Report 08-109: Passenger express Train 9113, platform overrun resulting in signal passed at danger, Fruitvale Road Station, North Auckland Line, 4 September 2008

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 08-109
Passenger express Train 9113,
platform overrun resulting in signal passed at danger,
Fruitvale Road Station, North Auckland Line,
4 September 2008

Approved for publication: November 2010

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission and this report

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

This final report may not be used to pursue 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.

Source: mapsof.net

Figure 1
Location of incident

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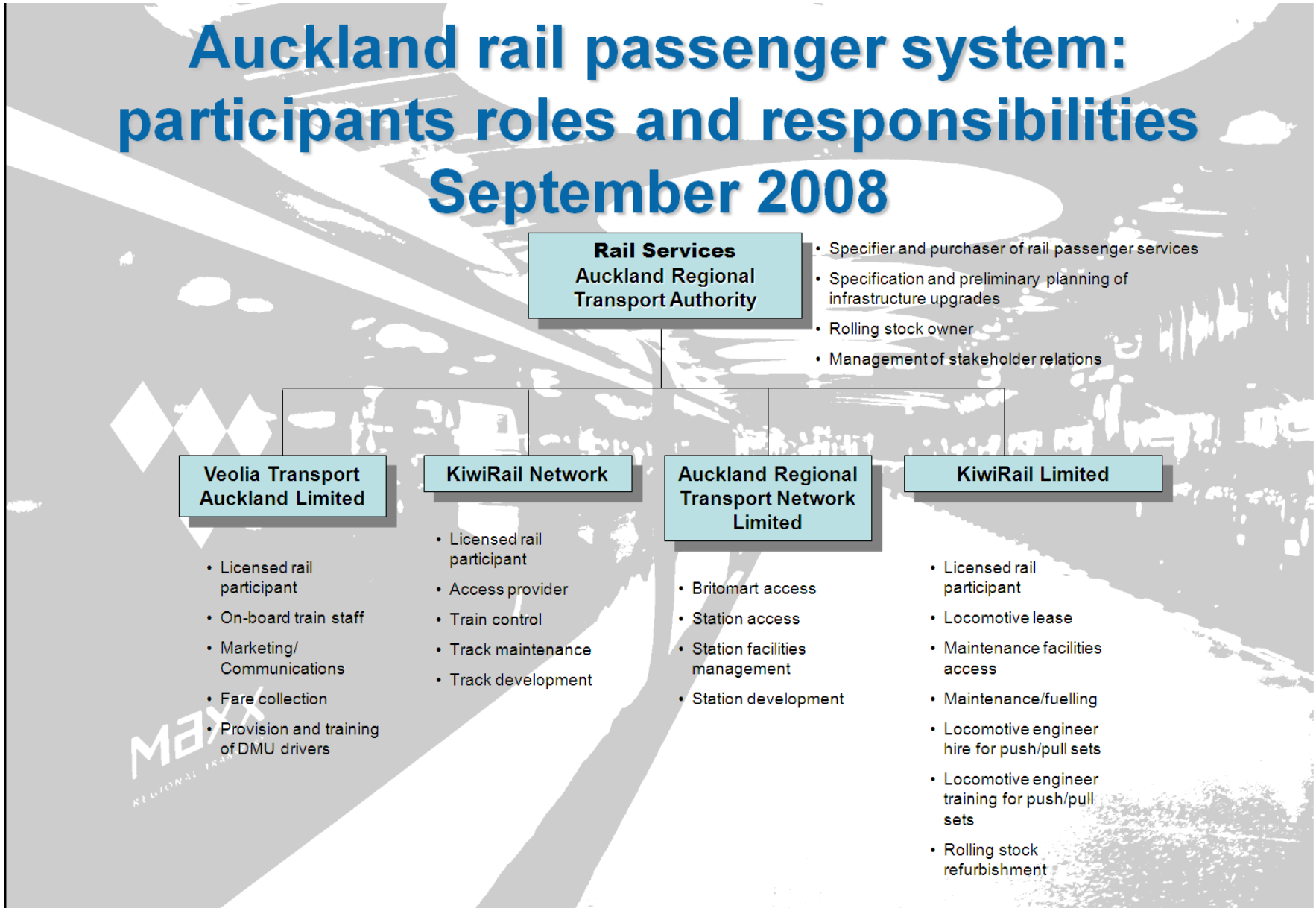
Abbreviations

ARTA	Auckland Regional Transport Authority
DLAS	double line automatic signalling
ER	equalising reservoir
km/h	kilometre(s) per hour
kPa	kilopascal(s)
m	metre(s)
SPAD	signal passed at danger
t	tonne(s)
Toll Rail	Toll NZ Consolidated Limited
UTC	universal co-ordinated time
Veolia	Veolia Transport Auckland Limited

Data summary

Train type and number:	Passenger express Train 9113,
Classification:	DC-class locomotive pulling SA passenger carriages and SD driving trailer
Year of manufacture:	locomotive: Originally DA class locomotive built about 1960 by General Motors, Canada then rebuilt about 1980 by Clyde Engineering, Australia carriages: 1972 British Rail Mk 2 passenger carriages converted in 2004 at Toll NZ Consolidated Limited's (Toll Rail's) workshops in Dunedin
Date and time:	4 September 2008 at 0827[1]
Location:	Fruitvale Road Station, North Auckland Line
Persons on board:	crew: 4 passengers: about 100
Injuries:	crew: nil passengers: nil
Damage:	nil
Operator:	Veolia Transport Auckland Limited (Veolia)

[1] Times in this report are New Zealand Standard Times (UTC + 12 hours) and are expressed in the 24-hour mode.


Auckland rail passenger system: participants roles and responsibilities September 2008
Rail Services
Auckland Regional Transport Authority
• Specifier and purchaser of rail passenger services
• Specification and preliminary planning of infrastructure upgrades
• Rolling stock owner
• Management of stakeholder relations
Veolia Transport Auckland Limited
• Licensed rail participant
• On-board train staff
• Marketing/ Communications
• Fare collection
• Provision and training of DMU drivers
KiwiRail Network
• Licensed rail participant
• Access provider
• Train control
• Track maintenance
• Track development
Auckland Regional Transport Network Limited
• Britomart access
• Station access
• Station facilities management
• Station development
KiwiRail Limited
• Licensed rail participant
• Locomotive lease
• Maintenance facilities access
• Maintenance/fuelling
• Locomotive engineer hire for push/pull sets
• Locomotive engineer training for push/pull sets
• Rolling stock refurbishment

1. Executive summary

Introduction

1.1. This executive summary summarises the main points contained in this report to provide the reader with an overview of the circumstances and causes of the occurrence, and the Transport Accident Investigation Commission's (the Commission's) findings and recommendations. For the full details of these matters, readers should refer to the main part of this report and its appendices.

Summary

1.2. On Thursday 4 September 2008 at about 0827, push/pull commuter passenger Train 9113, travelling on the Down Main North Auckland line from Waitakere to Britomart, overran Fruitvale Road Station platform. The train was travelling at 36 kilometres per hour (km/h) when it passed the end of the platform and had slowed to 31 km/h when it passed Stop and Proceed Signal 2097 displaying a Stop indication. The train was still travelling at 29 km/h when it entered Fruitvale Road level crossing, 38 metres (m) past the end of the platform and 27 m past Signal 2097.

1.3. The train stopped with the rear door of the fourth carriage alongside the station platform. All doors on the platform side of the train were opened and alighting passengers were allowed to step down onto the track formation and the level crossing. The train continued on towards Britomart after those passengers waiting at the platform had boarded through the rear passenger car.

1.4. Trains approaching Fruitvale Road Station on the Down Main line were restricted to a maximum speed of 65 km/h because of the track alignment. Therefore, the non-stopping approach distance for trains was 436 m from the Fruitvale Road kerb line to provide motorists with 24 seconds' warning time on the flashing lights and bells and barrier arms protecting the level crossing. Because nearly all trains travelling on the Down Main line stopped at Fruitvale Road Station, a "vital timer" delay was set at 30 seconds to delay the activation of the flashing lights and bells. This time delay was built into the level crossing control system to minimise the waiting time for motorists while the train was stopped at the station for passenger work.

1.5. The barrier arms at Fruitvale Road level crossing were fully extended into the horizontal position just as Train 9113 passed Signal 2097. The level crossing protection had been activated by Train 8110, approaching Fruitvale Road on the parallel Up Main line. Had Train 8110 entered Fruitvale Road level crossing more than 12 seconds later than it did, Train 9113 would have entered the level crossing with the flashing lights and bells having only been operating for 1.3 seconds and the barrier arms would still have been in the vertical position. The Commission has made a recommendation to the Chief Executive of the NZ Transport Agency to conduct a risk assessment of the level crossing control system at those locations where station platforms are located between level crossings and the start of level crossing approach track circuits.

1.6. The platform overrun at Fruitvale Road Station was similar to other events investigated in Commission report 07-105.

1.7. At the time of the overrun at Fruitvale Road Station, KiwiRail had not trained locomotive engineers in a "best practice" train handling technique for stopping push/pull passenger trains fitted with graduated release brakes. The Commission would have made such a recommendation had KiwiRail not developed an operating instruction and started retraining locomotive engineers.

2. Conduct of inquiry

2.1. Between June 2006 and April 2007, the Commission launched inquiries into 5 separate platform overrun events on the Auckland suburban rail network. All the overruns involved push/pull train sets being driven from SD driving trailers in the push mode (Commission report 07-105).

2.2. In report 07-105, driver training was identified as a significant contributing factor to the platform overruns. In particular, the locomotive engineers had not been taught a standard train handling and braking technique when approaching station platforms. Also, the instructing locomotive engineers (minder drivers) had not been taught how to instruct the trainees and were themselves not required to meet a defined service level or competency level before undertaking training duties.

