



Railway Safety Investigation Report

Baan Baa

4 May 2004

Road Motor Vehicle Struck by Countrylink Xplorer Service NP23a on Baranbah Street Level Crossing (530.780kms).



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PART 1 EXECUTIVE SUMMARY

- 1.1 At approximately 5.10pm on Tuesday 4 May 2004, Countrylink¹ Xplorer passenger service NP23a, carrying 33 passengers and three crew members, collided with a motor vehicle on the Baranbah Street Level Crossing at Baan Baa. Baan Baa is located between Boggabri and Narrabri in the Northwest Plains region of NSW.
- 1.2 Following the collision, the leading carriage of the two carriage consist derailed and came to rest on its right side across the tracks approximately 420 metres beyond the crossing. The rear carriage remained upright.
- 1.3 As a result of the collision:
 - a. the driver of the car, who was a local resident, was fatally injured;
 - b. four train passengers were hospitalised and a number of persons, both passengers and train crew, were treated on site for shock and minor injuries;
 - c. the car was destroyed and there was considerable damage to the train and track, and
 - d. the rail line was closed for three days to effect repairs.
- 1.4 The investigation established that the accident was a consequence of the car being positioned within the crossing's danger zone, or what in rail terms is commonly referred to as being 'foul of the (track) line'. The investigation could not establish whether this was a consequence of an unintentional or intentional act.
- 1.5 The investigation established that the respective mechanical conditions of the car and train did not contribute in any way to the accident. It also established that the train driver operated the train within specified limits and that he responded appropriately when it became apparent that a collision was in prospect.
- 1.6 The investigation also re-confirmed what is already known about the limitations of passive level crossings, i.e., crossings where there are no traffic lights and/or boom gates. However, OTSI has refrained from making specific recommendations that the Baan Baa crossing should be significantly upgraded. The crossing is unremarkable from many others throughout NSW and the priority for upgrading level crossings throughout NSW has been, and continues to be, the subject of detailed review by the NSW Joint Parliamentary Committee's Level Crossing Sub Committee.
- 1.7 Whilst emergency services responded efficiently and effectively to the accident, the evacuation of passengers and crew from the train was complicated by a number of the train's design features. In the light of these design features and in order to more fully discharge its duty of care to passengers, OTSI believes that RailCorp needs to review general safety arrangements on board its Countrylink services.
- 1.8 As a consequence of this investigation OTSI recommends that:
 - a. **RailCorp:**
 - (1) reviews the arrangements for emergency egress on both its diesel and electric rolling stock fleets and gives specific consideration to the following matters:

¹ Countrylink is a business group of RailCorp

- (a) the containment of luggage and equipment in roll-over situations;
 - (b) the provision of latching arrangements on all doors;
 - (c) the provision of improved emergency signage and illumination;
 - (d) the provision of an improved emergency power supply;
 - (e) the fixed installation and leak-proofing of appliances and equipment in the buffet, and
 - (f) the addition of a ladder and a rubber mallet to the emergency equipment schedule;
- (2) improves the identification of emergency access points on its diesel and electric fleets;
 - (3) provides and distributes relevant information in relation to emergency access and power shutdown to Emergency Services;
 - (4) provides safety briefings, similar to those provided by airlines, to its passengers on interstate and intrastate services;
 - (5) requires all train crew to participate in initial and refresher emergency/evacuation training and enforces such a requirement;
 - (6) reviews its procedures for the setting/calibration, testing, removal and storage of voice-recording and data-logging equipment and records;
 - (7) reviews its Operator Specific Procedures (OSPs);
 - (8) reviews the design, positioning and protection of fuel tanks on its diesel fleet, and
 - (9) in the light of the similarity in circumstances, reviews the recommendations arising out of the Ladbroke Grove Rail Inquiry Report, particularly those pertaining to the positioning and construction of fuel tanks, emergency power, egress arrangements and the provision of safety information, i.e., recommendations 61, 69, 70, 71, 74 and 78.
- b. **ARTC.** Notwithstanding any decisions that the NSW Joint Parliamentary Level Crossing Committee might make in respect of the Baan Baa level crossing, ARTC and the Narrabri Council act immediately to upgrade the crossing in accordance with the minimum standards required for passive crossings.
- c. **Independent Transport Safety and Reliability Regulator (ITSRR).**
- (1) in conjunction with the NSW Joint Parliamentary Level Crossing Committee and the Rail Industry, give consideration to the installation of remotely activated proximity warning systems that can be activated by drivers on the approaches to, and at, level crossings, and
 - (2) monitors the nature, and progress, of actions taken by RailCorp in response to the recommendations in paragraph 7.1.a above.

