special inspection required in a severe weather event
selcall	a selective call feature built into a radio network that suppresses the squelch function to prevent non-intended recipients on the same channel hearing a broadcast message. The selcall system is used to send a vehicle number and a status or alarm indication to train control

Data summary

Vehicle particulars

Train types and numbers:	Train 6250 consisted of passenger cars ET3010 leading, EM1010, ET3154 and EM1154. The train was 86 metres (m) long and had a tare weight of 144 tonnes (t) Train 6247 consisted of passenger cars EM1223 and ET3223. The train was 43 m long and had a tare weight of 72 t
Classification:	electric multiple units
Year of manufacture:	Built by Ganz Mavag (Ganz), Hungary, and entered service in 1982-1983
Operator:	Operated by Tranz Metro, a KiwiRail business unit.
Owner:	Ownership of the Wellington commuter rail fleet was transferred from KiwiRail to Greater Wellington Rail Limited on 1 July 2011

Date and time	30 September 2010 at 1503[1]
Location	about 26.9 kilometres (km) North Island Main Trunk (NIMT), between Plimmerton and Pukerua Bay
Persons involved	Train 6250 was carrying 44 passengers and 3 crew, Train 6247 was carrying 14 passengers and 3 crew
Injuries	minor injuries to 2 passengers
Damage	substantial damage to the passenger cars

[1] Times in this report are New Zealand Daylight Times (UTC + 13 hours) and are expressed in the 24-hour mode.

1. Executive summary

1.1 On Thursday 30 September 2010, Ganz passenger Train 6250 was travelling from Wellington to Paekakariki on the northbound main line with 44 passengers on board. It was raining heavily and had been for several hours. A landslide had come down from a cutting above the rail corridor and covered the northbound line with debris between Plimmerton and Pukerua Bay. The train was travelling at 60 kilometres per hour (km/h) when it rounded a curve and the driver saw the landslide. He made a full brake application but his train was still travelling at 59 km/h when it struck the landslide and derailed in the direction of the adjacent southbound main line.

1.2 Train 6247 was another Ganz passenger train travelling from Paekakariki to Wellington on the southbound main line with 14 passengers on board. The driver saw the other train strike the landslide and derail when his train was about 250 m away from it. He made a full-service brake application but his train was still travelling at 54 km/h when it struck the then stationary derailed train a glancing blow, stopping about 75 m past the point of impact. Train 6247 did not derail.

1.3 The driving compartments on both trains were on the right-hand sides and these absorbed most of the impact. Both drivers had predicted this and had left their driving compartments to escape injury and warn the passengers of the pending collision. The passenger compartments suffered broken windows and major structural damage. Nobody was seriously injured in the collision.

1.4 The landslide had occurred sometime after 2 other trains had passed the location, 28 minutes earlier.

1.5 MetService had issued a severe weather warning the day before, forecasting heavy rainfall for the Wellington area. The KiwiRail network control manager had received the warning and passed it on to the Wellington area manager, who had then passed it on to his gangers responsible for maintaining various sections of track within the area. Instead of the area manager deciding what to do, he left his gangers to decide whether to carry out any special track inspections or impose any speed restrictions for their respective sections of track.

1.6 No special track inspections were made in the area of the landslide and no speed restrictions were put in place. The Commission made findings that a special track inspection might have revealed signs that a landslide was about to occur and that had a speed restriction been put in place, the initial derailment might not have been as severe and the opposing train would highly likely have been able to stop before meeting the derailed train; in other words the collision would have been avoided.

1.7 The cutting where the landslide occurred was on an “essential features list” because of previous landslides that had occurred there. The slip site had been assessed by a KiwiRail geologist as part of a nationwide assessment of at-risk sites and had been identified as ranking 31 out of a list of 180 identified sites within the Wellington metro area. As such, the order of priority would not have seen remedial work at this site for at least another 2 years.

1.8 The rainfall at the time of the landslide was calculated to have been an event expected to occur once in 15 years and the total rainfall recorded for the month of September was the highest since recording at the site began in 1991.

1.9 The Commission made other findings about shortcomings in the design of the radio equipment on board the Ganz trains that meant train control was not automatically alerted to the accident when the drivers made emergency brake applications, and about the need to improve the crashworthiness of older trains that are going to be kept in service for any appreciable time.

1.10 Since this accident, KiwiRail's safety actions have been to establish a series of online rainfall monitoring sites within the Wellington rail network. An interim decision-making matrix has been developed to assist area managers and gangers to decide when to undertake special track inspections and impose speed restrictions.

1.11 The Commission made recommendations to address the safety issues of the crashworthiness of older trains and the fitting of modern radio equipment that will automatically alert train control when a train driver makes an emergency brake application.

1.12 The key lessons from this inquiry are:

- in order to undertake an adequate risk assessment there must be a clearly mapped out methodology that should be followed
- good, effective communication in any form is essential for preventing accidents occurring and essential for minimising the consequences if one does occur
- people with designated responsibility must exercise that responsibility or delegate to another person to ensure important decisions are made at the right time.

2. Conduct of the inquiry

2.1. On Thursday 30 September 2010 at about 1515, the NZ Transport Agency notified the Commission of the accident under section 13(4) of the Railways Act 2005. The Commission opened an inquiry under section 13(1) of the Transport Accident Investigation Commission Act 1990 to determine the circumstances and causes of the accident, and appointed an investigator in charge.

2.2. An investigation team was assembled and attended the accident site that afternoon while the recovery operation was still underway. Interviews were conducted with the train crews, the train controller, the network control manager, the on-site rail incident controller and KiwiRail Network[2]'s engineering geologist and area manager. On 12 October 2010 the investigators attended an incident debrief conducted by New Zealand Police.

2.3. Evidence was gathered from train control records, on-board data recorders, operational staff reports, KiwiRail operating procedures and rules, KiwiRail's internal accident investigation report, rainfall data provided by Greater Wellington Regional Council (the regional council) and Police communication records.

2.4. The Commissioners, executive management team and investigators attended a presentation by the KiwiRail investigation team on 20 October 2010.

2.5. On 18 April 2012 the Commission approved the draft final report 10-102 for circulation to interested persons for comment, who included train crews, other operating staff, KiwiRail and the regulator.

2.6. Submissions were received from KiwiRail, the NZ Transport Agency, Greater Wellington Rail Limited and KiwiRail's area manager. Those comments have been considered and included in the final report where appropriate.

2.7. On 31 May 2012 the Commission approved the final report for publication.

[2] KiwiRail Network was a business unit of KiwiRail that managed train operations and network maintenance, upgrades and infrastructure projects.