2.3. The Commission determined that the brake system design was not ideally suited for push/pull commuter train operations, although it was considered fit for purpose for the trains' intended use on outer-suburban limited-stop operations that existed at the time.

2.4. While inquiry 07-105 was still underway, this incident involving a platform overrun and a signal passed at danger (SPAD) occurred at Fruitvale Road Station.

2.5. The Commission opened an inquiry into the overrun and the investigation team travelled to Auckland to oversee testing of the train brake system, view the incident site and interview key personnel.

2.6. Because of the special signalling arrangements and the location of a level crossing immediately beyond the station, this inquiry was conducted separately from the events in inquiry 07-105.

2.7. The draft final report on this incident was approved for circulation to interested persons on 22 September 2010.

2.8. Submissions were received from the regulator, the operator, the provider of the locomotive engineer services and the specifier and purchaser of Auckland rail passenger services, whose comments have been considered and included in the final report where appropriate.

3. Factual information

3.1. Narrative

3.1.1. On Thursday 4 September 2008 at 0805, Train 9113, a Veolia commuter passenger train, departed from Waitakere on the North Auckland Line to Britomart. The train consisted of locomotive DC4939 pulling passenger cars SA3216, SA3263, SA322 and driver trailer SD3199. The train had a total tare weight of 206 tonnes (t) and was 95.60 m long (see Figure 2).

Figure 2
Consist of Train 9113

3.1.2. The locomotive engineer had started duty at Westfield at 0530. He had driven a commuter train from Westfield to Britomart, where he had a short lay-over before changing sets and driving the consist of Train 9113 to Waitakere from the SD driving car, arriving at 0756.

3.1.3. The locomotive engineer changed driving ends to the locomotive for the return journey to Britomart. Train 9113 departed from Waitakere on time at 0805. The locomotive engineer said that the train had handled as expected when he stopped at the 6 stations between Waitakere and Fruitvale Road. He said that after he departed from Glen Eden, the train reached a speed of about 70 km/h before he made an initial brake application approaching Fruitvale Road Station. The train overran the platform and passed the departure signal near the end of the platform that was displaying a red aspect before entering Fruitvale Road level crossing immediately beyond. The train came to a stop across the level crossing with the rear door of the rear car just on the platform. The level crossing bells and barriers had been activated before Train 9113 entered the level crossing, not by Train 9113 but by another train approaching the level crossing from the other direction.

3.1.4. The locomotive engineer said that after making the initial brake application he felt what he thought was the train sliding; he released the brakes, applied the independent brake, released the train brake and made a full service brake application (refer table in 3.7.2). The full service application was made as the train passed Signal 2097 displaying a red aspect (see Figure 3).

3.1.5. Using footage from Fruitvale Road Station security cameras with the times adjusted to New Zealand Standard Times from the locomotive event recorder download, the following sequence of events was established.

3.1.6. Train 9113 passed Signal 2097 displaying a red aspect at 0826:57 (referred to as a SPAD). The barrier arms protecting the level crossing descended to the horizontal position at the same time the train entered the level crossing. There were motor vehicles waiting on both road approaches when the train entered the level crossing.

3.1.7. At 0827:10 Train 9113 stopped with the front of the locomotive 66 m past Signal 2097 and 93 m past the end of the station platform. The second passenger car was straddling Fruitvale Road with the rear 30 m of the train (about one and a half passenger cars) ahead of Signal 2097. The rear door on the rear carriage was the only door alongside the station platform.

3.1.8. At 0827:10, passenger Train 8110, travelling from Britomart to Waitakere on the adjacent Up Main line, running about 10 minutes behind schedule, entered the level crossing at the same time as Train 9113 stopped.

3.1.9. At 0827:18, eight seconds after the train stopped, all 8 doors on the platform side of the train were opened. Eleven passengers alighted from the train through doors away from the station platform and had about a metre drop from the step to the track formation before making their way back towards the station platform. There were no reported passenger injuries. Nine passengers waiting to board the train did so through the only door alongside the platform.

3.1.10. Once the passenger work was complete and all doors were closed, the train manager gave right of way to the locomotive engineer. Train 9113 departed at 0828:46 and continued to Britomart.

3.1.11. The locomotive engineer and the train manager did not discuss the overrun until after the train had terminated at Britomart. The locomotive engineer indicated to the train manager that the train had faulty brakes. At Britomart, the locomotive engineer changed driving compartments to the SD driving trailer to drive the empty service to Westfield depot, where it was stabled until the afternoon peak services. The train manager travelled on the empty service to Westfield Station where he boarded another train to Papakura.

3.1.12. At about 0930, the locomotive engineer notified his manager of the incident at Fruitvale Road after he had stabled the set. The train set was taken out of service immediately and the train braking system inspected and tested. The results of the braking system inspection are referred to in section 3.8.

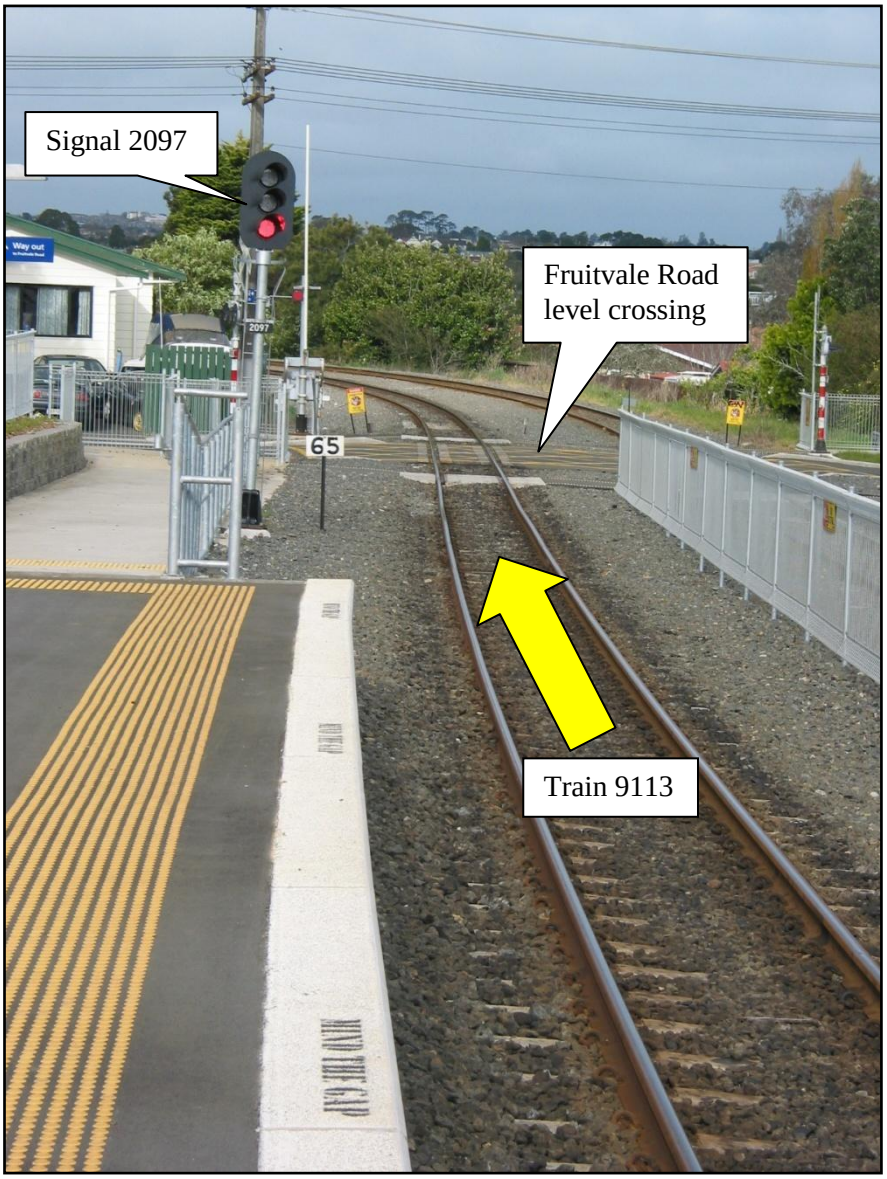


Figure 3
Signal 2097 at Fruitvale Road Station

3.2. Site and operating information

3.2.1. The push/pull sets were designed to be used on limited-stop outer-suburban routes similar to what the Auckland suburban rail system was considered to be at the time.

3.2.2. The Auckland Regional Transport Authority (ARTA) was formed in December 2004 from the Auckland Regional Council to plan, fund and develop Auckland's regional transport system. In a strategy document of 2005, ARTA stated that there was capacity within the rail network to cater for additional passenger traffic, and that the current under-utilisation of the rail mode represented an inefficient use of resources when taking into account the capital expenditure (both past and present) on infrastructure associated with the rail network. In addition to the existing network, there was potential to expand the rail network to provide for additional passenger services.

3.2.3. ARTA owned the push/pull sets and leased the DC locomotives from Toll NZ Consolidated Limited[2] (Toll Rail). Veolia operated all the Auckland suburban commuter rail fleet, including the push/pull sets. The locomotive engineers who drove the push/pull sets were provided by Toll Rail. All other on-board staff were provided by Veolia. Toll Rail was contracted by ARTA for the

[2] Toll Rail was the predecessor of KiwiRail Freight.

mechanical maintenance of the sets, which was carried out at the Toll Auckland Metro Maintenance facility in Westfield.

3.2.4. The push/pull sets were permitted to travel at a maximum speed of 100 km/h, but there were speed-restricted areas within the Auckland suburban rail network where all types of train were required to travel at lower speeds because of track curvature, track junctions and track engineering requirements.

