Report 11-104: Freight Train 261 collision with bus,
Beach Road level crossing, Paekakariki, 31 October 2011

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Final Report

Rail inquiry 11-104
Freight Train 261 collision with bus,
Beach Road level crossing, Paekakariki
31 October 2011

Approved for publication: August 2012

Transport Accident Investigation Commission

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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 cause 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

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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

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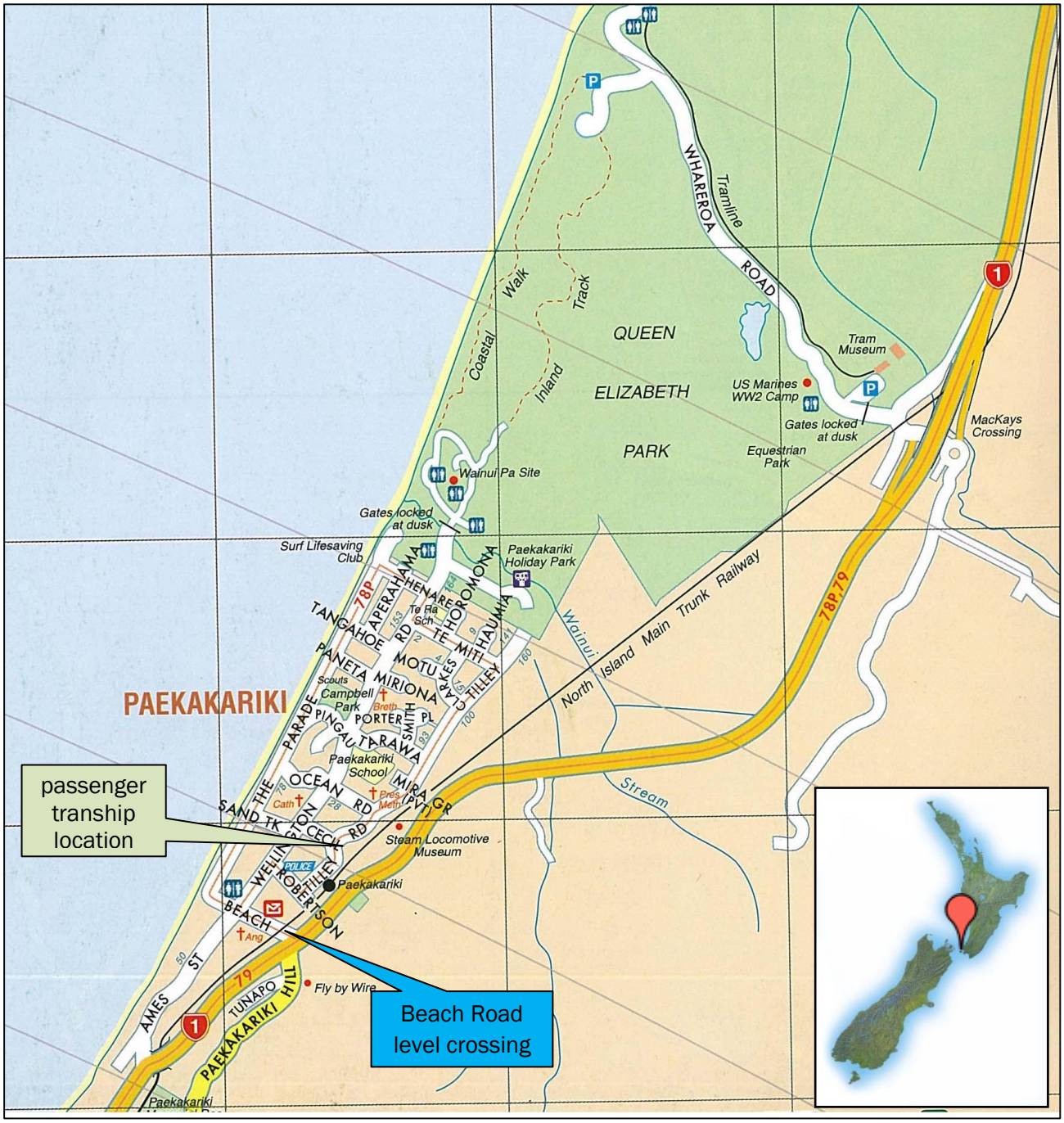

Location of collision

Source: Avis Wellington Street Directory

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Abbreviations

Commission	Transport Accident Investigation Commission
km/h	kilometre(s) per hour
m	metre(s)

Glossary

stacking distance	distance between a road intersection and a railway level crossing
short stacking	a road layout where a long vehicle could block a level crossing when waiting at an intersection
stub axle	an axle arrangement located either in front of or behind the drive axle on a heavy road vehicle to provide stability and distribute the axle loading on the road. The stub axle on the bus involved in the collision was fitted with brakes but was non-powered
train replacement	the general description and usual destination display carried on buses undertaking urban passenger train replacement work in the Greater Wellington Regional Council area
Tranz Metro	a business unit of KiwiRail responsible for the Wellington urban passenger train operation on behalf of the Greater Wellington Regional Council
super-low-floor urban bus	a bus designed with an internal low-level floor to facilitate the carriage of mobility-impaired passengers

Data summary

Train particulars

Type and number:	Express freight Train 261
Origin/destination:	Palmerston North-Wellington
Train weight:	771 tonnes including locomotive
Train length:	340 metres including locomotive
Operator:	KiwiRail Limited

Bus particulars

Type and registration number:	Zonda super-low-floor urban bus, registration GAN105
Bus tare weight/length:	12 tonnes/12.59 metres
Seating:	47 (46 passengers plus one driver)
Owner:	Suburban Buses Limited, Nelson
Operator:	Tranzit Coachlines (Wellington) Limited, Wellington
Date and time	31 October 2011 22:29
Location	Beach Road level crossing, 38.62 kilometres, North Island Main Trunk, Paekakariki
Persons on train at time of collision	one (train driver)
Persons on bus prior to collision	7 (6 passengers and one bus driver)
Injuries	nil
Damage to train	moderate to locomotive and minor to trailing wagons and containers
Damage to bus	major

1. Executive summary

General

1.1. On Monday 31 October 2011, a "super-low-floor" urban bus crossed the Beach Road level crossing at Paekakariki, 38.62 kilometres north of Wellington, and stopped at the road intersection with State Highway 1, where it became stuck. There were 3 sets of tracks at the level crossing and the bus encroached on 2 of these tracks. There were 6 passengers plus the driver on the bus.

1.2. The driver tried various methods to free the bus but did not succeed. After about 5 minutes a freight train approached the level crossing at about 70 kilometres per hour (km/h) and collided with the rear of the bus. The driver and passengers had seen the train approaching and vacated the bus moments before the collision. The train driver was the only person on board the train. Nobody was injured in the collision. The bus was extensively damaged and the train was slightly damaged. The train did not derail.