3. Factual information

3.1. Narrative

3.1.1. Tranz Metro is a business unit of KiwiRail and is responsible for operating the Wellington passenger commuter train fleet for the regional council. On 1 July 2011 ownership of the Wellington rail commuter fleet was transferred from KiwiRail to Greater Wellington Rail Limited, a business unit of the regional council.

3.1.2. On Thursday 30 September 2010, Train 6250 was a Tranz Metro passenger service scheduled to travel from Wellington to Paekakariki on the NIMT. The 4-car train departed from Wellington at 1430 with a crew of 3.

3.1.3. The journey from Wellington to Plimmerton was uneventful, although it was raining heavily. The train departed from Plimmerton Station on time at 1500 bound for Pukerua Bay with 44 passengers on board.

3.1.4. At about 1503 the train was climbing a 1 in 57 grade through a right-hand curve that then led into a left-hand curve. Because of the track geometry, train speeds on the curves were restricted to a maximum of 60 km/h. The train was travelling at about 60 km/h as it entered the left-hand curve, and was still under power.

3.1.5. When Train 6250 rounded the curve the driver saw that the track about 70 m ahead was covered with landslide debris.

3.1.6. At 1503:17 the driver made a full-service brake application when the train was travelling at 64 km/h about 54 m from the debris. Two seconds later, he moved the throttle to the emergency brake position.

3.1.7. At 1503:20, the train was travelling at 59 km/h when it ran into the landslide. The driver felt the front of the train lift, plough through the debris and derail to the right, towards the parallel Down Main line. Before the train stopped, the driver saw the headlight of a train approaching on the adjacent track and he sensed that a collision was inevitable. He jumped out of the driving seat and ran back into the passenger compartment and told passengers to get into the brace position because there was going to be a collision. The leading end of Train 6250 stopped 53 m past the landslide.

3.1.8. The other train was passenger Train 6247. When it was about 230 m away, the driver saw Train 6250 hit the slip, lift up and slew towards his track. At 1503:21 he made a full-service brake application and 2 seconds later he moved the throttle into the emergency brake position. The driver of Train 6247 also realised that a collision was imminent, so he vacated his driving compartment, instructed the train manager and his assistant to leave the dog box[3], and followed them into the passenger car. The driver reached the first set of doors and held on to the vertical support bars. He repeatedly warned the passengers to hold on because the train was going to crash.

3.1.9. At 1503:30 Train 6247 was travelling at 54 km/h when it struck the then stationary Train 6250 (see Figure 1).

3.1.10. After the collision, the driver and passenger operator of Train 6250 walked through the train and asked the passengers whether they had suffered any injury. After being told that there were no serious injuries, the crew brought all passengers together in the rear passenger car. The crew told the passengers that the overhead line was considered to be live and they were to wait on the train until the overhead line had been isolated.

[3] The dog box is a colloquial term for the storage compartment on the left-hand side of the driving position on the ET passenger car.

Figure 1
Driving compartment of derailed Train 6250 after being struck by Train 6247

3.1.11. Train 6247 was a 2-car set and had a crew of 3 and 14 passengers on board. It did not derail during the collision sequence. The train stopped about 74 m past the point of impact (see Figure 2). After the collision, the pantograph on EM1223 automatically retracted from the overhead contact wire. The back-up battery system was damaged in the collision, so the train was left with no electrical power.

3.1.12. As soon as Train 6247 came to a stop, the driver and the train manager asked the passengers whether any of them had been hurt during the collision. After determining that none of the passengers had suffered any serious injury, they were directed to the Wellington end of the train where they waited to be assessed by ambulance staff.

Figure 2
Driving compartment of Train 6247 after impact

3.2. Emergency response

3.2.1. KiwiRail's Joint Crisis Management Plan contained the company response to any crisis that affected the viability and survival of its assets. The Plan was aligned to the National Civil Defence Emergency Management Plan. Any incident management team controller could request the chief executive to activate the Plan. While activation of the Plan was considered, it was not requested on this occasion. Instead, KiwiRail's response to the accident was managed and co-ordinated locally under the respective Tranz Metro and KiwiRail Network Incident Management Plans.

3.2.2. At 15:05:05 (95 seconds after impact), the train manager from Train 6247 used his mobile phone to call the Wellington train controller and told him that his train had collided with a northbound train. He identified the location of the 2 trains, confirmed that the overhead traction lines appeared to be intact and reported that no passengers on his train had suffered serious injuries. A few seconds later, the driver from Train 6250 made a radio call to train control confirming that his train had hit a slip, derailed and then been struck by a southbound train. Immediately after receiving the radio call, the train controller informed the network control manager of the accident.

3.2.3. By 1507 the passenger operator from Train 6247 had telephoned the Tranz Metro customer services manager and the central region communications emergency centre to report the accident. He identified the location as being near Taupo Swamp and that the recommended vehicle access to the accident site was from the Airlie Road over bridge, north of the accident site. He confirmed that there was a combined total of about 50 passengers on the 2 trains, reported that there were no serious injuries and requested immediate assistance from all emergency services.

3.2.4. At 1508 the train controller stopped all other trains entering the area.

3.2.5. The first Police officer arrived at the Airlie Road over bridge at about 1518. Fire appliances and ambulances were waiting for the access gate to the maintenance service track to be unlocked so that they could drive to the disabled trains. Two Police officers and an ambulance officer travelled in one vehicle from Airlie Road to the accident site. When they reached the accident site, they were met by Fire Service personnel from Plimmerton and ambulance staff who had gained access from the southern end of the access road.

3.2.6. The Fire Service personnel had conducted an initial site hazard assessment while they were travelling to the accident site. They had become aware that there were double train tracks and were aware of the potential danger posed by overhead traction lines.

3.2.7. The train crews had conducted an initial triage assessment and had assembled all passengers in the southern passenger car on each train before emergency staff arrived. Emergency timber ladders, carried on the trains, were already in position to facilitate people getting on and off the trains.

3.2.8. The ambulance medics made a triage check of all passengers on both trains.

3.2.9. The senior Police officer who initially took charge of the on-site emergency response was approached by a KiwiRail Network employee, who advised that the overhead traction system was still to be treated as live and that traction line personnel were already on their way to make the overhead power system safe.

3.2.10. The passengers were briefed by the person in charge of the accident site about the intended rescue and evacuation plan, and told to remain where they were assembled until rescue vehicles arrived. Passengers were kept updated as the rescue effort developed.