3.2.5. Track duplication of the North Auckland Line was carried out between stations between Westfield and Swanson. Stations were upgraded so that they were easy to get to, comfortable to use and clearly marked.

3.2.6. Fruitvale Road Station was relocated from a single-track station on the Westfield side of Fruitvale Road to a dual platform servicing both Up and Down Main lines on the Swanson side of Fruitvale Road.

3.2.7. The rail corridor between New Lynn and Swanson was double-tracked, consisting of an Up Main line for trains running from Westfield and a Down Main line for trains running to Westfield.

3.2.8. The 140 m long Fruitvale Road Station platforms were on compound 600 m and 305 m radius curves, with a shelter positioned centrally on each platform (see Figure 4). The platforms were designed to accommodate 6-carriage passenger trains. Because of the track curvature, the maximum train speed was restricted to 65 km/h.

3.2.9. The Down Main line approach to Fruitvale Road Station from the direction from which Train 9113 approached was between 1 in 60 and 1 in 70 down grade for about 500 m.

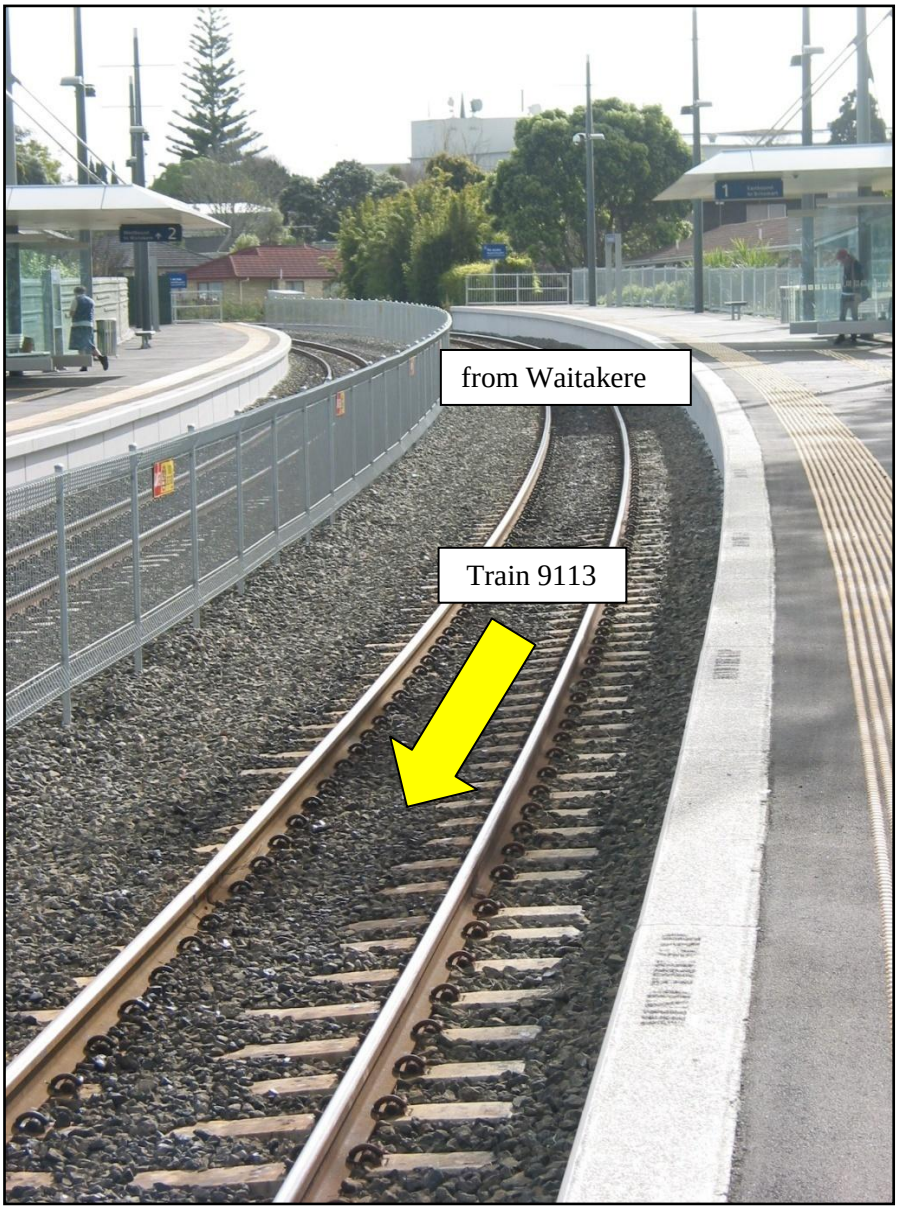


Figure 4
Fruitvale Road Station Down Main line platform

3.2.10. Signal 2097 had been positioned 27 m past the end of the platform, in line with international practice (see Figure 3). This was done so that the driver of a train stopped at the platform could always see the signal. There was not enough space to provide a standard overrun distance of 150 m from the signal at the end of the platform to the level crossing. In this case only 11 m were available between Signal 2097 and the near kerb line on Fruitvale Road.

3.2.11. The objective of automatic signalling is to facilitate the regular movements of trains by dividing the line into sections and automatically maintaining safe distances between following trains. This is accomplished by controlling the signal governing the entrance to a section using track circuits, so that when a train enters a section the signal is automatically held at "Stop" by displaying a red aspect until the train is under the protection of the signal next in advance. When the track controlling an automatic signal is unoccupied, the signal automatically assumes either a "Clear" green aspect or "Caution" yellow aspect.

3.2.12. Train movements on the double-line running section between New Lynn and Swanson were managed from KiwiRail Network's national train control centre in Wellington and operated under double line automatic signalling (DLAS) regulations.

3.2.13. Areas of line worked under DLAS were arranged and equipped with intermediate signals and interlocked stations. KiwiRail's Rail Operating Code provided the following definitions relevant to DLAS.

> **Double line sections**
> A Double Line section is the section of either main line between two interlocked stations the entrance to which is governed by a fixed signal.
>
> **Intermediate Section**
> Any division of a double line section the entrance to which is governed by an intermediate signal.
>
> **Interlocked Station**
> A station where control of points and fixed signals is centralised and arranged to prevent conflicting movements. The operation of points and signals is manually controlled in addition to being controlled by track circuits. Interlocked stations are protected by Home Signals, or Outer Home signals where provided.

3.2.14. KiwiRail's Signals Rule 58(a) Classification of Automatic Running Signals stated in part:

> **(a)** Automatic Running signals are divided into three main classes, viz:
> **Stop and Proceed signals;**
> **Stop and Stay signals;**
> **Departure signals.**
>
> The light units of Stop and Proceed signals are "staggered", i.e., the lower unit is in a diagonal line to the right and not vertically below the upper unit.

3.2.15. Signal 2097 at Fruitvale Road Station was classified as an Advanced Intermediate Stop and Proceed Signal.

3.2.16. KiwiRail's Operating Rules (general) stated in part:

> **112. Trains Overrunning or Stopping Short of Platform**
> When a train conveying passengers overruns or stops short of the platform at an attended station it must not be moved until the crew have conferred with the Officer in Charge. If the train is to be moved staff concerned must first ensure that passengers will not attempt to leave the train whilst in motion. The Officer in Charge will then give the necessary instructions to the Locomotive Engineer to move the train.
>
> At unattended stations the crew must advise passengers before the train is moved.

3.2.17. KiwiRail's Rail Operating Rules and Procedures Section 11 – Emergency Procedures required that, as a precautionary action, locomotive engineers were to be relieved in all cases where their trains had been involved in serious operating irregularities such as a signal passed at danger.

3.3. Fruitvale Road level crossing protection

3.3.1. The centre line of Fruitvale Road crosses both the Up Main and the Down Main lines of the North Auckland Line at 20.944 kilometres. The level-crossing control system is equipped with flashing lights and bells, and half-arm barriers (see Figure 5).

3.3.2. Level-crossing alarm installations close to where trains regularly stop on the approach, such as at Fruitvale Road Station, created a design dilemma for signalling systems. In such situations the following had to be considered:

- sufficient warning time to motorists for non-stopping freight trains
- minimise the road closure time when trains stop at the station
- minimise the impact on train operations.

Figure 5
Fruitvale Road level crossing

3.3.3. KiwiRail's standard warning time for a level crossing equipped with active protection was 22 seconds for a train travelling at the maximum line speed, plus 2 seconds for every additional line protected. In the case of Fruitvale Road with 2 lines, the warning time was therefore 24 seconds; enough time for a non-stopping train restricted to a maximum of 65 km/h travelling on the Down Main line to travel a distance of 436 m (see Figure 6).

3.3.4. Because nearly all trains travelling on the Down Main line stopped at Fruitvale Road Station for passenger work, a "vital timer" was installed to delay the activation of the flashing lights and bells and barrier arms at the level crossing so that road users were not held for too long waiting for trains to clear. KiwiRail determined that an activation delay of 30 seconds, in line with international standards, was appropriate.

3.3.5. The normal operational sequence for the level crossing protection for Down trains approaching Fruitvale Road was therefore:

- a 30-second timer starts to run down when a train occupies the circuit 2221CT
- 30 seconds later, the alarms at the level crossing start to ring
- after a further 5 seconds, the half-arm barriers start to descend
- when the barrier arms reach the horizontal position (about 7 seconds later), Signal 2097 clears.

However, should another train be in the section ahead, Stop and Proceed Signal 2097 would not clear but continue to display a red aspect (Stop indication), but could be passed after stopping for 10 seconds before proceeding at slow speed and being prepared to stop in the clear distance ahead.