1.3. Had the bus not become stuck it could have pulled forward far enough to just clear the train on the main line when stopped at the stop sign, but there was not sufficient "stacking distance" available to ensure the bus was clear of the third set of tracks.

1.4. The Transport Accident Investigation Commission (Commission) found that the bus complied with the Land Transport Rule: Vehicle Dimensions and Mass for heavy road vehicles, but that the profile of the level crossing and short section of road leading up to the road intersection was not compatible with long and low road vehicles as required by the NZ Transport Agency Rules.

1.5. The Commission also found that there was not a sufficient stacking distance for road vehicles longer than about 10 metres (m) to stop at the intersection as required and still remain clear of the level crossing. There are some 251 other level crossings in New Zealand with similar stacking distance issues.

1.6. As a consequence of the collision, the bus operator has included the emergency telephone number for the National Train Control Centre in its vehicle operating plan, and has advised other bus operators of this safety action through an industry magazine. The Commission recommended that the Chief Executive of the NZ Transport Agency advise other operators of large road vehicles that their drivers should carry the National Train Control Centre emergency telephone number so that they can alert the train controller in any similar situation.

1.7. The Commission made other recommendations about the layout, profile and stacking distance issues at the Beach Road level crossing, as well as with other level crossings and road intersections throughout New Zealand with similar issues. It also recommended that the NZ Transport Agency ensure that formal consultation takes place between key rail and road industry participants and regulators before changes are made to legislation that could affect other users.

1.8. The key lessons from this inquiry are:

- changes to rules and standards for road transport can compromise safety at rail level crossings. Groups responsible for setting standards for road vehicles and rail level crossings should therefore consider the consequences for other users before making those changes
- drivers of long road vehicles need to know if there is not enough room for their vehicles between a road intersection and a rail level crossing.

2. Conduct of the inquiry

2.1. The accident happened on 31 October 2011 at 2229. The NZ Transport Agency notified the Commission of the accident under section 13(4) of the Railways Act 2005 the following day, 1 November 2011. 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 collision.

2.2. Commission investigators travelled to Paekakariki to conduct an on-site investigation on 1 November 2011. The investigators conducted a survey of the gradients and measured distances on Beach Road from State Highway 1 to the level crossing.

2.3. The bus driver and the bus company's management/supervisory staff were interviewed and the bus driver's duty log book examined. An investigator also visited the railway workshops in Lower Hutt to examine the damaged locomotive and visited the bus company's Masterton maintenance depot to examine the damaged bus.

2.4. An investigator interviewed the KiwiRail train driver and an off-duty track worker who had been a passenger on the bus. Recorded data from KiwiRail's locomotive and signalling systems was secured for analysis.

2.5. The investigators convened a meeting with NZ Transport Agency road vehicle engineers and the NZ Transport Agency rail regulation unit. A subsequent meeting was held with a KiwiRail Infrastructure and Engineering signals engineer to discuss safety issues that had been identified. Following those meetings the Commission issued 3 urgent recommendations to the NZ Transport Agency on 16 December 2011.

2.6. On 31 May 2012 the Commission approved this draft final report for circulation to interested persons for comment.

3. Factual information

3.1. Narrative

3.1.1. KiwiRail was undertaking a long-term project to upgrade the Wellington electric overhead traction wires and ancillary infrastructure in the Kapiti area. Some of this work was undertaken at night between 2000 and 0500 to minimise disruption to Tranz Metro's electric passenger train services.

3.1.2. Tranz Metro replaced its late evening trains with buses between Porirua and Waikanae for the week beginning Sunday 30 October 2011, in order to meet its service-level agreement with the Greater Wellington Regional Council. KiwiRail's diesel-locomotive-hauled freight trains continued operating during this upgrade work.

3.1.3. Tranz Metro had contracted Tranzit Coachlines (Wellington) Limited to provide buses and drivers for the train replacement work. Tranzit Coachlines was a bus-operating company that provided charter and urban services using a fleet of 400 vehicles throughout the North Island.

3.1.4. Tranzit Coachlines leased a Zonda super-low-floor bus for the train replacement work beginning on Sunday 30 October 2011. The Tranzit Coachlines bus driver was based in Wellington and held an appropriate NZ Transport Agency heavy traffic driver's licence. He had been driving buses since February 2010. He had joined Tranzit Coachlines in July 2011.

3.1.5. The bus driver said that he had received an induction to the Zonda bus when he booked on for his train replacement duty on Sunday 30 October 2011. This had included an overview of the vehicle and a supervised driving exercise with a Tranzit Coachlines-approved appraiser around some suburban streets near its Wellington depot. The Sunday assignment was the bus driver's first solo occasion with the Zonda bus.

3.1.6. On that first day the bus driver had to stop at Paekakariki on one occasion. He said that he had felt the back of the bus scrape the road surface when he drove over the Beach Road level crossing and up to the intersection at State Highway 1. He estimated that he had had 20 passengers on board at that time.

3.1.7. The next day, Monday 31 October, the bus driver drove the same Zonda bus and completed 3 return journeys between Paekakariki and Paraparaumu without incident. His fourth and final journey for the evening was from Waikanae to Porirua.

3.1.8. At about 2220 the bus turned right from State Highway 1 to Beach Road at Paekakariki and proceeded to the passenger transhipment location on Tilley Road (refer map on page iv). After exchanging passengers the bus left the transhipment location with 6 passengers on board, of whom one was an off-duty KiwiRail track worker seated in a back-row seat.

3.1.9. The bus turned on to Beach Road, travelled over the level crossing and stopped about 2 m short of the compulsory stop limit lines at the intersection with State Highway 1. The driver thought that he had stopped in about the same position as on the day before, but this time had let his bus roll back slightly.

3.1.10. The level crossing comprised 3 sets of tracks: an Up main line, a Down main line and a Loop line. When the bus stopped, its back end encroached over the Loop line and the Down main line. The wheels of the stub axle were positioned on the Loop line and the drive axle was positioned over a covered drain on the outside of the Loop line (see Figures 1 and 2).