3.2.11. At about 1548 the Police area commander arrived at the accident scene and received a briefing before taking over the role of incident controller. He soon relocated the incident command post from Airlie Road to the Plimmerton Domain at the southern approach to the accident site. A KiwiRail manager was assigned to the command post to provide a KiwiRail interface with the Police and the other emergency services, as all parties operated on separate radio frequencies.

3.2.12. The first vehicle used to evacuate passengers arrived at the maintenance access road off Airlie Road at 1545. The evacuation began about an hour later using Police vans. Passengers were first taken to the command post for further medical assessments, after which they were offered counselling from Victim Support.

3.2.13. At 1711, once all the passengers and crew had been evacuated safely, the incident controller handed control of the accident site back to KiwiRail.

3.2.14. By 2350 Train 6247 had been recovered and the Down Main line between Pukerua Bay and Plimmerton had been re-opened. The Up Main line between Plimmerton and Pukerua Bay was declared safe for traffic at reduced speed by 1200 the next day.

3.3. Severe weather actions

3.3.1. The process for managing severe weather warnings was described in KiwiRail's Rail Operating Rules and Procedures, Section 1, Rule 6 (b). The general process is described below.

Actions upon receipt of a severe weather warning message

3.3.2. A severe weather event starts when MetService issues a severe weather warning to subscribers to its service. This message is received by the national train control centre in Wellington and assessed by the duty network control manager. In relation to this accident, the initial message was treated as a level 1[4] severe weather warning. The network control manager is required to start and maintain an event log.

[4] A level 1 severe weather warning arises when the forecast weather conditions may result in damage to the track that could result in a significant safety risk for drivers, maintenance personnel or the public.

3.3.3. The network control manager directs the message to the relevant rail track areas and train control desks. The essential content of the message is then rewritten as a text message and sent to standard severe-weather-warning recipients via a web-based text distribution message system using a pre-programmed distribution list.

3.3.4. The severe weather warning message is entered into the speed restriction and condition notification, which is distributed automatically to all persons affected. For Tranz Metro, the advice is normally made available from a printer within the operations office and passed on. However, on this occasion no such notification was available because of a printer software issue.

3.3.5. The network control manager also contacts the area managers responsible for the affected track sections to inform them that a severe weather warning has been issued. This call (date and time) is recorded on a Severe Weather Warning Aid Memoire.

3.3.6. The train controllers responsible for the affected track lengths are then advised by the network control manager and mark the train control diagram with blue highlighter for the period of the warning.

Area manager's assessment

3.3.7. After receiving notification of a severe weather warning, each area manager assesses the risk to operations within their area. There was no guidance in the Rules on how to make this assessment, but KiwiRail's Emergency Procedures required that the level be raised to level 2[5] Adverse should any of the following conditions exist:

- reports from the field indicate an immediate escalation was required
- the line is blocked due to an incident.

3.3.8. The area manager should normally advise what speed restriction to apply, and whether any additional special inspections are required before the next and following trains enter the affected section of track. The area manager did not do so on this occasion, but instead left those decisions for his gangers to make. It was the area manager's responsibility to contact the network control manager if the response level was to be raised from level 1 to level 2.

This severe weather warning

3.3.9. At 1016 on the day before the slip occurred (Wednesday 29 September), MetService sent the network control centre a severe weather warning by facsimile. The warning had been issued by MetService at 0952 and included a forecast of 70 millimetres (mm) to 120 mm of rain falling about the hills of Hutt Valley and Kapiti Coast from Thursday morning until early Friday. At 1625 the network control manager sent the severe weather warning to the respective area managers, including the Wellington area manager. Within minutes of receiving the warning the Wellington area manager redirected the message to all his gangers.

3.3.10. Later the same day at 2058, the network control centre received an updated severe weather warning from MetService issued at 2024, forecasting 70 mm to 100 mm of rain falling through to late Thursday on the hills of Hutt Valley and Kapiti Coast. The updated severe weather warning was not forwarded to the area manager.

3.3.11. A special condition "severe weather warning" was added to the temporary speed restriction documentation report effective from 2100 on 29 September, warning of heavy rain on the Wairarapa Line and on the NIMT between Wellington and Taihape. The KiwiRail computerised message distribution system was supposed to have sent this updated report to all driver "book-on" depots in Wellington, Masterton and Palmerston North. However, the auto-print function within the computer system failed to send the print message to the printer located in the Tranz Metro operations office, so no Tranz Metro drivers were issued with the updated

[5] A level 2 adverse weather condition is an escalation of the level 1 severe weather condition made by the area manager after assessing reports from the field. Upon escalation, all trains are stopped within the affected area until a special track inspection has been carried out and a safe running speed determined.

speed restriction and condition report that made reference to the active severe weather warning.

3.3.12. The computer error was later traced to a recent software upgrade where the system did not recognise the start time for the severe weather warning because it was retrospective. The system had been configured to only send and print information for future events and the issue time for the severe weather warning was in the past.

3.3.13. On Thursday 30 September at 0841, the network control centre received a further updated severe weather warning from MetService issued at 0810 forecasting 50 mm to 90 mm of rain falling on the hills of Wellington and Kapiti Coast from Thursday morning through to Friday. The active KiwiRail heavy rain warning was not updated on receipt of the latest MetService warning.

3.3.14. At the time of the landslide, there were no current severe-weather-related temporary speed restrictions posted within the Wellington metro area, and no special track inspections had been carried out between Plimmerton and Pukerua Bay.

3.4. Rainfall information

3.4.1. The regional council had a rainfall monitoring site near Taupo Stream at Whenua Tapu Cemetery, about a kilometre north of the landslide (see Figure 3).

3.4.2. The major rainfall event that preceded the slip started at about 1900 on 29 September and ended at 0200 on 1 October. During the 31 hours, there were 103 mm of rainfall recorded at the Whenua Tapu Cemetery monitoring site. The landslide occurred after 20 hours of rainfall, by which time 80 mm of rain had been recorded.

3.4.3. The regional council calculated the return period for the one-day rainfall on 30 September to be equivalent to an event expected to occur once in 15 years.

3.4.4. A cumulative total of 209.5 mm of rainfall was recorded by the regional council during the month of September. This total was the highest September rainfall recorded since the site was commissioned in 1991. During those 20 years the average September rainfall recorded was 94.2 mm. A comparison of cumulative rainfall data recorded at Whenua Tapu Cemetery between 1 April and 30 September 2010 confirmed that 2010 had the second-wettest winter rainfall on record, with rainfall exceeding the median for the period by almost 30%.