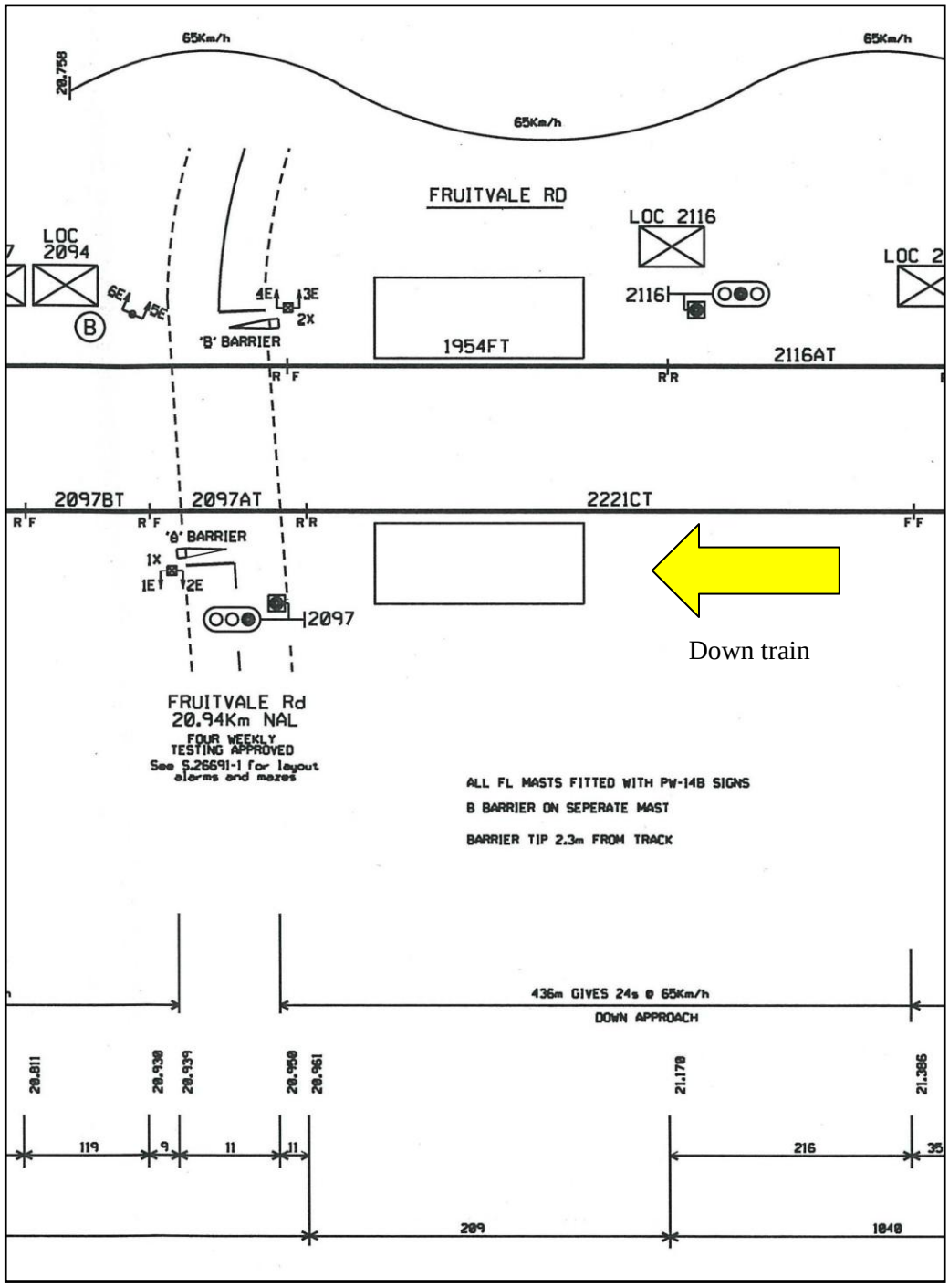


Figure 6
Fruitvale Road signals layout (not to scale)
(provided by KiwiRail Network)

3.3.6. When non-stopping Down trains approached Fruitvale Road level crossing, the following operational sequence occurred:

- the train controller manually issues advanced intermediate control on Signal 2097 (the 30-second vital timer is disabled)
- Signal 2097 clears
- the level crossing alarms start to ring when a train occupies 2221CT
- 5 seconds later, the barrier arms start to descend

- when the barrier arms reach the horizontal position (7 seconds later), Signal 2097 clears.

3.3.7. The level crossing design had 3 other safety features:

- the advanced intermediate command will not be effective if another Down train is already on the outer approach (2221BT) or approach (2221CT) when the command is issued
- when a Down train is on either the outer approach or approach and the alarms are already operating, they will continue to operate
- if the barrier arms are down already, Signal 2097 will clear as soon as the 30-second timer runs down under normal operation.

3.3.8. A risk assessment undertaken by KiwiRail Network concluded that there was a higher risk of a fatality should a motorist ignore the active level-crossing protection than the risk of a train passing Signal 2097 at Stop and the warning devices not operating. The higher risk score was based on the higher likelihood of a motorist ignoring the bells and barriers if they were kept waiting for too long than the likelihood of a train overrunning the platform and thus the signal. The assessment determined that the consequences of a collision owing to a SPAD were reduced owing to the relatively low speed of a train because it would normally be stopping at the station platform before the signal, and that most SPAD events incurred an overrun distance of less than 20 m. The likelihood of a collision due to operating alarms being ignored by motorists was mitigated by ensuring that the alarm operation was not excessive.

3.3.9. There were 5 other level crossings near stations within the Auckland commuter rail network on the North Auckland Line that had similar time-delay features for stopping trains and an advanced indicator control for non-stopping trains.

3.4. Personnel

The locomotive engineer

3.4.1. KiwiRail's Operating Rule 104 stated in part:

> A train is in the charge of the Locomotive Engineer who is responsible for its safe running. They must be sufficiently familiar with the track over which they are required to work to ensure that they can maintain full control of their train at all times and have a thorough knowledge of any special instructions and signals controlling the movement of trains over that track.
>
> All personnel of the train crew must obey the Locomotive Engineer's instructions as to the working of the train. In the event of unusual circumstances the Guard/Train Manager on a passenger train has a shared responsibility with the Locomotive Engineer to provide protection for the train when necessary and assist to resume normal; operation.

3.4.2. The locomotive engineer of Train 9113 was employed by KiwiRail. He had gained his first-grade locomotive engineer certification in 1987 and he had driven both freight and passenger trains from the Westfield locomotive depot since that time.

3.4.3. He was not required to complete the full on-the-job training for SA/SD trains equipped with graduated release braking systems because he held current certification to operate locomotive-hauled express freight trains and already had route knowledge of the Auckland suburban rail network.

3.4.4. On Sunday 5 March 2006, he received instruction and completed the prescribed 4-hour familiarisation training on the SA/SD trains equipped with graduated release braking systems. The familiarisation included:

- prepare to drive an SA/SD train
- drive an SA/SD train
- demonstrate knowledge and use of the graduated release braking system
- change driving ends on the SA/SD set
- demonstrate knowledge of the emergency exit operation.

The locomotive engineer's on-job training included one non-commercial return trip between Westfield and Britomart, during which he correctly positioned the train at Panmure, Glen Innes and Orakei Station platforms. When he returned to Westfield, he was assessed as being competent to drive an SA/SD train and operate commercial services unsupervised.

3.4.5. Nine days later, on 14 March 2006, the driver overran Ellerslie Station platform. The train was then set back to the platform without the required authorisation from the train controller. KiwiRail's investigation identified distraction from a crew member travelling in the driving compartment as the prime contributor to the platform overrun.

3.4.6. KiwiRail provided the locomotive engineer with additional tuition regarding DLAS operating rules and he was required to re-sit and pass a DLAS theory assessment before being allowed to resume driving SA/SD passenger trains.

3.4.7. Training records confirmed that post-incident follow-up safety observations/assessments were carried out on the locomotive engineer on 27 March 2006, 22 June 2006, 13 July 2006, 20 July 2006 and 18 August 2006. During these observations he correctly answered questions relating to setting back in DLAS territory.

3.4.8. There were no other recorded incidents until 28 June 2008, when the driver passed Signal 12L, Penrose, displaying a Stop indication. Following the SPAD, he was placed with a minder driver (tutor) for 3 weeks focusing on best practice defensive driving and train handling. His driving performance was reassessed by a team leader before he resumed driving passenger services unsupervised, with a requirement that he be assessed at more regular intervals during the following year.

3.4.9. A safety observation was carried out on the locomotive engineer on 21 July 2008. The assessor recorded that he was cautious when approaching platforms and signals.

The train manager

3.4.10. The train manager of Train 9113 had been employed by Veolia for 2 years. He had been a train manager for 7 months.

3.4.11. The train manager had started his shift at Westfield at 0600 on 4 September 2008. He was travelling in the front carriage of Train 9113 when it approached Fruitvale Road Station. He said that he thought the brakes were coming on nicely, but it seemed as though the brakes were applied a bit late.

3.4.12. Once the train came to a stop, the train manager was aware that one passenger door on the last carriage was positioned over Fruitvale Road Station platform, but in spite of this he opened all doors on the platform side within 8 seconds of the train stopping. The train manager did not communicate with the passengers before or after opening the doors, nor did he communicate with the locomotive engineer.

3.4.13. Section 4 of Veolia's Operating Rules stated in part:

> If the train should over run a platform the crew must confer so as to inform the customers of the situation and make sure no one is placed in any position of danger by alighting from the train where there is no platform. If there is 1 [one] door on the platform the Train Manager may let passengers out of this doorway only. There are instructions that the Locomotive Engineer must follow before the setting back movement can be made.