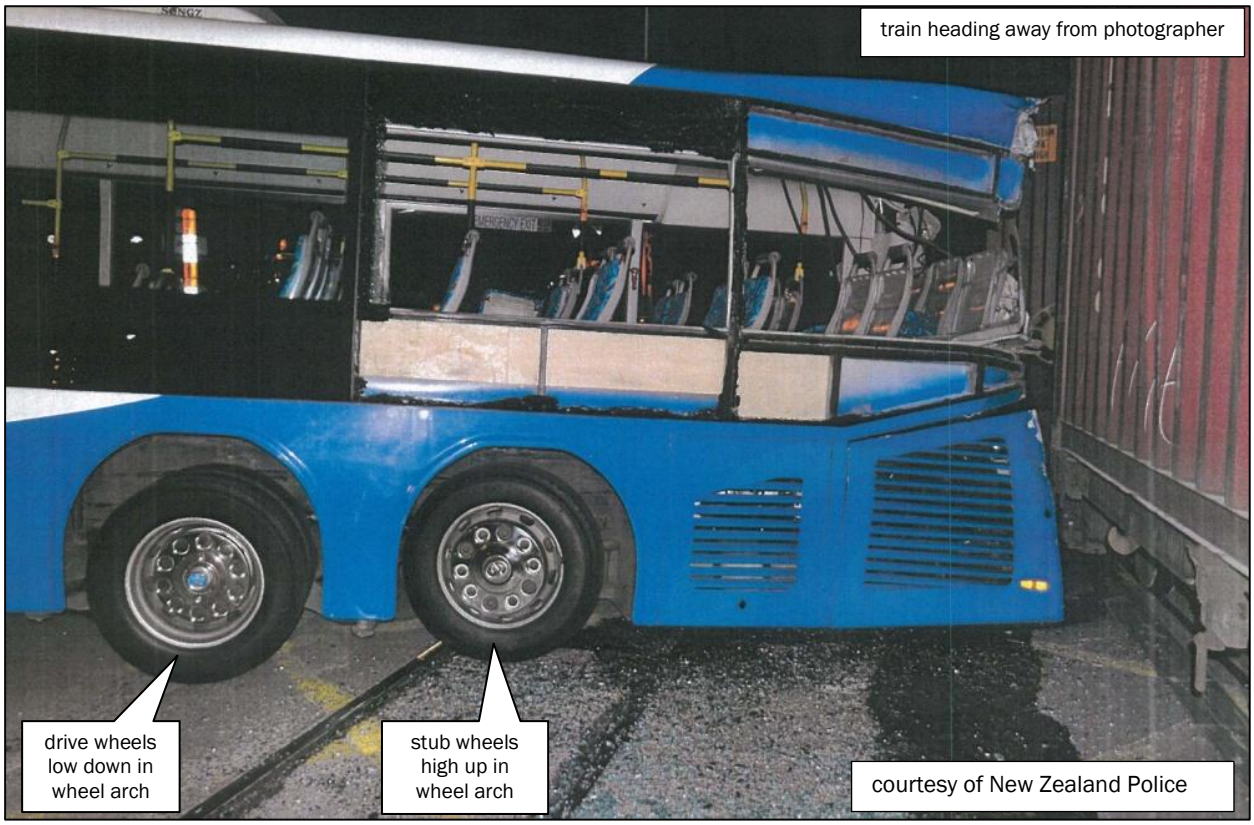

Figure 1
Photograph of the collision aftermath (looking south)

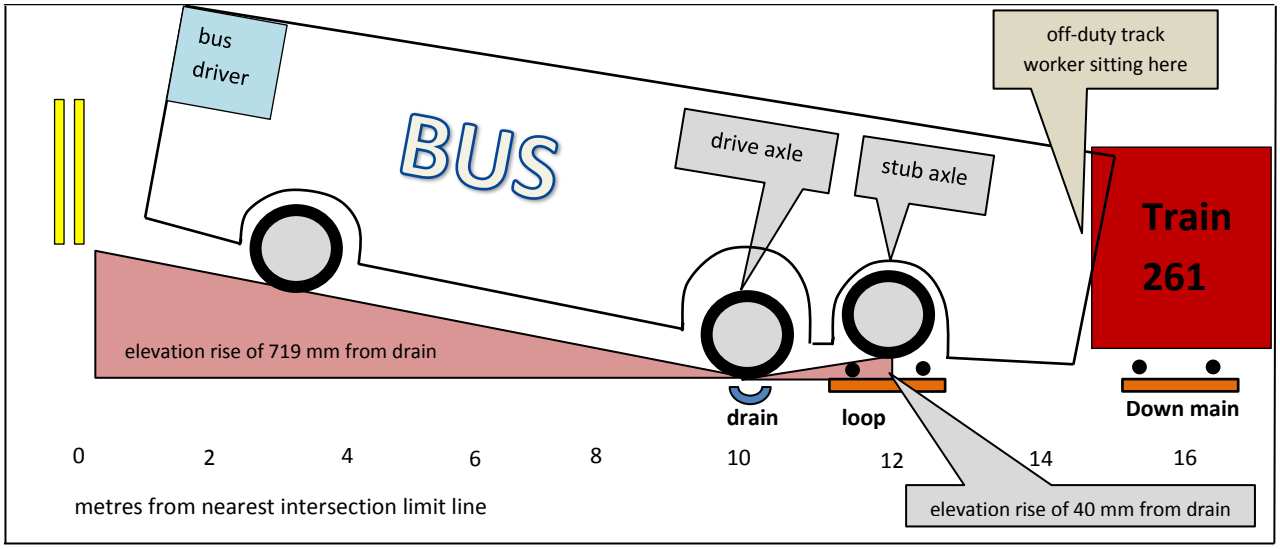

Figure 2
An elevation of the bus stopped over the level crossing (not to scale)

3.1.11. The drive axle was suspended from the bus under-frame, with the wheels having limited traction with the road surface.

3.1.12. The driver tried to drive the bus forward, but the driving wheels were spinning and the bus did not move. He tried to reverse the bus but it did not move then either. He left the bus to review his predicament. He was aware that his bus had encroached on the Down main line, but was not concerned because he assumed that no trains were running because his bus was replacing the train services.

3.1.13. The driver re-entered his driving position, lowered the bus using the kneeling function and repeated the drive options, again without success.

3.1.14. The bus had been stuck on the level crossing for about 5 minutes when the off-duty track worker saw a nearby railway signal on the Down main line change from red to green. Seconds later he saw the headlight of an approaching southbound train (freight Train 261). He called out a warning to the bus driver, who immediately ordered the passengers from the bus via the front door.

3.1.15. The automatic warning devices for the Beach Road level crossing started to activate while the passengers were vacating the bus.

3.1.16. The driver of Train 261 saw the bus and initially thought it was moving. He saw the bus driver waving his arms in the air when he got closer and realised that the rear of the bus was stopped over the Down main line on which his train was travelling. The train driver applied emergency braking and took shelter on the locomotive cab floor. The train event recorder showed that the train was travelling at 71 km/h when the brakes were applied.

3.1.17. Train 261 collided with the empty bus 8 seconds later at a speed of 69 km/h. The train took 320 m to stop after the collision, with the second-to-last wagon standing adjacent to the bus. The train driver was showered with broken glass from the locomotive's windscreens, but he was not injured. Nobody from the bus was injured. The rear of the bus was shunted about one metre southwards and was extensively damaged. The train did not derail and damage to it was minor.

Beach Road rail level crossing

3.1.18. Paekakariki station opened at about the same time that the Wellington and Manawatu Railway Company's line was built through the area in 1886. The line through Paekakariki was double-tracked sometime in the late 1930s and was electrified in 1940.