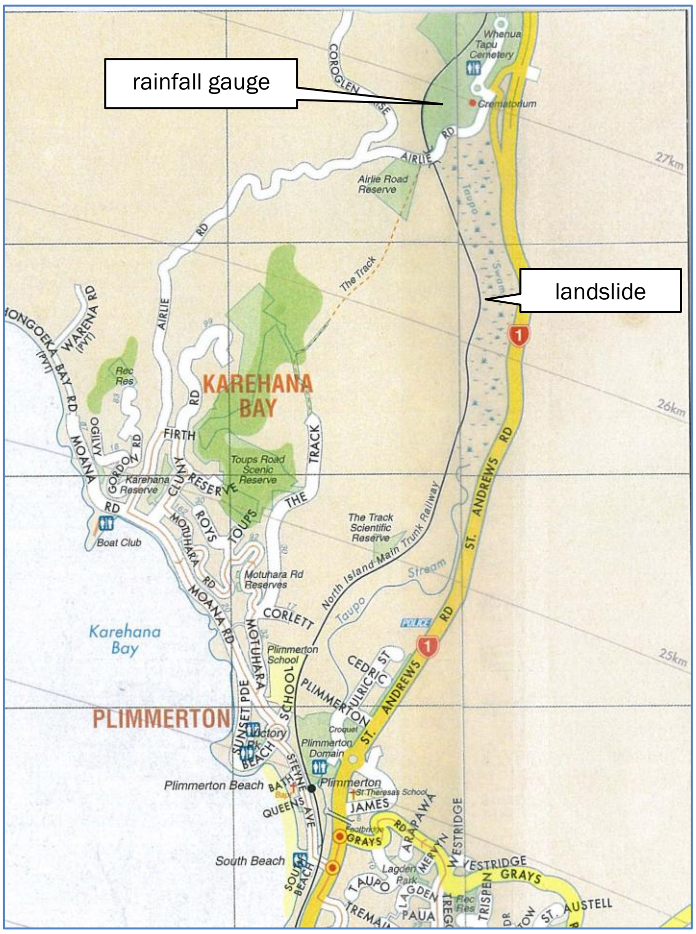

Figure 3
Location of rainfall monitoring gauge close to the landslide
Source: Avis Wellington street directory

3.5. Site and operating information

3.5.1. The track from Wellington to South Junction and from North Junction to McKays Crossing (42 km) was double track, with Up Main and Down Main lines. Trains travelled on the left-hand line in the direction of travel. Train movements were managed from KiwiRail's national train control centre in Wellington under double-line automatic signalling regulations.

3.5.2. The location of the landslide was thought to have been excavated when the corridor was widened to accommodate double tracking about 60 years ago. The vegetated cutting was about 17 m high and was laid back with a batter[6] of about 45 degrees.

3.5.3. The 20 m wide landslide was centred at the 26.887 km mark with the headscarp[7] about 16 m above rail level (see Figure 4). The maximum depth of the landslide was about 2 m below the pre-existing ground surface. The toe[8] of rupture of the landslide varied between 5 m and 10 m upslope from the base of the slope. Below this level, landslide debris consisting of saturated colluvial soils made from silty sands and clay flowed to cover the Up Main line.

3.5.4. The volume of the landslide material was estimated to be about 110 cubic metres.

3.5.5. The toe of the landslide and lower part of the landslide were located within weathered greywacke rock commonly referred to as mudstone. Fine sand/silt was exposed in the headscarps of both lobes.

[6] Batter is the slope face of the cutting.
[7] Headscarp is the top of the landslide.
[8] Toe is the location of the lower portion of the landslide.

3.5.6. KiwiRail confirmed that there had been previous slips and slumps within the cutting. An examination of historical aerial photographs showed that in 1977 there had been recent benching earthworks at the head of the cutting on which this landslide occurred. Again, on 14 September 1996, the track was closed temporarily when slip material covered the Up Main line near the 26.9 km mark.

Figure 4
Extent of the landslide

3.5.7. On the same day and soon after the collision happened, there were 3 other landslides within the Wellington rail commuter network that resulted in temporary line closures:

- at about 1525 the track scoured under the Up Main line near 31 km on the NIMT. The line was closed for 2 days until remedial work was completed
- at about 1600 a driver reported landslide material covering a section of track on the Johnsonville Line. The train stopped short of the obstruction and waited for it to be cleared
- at about 1745 an on-site safety observer reported a landslide near the entrance to Tunnel 2 on the NIMT. Train services continued on the Down Main line until the obstruction was cleared.

3.6. Slope risk assessment

3.6.1. Since 2009 KiwiRail Network had adopted a methodology for the assessment and rating of slopes adjacent to the track. Slopes were ranked in order of the risk level. The higher the risk, the sooner the slope was programmed for remedial work.

3.6.2. The slope ranking system was points based. The maximum ranking that a slope could be assigned was 653, and the minimum was zero. Points were assigned on the basis of several factors, including:

- the slope height and angle
- the distance of the track from the toe or crest of the slope
- the history of landslide movement
- the evidence of active failure
- the vegetation cover
- the condition of the drainage
- the assessment of the local geological conditions
- the number of trains per week passing the site
- the line speed and available view lines; track gradient; train stopping distance; double track v single track; passenger v freight-only line; and the consequences of a derailment.

3.6.3. The 324 m long cutting where the landslide occurred had been assessed by a KiwiRail Network engineering geologist on 17 November 2009.

3.6.4. The final slope rating for the cutting had been assessed to be 193, placing it as the thirty-first highest priority of approximately 180 sites around the Wellington rail commuter network. On the basis of the ranking order, it was unlikely that any engineered works to reduce the level of risk would have been considered for at least another 2 years.

3.6.5. As part of the assessment, a consequence of a derailment at the site was recorded as "the train could overturn onto the Down Main line".

3.7. Track inspections

3.7.1. Track inspections were carried out to ensure that the track, structures and formation were safe for the passage of trains at authorised speeds until the next scheduled inspection. Track inspections were carried out by qualified track staff by walking the track, from a slow-moving hi-rail vehicle or from a train cab.

3.7.2. There were 3 types of inspection that were relevant to this investigation: a general inspection, a detailed engineering inspection, and a special inspection. The general inspection was carried out twice per week, while the engineering inspection was undertaken annually. Special inspections were carried out by the section track ganger when there was a concern that the track may have been damaged or be at risk from environment-related events such as high-intensity rainfall, strong winds or after an earthquake. Special inspections focused on identified at-risk sites recorded on an essential features list. The critical features were checked to confirm that they remained serviceable for the line to remain open.