PART 2 TERMS OF REFERENCE

Type of Inquiry:Railway Safety Investigation, under Section 67 of the NSW Rail Safety Act, 2002

Investigator:.....Office of Transport Safety Investigation (OTSI)

Incident date:.....4 May 2004

Owning Railway:RailCorp

Operator:.....Countrylink

Infrastructure Maintainer:.....ARTC²

- 2.1 The terms of reference established by the Chief Investigator OTSI required the investigator to:
- a. identify and report on both the contributing factors (including individual/team actions, technical failures and task/environmental conditions) and organisational factors which led to this accident;
 - b. assess the adequacy of the incident response (including emergency response where relevant) as it affected the safety of all persons involved, and
 - c. identify and report on any safety actions that will assist to mitigate or eliminate the risk of similar events occurring in the future and any other matters arising from the investigation that would enhance rail safety operations.

PART 3 INVESTIGATION METHODOLOGY

- 3.1 The investigation was conducted according to the principles set out in Australian Standard AS 5022-2001, Guidelines for Railway Safety Investigation.
- 3.2 OTSI has sought to establish why the accident happened and how recurrences of a like nature might be prevented. The investigation therefore provides factual information and an analysis of that information to establish findings and to determine appropriate recommendations.
- 3.3 OTSI has also sought to look beyond the immediate cause of the incident to establish broader or 'systemic' matters that may have previously lain 'dormant' but which in isolation, or in concert, contributed to the accident.
- 3.4 Specific information in relation to a number of tests conducted on NP23a and AIQ 58V is included in Appendix 1.
- 3.5 OTSI has been assisted throughout its investigation by RailCorp; the crew and passengers of NP23a; ARTC; the NSW Police, especially those stationed at Narrabri and within the NSW Police Vehicle Examination Unit; the Office of the NSW Coroner; Bombardier Transportation and its sub-contractors and the citizens of Baan Baa.

² At the time of the accident, the track and associated infrastructure was the responsibility of the Rail Infrastructure Corporation (RIC).

OTSI wishes to acknowledge the willing assistance provided to it by all of these parties.

PART 4 FACTUAL INFORMATION

Overview

- 4.1 At approximately 17:10hrs on 4 May 2004, Countrylink Xplorer passenger service NP23a, enroute from Werris Creek to Moree, collided with a car (AIQ 58V) on the Baranbah Street level crossing at Baan Baa. Baan Baa is located approximately 530 kms, by rail, north-west of Sydney.
- 4.2 The driver of AIQ 58V, a local resident aged 54, was killed and four passengers aboard NP23a required hospitalisation. Other train passengers and crew were treated on-site for shock and minor injuries.