3.5. Train handling

3.5.1. KiwiRail's Operating Code, Section 4.3, Train Handling and Associated Instructions had 52 pages of instructions relating to driving freight trains. Section 4.3 also had 4 pages relating to driving passenger trains. The following are relevant extracts from those instructions:

> **1.13 PASSENGER SERVICES**
> In handling a passenger train the problem of slack control is much the same as with freight trains. Most rough handling occurs at slow speeds and extreme care must be used to avoid heavy brake applications at the lower speeds.
>
> Most passenger trains consist of only a few vehicles. In this case the locomotive brake must be allowed to apply; if not, the few vehicles on the train will be asked to do an undue share of braking. If the locomotive's weight is 80 tonne and if there are only 4 vehicles on the train then each vehicle would need to brake 20 tonnes of locomotive as well as itself, and in this case very heavy reductions would be needed, resulting in high brake block wear and rough stops. With such short trains the locomotive must do some of the braking either with the air brake or dynamic brake where this can be used.
>
> **1.13.2 Stopping Using Air Brake/Dynamic Brake**
> Approaching a stopping point the train should be taken hold of in good time. While not essential, the best control is obtained by setting up into dynamic brake after making the automatic reduction. Speed should be pulled down so that a release of the air brake can be made at about 40 km/h with some distance still to go, then running along the platform with speed being reduced by dynamic braking until approaching the stopping point with a light reduction, then stop the train at the correct point. A similar technique can be used without using dynamic braking but control is not as positive.
>
> **1.14 POWER AND PROLONGED BRAKING**
> Power braking is where the train brakes are applied while the locomotive is still in power. This is wasteful as more braking effort is required to slow the vehicle than if power was shut off, resulting in greater heat being generated by friction causing the wheels to heat up excessively.
>
> Stretched braking is power braking and is necessary for successful train handling, and will not result in overheating of the wheels if applied correctly.
>
> Prolonged moderate to heavy braking also is wasteful as it is usually the result of entering the top of a grade at too high a speed.
>
> Both power braking and prolonged heavy braking can result in overheated tyres and solid disc wheels. Both of these braking situations have resulted in:
>
> - loose tyres – in a number of cases, the tyre came off and a derailment resulted
> - solid disc wheels becoming loose on the axle and moving resulting in derailment
> - cracked tyres
> - spalled treads
> - burned out brake blocks and brake shoes.
>
> Locomotives hauling passenger trains must not use power braking above notch 2.

3.5.2. The DC-class locomotives assigned to haul SA/SD train sets had the 26C brake cut-off set up for 3 positions: Out, Freight and Passenger. The Passenger position had to be used on the locomotives when hauling the SA/SD train sets. The train handling instructions for SA/SD train sets were contained within mechanical engineering document M9349 SA/SD Car Operating Instructions and stated in part:

> **18. SA/SD Train Handling instructions**
>
> **Graduated Release**
> All SA/SD carriages are fitted with WG1 triple valves. The WG1 triple valves have a graduated release capability which means that in addition to the brakes being able to be applied gradually in steps, they can be released gradually in steps.

18.1 Key points for handling SA/SD train sets

Operation as a Three Car + 1 SD car consist with a locomotive Working At One End (Push – Pull Configuration)

- The locomotive will comprise 1/3rd the total train weight. Therefore to avoid skids on the carriages or overheating of the wheels, the independent release should not be used to bleed off any automatic brake application on the locomotive.
- The locomotive and carriage brakes are capable of being applied, then partially released to any point between full service and release and can then be reapplied a further number of times. The air supply that feed the brake cylinders is constantly topped up out of the Main Reservoir pipe, to ensure brake cylinder air is always available.
- If a brake application is made and then the brake handle is moved part way back towards release the brake cylinder pressure will reduce according to the new handle position.
- With the graduated release brakes on both the locomotives and carriages, there will always be air pressure in the brake cylinders after a brake reduction, until the brake pipe is fully recharged again. If the locomotive automatic brake application is left applied as recommended, the locomotive brake cylinder pressure will mimic the brake cylinder pressure on the carriages.
- The emergency brake cylinder pressure on the SA/SD carriages is the same as the full service brake cylinder pressure. In emergency the speed of the brake application is faster due to the faster brake pipe discharge rate.

3.6. Door operation

3.6.1. Toll Rail's M9349, SA/SD Cars Operating Instructions, Issue 1, dated 11 November 2004 stated in part:

3. Door Operation

Important Note: The doors must only be operated when the train is at a complete standstill.

4.1 Door Release:
The doors can only be released for operation by the locomotive engineer from the locomotive cab. Door release only becomes operative when the locomotive throttle is in idle and the brakes are applied. (Either Brake Pipe Pressure below 500 kPa or Brake Cylinder Pressure more than 100 kPa).

4.2 Opening of all doors on a side:
Once the locomotive engineer has released the doors from the locomotive cab, insert the key and turn to position **"1" or "2".** Press **"All Doors Open"** pushbutton and all doors on that side will open, **"Doors Open"** lights come up as doors open.

4.3 Local opening of a door:
Insert key and turn to position **"1" or "2",** press **"Local Open"** pushbutton. Local door opens **"Door Open"** light comes up as the door opens. The **"All Doors Open"** pushbutton can then be pressed if desired.

3.7. Downloaded data from the locomotive event recorder

3.7.1. Data was downloaded from the Tranzlog event recorder fitted to locomotive DC4939 and SD3199 following Train 9113 overrunning Fruitvale Road Station platform and the subsequent passing of Signal 2097 at Stop. The downloaded data confirmed:

- the Tranzlog event recorder was working correctly at the time of the overrun
- the Tranzlog global positioning system was working correctly to update the clock to New Zealand Standard Time at one-minute intervals
- an average of 8 speed system messages from the logged data showed that the radar speed was 0.4% faster than true speed, while the locomotive speedometer gauge was 0.2% faster than true speed. Radar speed is used in the Tranzlog output graph (see Figure 7 and Appendix 1).

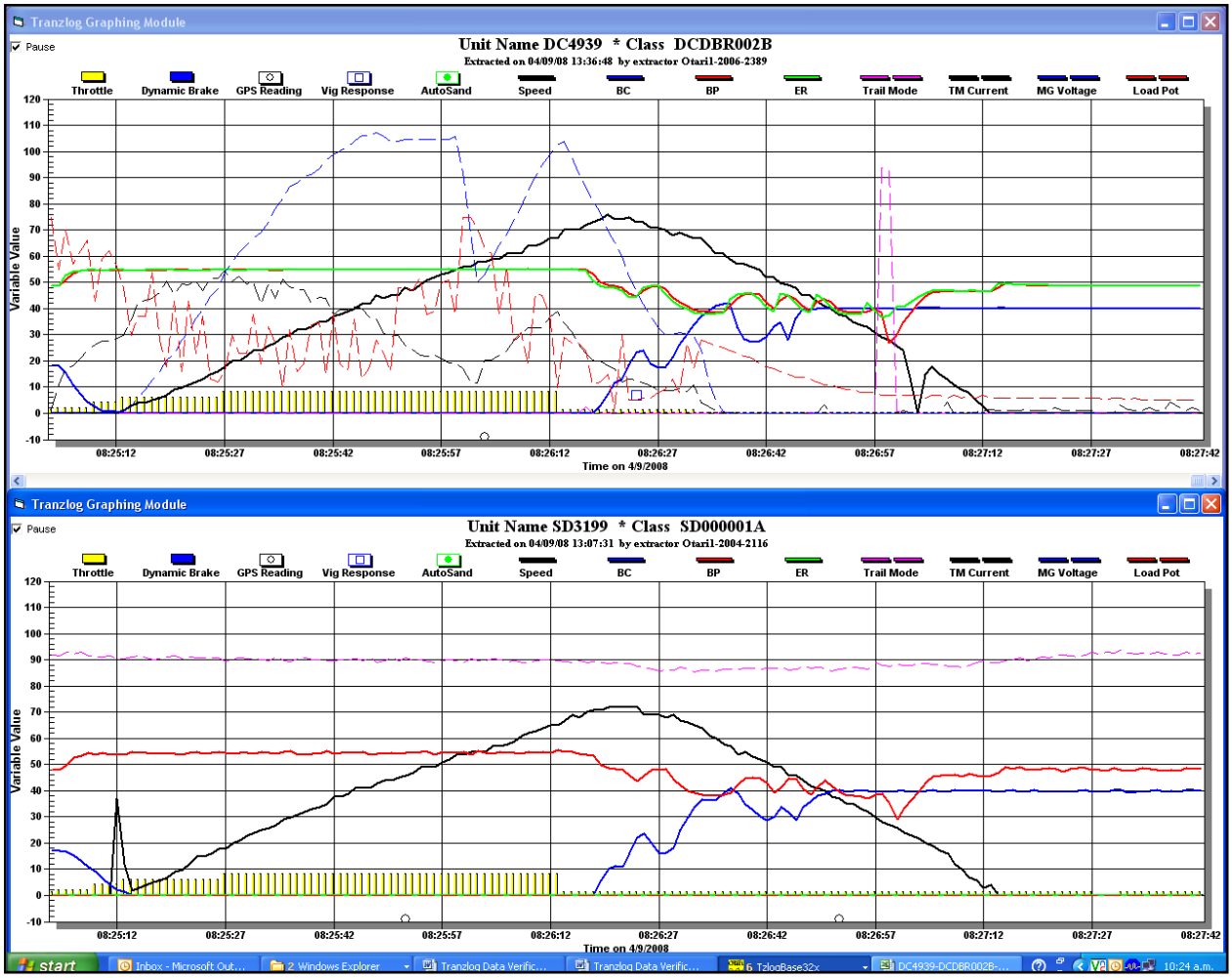


Figure 7
Tranzlog outputs for Train 9113 approaching Fruitvale Road Station

3.7.2. The following table shows the braking sequence of Train 9113's approach to Fruitvale Road Station. Data was sourced from equalising reservoir (ER) pressure changes, which were controlled by the locomotive engineer. For each event the distance in metres is given between the locomotive and where it stopped, from the locomotive to Signal 2097 and from the locomotive to the end of the station platform.