3.1.19. Records showing the date on which the Beach Road level crossing was opened and when it was equipped with flashing lights and bells could not be found, but automatic half-arm barriers were fitted during an upgrade in May 1962. There had been no reported train/vehicle accidents at the level crossing since that date.

3.1.20. Figure 3 shows the general layout of the level crossing and the intersection of Beach Road and State Highway 1.

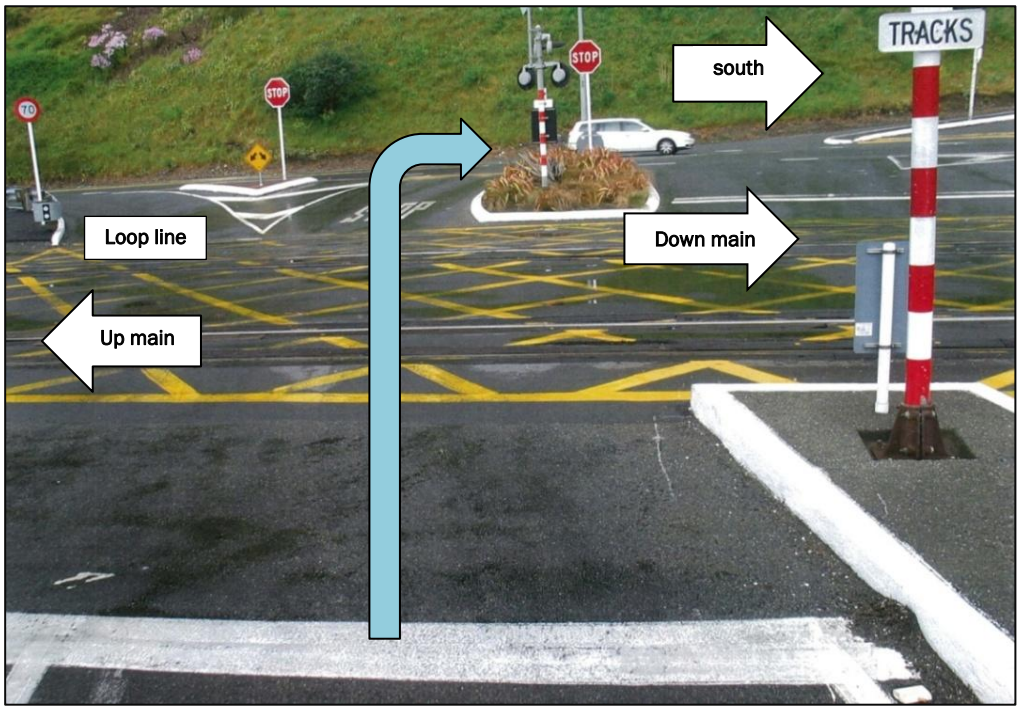

Figure 3
Photograph showing the level crossing with the bus's intended movement shown in blue

3.1.21. The maximum speed of all trains travelling on the Up and Down main lines over the Beach Road level crossing was 70 km/h. The maximum train speed on the Loop line was 25 km/h. Road traffic on Beach Road was authorised to travel at up to 50 km/h.

3.1.22. Road traffic signage was erected to warn road users of the level crossing, but there was no signage to warn road users of the short stacking situation.

Beach Road/State Highway 1 intersection

3.1.23. In 1996 the Commission published a report into a collision between passenger Train 903 and a truck and trailer unit at Kirk Road level crossing near Christchurch on 17 May 1996. The Commission found that there was a lack of stacking distance for long road vehicles between the level crossing and State Highway 1.

3.1.24. In December 1996 the Commission recommended to the Director, Land Transport Safety Authority that he liaise with Transit New Zealand (both entities were predecessors to the NZ Transport Agency), Tranz Rail Limited and the appropriate local authorities. The recommendation was that a review be initiated to define all public level crossings where the stacking distance for long road vehicles was insufficient to ensure safe entry to or exit from the crossings, and to ensure that appropriate action was taken, consistent with the frequency of use and the potential consequences of collision.

3.1.25. During May 2001 Transit New Zealand carried out minor roadwork improvements to the Beach Road/State Highway 1 intersection. The stacking distance between the edge of the level crossing and the intersection compulsory stop lines was extended by 2 m to 10.5 m as a result of the work.

3.1.26. In 2002 the Commission published a report into a near collision between passenger Train 700 and a petrol tanker at Vickerman Street level crossing near Blenheim on 25 April 2002. The Commission found that there was a lack of stacking distance for long road vehicles between the level crossing and State Highway 1. The Commission repeated the 1996 recommendation to the Director of the Land Transport Safety Authority. Details of the recommendations and the Director's responses can be found in the recommendation section of this report, together with 3 urgent safety recommendations made to the Chief Executive of the NZ Transport Agency earlier in this inquiry.

3.1.27. In 2005 a conceptual study report comparing the costs and improvement programmes of the current State Highway 1 route and the proposed Transmission Gully route was produced for Transit New Zealand and the Greater Wellington Regional Council. The report described the Beach Road/State Highway 1 intersection as having a poor safety rating and proposed the elimination of both the intersection and the level crossing.

3.1.28. A 2007 Transit New Zealand report, which proposed a redesign, described the intersection as being a major safety problem. The redesign included the installation of an acceleration/entry slip lane controlled by give-way signs (where the stop signs are currently erected) for right-turning road traffic moving from Beach Road to State Highway 1.

3.1.29. Neither the 2005 conceptual study report nor the 2007 proposal was implemented.

3.1.30. A 2009 joint assessment of the Beach Road/State Highway 1 level crossing conducted by KiwiRail and the NZ Transport Agency using the "Australian Level Crossing Assessment Model" included a comment that short stacking was an issue because the available space for road traffic was less than 20 m from the nearest rail edge.

3.2. The NZ Transport Agency

Traffic Control Devices Manual

3.2.1. The NZ Transport Agency produced a Traffic Control Devices Manual (dated 2008 and draft dated 2011). Part 9 of the Manual provided guidelines on industry good practice for level crossings, and also referenced some mandatory practices. The Manual provided guidelines for the installation of road-traffic-control devices. It also provided guidelines on operational policies affecting road traffic movements across, and activities on or adjacent to, railway level crossings.

3.2.2. The Manual commented that level crossings were different from road intersections in that the overall risk was skewed toward low-probability but high-consequence events (particularly on passenger train routes). In addition there were few level crossing accidents in comparison with road vehicle accidents, meaning that any prioritisation of level crossings needed a more proactive approach.

3.2.3. The Manual included a policy statement that appropriate signage should only be considered where the distance between the level crossing and the intersection was less than 30 m. This distance allowed a 20 m long vehicle (25 m long with an individual permit) to stop at the intersection and stay clear of the railway line. The Manual said that an escape lane or clear zone should be provided where the departure of a long vehicle from a level crossing was blocked by a nearby intersection.