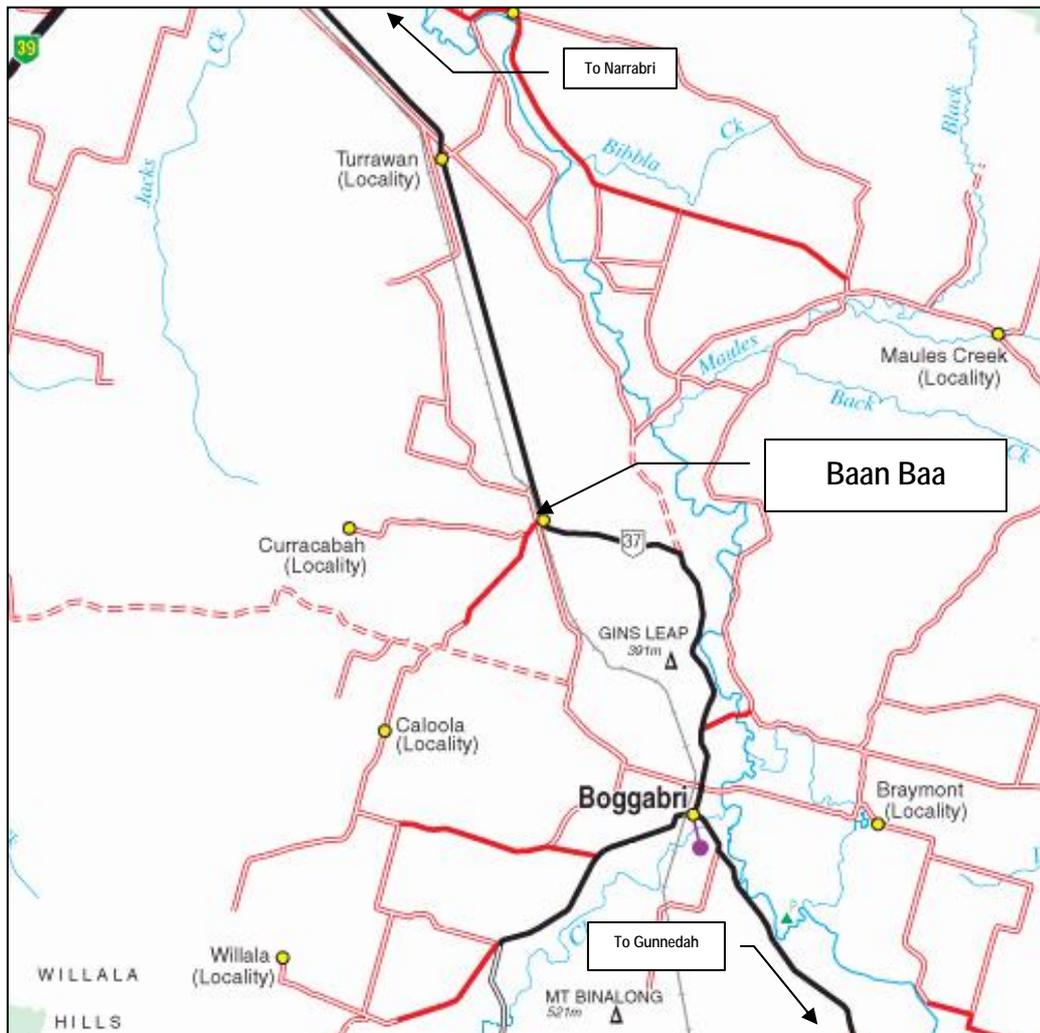


Figure 1: Map of Baan Baa Region

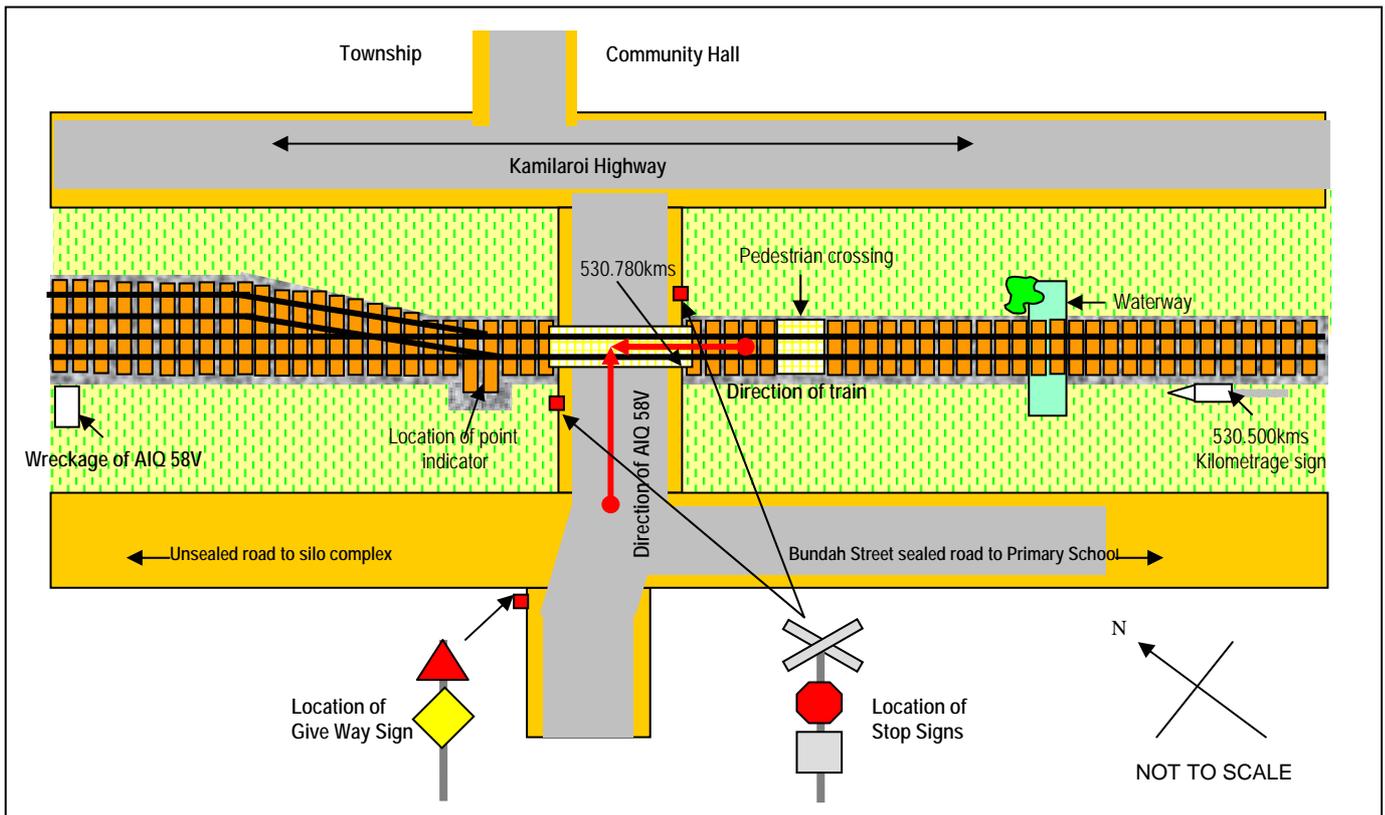


Figure 2: Layout of Baranbah Street Level Crossing (530.780kms)

Sequence of Events

4.3 Pre Incident

- a. NP23 is a daily CountryLink Xplorer passenger service, operated by RailCorp, that departs Sydney at 10:05hrs and terminates at the towns of Armidale and Moree at 18:20hrs and 19:00hrs respectively. Enroute, at Werris Creek, the service divides into two with one train travelling to Armidale and the other to Moree; these trains are then identified as NP23 and NP23a respectively. Drivers are replaced at Werris Creek.
- b. NP23 arrived at Werris Creek on 4 May 2004 at 15:39hrs and departed for Armidale at 15:43hrs. NP23a departed Werris Creek for Moree at 15:45hrs with 33 passengers and three crew members. The car number of the leading carriage was EA2507 and the second carriage was EC2523.
- c. NP23a's journey to Boggabri, located approximately 15 kms by rail from Baan Baa, was described by the crew and passengers as uneventful.
- d. NP23a departed Boggabri for Baan Baa, on schedule, at 17:03hrs with both head and ditch lights illuminated.

4.4 The Collision