Time	Speed (km/h)	Throttle position	Event	Feature	Distance to where train stopped (m)	Distance to Signal 2097 (m)	Distance to Fruitvale Road end of station platform (m)
0826:16	70	1	Automatic brake applied, 110 kPa reduction over 10 seconds		726	660	633
0826:23	75	1	Automatic brake application eased, ER increased by 46 kPa		585	519	492
0826:27	71	1	Automatic brake moved to full service over 4 seconds		504	438	411
0826:28	71	1	30-second timer is activated	Occupied 2221CT	491	425	398
0826:32	67	1	Throttle moved from notch 1 to idle		408	342	315
0826:36	61	Idle	Automatic brake application eased, ER increased by 79 kPa		336	270	243
0826:40	56	Idle	Automatic brake moved back to full service over 3 seconds		272	206	179
0826:43	52	Idle	Train 9113 reaches station platform	Start of platform	233	167	140
0826:43	52	Idle	Automatic brake application eased, ER increased by 70 kPa		227	161	134
0826:44	50	Idle	Automatic brake moved back to full service over 4 seconds		212	146	119
0826:48	45	Idle	Automatic brake eased, ER increased by 79 kPa	Near station shelter mid-platform	159	93	66
0826:49	43	Idle	Automatic brake back to full service over 3 seconds		147	81	54
0826:54	36	Idle	Train past end of platform	End of platform	93	27	0
0826:55	34	Idle	Automatic brake eased, ER increased by 43 kPa		82	16	(9)
0826:56	33	Idle	Automatic brake moved back to full service over 2 seconds		73	7	(20)
0826:57	31	Idle	Train past Signal 2097	Signal 2097	66	0	(27)
0826:58	29	Idle	Automatic brake application eased, ER increased by 94 kPa over 6 seconds	Roadside kerb	55	(11)	(38)
0827:10	0	Idle	Movement stopped	Train stopped	0	(66)	(93)

3.8. Inspection and testing of train's air brake system

3.8.1. KiwiRail's mechanical code M9352, effective 19 October 2006, specified types of air brake inspection and test procedures for the push/pull train sets. The code contained procedures for an SA single-car brake test, the SD driving trailer and a brake efficiency test as a complete train.

3.8.2. Mechanical code M9103, effective 1 September 2006, Revision 9, provided details of the Locomotive Air Brake Code Operating Efficiency test to be carried out annually during a scheduled C-check. The brake efficiency test could be carried out at more regular intervals following a report from a locomotive engineer of defective braking performance, and the braking test had also to be performed whenever there was an operating incident in which a train's braking system could have been a contributory factor.

3.8.3. The train set was withdrawn from service after the locomotive engineer reported the platform overrun to his manager. A brake efficiency test as specified in KiwiRail's mechanical code M9103 was performed on locomotive DC4939 later that day. The results from the required 18 individual tests confirmed that the braking system on locomotive DC4393 was operating correctly and was compliant with the mechanical code.

3.8.4. The SA/SD train set brake operation efficiency test specified in M9352 was carried out the following day. The individual tests carried out on each carriage confirmed that the braking performance on the SA and SD passenger carriages was compliant with the code.

3.8.5. A review of the Loco. 54D Fault Reports for the train set for the 6 months leading up to the overrun revealed a single entry only relating to a braking issue. On 7 April 2008, the triple valve had been replaced on SD3199.

4. Analysis

4.1. The Commission started monitoring platform overrun incidents on the Auckland passenger rail network, not because each incident on its own was seen as a high risk, but because the statistics showed that the frequency of platform overruns was trending up. To keep the matter in perspective, one overrun incident was reported for about every 25,000 scheduled passenger stops. Locomotive engineer training and braking technique were considered to be a significant contributor to this platform overrun and will be discussed in this report as was done in the Commission's published report 07-105.

4.2. This platform overrun differed from those in report 07-105 in that this overrun resulted in Train 9113 entering the Fruitvale Road level crossing, which would, it has been determined, have been unprotected had it not been for a train approaching from the other direction on the Up Main line. This report therefore discusses the design of the signalling system and its interface with the warning devices making up the level-crossing protection.

4.3. Also relevant to the overall safety of the passengers were the immediate actions taken by the train crew in response to the train overrunning the platform.

Train 9113 approaching Fruitvale Road Station

4.4. To comply with KiwiRail's track geometry standards, all trains approaching Fruitvale Road Station on the Down Main line were restricted to a maximum line speed of 65 km/h for more than 500 m leading up to the station platform. Trains on this approach crossed the insulated joint between track sections 2221C Track and 2221B Track, and for non-stopping freight trains this activated a timing sequence that provided a minimum 24 seconds' warning time for pedestrians and motorists using the Fruitvale Road level crossing. The design of the track circuitry (and the warning to level-crossing users) was based on the trains travelling at no more than the maximum speed of 65 km/h.

4.5. For passenger trains stopping at the platform, the vital timer delayed the start of the 24-second warning to motorists by 30 seconds to allow the train to stop and conduct passenger activity before moving off and entering the level crossing.

4.6. The Tranzlog data downloaded from locomotive DC4939 showed that Train 9113 exceeded the maximum authorised line speed by 10 km/h on approach to Fruitvale Road Station. At 0826:23, the train reached a maximum speed of 75 km/h about 352 m from the start of the platform.

4.7. Five seconds later at 0826:28, the 30-second vital timer started to count down when the train crossed the insulated joint travelling at 71 km/h; at that point 436 m back from the kerb line at Fruitvale Road level crossing. Fifteen seconds later, the train slowed to 52 km/h when the locomotive reached the start of Fruitvale Road Station platform.

4.8. By the time the train slowed to 40 km/h it had travelled 109 m along the platform; 31 m from the end of the platform. The train stopped 124 m past that point. The recorded stopping distance of 124 m from 40 km/h showed that the push/pull train set could have been stopped within a standard 140 m long station platform had the driver slowed the train speed to 40 km/h before it reached the start of the station platform, a guide used by some drivers. To compensate for the down-grade approach to Fruitvale Road Station on the Down Main line, the recommended approach speed would have been less than 40 km/h to achieve a controlled and conservative stop. This was an example of a "best-practice" braking technique that, had it been developed for passenger trains fitted with graduated release brakes at the time the push/pull train sets were introduced, could have significantly reduced the frequency of platform overruns.

4.9. Train 9113 was travelling at 36 km/h when it passed the end of the station platform. It had slowed to 31 km/h when it passed Signal 2097 at danger and was still travelling at 29 km/h when it reached Fruitvale Road level crossing 30 seconds after activating the vital timer at 0826:58.

4.10. When Train 9113 entered Fruitvale Road level crossing exactly 30 seconds after occupying 2221 C Track, the barrier arms were already down. The barrier arms take about 7 seconds to

descend and this is preceded by about 5 seconds of flashing lights and bells, so it could not have been Train 9113 that activated the protection, but instead the train travelling in the opposite direction on the adjacent Up Main line. Further evidence of this follows.

4.11. Because the Fruitvale Road Station platform on the Up Main line was beyond Fruitvale Road, there was no need for a 30-second vital timer delay for the level-crossing protection. The flashing lights and bells at the level crossing operated as soon as Up Train 8110 entered 1954 E Track, giving motorists a minimum of 24 seconds' warning time. Five seconds after the flashing lights started to operate, the barrier arms descended over the next 7 seconds. The flashing lights and bells continued to operate and the barrier arms stayed horizontal for at least another 12 seconds until Train 8110 entered the crossing, which from its Tranzlog data proved to be 13 seconds after Train 9113 passed Signal 2097.

4.12. Based on the aforementioned analysis the Commission concludes that had Up Train 8110 not approached Fruitvale Road Station at the time it did, Down Train 9113 would have entered Fruitvale Road level crossing with the flashing lights and bells having been operating for 1.3 seconds, and the barrier arms would not have started to descend. Motorists close to the level crossing would unlikely have had sufficient time to recognise that the signals were operating and stop their vehicles. Given the time of day and the high density of road traffic at that time of the morning, Train 9113 colliding with a road vehicle or pedestrian was a real possibility.

Signal design

4.13. The compromise between reducing undue delays to road traffic and providing adequate protection at level crossings is not an easy one to manage. Because the overlap distance from Signal 2097 to the kerb line of Fruitvale Road was 11 m only, rather than the recommended 150 m, there was a risk that the level crossing active protection would not be fully operational (barrier arms down) if a "stopping train" overran the platform and signal. One method of reducing the risk created by an overrunning train would be to reduce the delay caused by the vital timer so that the level crossing protection started sooner, but this creates another risk: road driver impatience leading to their driving around the barriers, particularly if they can see a train stopped at the station platform. The risk is increased at double-track level crossings because the protection can be activated by a train coming from the other direction as well, a point that could be easily missed by motorists, particularly those not familiar with the level crossing.

4.14. In a Literature Review of Human Factors Safety Issues at Australian Level Crossings (Edquist, Stephan, Wigglesworth, & Lenné, 2009) the writers say that road users are unwilling to stop if they believe that the likely costs from stopping outweigh the costs of continuing. The review goes on to say that this is particularly true for local road users, who may believe that they know the length of time from the activation of the warnings to train arrivals and decide that they can cross safely. Road users are more likely to violate crossings when the crossing signals are frequently activated without a train appearing (Wilde et al 1987, cited in Yeh & Multer, 2007), or when there are long warning times (Richards & Heathington, 1990).