3.2.4. The Manual stated that the road pavement should be sloped away (from the level crossing) at a minimum gradient of 1 in 50 for at least 5 m from the centreline of the railway line. The 5 m was the default boundary between the road and rail corridor (Railways Act 2005). The reasons for this were to ensure that surface water drained away from the level crossing and to help avoid road traffic inadvertently rolling on to a level crossing.

3.2.5. The Manual further stated that for uphill, steep road approaches either side of a railway line, the risks of long vehicles grounding on the railway lines should be assessed and, where necessary, long vehicle restrictions applied.

3.2.6. The Manual stated that where there were instances of short stacking, consideration should be given to providing the following treatments:

- auxiliary road space (slip lanes or shoulder widening) to allow a vehicle to escape or wait clear of the railway line or road traffic
- where an alternative route exists, partial closure (to vehicles over a defined length) or complete closure
- channelisation, realignment or relocation of the road
- realignment of the railway line
- active control of the level crossing and intersection.

3.2.7. The Manual stated that where queues of traffic blocked the level crossing, the third and fifth bullet points would be indicated. If the intersection and level crossing had signals, the intersection signals and railway circuits should be linked.

The bus

3.2.8. The NZ Transport Agency's Land Transport Rule: Vehicle Dimensions and Mass described the legal requirements for the registration of heavy road vehicles, including buses, using New Zealand roads. The Rule came into force on 1 May 2002 and extended the maximum length of buses from 12.60 m to 13.50 m. The change was made to recognise "as of right" longer buses that had previously been allowed to operate, by exemption, for several years.

3.2.9. The Zonda bus involved in the collision had recently been imported from China in a built-up condition and received its NZ Transport Agency road certification on 18 August 2011 in Nelson. The bus was 12.59 m long with a rear overhang of 3.92 m behind the rearmost (stub) axle. The maximum rear overhang was 4.50 m. The clearance between the underside of the bus (taken behind the rear axle) and the ground was measured at 170 millimetres. The legal minimum ground clearance for a heavy vehicle was 100 millimetres. The bus therefore met all of the Rule requirements.

3.2.10. The Zonda bus was fitted with a differential lock arrangement on the driving axle. The drive axle suspension system allowed a 75 millimetres downward movement of the axle before it would lift off the road surface and lose all traction.

3.3. KiwiRail Limited

3.3.1. KiwiRail's current infrastructure code supplement document G 417, dated January 1998, detailed its responsibilities for the provision, overview and maintenance of the 1334 public level crossings (as at May 2012) in New Zealand.

3.3.2. The following table shows the number of train/road vehicle collisions recorded at public level crossings between 2002 and 2011. KiwiRail used this information to update and monitor its level crossing priority list for warning device system upgrades.

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	**Total**
30	31	33	36	16	23	20	31	22	13*	**255**

*up to 25 November 2011 only.

3.3.3. There were 2 train/bus collisions included in the total of 255. KiwiRail had also recorded a 75% reduction between 2002 and 2011 in the number of level crossings at which 2 or more collisions had occurred within one calendar year, down to 5 in 2011.

4. Analysis

4.1. Introduction

4.1.1. The bus involved in this accident complied with all aspects of the Land Transport Rule: Vehicle Dimensions and Mass. It was shorter than the maximum allowable length. The rear overhang and the ground clearance behind the rear axle were both within the allowable limits.

4.1.2. The design of the intersection did not allow bus drivers any appreciable variation in the path they drove over the level crossing and up to the stop sign at the intersection with State Highway 1. The driver in this case drove his bus over the level crossing, where it became stuck after stopping at the intersection.

4.1.3. The train that struck the stationary bus was being driven at about the maximum allowable speed as it approached the level crossing. There was little the train driver could have done to prevent the collision. Even if the bus had not become stuck, there was not sufficient room for it to wait at the stop sign and remain clear of the Loop line at the level crossing.

4.1.4. The following analysis discusses how and why the bus became stuck with its back end fouling the level crossing, what could have been done to prevent the collision once it became stuck, and the interface between the road and rail regulatory systems that contributed to the bus becoming stuck. Also discussed is the issue of stacking distance between level crossings and road intersections.

4.2. The bus becomes stuck

4.2.1. The most recent major road upgrade works around the Beach Road intersection had been completed in 2001, about 10 years before this accident. The layout of the intersection and the profile of the road across the level crossing leading up to it had therefore not changed appreciably in that time.

4.2.2. There had not been any recorded accidents at the level crossing in that 10-year period, but the potential was there for a long and low road vehicle to become stuck on the crossing. The bus involved in this accident had scraped its underside on the level crossing the previous evening and it is possible that other low buses had done so before. A bus scraping its rear overhang would not feature in road accident databases.

4.2.3. The difference between negotiating the level crossing the previous evening and getting stuck on this occasion possibly came down to where the bus stopped after rolling back slightly. On this occasion the bus stopped 2 m short of the stop markings on the edge of State Highway 1, with its driving wheels suspended over the drain, the lowest point in the road profile. The bus had possibly stopped closer to the stop line on the previous evening, its momentum carrying the driving wheels through the dip formed by the drain.

4.2.4. Being a new bus, the Zonda was possibly the first of its type and configuration to pass over the level crossing. The bus met the current dimensions and mass rule, but that was no guarantee that it could travel on all roads without becoming stuck. There will be numerous roads or locations where such a bus would become stuck, as would a lot of modern low-slung cars. Such an event can be disruptive to other road users, but other road users have the ability to stop, whereas trains do not. That is why rail level crossing and adjacent road intersections deserve special consideration by the relevant road authorities.

4.2.5. Super-low-floor buses are designed more for scheduled urban routes to facilitate the carriage of mobility-impaired passengers, where the routes are usually fully assessed for suitability before buses can operate on them. Using such a bus on ad hoc routes will carry some risk, especially on those where rail level crossings are involved.

4.2.6. In this case the profile of the road coming off the level crossing was not well suited to long and low road vehicles. Had this been considered as recommended in the Traffic Control Devices Manual, signage warning motorists should have been erected as a minimum. Both Tranz Metro, which specified the use of super-low-floor buses on the route, and the bus operator should have checked the route before operating buses on it.

Findings:

The bus became stuck because its drive wheels lost traction with the road when the rear of the bus or its non-driving wheels were still on the rise of the level crossing.

The profile of the Beach Road level crossing and the adjacent section of road leading up to the intersection with State Highway 1 were not well suited for long and low road vehicles.

The bus complied with all aspects of the Land Transport Rule: Vehicle Dimensions and Mass.

4.3. Stacking distances

4.3.1. A short stacking issue is created when a long road vehicle is unable to clear a rail level crossing while waiting for road traffic at the intersection. It usually arises when a road intersection is close to a rail level crossing. It is not a new issue. The Commission has raised it in 2 rail reports, one in 1996 and another in 2002 (report 96-106 dated 19 February 1997 and report 02-113 dated 2 October 2002). In 1996 and again in 2002 the Commission recommended that the safety issue be resolved (refer the historical recommendations in section 8 of this report).