3.7.3. The essential features list was an electronic record. A copy was printed and carried by the person performing the track inspection. The process for reviewing and updating the essential features list was that it had to be reviewed by senior management at regular intervals. The track in the area of the cutting had been first recorded on the essential features list on 4 November 2002 and was to be inspected at times of heavy rainfall. The accompanying comment indicated that slips had occurred at the location but none had been reported during 2010.

3.7.4. On the same day as the landslide, a special inspection was carried out by another track ganger on the Johnsonville Line before the first scheduled train. A similar special inspection was also undertaken from Featherston to Upper Hutt on the Wairarapa Line separately. A special inspection had not been carried out on the NIMT section of the Wellington commuter network before Train 6250 departed from Wellington.

3.8. Ganz electric multiple units

3.8.1. The 44 two-car Ganz fleet of electric multiple units had been used on the Wellington commuter network since the early 1980s. The fleet was the mainstay of the Wellington metro service, with a capacity of 6512 seated passengers. Eleven 2-car and five 3-car English electric sets up to 70 years old provided an additional 2408 seats. The regional council intended to retire the English sets as the new Matangi fleet of 48 two-car electric sets were commissioned.

3.8.2. The regional council anticipated that the new Matangi fleet would operate peak and most off-peak services and the Ganz fleet would operate specific peak services where necessary.

3.8.3. The Ganz vehicle was considered by industry to be a well-balanced passenger rail vehicle with primary systems based on sound railway engineering practices at the time of build. The vehicle was built with very high static strength and met the crashworthiness standards of its day.

3.8.4. Early crashworthiness standards for passenger rolling stock were based on specified static loads that represented typical crash scenarios, often using an average collision speed of about 30 km/h. Present-day computing technology allows rolling stock manufacturers to do more complex non-linear energy absorption analysis to model the gross collapse of the entire vehicle structure.

3.8.5. At the time of the collision a prototype refurbishment of one 2-car Ganz set was nearing completion and it has since re-entered service for evaluation. Structural improvements undertaken as part of this refurbishment included:

- the inspection and restoration of the structural integrity of the mounting points
- the fitting of an anti-climb device to the driving cab at under frame level (the most structurally significant location on the train ends, but which is not at a height consistent with anti-climb devices fitted to locomotives). An anti-climb device reduces the risk of "over-riding[9]" another unit in the event of a front-on collision.

3.8.6. Following this accident, KiwiRail reviewed the structural performance of the Ganz fleet, and recommended to Greater Wellington Rail Limited that the following structural improvements be undertaken on any future Ganz refurbishments:

- inspect and restore the structural integrity of the mounting points
- fit a "face mask" kitset of increased material thickness on the driving end to provide greater resistance to tearing and rupture, and increase the strength of the connections between the driving cab and the under frame
- fit an anti-climb device to the driving cab at a height consistent with anti-climb devices already fitted to locomotives.

[9] Term used to describe one vehicle riding up and over another during a collision.

4. Analysis

4.1. Introduction to issues

4.1.1. The topography around much of the Wellington metropolitan rail network is hilly. Nature has a way of both creating and eroding hills over time. Landslides are a natural event; they are one mechanism of erosion. If a road or railway track is cut into a hillside, the risk of landslide will always be present. The risk can be mitigated using good design and drainage of the slope above, and also by good operational practice.

4.1.2. The landslide was a predictable event because heavy rain could trigger landslides and they had occurred at that site before. The report discusses the system for evaluating the risks created by a landslide at the accident site, whether it had been reasonably predicted, and what operational factors, if any, could have prevented or minimised the impact with the landslide.

4.1.3. Both trains in this event were being operated within allowable parameters. The landslide had occurred since the last train had passed through the area 28 minutes before the arrival of Train 6250. There was little more the driver could have done to prevent his train striking it. The arrival of Train 6247 from the other direction about 2 seconds after Train 6250 had derailed and stopped was unfortunate timing; a few minutes later and the derailment could have been reported and all other trains stopped. Communication after an accident is therefore important. The report discusses this issue in respect of train design and emergency preparedness.

4.1.4. None of the passengers and crew was seriously injured in the collision. The report discusses why that was, but also discusses the crashworthiness of the Ganz trains and how that might be enhanced to improve safety for passengers and crew in future.

4.1.5. The emergency response to any accident can affect the outcome. Nobody was seriously injured in this accident; nevertheless, under different circumstances they could have been, so the inquiry looked into this aspect in some detail. Some of this detail has been included in the factual section of this report. It is unlikely that any 2 emergency responses will be identical, so inevitably there will be lessons to take away from every response. The Commission has found that in this case the emergency response was effective and well-co-ordinated, and that any lessons were identified in the debrief that followed.

> **Finding:**
>
> The emergency response to the accident was effective and generally well-co-ordinated. Improvements were identified in the subsequent emergency response debrief for inclusion in the relevant emergency response plans.

4.2. Evaluating risk of the landslide

4.2.1. An examination of historical aerial photographs and records confirmed that this event was not the first landslide to occur within the cutting. Indeed, KiwiRail had taken into account such historical events when assessing the slope stability and assigning a slope rating to the cutting.

4.2.2. The fundamental question to ask was: why did the landslide event occur on this particular day and not during previous periods of heavy rainfall? There were several factors that could have contributed. Based on KiwiRail's geotechnical assessment, the most likely causes were a combination of the following:

- the relative steep angle of the cut slope for the material types
- the moderately high rainfall throughout the day combined with the highest April to September cumulative rainfall recorded in the previous 20 years

- the local groundwater flow collecting and being trapped in a localised depression formed where the relatively free-draining sand/silt surface material was in contact with the underlying clay-dominated weathered rock.

4.2.3. When taking into account previously reported landslide events within the cutting, this landslide was likely to have been a reactivation of an existing flow feature rather than a new event.

4.2.4. In the 2 years leading up to the collision, KiwiRail had adopted a systematic approach with its assessment and rating of slopes adjacent to the corridor to identify those slopes within the Wellington metro area where there was a risk of slope failure that could affect the safe running of trains. It used a points-based system: the higher the rating, the higher the level of risk.

4.2.5. When the cutting where the landslide occurred was rated there were 30 slopes within the Wellington metro network that had been assessed with a higher rating. Since then KiwiRail either has implemented mitigation strategies or has work currently underway on 15 of the higher-rated sites.

4.2.6. As a result of this accident KiwiRail has given some priority to the 324 m long cutting where the landslide occurred, and remedial work is well underway to stabilise the slope, which means the Commission has not needed to make a recommendation for it to do so.