- a. NP23a's data logger establishes that at 17:09:36hrs, the train was approximately 1440m from the Baan Baa crossing. It was travelling on a slight downhill gradient, had reduced to 1/3rd throttle, and was travelling at a speed of 139km/h (38.61m/s).

- b. At 17:09:59hrs and approximately 500m from the level crossing, the data logger confirms that the train driver sounded the horn; a routine action on approaching the level crossing. At this time, both the driver and the Passenger Services Supervisor (PSS) who was in the driver's cabin, sighted a white car (AIQ 58V) approaching the level crossing from a westerly direction. Very shortly afterwards, both crew members became concerned that AIQ 58V was foul of the crossing. However, there is some conjecture as to whether AIQ 58V had stopped foul of the line and then moved even further forward (the view of the PSS), or whether it simply rolled onto the crossing at very slow speed (the view of the train driver). Notwithstanding this conjecture, the data logger indicates that at 17:10:04hrs, the train driver sounded the train's horn for a second time with a sustained application lasting for six seconds. At precisely 17:10:06hrs, and approximately 250m from the crossing, he also applied the emergency brake. A further sounding of the horn was made at 17:10:11hrs.
- c. NP23a collided with AIQ 58V at 17:10:14hrs. NP23a was travelling at approximately 130kph at the time of impact.