4.3.2. The short stacking distance at the Beach Road level crossing did not necessarily contribute to this accident. If the bus had been able to pull forward to the stop markings on the road, its back end would have been clear of the Down main line and the collision would not have occurred. However, the bus would have been unable to clear the Loop line even if it had pulled right forward to the stop markings.

4.3.3. The bus was only 12.59 m long, whereas the maximum allowable length for a road vehicle is 20 m (25 m with a special permit). A 20 m vehicle would not be able to clear the Down main line when waiting at the stop markings on the road. Technically no vehicle over about 10 m could legally use the Beach Road intersection when turning right to State Highway 1. To do so would mean that either it could not stop at the stop sign or, if stopped, it would encroach on the rail corridor. This is a safety issue that the Commission has recommended that the Chief Executive of the NZ Transport Agency address (Recommendation 030/11).

4.3.4. An example of a short stacking distance issue was witnessed by Commission investigators in South Auckland a few weeks after the collision at Paekakariki. In this instance the vehicle was stopped over a level crossing for some minutes while waiting to turn on to an adjacent provincial highway (see Figure 4). The rear trailer wheels were standing over a main line along which frequently timetabled Auckland metro passenger trains were authorised to travel at 100 km/h.

Figure 4
Photograph of a truck stopped over a level crossing in South Auckland

4.3.5. KiwiRail records show there are another 251 level crossings where there is an insufficient stacking distance to accommodate long road vehicles. This represents about 19% of all recorded level crossings. The level crossing shown in Figure 4 was one of those listed. The overall risk for each of the level crossings would depend on a number of factors, such as:

- the number of road vehicles using the level crossing
- the number of trains using the level crossing
- train speeds at the level crossing
- the length of road vehicle using the road and level crossing
- existing vehicle length restrictions
- traffic volumes on adjacent roads
- slip lanes, road shoulders and emergency escape zones that allow road vehicles to get out of the way.

4.3.6. Generally, the longer a road vehicle, the heavier it is. A train colliding with a heavy vehicle is a serious safety issue. Not only are the occupants of the road vehicle at risk, so too is the train crew because the potential for damaging or derailing a train is higher. The Commission has issued an urgent recommendation to the Chief Executive of the NZ Transport Agency to address the stacking distance issues at these other identified level crossings (Recommendation 031/11).

Findings:

The Beach Road/State Highway 1 intersection did not have a sufficient stacking distance to accommodate this bus, and any other road vehicle over about 10 m in length, without those vehicles encroaching on the rail corridor at the Beach Road level crossing.

Any road vehicle over about 10 m in length could not safely use the Beach Road/State Highway 1 intersection when turning right to State Highway 1 from Beach Road.

About 19% of all rail level crossings have insufficient stacking distances available for long road vehicles using adjacent road intersections.

4.4. Preventing the collision

4.4.1. The bus driver could have contacted the train controller if he had been aware of the freephone emergency number. KiwiRail had erected a small placard on a signalling equipment shelter near the level crossing that included the phone number, but it was intended for rail employees. It would not have been immediately obvious to a road vehicle driver or a member of the public.

4.4.2. If the bus driver had known of the number and called train control, the train controller could have called the train driver to stop his train, or he could have changed the signals at Paekakariki to red until it was reported that the bus had been moved away from the crossing.

4.4.3. Even though on this occasion the bus driver erroneously assumed that no trains were running, he could have contacted train control if the telephone number had been immediately to hand. Someone else not under that assumption might also have made the call; the off-duty track worker, for example.

4.4.4. Following the incident Tranzit Coachlines updated the emergency plans carried on all of its buses to include the train control emergency number. The company also arranged for an article detailing the lessons it had learnt to be included in an industry magazine. The article encouraged other bus operators to update their emergency plans also. The Commission has made a recommendation to the Chief Executive of the NZ Transport Agency to extend the lessons learned to other operators of large road vehicles.

Finding:

The collision could have been prevented if the bus driver had known how to contact train control, and had immediately done so.

4.5. The road and rail regulatory interface

4.5.1. The rail regulation unit within the NZ Transport Agency was small in comparison with the road regulatory unit. From discussions with the 2 units it was apparent that an improving level of consultation has taken place over the last 10 years between the 2 regulatory modal units regarding changes in their respective legislation. Discussions regarding all aspects of the road/rail interface at level crossings are now occurring during the formal Level Crossing Working Groups meetings.

4.5.2. The rail industry uses a co-regulatory approach, with the main rail participants developing the industry standards and systems they intend to adopt. The rail regulatory unit approves, monitors and provides oversight of those standards. On the other hand, road transport is singularly regulated by the NZ Transport Agency.

4.5.3. If communication between the NZ Transport Agency regulatory units and the rail industry is not good, the potential exists for the respective standards to become incompatible. An example of how this could happen is in the relationship between road vehicle length, stacking distance and level crossing profiles. There are standards and guidelines for profiles of level crossings in relation to long and low road vehicles

4.5.4. .The maximum length of road vehicles has increased over the years. This increase has been by “creep” to meet the needs of the road transport industry. The 2002 amendment to the Land Transport Rule: Vehicle Dimensions and Mass rule was an example of this: the permissible length of a bus was increased to recognise longer buses that had already been operating under exemption for several years.

4.5.5. Changes to the permissible lengths and road clearances for buses have had 2 consequences, of which both were relevant to this accident. The first is that level crossing profiles that were

once suitable for current road vehicles might not be now. Secondly, the number of level crossings that have issues with stacking distances has likely increased.

4.5.6. The importance of level crossings being compatible with vehicle and road standards cannot be understated. The rail corridor has been created to give trains the absolute right of way, because trains cannot stop quickly, and not as quickly as road vehicles.

4.5.7. Any policy or legislation that could affect the safety of trains or vehicles that must cross the rail corridor should only be made following formal consultation with the relevant entities. However, standards and guidelines for traffic control devices at level crossings (first issued in 2008) that include the movement of long and low road vehicles now exists in the NZ Transport Agency's documentation management system.

Findings:

Level crossings warrant special consideration when setting road vehicle standards, because trains have the right of way along the rail corridor and cannot stop for road vehicles in their path.

Changes in the Land Transport Rule: Vehicle Dimensions and Mass have been made with little formal consideration for the compatibility of long and low road vehicles with existing rail level crossings throughout New Zealand.

5. Findings

5.1. The bus became stuck because its drive wheels lost traction with the road when the rear of the bus or its non-driving wheels were still on the rise of the level crossing.

5.2. The profile of the Beach Road level crossing and the adjacent section of road leading up to the intersection with State Highway 1 were not well suited for long and low road vehicles.