4.3. Operational response to risk of the landslide

4.3.1. When the network control manager informed the area manager of the severe weather warning, the KiwiRail process made it the area manager's responsibility to determine whether a special inspection was required anywhere within his area. On this occasion the area manager was told at 1625 the day before the predicted rain. The area manager did send the information to his track staff, but instead of making any decision himself, he left it to the individual track gangers to decide for the respective sections of track they maintained. Some decided to make special inspections, but not the ganger in charge of the section of track between Plimmerton and Pukerua Bay where the landslide occurred.

4.3.2. Given that the location where the accident happened was listed as an "essential feature" because of previous landslides that had occurred there, a special inspection should have been called for and that decision should have come from the area manager in consultation with the section ganger. That does not mean that the derailment would have been prevented had one been carried out, but it might have resulted in a temporary speed restriction, which would have reduced the risk.

4.3.3. The network control manager did not send any of the updates to the severe weather warning to the area manager as he should have done. Whether this would have changed the area manager's response is a matter of conjecture, but it would have reinforced to him that the severe weather warning was real and was specifically targeted at his area of responsibility.

4.3.4. The landslide occurred sometime within the 28 minutes before the arrival of Train 6250. We know this because 2 other trains had crossed in the area 28 minutes before the accident happened. The 2 train drivers might not necessarily have noticed any precursor to a landslide as their trains passed the cutting, but a properly trained inspector who knew what to look for and knew that the cutting was on the essential features list might have at least picked up signs of a pending landslide. In that case a speed restriction could have been put in place or the site closely monitored, or both. For example, a 5 km long temporary speed restriction was in place between Upper and Maymorn on the same day following a special track inspection.

4.3.5. A speed restriction would probably not have prevented Train 6250 striking the landslide because of the limited view the driver had of the track ahead. A slower speed, however, might have resulted in less displacement from the track when the train derailed, which would have lessened the impact of the collision.

4.3.6. More importantly however, Train 6247 coming from the opposite direction would also have been travelling at a reduced speed. The driver of this train had an almost 500 m sighting distance to the derailed train ahead of him. The National Rail System Standard (Section 6) required Ganz trains travelling at 100 km/h to stop within 460 m on flat and level track, even in wet conditions. Even though Train 6247 was travelling down a 1 in 57 gradient, it is highly likely that the driver would have been able to stop his train within the clear distance ahead. A speed restriction therefore would have created 2 opportunities to either prevent or minimise the seriousness of this collision.

4.3.7. KiwiRail's Rule 6 required the network control manager to arrange for the special conditions in the speed restriction system to be updated when MetService issued a severe weather warning.

4.3.8. At the time of the derailment there was a severe weather warning in place that covered the Wellington metro network. KiwiRail's network control centre had first received a warning from MetService at 1016 the previous day (Wednesday 29 September), forecasting 70 mm to 120 mm of rain to fall in the Wellington metro area from Thursday morning to early Friday.

4.3.9. Later on that same day the network control manager had added the severe weather warning condition status to the speed restriction system effective from 0900 the next day. This action should have sent an auto-print command to the printer in the Tranz Metro operations office. However, the automatic printing of the pending restrictions did not occur because of the software problem. This system error could have been avoided had complete end-to-end testing been undertaken when changes were made to the software.

4.3.10. At 2100 that day the network control manager received an updated MetService severe weather warning and at 2115 updated the condition status within the speed restriction system to bring forward the start time for the severe weather warning period to 2100. Again, the update failed to create an auto-print command to the Tranz Metro operations office printer.

4.3.11. Because the automatic print function failed to operate, no drivers of the passenger trains were aware that a severe weather warning had been issued. This situation is concerning but is not likely to have affected the outcome of this accident. It was the fact that a speed restriction had not been put in place for the area of the cutting that is more concerning. When a speed restriction is put in place, speed boards are placed before the affected area and train drivers already on the network are verbally informed by train control.

4.3.12. Commission inquiry 06-108 reported on an incident in which passenger Train 9328 travelling from Wellington to Johnsonville struck a slip and derailed. At the time, MetService had issued a severe weather warning but the network control manager had yet to promulgate the warning.

4.3.13. The Commission identified the lack of effective severe/adverse weather forecasting and real-time monitoring of rainfall in the Johnsonville Line and other areas as a safety issue. The Commission recommended that the Director of the NZ Transport Agency address that safety issue.

4.3.14. During 2011 KiwiRail established a series of rainfall monitoring sites within the Wellington metro network where there was a high risk of landslide failure. The forecast rainfall could then be reconciled with real-time gauge data and responsive action taken. The Commission closed its recommendation "acceptable" based on that follow-up action. An interim decision-making matrix has now been developed to facilitate decision-making in the event of either forecast high-intensity rainfall or actual rainfall recorded during the previous 28 days. This matrix is shown below.

Rainfall forecast for the next 24 hours	Rainfall recorded during preceding 4-week period	Rainfall recorded during preceding 4-week period
	< 150 mm	> 150 mm
< 25 mm	Condition 0: Normal operation	Condition 1: General warning
25-50 mm	Condition 2: General warning	Condition 3: Track inspection
50-75 mm	Condition 4: Track inspection	Condition 5: Track inspection and 40 km/h speed restriction
> 75 mm	Condition 6: Track inspection and 40 km/h speed restriction	Condition 7: Track inspection and 25 km/h speed restriction

- General warning: Notification to line managers of elevated risk due to either saturation of soils or a specific predicted event
- Track inspection: Periodic track inspections in areas of elevated risk. The frequency and locations of inspections will depend on the geotechnical hazard, train schedule and severity of the event
- Speed restriction: Graduated speed restrictions depending on the risk level and location
- Stop train movements: This action would be a direct response to a reported event.

Had the interim decision-making matrix been operational at the time of this accident, a special track inspection would have been required and the maximum permitted line speed reduced to 25 km/h.

Findings:

A 25 km/h temporary train speed restriction would likely have prevented Train 6247 colliding with the stationary derailed Train 6250.

A 25 km/h temporary train speed restriction might not have allowed the driver of Train 6250 to stop the train short of the landslide debris, but it would have reduced the risk of a derailment and the subsequent collision.

The location of the landslide where the derailment and collision happened was prone to landslides during periods of heavy rain and ground saturation. Given the predicted rainfall for the area, and that the location was on the essential features list, a special track inspection should have been made and a speed restriction should have been put in place.

KiwiRail's slope ranking system for evaluating the landslide risk on the rail network was an effective tool for prioritising remedial work at locations that were prone to landslides. However, KiwiRail had not conducted a complete risk assessment for each identified location to identify what action could be taken to reduce the risk in the meantime, such as monitoring rainfall, applying temporary speed restrictions and conducting special track inspections.