4.5 **Post Collision**

- a. NP23a remained on the rails initially with the wreckage of AIQ 58V entangled around the front of train. Approximately 15m beyond the point of impact, the wreckage of AIQ 58V struck a points indicator³ and was disentangled, coming to rest approximately 65 metres north of the crossing and seven metres west of the track.
- b. NP23a continued to move forward, with emergency brakes still applied. The leading carriage, EA 2507, with both bogies⁴ still on the rails, then traversed the points for the No.2 Siding whereupon the leading bogie derailed towards the western side of the track. Notwithstanding, NP23a continued to move forward with the leading bogie of the leading carriage derailed. The second bogie remained on the rails, as did the second carriage EC2523 and both its bogies.
- c. EA 2507 then struck the points indicator and interlocking timbers for "E" Frame⁵ and, as a consequence, the pilot⁶, air-surge tanks for the secondary suspension and remaining pieces of AIQ 58V were ripped from under the train. The fuel tank of EA2507 also ruptured when it struck the remnants of the points indicator.
- d. EA2507 then continued to plough up and to the left into a gravity hump⁷ of the Silo Road embankment. All remaining bogies, i.e., the second bogie on EA2507 and the two bogies on EC2523 remained on the track. The rapid deceleration when the first bogie of EA2507 mounted the embankment caused the front-end of EA2507 to be pushed further to the left and the rear-end pivot counter-clockwise, i.e., out to the right. The couplings linking EA2507 and EC2523 parted and EA 2507 toppled onto its right side approximately 420m from the point of impact. EC 2523 remained upright and did not derail.

³ A visual indicator to train drivers as to the direction the points are set at the location.

⁴ Bogies are the assemblies beneath a rail vehicle that house the wheels, axles, suspension, propulsion and brake components of the vehicle. They are pivoted to allow the vehicle body to rotate during cornering.

⁵ A series of levers used for operating points and signals to control train movements in and out of sidings.

⁶ The pilot is also colloquially known as the "cowcatcher". The purpose of the cowcatcher is akin to that of a front bumper bar.

⁷ An earthen track formation designed to prevent wagons from rolling out of the siding onto the main line.