5.3. The bus complied with all aspects of the Land Transport Rule: Vehicle Dimensions and Mass.

5.4. The Beach Road/State Highway 1 intersection did not have a sufficient stacking distance to accommodate this bus, and any other road vehicle over about 10 m in length, without those vehicles encroaching on the rail corridor at the Beach Road level crossing.

5.5. Any road vehicle over about 10 m in length could not safely use the Beach Road/State Highway 1 intersection when turning right to State Highway 1 from Beach Road.

5.6. About 19% of all rail level crossings have insufficient available stacking distances available for long road vehicles using adjacent road intersections.

5.7. The collision could have been prevented if the bus driver had known how to contact train control, and had immediately done so.

5.8. Level crossings warrant special consideration when setting road vehicle standards, because trains have the right of way along the rail corridor and cannot stop for road vehicles in their path.

5.9. Changes in the Land Transport Rule: Vehicle Dimensions and Mass have been made with little formal consideration for the compatibility of long and low road vehicles with existing rail level crossings throughout New Zealand.

6. Key lessons

6.1. Changes to rules and standards for road transport can compromise safety at rail level crossings. Groups responsible for setting standards for road vehicles and rail level crossings should therefore consider the consequences for other users before making those changes.

6.2. Drivers of long road vehicles need to know if there is not enough room for their vehicles between a road intersection and a rail level crossing.

7. Safety actions

General

7.1. 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.

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

Safety actions addressing safety issues identified during an inquiry

7.2. On 8 December 2011 Tranzit Coachlines advised the Commission that the following article (in part) was included in the December 2011 issue of the Circular, a monthly industry magazine published and circulated by the Bus and Coach Association New Zealand Incorporated to its members.

> Tranzit Coachlines has begun an internal investigation and an initial outcome of the investigation has been to ensure the rail emergency 0800 number is included in their vehicle emergency plan. Tranzit is encouraging other bus operators to include this contact number in their emergency contacts list. The 0800 number connects with KiwiRail's national train control centre.
>
> KiwiRail Emergency Contact: 0800 808 400

8. Recommendations

8.1. General

8.1.1. The Commission may issue or give notice of recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, 3 recommendations were issued under urgency to the Chief Executive of the NZ Transport Agency on 16 December 2011.

8.1.2. 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.

8.2. Historical recommendations made regarding stacking distances between rail level crossings and road intersections

8.2.1. On 19 December 1996 the Commission recommended to the Director, Land Transport Safety Authority, that he liaise with Transit New Zealand, Tranz Rail and the appropriate local authorities to initiate a review to define all public level crossings where the stacking distance for long road vehicles was insufficient to ensure safe entry to or exit from the crossings, and to ensure that appropriate action was taken, consistent with the frequency of use and the potential consequences of collision.

8.2.2. The Director, Land Transport Safety Authority, responded inter alia that:

> The Land Transport Safety Authority (LTSA) acknowledges the TAIC recommendation regarding the safety of railway level crossings for long vehicles and will liaise with Transit New Zealand, Tranz Rail Ltd and other road controlling authorities appropriately. The LTSA will request road controlling authorities to identify all level crossings within their districts where stacking distances for long road vehicles are insufficient to ensure safe entry or exit from the crossings, and develop and implement appropriate road or rail strategies to minimise risk of collision.
>
> For the information of the Commission, the LTSA has received a copy of a Ministry of Transport document entitled "Road Management, Options for Reform", submissions on which close on 31 July 1997. The LTSA plans to address the issue of responsibilities and accountabilities for road safety actions in our submission on the paper to the Ministry of Transport.

8.2.3. On 10 June 2002 the Commission repeated the 1996 recommendation.

8.2.4. On 27 June 2002 the Director, Land Transport Safety Authority responded to the repeated recommendation in part as follows:

> Since the recommendation was first made in 1996 there has been some progress on this aspect of rail safety. During the intervening years [period] the Land Transport Safety Authority, Transit New Zealand, and Tranz Rail Ltd and appropriate local authorities have concentrated on improving the general standard of sign posting required at all level crossings believing this to be the most appropriate area for attention. The programme has now been substantially completed.
>
> There are currently a range of signs used to warn drivers of limited stacking length between the rail and a nearby intersection. However, these provide only general warning and do not specify actual stacking lengths. Transit and Land Transport Safety Authority have been considering methods of effectively providing such specific information but have yet to arrive at a satisfactory solution. It is recognised that warning signs are only one avenue for addressing concerns in this area but most others involve disruption to access or major costs.
>
> The Land Transport Safety Authority is to convene a special working group, to be entitled the Rail-Road Level Crossing Safety Forum, and its first meeting is planned before the end of August 2002. The Forum is to be made up of representatives of rail service operators, Transit and other interested parties including the Road Transport Forum.

> The Forum will be tasked with investigating, recommending or proposing projects or practices to improve safety at rail-road level crossings. It will assist the Land Transport Safety Authority and the constituent members in defining, prioritising and implementing projects and programmes.

8.2.5. On 2 September 2002 the Manager, Rail Safety, Land Transport Safety Authority, wrote in part as follows:

> With references to your recommendation 036/02 to the Land Transport Safety Authority regarding a review of road stacking distances at level crossings and our subsequent response; I now can advise that the inaugural meeting of the Land Transport Safety Authority Level Crossing Forum was held on 22 August [2002]. All those attending the Forum considered it very useful, with a variety of issues, including stacking distances being discussed.
>
> At this stage the Forum considers there is a need to quantify the scale of the issue of road stacking distances, so that site-specific options for solutions or mitigation can be identified.

8.2.6. On 20 August 2012 the NZ Transport Agency supplied copies of the Terms of Reference and minutes of most of the annual meetings of the Level Crossing Working Group Forum recorded between 2002 and 2012. It was advised that since the 2008 merger of the Land Transport Safety Authority (initial rail regulatory body) and Transit New Zealand (road transport funding agency), the opportunity for communication issues to arise between the rail and road regulatory divisions has somewhat diminished.

8.3. Urgent recommendations made during this inquiry

Compatibility of super-low-floor buses with Beach Road level crossing profile

8.3.1. The profile (specifically the rate of change in gradient) of the Beach Road level crossing at Paekakariki on the State Highway 1 side has been formed in such a way that those super-low-floor buses like the one involved in the Beach Road level crossing accident (or of similar design) are at risk of becoming stuck with their back ends foul of the railway tracks when they stop, as they are required to, at the stop sign before turning right to State Highway 1. In other words the same or a similar accident could happen again.

The Commission recommends to the Chief Executive of the NZ Transport Agency that as a matter of urgency he address this safety issue (Recommendation 029/11).