The KiwiRail rainfall monitoring system and risk management framework put in place since the accident, which includes information from the slope ranking system, is a more effective tool for managing the risk of landslides.

4.4. Communication

4.4.1. Radio communication is an important component of a safe rail operation. The National Rail System Standard required all locomotives and self-propelled rail vehicles to be fitted with radio equipment capable of transmitting communications to, and receiving communications from, train controllers and other rail vehicles on the network.

4.4.2. For a single-person train operation on the rail network, the lead motive power unit must be fitted with a very-high-frequency E-band radio equipped with at least 4 channels. Channel 1 is dedicated to short-range communication, including to a driver on a different train, a signal box controller and train examination and maintenance personnel.

4.4.3. The Standard required the driving cabs of all rail vehicles to be equipped with vigilance systems to monitor driver alertness by requiring the drivers to respond to indicator lights and/or audible warning devices within a maximum period of 70 seconds.

4.4.4. The vigilance cycle is reset when the driver presses the vigilance cancellation button, makes a change to either the air brake or throttle control setting or sounds the whistle. If the vigilance system is not cancelled by the driver within 10 seconds of the in-cab alarm sounding, the air brake is applied automatically and the train is stopped and an alert sent to train control.

4.4.5. Brake pipe pressure is monitored continuously and when a sudden reduction of air pressure from 550 kilopascals to 350 kilopascals in less than 10 seconds is detected, such as when an emergency brake application is made, the vigilance system automatically sends an emergency vigilance alarm to train control through the radio system. When the alarm activates, the scanner sends the alarm signal until train control acknowledges by calling the driver. The alarm sequence is repeated every 30 seconds, up to 30 times. For this to occur the radio must be capable of “selective calling” (selcall).

4.4.6. When receiving an emergency alarm, the train controller is required to contact the driver immediately to determine the reason for the activation. Should the first attempt be unsuccessful, the train controller is required to make further calls during the next 2 minutes. If there is still no response, the train controller is required to send a person to the train to find out what caused the alarm activation.

4.4.7. At the time the Ganz fleet was commissioned, selcall radios were not available. When they did become available later, they were fitted to main line locomotives as a safety precaution when the “second person” was removed from locomotive-hauled freight trains in 1987. KiwiRail’s predecessors determined that the operation of the passenger trains on the Wellington commuter network was not a single-person operation because the passenger train had a crew of at least 2 people, namely a driver and a train manager, plus passenger operators depending on the number of passenger cars on a train. The consequence of this was that the radio system fitted to the fleet of Ganz units did not have a selcall capability. Therefore despite emergency brake applications having been made on Train 6250 and Train 6247 before the collision, train control did not and could not receive the alerts automatically.

4.4.8. The Tranzlog event recorders from the leading and trailing ends of Train 6247 shut down 0.6 seconds after the collision. The driving compartment on EM1223 was damaged to such an extent that the train radio equipment was unusable, and because the battery supply failed, all electrical power was lost throughout the train. With no electrical power, the radio equipment in the **undamaged** driver’s cab at the trailing end was also unusable.

4.4.9. The absence of selcall capability on the Wellington passenger fleet meant there was a delay in train control being made aware of the collision and in turn calling the emergency services. In this case the next train coming from the opposite direction arrived at about the same time that the derailment occurred. In other circumstances a delay in train control becoming aware of such an event in double-track territory is a lost opportunity to warn other trains in the vicinity. The delay can be overcome by fitting an improved radio system with selcall capability to the Wellington commuter rail fleet. A recommendation has been made to address this issue.

Findings:

Most of the passenger trains in the Wellington commuter fleet are not equipped with selcall-capable radio equipment, which means that in the event of an emergency brake application or other event that causes a rapid reduction in air brake pipe pressure, there could be a critical delay in train control being alerted in time to prevent the event escalating.

4.5. Crashworthiness

4.5.1. Crashworthiness is a term used to describe a vehicle's ability to absorb impact forces and protect the occupants from serious injury. The leading passenger vehicle of northbound Train 6250 hit the landslide material, derailed and 2 seconds after stopping was struck by southbound Train 6247, travelling at 54 km/h on the adjacent line. Train 6247 stopped about 77 m past the initial point of impact and remained on the track.

4.5.2. The driving compartments of both trains were severely deformed during the collision sequence, with significant loss of what is known as driver survivable space. Had both drivers not evacuated their driving positions, they would likely have been at least seriously injured.

4.5.3. When commissioned nearly 30 years ago, the Ganz train was considered to be a well-designed and well-built vehicle with appropriate crashworthiness features for the time. However, when compared with current design standards, the Ganz units lack the same structural energy absorption at the corner and end posts, and do not have the same "anti-climb" features. Corner posts and end posts either side of the central end door are an integral part of modern passenger vehicle design. The purpose of corner posts is to deflect corner impacts and contain damage to energy-absorbing deformation. These corner posts are particularly important on these vehicles where the driver position is offset to the right, which means the driver is closer to trains approaching on the adjacent main line. Additionally, because the commuter network is also used by freight trains, the corner post helps to protect the driver from any overhanging load on a passing train.

4.5.4. At the time of the collision both trains were lightly loaded with all passengers seated. None of the passengers suffered serious injury.

4.5.5. Since the collision, improvements to the rupture resistance of the Ganz fleet have been recommended to be included as part of the scope for any future refurbishments. These would include the fitting of an "end mask".

4.5.6. The anti-climb feature that is typically found on modern passenger cars provides some protection against over-riding, considered by the industry to be the most dangerous accident scenario. These features have been present on the New Zealand locomotive fleet since the 1980s and on the SD driving trailer cars used on the diesel-hauled, push/pull commuter trains that have been operating on the Auckland commuter rail network since 2004. They also feature on the newer Matangi fleet introduced to the Wellington network in 2011.

4.5.7. While it might not be economically feasible to modify the older fleet to meet the crashworthiness standards of modern trains, projects such as trialling end masks on the Ganz fleet, installing anti-climb devices and restoring structural attachment points to original or better standards should be included in any future upgrade if the fleet is to remain in service for any appreciable length of time. A recommendation has been made to address this safety issue.

Findings:

The driving compartments on Trains 6250 and 6247 were damaged during the collision sequence to such an extent that had the drivers not vacated their driving positions before impact they would likely have been fatally injured.

The Ganz trains were generally strong and well-built and had met the crashworthiness standards at the time of build some 30 years earlier, but they did not perform as well as a modern train during a similar front-end collision, thereby increasing the risk of injury to the drivers and possibly passengers seated near the ends of the trains.