4.15. The literature review also quotes a second factor affecting the credibility of warning signals as being the length of time for which they are active before a train appears. A succession of studies (all from the United States) has shown that crossings with longer warning times have higher violation rates, and more road users who cross when train arrival is imminent (Carlson & Fitzpatrick, 1999; Richards & Heathington, 1990; Richards, Heathington & Fambro, 1990; Yeh & Multer, 2007). This occurs when road users stop at activated warnings, wait for trains, get impatient and start to cross as the trains finally appear. Richards and Heathington (1990) found that drivers expect trains to appear within 20 seconds of warning activations. If warning times exceed 30-40 seconds, there is an increase in risky behaviour. They suggested that warning times should be set as closely as possible to the minimum required for long/heavy vehicles to clear the crossing.

4.16. A passenger train intending to stop at Fruitvale Road Station had 42 seconds to travel 436 m if it were to enter the level crossing with full protection in place (bells, lights and barrier arms). The average speed under which the train would need to remain was about 37 km/h. If the train was under control and down to a maximum speed of 40 km/h by the time it reached the beginning of the platform, a 37 km/h average would easily be achievable. One method of reducing the

average speed of trains to a manageable level is to place a lower speed restriction out from the station platform. For example, a speed restriction of 40 km/h from the insulated joint would achieve 2 things: the first is it would lessen the likelihood of a platform overrun through driver mishandling; and the second is that even if an overrun did occur, there would be more chance that the level-crossing protection would have time to be fully activated.

4.17. There would in this example be a possible increase in waiting time for motorists sitting at the level crossing, but this would only be in the region of 3-4 seconds, which would be negligible in the context of the delays that could occur with passenger operations at the platform.

Locomotive engineer training and experience

4.18. Because there was no failsafe engineering solution for the Down Main line activation of Fruitvale Road level-crossing protection, the safe operation of the level crossing was reliant on a locomotive engineer having their train under control and in strict compliance with the speed restriction approaching the station.

4.19. Historically, the training of KiwiRail locomotive engineers had focused on driving freight trains, although much of the knowledge gained and skills developed were transferable to driving the push/pull passenger trains. However, with such a rapid growth in the number of push/pull train sets operating on the Auckland rail commuter network, there was a consequential demand for more trained locomotive engineers who could operate on both the freight train roster and the push/pull passenger train roster. While this did provide a flexible workforce, locomotive engineers moving between the 2 operations were required to adjust driving styles to suit the partilcular operations.

4.20. When the locomotive engineer of Train 9113 had received his 4-hour formative training for driving push/pull trains equipped with graduated braking systems, about 30 months earlier, it was done so with no “best-practice” train handling method developed to position a train correctly at station platforms. At that time, some locomotive engineers were told to focus on the near end as a landing point then proceed along the platform with the train under control, while others were told to focus on the stopping point at the far end of the platform. The chosen approach depended on which method the particular minder driver favoured (Commission report 07-105).

4.21. The concept of driving push/pull trains on multiple-stop outer-urban routes was vastly different from driving long-haul freight trains that did not have graduated release brake systems. Locomotive engineers were required to consider a number of variables when braking a push/pull train so that it could be positioned correctly at a station platform. These included:

- the length of the train relative to the length of the platform
- the passenger loading
- the track alignment and gradient on the approach to and at the station platform
- the prevailing weather conditions; rail dry or wet
- the respective driving end; whether the train was being driven from the locomotive or the SD driving trailer
- the feel of the braking performance on the particular push/pull set being driven.

All these variables were not dissimilar to those encountered with other transport modes, where operators were taught and learned by experience to make adjustments for the operating variables. A similar programme aided by a manual of best-practice driving technique would have minimised the problems encountered in the first years of push/pull operation, including platform overruns such as at Fruitvale Road Station.

4.22. An analysis of the Tranzlog data showed a number of errors in train handling technique that contributed to the platform overrun. To start, Train 9113 exceeded the maximum curve speed limit by 10 km/h on approach to the station, then the locomotive engineer only made minimal brake applications as he attempted to bring his train speed under control. Even when the

locomotive had passed Signal 2097 at danger, not only did the driver not make a full service brake application, he actually decreased the brake application. The driver's explanation that he felt his train had gone into a slide is not consistent with the minimal brake applications he was making and the dryness of the track at the time.

4.23. The locomotive engineer's history of performance issues indicates that he, in particular, was in more need of a thorough training and familiarisation package than he had received at the time of converting to the push/pull trains.

4.24. A recommendation was made in the Commission's report 07-105 to the Chief Executive of the NZ Transport Agency to address with KiwiRail the shortfall in training standards for push/pull train locomotive engineers. KiwiRail started a programme of re-training in 2010. Refer section 6 "Safety actions".

Post-incident recovery

4.25. Having overrun the station platform by almost a train length and unsure whether he had passed Signal 2097 at Stop, at the very least the locomotive engineer was required to converse with the train manager so that passengers could be informed of the situation and to make sure that no passengers would be put at risk by alighting from the train where there was no platform. The lack of effective communication that was required was not helped by the fact that there was no direct access between the passenger cars and the locomotive, and train managers had not been issued with portable radios. This issue was raised in Commission report 06-110 with recommendation 016/08.

4.26. Even though the locomotive engineer was unsure whether Stop and Proceed Signal 2097 was at Stop when Train 9113 passed it, KiwiRail's operating procedures required him to report the incident. Passing a signal at Stop was considered by KiwiRail to be a serious operating irregularity, and as a precautionary measure the locomotive engineer should have been relieved. The relief of a locomotive engineer during the morning peak would have caused considerable delays for passengers both on the train and on following scheduled services. The locomotive engineer said he did not know why he had not reported the incident immediately. Two possibilities are that he was aware that being replaced would disrupt services, or it may have been because he had passed a signal at Stop some 2 months earlier and he had only recently returned to driving duties after 3 weeks' coaching and on-the-job retraining. Similarly, the locomotive engineer said he did not know why he had released the doors within a few seconds of the train stopping without first determining how many, if any, doors were over the platform.

4.27. Similarly, the train manager said he did not know why he had open all doors on the platform side of the station instead of walking to the rear of the train and only opening the local door that was positioned over the station platform. There was potential for injury to passengers through slips, trips and falls when passengers were allowed to alight from Train 9113 through 7 of the 8 doors that were not located over the platform.

5. Findings

Findings are listed in order of development and not in order of priority.

5.1. If a train on the adjacent Up Main line had not activated the Fruitvale Road level-crossing protection, Train 9113 travelling on the Down Main line would have entered the level crossing at close to 30 km/h with the barrier arms still raised and the flashing lights and bells having operated for 1.3 seconds only.

5.2. Stop and Proceed Signal 2097 between the station platform and Fruitvale Road level crossing was displaying a red aspect when Train 9113 passed it without stopping for the required 10 seconds. The SPAD was the result of a platform overrun rather than the driver misreading that and the previous signal.

5.3. Train 9113 overran the platform because the locomotive engineer approached the platform in excess of the maximum allowable speed and did not brake his train early enough, and his initial brake application was insufficient to overcome natural tolerances in the brake control rigging and begin to slow the train effectively.

5.4. The locomotive engineer of Train 9113 was not fully conversant with the braking capabilities of the push/pull trains because the Toll Rail/KiwiRail locomotive engineer training programme for the push/pull train sets did not teach a standardised methodology for driving the push/pull sets, it did not have standard methodology for minder drivers to pass on to trainees, and it did not set minimum levels of service and competency for trainee locomotive engineers.

5.5. The risk created by having a station platform close to a level crossing meant there was an increased reliance on good driver performance to mitigate the risk of a train overrunning the platform and entering a level crossing with no active protection operating.

5.6. No train or equipment failure contributed to the platform overrun.

5.7. The post-platform overrun actions by both the locomotive engineer and the train manager did not comply with company procedures and created safety issues for the passengers alighting from the train.

5.8. The interface between the signalling system and the activation of the level-crossing protection struck about the right balance between protecting the level crossing and minimising the risk of the warning signals being ignored owing to the length of time they were active until a train appeared or began to move away from the platform.

5.9. The risk of trains overrunning platforms entering unprotected level crossings could be mitigated by the use of speed restrictions to force drivers to approach station platforms at reduced line speeds.

6. Safety actions

General

6.1. 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 that would otherwise have resulted in the Commission issuing a recommendation; and

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

6.2. The following safety actions are not listed in any order of priority.

Safety actions addressing proposed recommendations

6.3. On 14 June 2010, the Commission received a copy of KiwiRail's Bulletin No. 100, dated 17 February 2010, Rail Operating Code Section 4: Operating Instructions for Locomotive Running Personnel, referred to as a revised train handling technique for stopping at station platforms, which stated in part:

Section 4.3 Train Handling and Associated Instructions

1.13.5 **Graduated Release Brakes** (amended instruction)
Replaces existing instruction:

1.13.5.1 Operation:

- Graduated release brakes are fitted to some classes of passenger car.
- This system allows a gradual increase in brake pipe pressure. It removes the need to fully release then re-apply braking.
- When the brake handle is moved towards release the system reduces the breaking effort on each car and the locomotive in proportion to the rise in brake pipe pressure.
- The brakes will not fully release until the brake handle has been restored to the "release/running" position.
- To operate the graduated brake the locomotive valve must be in the "PASS" position.

1.13.5.2 Platform Stops:

- This technique is intended to protect against platform overruns resulting from :

  Excessive train speed approaching platforms.

  A loss of braking effort through excessive wheel/brake block heat- known as "brake fade".