On 2 February 2012 the Chief Executive of the NZ Transport Agency responded:

> Following this collision incident, staff from the NZ Transport Agency, MWH (infrastructure consultants), KiwiRail and Kapiti Coast District Council met and implemented the following actions:
>
> The NZ Transport Agency has erected a surveillance camera on-site and is currently monitoring the usage of this crossing by heavy vehicles, driver behaviour and the number of incidents caused by road profiling and/or stacking distances;
>
> The design and profiling of the level crossing have been assessed. As a result, remedial work covering re-profiling the intersection and redesign of the splitter island to create room for a large vehicle to make a left turn in the situation when a right turn is not possible is underway. Works are expected to be completed by 16 May 2012 as part of a programmed carriageway rehabilitation scheme.
>
> Aspects of the bus design have also been considered.
>
> The Land Transport Rule: Vehicle Dimensions and Mass (the Rule) in table 4.1 specifically sets ground clearance requirements for all heavy vehicles based on a design to adequately clear level rail crossings and similar. The required clearance is the greater of 100 millimetres or 6% of the distance from the nearest axle to the point where the ground clearance is measured. The actual ground clearance of the bus does comply. It is noted that the bus has a manual override to lower the bus to facilitate ease of boarding by lowering passenger floor height. This feature is permitted under Rule when the vehicle is loading or unloading.

> The NZ Transport Agency has also noted that a circular produced by the Bus and Coach Association has been distributed following this collision. It highlights this incident and particularly the Train Control emergency contact number. We are also aware that the Train Control emergency number has been added to the list of emergency contact numbers in all buses operated by the company involved in the collision.

Waiting (stacking) distance between Beach Road level crossing and State Highway 1

8.3.2. The distance between the compulsory stop line and the rail corridor at the Beach Road level crossing at Paekakariki is 10.5 m. The bus involved in this accident was 12.6 m long. Many other buses and various configurations of trucks are longer than 10.5 m. This means that when one of these long vehicles stops at the stop sign (as it is required to do) the back of the vehicle will foul the rail corridor and be at risk of being struck by a train. Technically then, any such vehicles intending to turn right to State Highway 1 cannot comply with the road rules when using this level crossing. Any long vehicle would be at risk of being struck by a train when waiting at the stop sign for a break in the traffic travelling on State Highway 1. Additionally, there is no signage at the level crossing warning drivers of long vehicles that there is only a 10.5 m stacking distance.

The Commission recommends to the Chief Executive of the NZ Transport Agency that as a matter of urgency he address this safety issue (Recommendation 030/11).

8.3.3. On 2 February 2012 the Chief Executive of the NZ Transport Agency responded:

> The stacking distance issue applying to right turning traffic exiting/entering Beach Road from State Highway One [one] is acknowledged. However a solution to this is problematic.
>
> Restriction of turning movements out of Beach Road is not favoured by the Kapiti Coast District Council. However, the prohibition of right turns out of Hill Road would simplify movements at the intersection and might aid right turns out of Beach Road. This option will be investigated further.
>
> Installation of traffic signals is a high cost option requiring land acquisition. Although this is favoured by the Kapiti Road District Council, it has the potential to impose significant delays on the State Highway resulting in queuing and the potential to increase the collision risk. The current crash record at the intersection is low and it is likely that this option would increase it.
>
> Further to the above, the NZ Transport Agency has been advised by the Greater Wellington Regional Council that it [the Council] is considering the mandating of shorter buses at the Beach Road level crossing.

Stacking distances at other public level crossings

8.3.4. KiwiRail is aware of 264 other public level crossings in New Zealand that have the same or similar issues with stacking distances for long road vehicles as that encountered at the Beach Road level crossing at Paekakariki.

The Commission recommends to the Chief Executive of the NZ Transport Agency that as a matter of urgency he address this safety issue. (Recommendation 031/11)

8.3.5. On 2 February 2012 the Chief Executive of the NZ Transport Agency responded:

> KiwiRail has provided information that there are now 252 level crossings with less than 23 metres distance between the centreline of the nearest railway line and the continuity/edge line at an adjacent intersection where road traffic from the railway does not have right of way. I have attached a register for your information. The register of crossings has been coded according to collision history in the last ten years. There are nine crossings that had two or more collisions. Of these five had alarm upgrades during this period and there have been no further collisions.
>
> Further analysis by KiwiRail indicates that average collision rates (adjusted for the level of both road and rail traffic) at crossings where there are adjacent intersections within 23 metres are only 6% higher than collision rates at crossings with no nearby intersection. This suggests that it is where there is a high level of traffic on the parallel road that risk of collision significantly increases. This matter is subject to

> further discussion between KiwiRail and NZ Transport Agency to determine further options.
>
> The NZ Transport Agency takes this situation seriously and will continue to discuss these situations with external parties to explore new solutions for the improvement of rail and road safety.

8.3.6. On 28 February 2012 the NZ Transport Agency responded:

> Significant work and consultation has been undertaken since this incident occurred in October 2011, and has continued following receipt of your [TAIC] letter. Meetings have been conducted between representatives from the NZ Transport Agency, the Kapiti Coast District Council and KiwiRail.

8.4. Further recommendation

8.4.1. Operators and drivers of large road vehicles should have quick access to the emergency telephone number of the National Train Control Centre for alerting the train controller if there is any issue with their vehicles that could compromise the rail corridor.

The Commission recommends that the Chief Executive of the NZ Transport Agency advise other operators of large road vehicles that their drivers should carry the train control emergency telephone number so that they can alert the train controller in any similar situation. (Recommendation 026/12)

8.4.2. On 8 August 2012, the Chief Executive of the NZ Transport Agency responded.

> This recommendation is accepted. We intend to notify large road vehicle operators of the emergency contact number of the National Train Control Centre. The NZ Transport Agency aims to implement this recommendation as soon as practicable. When this notification is completed, we will submit appropriate evidence with a view to closing out this safety recommendation.

9. Citations

Western Corridor Transport Study, Cost and Programme Review Update; Transmission Gully Motorway and Coastal Route, compiled for Transit New Zealand and the Greater Wellington Regional Council, dated August 2005.

A Transit New Zealand-sponsored report regarding the State Highway 1 intersection with Beach Road at Paekakariki, dated June 2007.

NZ Transport Agency Rule, Vehicle Dimensions and Mass: Guide to the factsheet series (Factsheet 13), published April 2011.

NZ Transport Agency, Traffic Control Devices Manual, Part 9 Level crossings, dated December 2008 and draft update dated July 2011.

Commission report 96-106, Passenger Train 903, *Southerner* and truck and trailer unit, collision, Kirk Road level crossing near Christchurch, 17 May 1996.

Commission report 02-113, Passenger Train 700, *TranzCoastal* and petrol tanker, near collision, Vickerman Street level crossing near Blenheim, 25 April 2002.

KiwiRail Infrastructure Code Supplement (G 417) Company Procedure (Q517), dated December 1997.

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

10-102	Collision between 2 metro passenger trains, after one struck a landslide and derailed between Plimmerton and Pukerua Bay, North Island Main Trunk, 30 September 2010
07-102	(incorporating inquiry 07-111) freight train mainline derailments, various locations on the national network, from 6 March 2007 to 1 October 2009
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

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