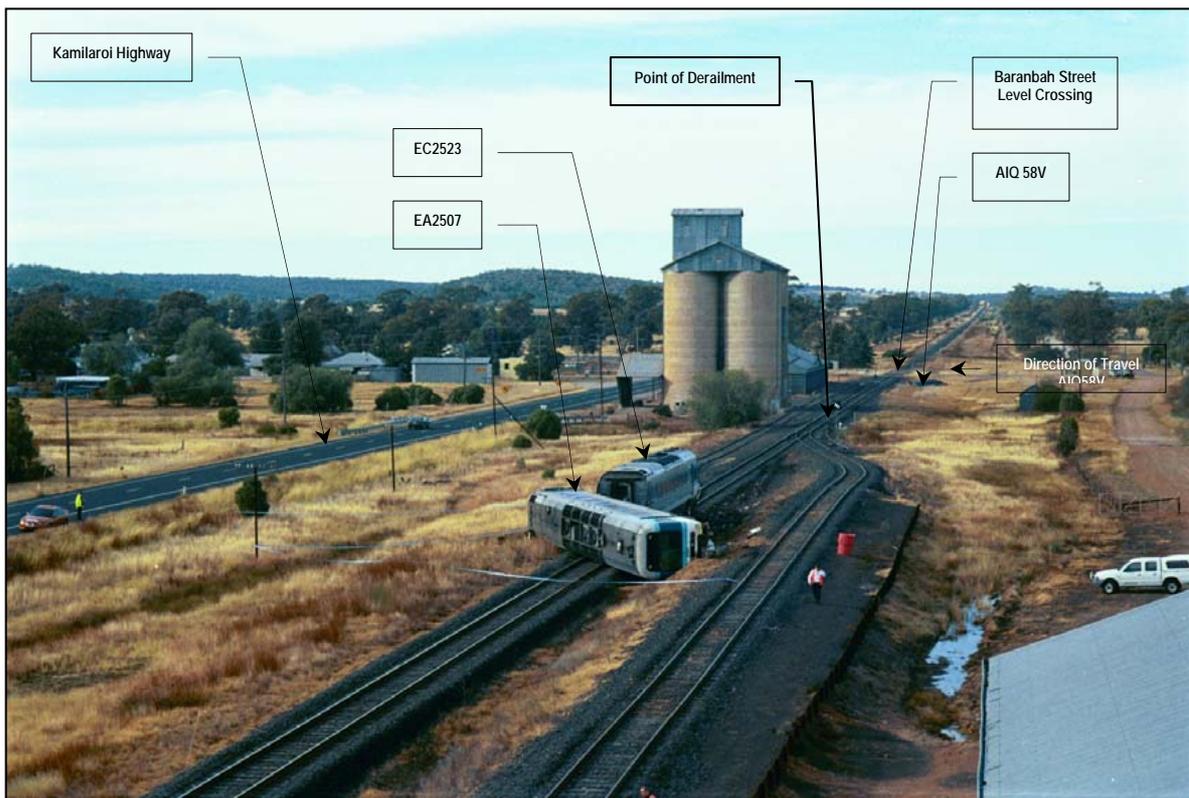


Photo 1: Incident scene on 5 May 2004

4.6 Emergency Actions and Response

- a. The driver of NP23a initiated an emergency call, via the train radio, to the Northern Rail Management Centre at Broadmeadow and requested the attendance of emergency services. At the same time, an additional driver who was not rostered for crew duty⁸ sought to confirm the condition of the driver and Passenger Services Supervisor (PSS).
- b. The PSS then attempted to vacate the cab via the crew compartment doors but encountered problems because of the weight and inclination of the doors. The doors were hinged on the high side and there were no latching arrangements which would allow them to be left open. After utilising a milk crate to effect his exit from the driver's cab, the PSS entered the passenger section to determine the condition of the passengers in the lead carriage. The PSS, assisted by the Senior Passenger Attendant (SPA), then commenced to evacuate the passengers through the rear of the derailed carriage EA2507. They were assisted in this endeavour by local residents who had converged on the accident site. Passengers from the second carriage EC2523 utilised the emergency key in that carriage and exited via the crew doors at the rear of the carriage.
- c. By the time the driver of NP23a had exited the cab, most of the passengers had already been evacuated from EA2507.
- d. Baan Baa's Rural Fire Service was contacted by patrons of the local hotel at 17:15hrs and a number of its members arrived on site at 17:19hrs and assisted the evacuation of passengers.

⁸ This driver was travelling as a passenger to Moree in his capacity as a union delegate.

- e. Ambulance and Police duty logs record that these Services were made aware of the incident at 17:14hrs and 17:16hrs respectively and their initial response personnel, who had to travel from Boggabri and Narrabri respectively, arrived on site at 17:32hrs. On arrival, the Police established a Command Centre, invoked an emergency response plan and opened a Disaster Victim Registry.
- f. The RailCorp Network Operations Supervisor (NOS), based in Tamworth, was advised of the incident at 17:20hrs and arrived on site at 18:40hrs.
- g. The NSW Fire Brigade HAZMAT team, based at Narrabri, arrived at 17:52hrs.
- h. By approximately 22:00hrs, all passengers and crew had been medically assessed and either evacuated to hospital or had recommenced their travel by bus.
- i. RailCorp subsequently applied a blanket speed reduction of 120kph for Xplorer and XPT trains outside the area bounded by Maitland, Macarthur and Lithgow.