- To achieve a controlled stop at station platforms the following must be applied:
  - The braking sequence must ensure the train is travelling at approximately **40 km/h,** when the locomotive (or SD cab for push/pull trains) reaches the commencement of the station platform. The speed at platform entry can be varied to compensate for gradient provided the stop is achieved in a controlled manner.
  - At least 10 seconds before reaching the point at where the speed is to be reduced:
  - Reduce power to idle.

- Make an initial 50 kPa reduction to "set up" the brake rigging and blocks.
- At the point where speed is to be reduced make a second reduction sufficient to bring the train speed down to approximately **40 km/h** entering the platform.
- Dependent on platform length or gradient, increase and decrease **brake pipe** pressure by manipulating the automatic brake valve handle in the **service zone** to "drift" the train to a smooth stop.

  Note: As a guide 100kPa brake cylinder pressure at the instant of stopping ensures a smooth stop.

6.4. KiwiRail required all locomotive engineers who held a current certification to operate passenger trains fitted with graduated release brake systems to be retrained in the revised train handling technique. The retraining started in September 2009 and included a review of each locomotive engineer's Tranzlog extraction from one of the driver's recent trips, and theoretical training before on-the-job training using the revised technique over routes for which road knowledge was held. The training was expected to be completed within one day.

6.5. Three locomotive engineers, including the one driving Train 9113 at the time of the overrun, completed the "retraining" module in 2009. The programme resumed in March 2010. As at 1 August 2010, 55 of the 74 locomotive engineers qualified to operate the push/pull train sets had completed the retraining module "Retraining for Platform Stopping Technique for Passenger Trains fitted with Graduated Release Brakes".

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 the NZ Transport Agency, with notice of these recommendations given to KiwiRail Network.

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.

Previous recommendations

7.3. On 21 August 2008 and arising out of an investigation into the uncontrolled movement of a passenger train between Britomart Station and Quay Park junction (report 06-110) the Commission recommended to the Chief Executive of the NZ Transport Agency that he address the following safety issue:

> There is no requirement for operators of passenger trains to have effective communication between the locomotive engineer and the onboard person in charge of passenger operations that will facilitate good crew resource management and be effective in emergency situations. (016/08)

7.4. On 19 August 2010 and arising out of an investigation into push/pull passenger train sets overrunning platforms at various stations within the Auckland suburban rail network (report 07-105), the Commission recommended to the Chief Executive of the NZ Transport Agency that he address the following safety issue:

> The training system for drivers of the push/pull sets on the Auckland rail network did not use standard training techniques, did not teach standard best-practice methods for train operations, and did not include appropriate standards for minder drivers to achieve before being certified to teach trainee drivers. (032/10)

On 25 August 2010, the Chief Executive of the NZ Transport Agency replied in part:

> Discussions on this issue have been ongoing both with the Transport Accident Investigation Commission and various rail industry organisations for some time now since this issue was first raised with the NZTA. SA/SD set braking performance and associated issues also formed an integral part of both the Veolia and KiwiRail assessments this year.
>
> We intend to work closely with KiwiRail with an aim to implementing and closing these recommendations as soon as practicable.
>
> Discussions on them will be ongoing. Any outstanding Transport Accident Investigation Commission (TAIC) recommendations continue to form an integral part of our annual safety assessments of the rail industry.
>
> When these discussions are concluded and the appropriate evidence has been gathered, we will be liaising with TAIC with a view to closing this safety recommendation.

New recommendation

7.5. On 25 November 2010 the following recommendation was made to the Chief Executive of the NZ Transport Agency:

> The location of the Fruitvale Road level crossing close to the Fruitvale Road Station platform represents a risk to level-crossing users in the event of a platform overrun for whatever the reason. There is a delicate balance between the signalling ensuring the level crossing is protected in the event of a platform overrun and ensuring road

users are not kept waiting for so long as to engender the known unsafe practice of road users ignoring signals and barriers and entering the level crossing ahead of passing trains.

Speed restrictions are often used around the rail network as a method of supplementing signals to ensure trains can stop within the available distance ahead without passing signals at danger.

The Commission recommends that the Chief Executive require KiwiRail Network to review the Fruitvale Road Station and associated arrangements for protecting the adjacent level crossing, to see if speed restrictions or other changes to the signalling system can be made to minimise the possibility of an overrunning train entering an unprotected level crossing, without compromising the waiting time for motorists using the level crossing. This review should be extended to other stations where the distance between the stations and level crossings is less than the recommended 150 metres. (044/10)

On 13 December 2010, the Rail Safety Manager replied on behalf of the Chief Executive of the NZ Transport Agency, in part:

We intend to work closely with KiwiRail to oversee the internal review recommended in this report with an aim to implementing and closing this recommendation as soon as practicable.

We note and agree with the comments in Para 4.13 of the draft final report and the comment that it is a delicate balance between the protection of the level crossing and increasing waiting time at the level crossing for motorists leading to unsafe practices.

Discussion on this review will commence on publication of the report and will be ongoing. All outstanding Transport Accident Investigation Commission (TAIC) recommendations also form an integral part of our annual safety assessments of the rail industry.

When this review is concluded and the appropriate evidence has been gathered, we will be liaising with TAIC with a view to closing this safety recommendation.

8. Works cited

Edquist, J., Stephan, K., Wigglesworth, E., & Lenne, M. (2009). *A Literature Review of Human Factors Safety Issues at Australian Level Crossings.* Melbourne: Monash University.

Appendix 1

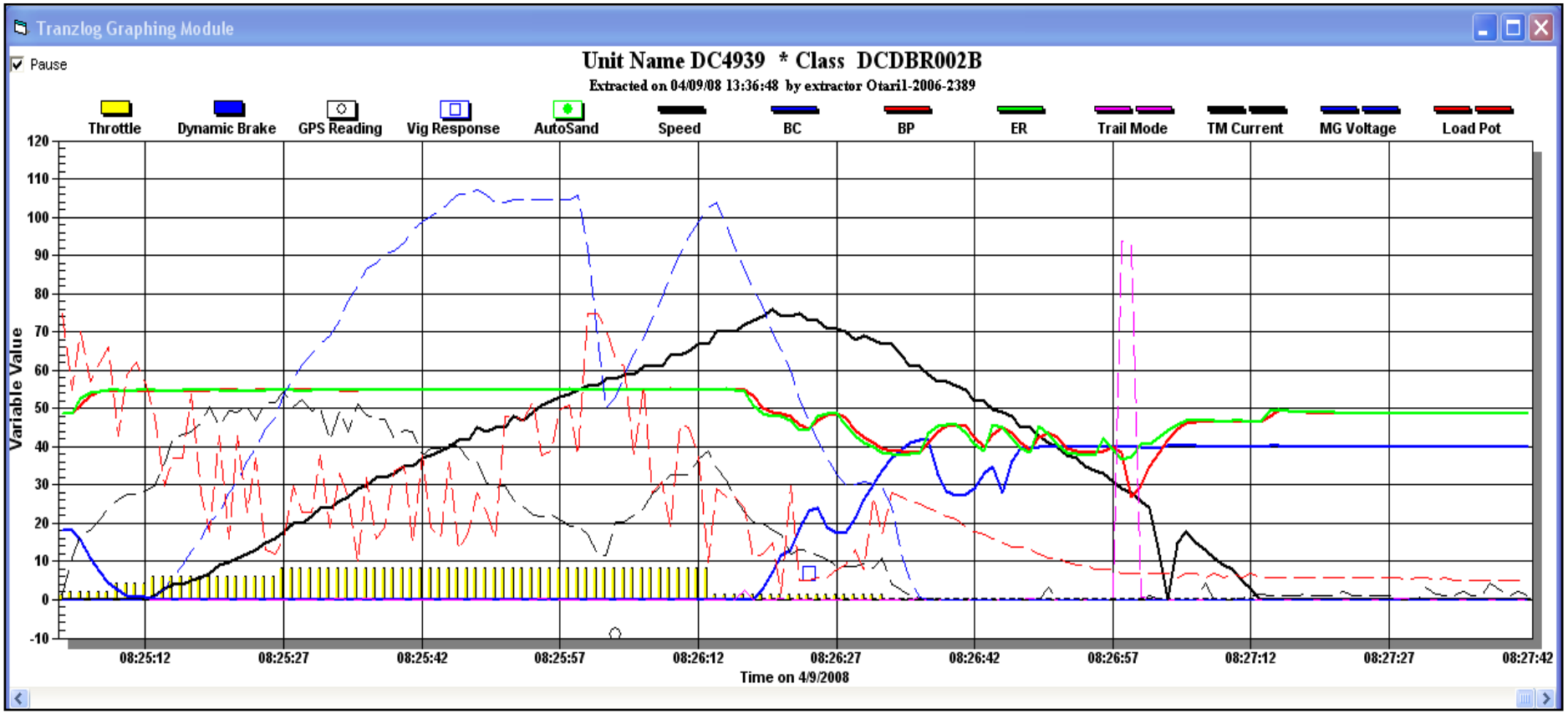


Figure 8
(larger version of Figure 7)

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

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
08-113	empty push/pull passenger Train 5250, collision with platform-end stop block, Britomart station, Auckland, 19 December 2008
08-103	Passenger Train 6294, electrical fire and collapse of overhead traction line, Mana station, Wellington, 18 April 2008
08-108	Express freight Train 845, track warrant overrun, Reefton - Cronadun, 13 August 2008
07-103	Passenger express Train 200, collision with stationary passenger express Train 201, National Park, 21 March 2007
07-115	Express freight Train 533, derailment, 103.848 kilometres, near Tokirima, Stratford – Okahukura Line, 7 November 2007
06-106	Express freight Train 826, signalling irregularity, Cora Lynn, 31 July 2006

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