5. Findings

5.1. The emergency response to the accident was effective and generally well-co-ordinated. Improvements were identified in the subsequent emergency response debrief for inclusion in the relevant emergency response plans.

5.2. A 25 km/h temporary train speed restriction would likely have prevented Train 6247 from colliding with the stationary derailed Train 6250.

5.3. A 25 km/h temporary train speed restriction might not have allowed the driver of Train 6250 to stop the train short of the landslide debris, but it would have reduced the risk of a derailment and the subsequent collision.

5.4. The location of the landslide where the derailment and collision happened was prone to landslides during periods of heavy rain and ground saturation. Given the predicted rainfall for the area, and that the location was on the essential features list, a special track inspection should have been made and a speed restriction should have been put in place.

5.5. KiwiRail's slope ranking system for evaluating the landslide risk on the rail network was an effective tool for prioritising remedial work at locations that were prone to landslides. However, KiwiRail had not conducted a complete risk assessment for each identified location to identify what action could be taken to reduce the risk in the meantime, such as monitoring rainfall, applying temporary speed restrictions and conducting special track inspections.

5.6. The KiwiRail rainfall monitoring system and risk framework put in place since the accident, which includes information from the slope ranking system, is a more effective tool for managing the risk of landslides.

5.7. Most of the passenger trains in the Wellington commuter fleet are not equipped with selcall-capable radio equipment, which means that in the event of an emergency brake application or other event that causes a rapid reduction in air brake pipe pressure, there could be a critical delay in train control being alerted in time to prevent the event escalating.

5.8. The driving compartments on Trains 6250 and 6247 were damaged during the collision sequence to such an extent that had the drivers not vacated their driving positions before impact they would likely have been fatally injured.

5.9. The Ganz trains were generally strong and well-built and had met the crashworthiness standards at the time of build some 30 years earlier, but they did not perform as well as a modern train during a similar front-end collision, thereby increasing the risk of injury to the drivers and possibly passengers seated near the ends of the trains.

6. Safety actions

General

6.1. The Commission classifies safety actions by 2 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.

Safety actions addressing safety issues identified during an inquiry

6.2. KiwiRail has taken action by improving slope stability to reduce the risk of a landslide occurring at the accident site.

6.3. Online, real-time rainfall measuring and recording sites have been established at 6 identified at risk sites within the Wellington rail commuter network and a decision-making matrix has been established to reduce the risk created by landslide.

7. Recommendations

General

7.1. 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, recommendations have been issued to NZ Transport Agency.

7.2. In the interests of transport safety it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

Recommendations

7.3. On 31 May 2012 the following recommendation was made to the Chief Executive of the NZ Transport Agency:

7.4. KiwiRail's predecessors determined that the Wellington rail electric multiple unit commuter service was not a single-person operation. Irrespective of whether these trains were a "single-person" or a "two-person" operation, as a consequence, the radio system fitted to these trains did not have selcall capability and could not send an alert to train control automatically when there was a rapid drop in brake pipe pressure such as when the driver makes an emergency brake application. Any delay in train control being alerted to an accident or incident within the double-tracked commuter network is a safety issue. The Commission recommends to the Chief Executive of NZ Transport Agency that he address this safety issue. (021/12)

On 13 June 2012, the Manager Rail Systems, replied in part:

> The NZTA intends to work closely with the rail industry with an aim to addressing and closing this recommendation as soon as practicable.

7.5. The driving compartments on Trains 6250 and 6247 were damaged during the collision sequence to such an extent that had the drivers not vacated their driving positions before impact it was likely that they would have been at least seriously injured. Although the Ganz Mavag trains were generally strong and well-built and had met the crashworthiness standards at the time of build some 30 years earlier, they did not perform as a more modern train would have been expected to perform during a similar front-end collision, thereby increasing the risk of injury to the driver and possibly passengers seated near the ends of the trains.

The Commission recommends that the Chief Executive of the NZ Transport Agency monitor the development of current prototype improvements in crashworthiness for the Ganz Mavag rail fleet and requires that such improvements be adopted for any trains that are to remain in service for an appreciable time. (022/12)

On 13 June 2012, the Manager Rail Systems, replied in part:

> The NZTA will monitor the development of modifications to the Ganz Mavag rail fleet, taking into account the length of time the Ganz Mavag fleet may remain in service.

8. Key lessons

8.1. In order to undertake an adequate risk assessment there must be a clearly mapped out methodology that should be followed.

8.2. Good, effective communication in any form is essential for preventing accidents occurring and essential for minimising the consequences if one does occur.

8.3. People with designated responsibility must exercise that responsibility or delegate to another person to ensure important decisions are made at the right time.

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

07-102	(Incorporating inquiry 07-111) freight train mainline derailments, various locations on the national network, from 6 March 2007 to 1 October 2009
11-101	Wrong line running irregularity, leading to a potential head-on collision, Papakura – Wiri, 14 January 2011
08-102	Metro passenger train derailment, Sylvia Park, 14 April 2008 (incorporating inquiries 08-104 and 08-107), diesel motor fires on board metro passenger trains, 3 June 2008 and 25 July 2008
08-111	Express freight Train 524, derailment, near Puketutu, North Island Main Trunk, 3 October 2008
08-112	Safe working irregularity resulting in a collision and derailment at Cass Station on the Midland Line, 8 November 2008
09-102	Passenger fatality after falling between platform and passenger Train 8125, Newmarket West Station, 1 July 2009
08-109	Passenger express Train 9113, platform overrun resulting in signal passed at danger, Fruitvale Road Station, North Auckland Line, 4 September 2008
07-114	Derailment caused by a wheel-bearing failure, Huntly, 19 October 2007, and 11 subsequent wheel-bearing failures at various locations during the following 12-month period
09-103	Passenger Train 1608, collision with slip and derailment, Tunnel 1, Wairarapa Line, Maymorn, 23 July 2009 (incorporating investigation 08-106, collision with slip and derailment on the Johnsonville Line)
09-101	(Incorporating 08-105) express freight train derailments owing to the failure of bogie side frames, various locations on the North Island Main Trunk, between 21 June 2008 and 7 May 2009
07-105	Push/pull passenger train sets overrunning platforms, various stations within the Auckland suburban rail network, between 9 June 2006 and 10 April 2007
08-110	Train control operating irregularity, leading to potential low-speed, head-on collision, Amokura, 23 September 2008
08-101	Express freight Train 923, level crossing collision and resultant derailment, Orari, 14 March 2008
06-111	Express freight Train 237, derailment, Utiku, 20 October 2006

Price $30.00

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