Loss, Damage and Environmental Matters

- 4.7 In addition to the injuries described in paragraph 4.1.2, the following damage was occasioned:
- 4.8 EA2507 suffered (see Photo 2):
- a. severe impact and derailment damage to the headstock, underside of the driver's cab, leading bogie, traction/suspension control equipment for both bogies, fuel tank, auxiliary generator set, traction engine and access skirts;
 - b. a shattered front windscreen;
 - c. horns dislodged from mountings;
 - d. shattered passenger windows;
 - e. extensive buckling to various carriage body panels on all sides, and
 - f. extensive damage to electrical couplings and inter-carriage connections.
- 4.9 EC2523 suffered (see Photo 3):
- a. moderate damage on the "A" end⁹ and left side of the body pillar, and
 - b. extensive damage to electrical and inter-carriage connections.
- 4.10 AIQ 58V was destroyed in the collision (see Photo 4).
- 4.11 The fuel tank on EA2507 ruptured as it came in contact with damaged signalling equipment and approximately 1100 litres of diesel fuel spilt onto the ground. Fortunately, this fuel did not ignite.
- 4.12 There was relatively minor damage to the track, signalling and points equipment. Repairs and restoration of the site took three days to effect.

⁹ The end of the carriage where the air conditioning unit is located.



Photo 2: Damage to EA2507



Photo 3: Damage to EC2523



Photo 4: Damage to AIQ 58V

Train Driver's Qualifications, Competencies and Related Matters

- 4.13 The driver of NP23a was qualified and authorised to operate the train. Qualification and authorisation processes require drivers to be certified as competent to operate trains over specific routes. This train driver had 41 year's experience and had been assessed as competent to operate over the specific route. He had traversed the route twice over the preceding fortnight. In addition, he had also undergone refresher training on RailCorp's Network Rules on 23 April 2004.
- 4.14 The train driver was breath-tested on site and recorded a zero blood alcohol count. A subsequent review by OTSI of the train driver's roster for the preceding fortnight eliminated fatigue as a possible contributing factor.

Track & Crossing Details

- 4.15 **Track**
- a. Baan Baa is located on a single line section between Boggabri and Turrawan on the branch line from Werris Creek to Moree.
 - b. The Baranbah Street Level Crossing at Baan Baa is located 3.8kms from the beginning of a straight section of track running for approximately 35 kilometres in a north-westerly direction towards Narrabri.
 - c. The track grades leading into Baan Baa fall from a 1:134 gradient at the beginning of the straight to a 1:623 gradient at the crossing, before levelling after the sidings.

- d. The track is 53kg rail and the timber sleepers are secured with Pandrol fastenings.
- e. The track speed approaching Baan Baa from Boggabri is 115/140km/h with the speed board located at 527.000kms.¹⁰
- f. The level crossing had been assessed as priority No.100 in the list of crossings throughout NSW identified for upgrade.
- g. Records indicate an average of 11 train movements a day through the crossing.



Photo 5: Baranbah Street Level Crossing (530.780kms) looking in direction of travel of AIQ 58V

4.16 **Crossing**

- a. The level crossing is located at the point 530.780kms from Sydney, by rail, with the approaches running in an east-west direction and perpendicular to the line (see photo 5).
- b. The crossing is 'passive', i.e., there are no traffic lights or boom gates.
- c. While the crossing was signposted with "Stop" signs, signage did not conform to the minimum standards as specified in AS 1742.7 (1993)¹¹. There were no painted markings on the roadway, on either side of the crossing, to indicate stopping points. There was only one advance warning sign, posted 38m prior to the crossing on the western approach, and this sign was only .7m above the ground.¹²
- d. A "T" intersection exists just prior to the crossing on the western side, with the side road running in a southerly direction, i.e., parallel to the track.

¹⁰ Trains hauled by locomotives are restricted to an operating speed limit of 115kph. Xplorer and XPT trains, having a different wheel profile, may operate at speeds up to 140kph.

¹¹ Australian Standard AS 1742.7 specifies the type and standard of traffic control devices required in advance of, and at railway crossings.

¹² AS 1742.7 requires that an early warning sign be located between 80-120m of a level crossing and that signage be at least 1.5m above the ground.

- e. The Kamilaroi Highway is located approximately 35m from the eastern side of the level crossing. Standard “Give Way” signs face traffic approaching the highway from Baranbah Street.
- f. Records indicate that an average of 100 motor vehicles use the crossing a day. A previous collision at this level crossing occurred in 1994.



Photo 6: Train driver’s view of Baranbah Street Level Crossing 280m from crossing



Photo 7: Road motor vehicle driver’s view of track looking at direction of approach of NP23a.



Photo 8: Road motor vehicle driver's view of Xplorer train (all external lights on) positioned 280m from Baranbah Street Level Crossing.

Weather Conditions

4.17 At the time of the collision, it was dry and sunny. Information recorded at the automatic Weather Station at Narrabri Airport (approximately 20kms away) approximately 50 minutes after the incident described weather conditions as follows:

Temperature: .. 11.5 degrees Celsius
Humidity:..... 63%
Air Pressure:... 1023.6 HPa
Wind: SE at 8 kph

4.18 Sunset on the day was due at 17:15hrs, i.e., the sun was positioned West/North-West, behind the driver of AIQ 58V.

PART 5 ANALYSIS

Focus of investigation

5.1 Although OTSI investigated the totality of the circumstances of this accident, its lines of inquiry ultimately focused on the following three issues: how AIQ 58V came to be foul of the line; the actions taken by the driver of NP23a when it was apparent that AIQ 58V was foul of the line and the effectiveness of the subsequent emergency response.

How Did AIQ 58V become Foul of the Line?

- 5.2 Australian Road Rule No. 121 requires that a driver at a level crossing with a *stop sign* must:
- a. stop at the stop line or, in the absence of stop line, at the stop sign, and
 - b. give-way to any train or tram on, approaching or entering the crossing.
- 5.3 Australian Road Rule No123 prohibits a driver from entering a level crossing if:
- a. warning lights are operating or warning bells are ringing;
 - b. a gate, boom or barrier at the crossing is closed or is opening or closing;
 - c. a train or tram is on or entering the crossing;
 - d. a train or tram approaching the crossing can be seen from the crossing;
 - e. a train is sounding a warning and there would be a danger of a collision with the train or tram if the driver entered the crossing, or
 - f. the driver cannot drive through the crossing because the crossing, or a road beyond the crossing, is blocked.
- 5.4 The driver of AIQ 58V clearly breached both Rules No. 121 and 123. It is inconclusive whether the limitations of signage in this instance affected the motor vehicle driver's behaviour. What is apparent is that there are new, relatively low cost technologies that could be utilised on the approaches to level crossings that would provide increased warning of both the presence of a level crossing and of approaching trains. Remotely activated proximity warning systems such as those employed in the aviation industry are good examples of such contemporary safety technologies. Such technology might allow a train driver to not only sound the train's alarms on approaching a level crossing and activate alarms at the level crossing, but also to be given a positive indication that there is no obstruction at the crossing.
- 5.5 In pursuing the possibility that AIQ 58V was foul of the line as a consequence of an unintended action, OTSI examined the following possibilities:
- a. the driver was distracted or unaware of NP23a's approach;
 - b. the driver appreciated NP23a's approach but that AIQ 58V's brakes failed when applied;
 - c. the driver panicked when she appreciated that she was foul of the line and erred when she reacted instinctively, in either depressing the accelerator instead of the brake or engaging a forward rather than a reverse gear, or
 - d. that the driver was in some way impaired.
- 5.6 ***Distraction or Lack of Awareness of NP23a's Approach***
- a. With the assistance of the NSW Police and RailCorp, the pre-collision situation was recreated. OTSI investigators positioned themselves in the cabin of a like train travelling at the same speed at approximately the same time of day and under similar weather conditions. The Police, driving an almost identical vehicle to AIQ 58V, approached the crossing from the west, but for obvious reasons did not foul the line.

- b. Approximately 500m from the crossing the train driver, who had already activated the same train lights, sounded his horn. The Police advise that even with the car radio turned off,¹³ the sound-dampening features on the like vehicle (same model, age and very similar mileage) were such that it was difficult to hear the train's horn. However, bench tests established that the horn on both NP23a and the test train both functioned as intended. The level of damage to AIQ 58V precluded forensic investigators from establishing whether the car's radio had been on at the time of the collision. However, Police telecommunications checks eliminated the possibility that the driver of AIQ 58V may have been using her mobile phone at the time.
- c. There were no passengers in AIQ 58V who might have distracted the driver and, assuming she looked, she would have enjoyed good visibility to observe any approaching train.
- d. Studies into level crossing accidents/incidents have established that the majority of level crossing incidents occur, not surprisingly, at passive crossings and that the motor vehicle driver involved is, more often than not, familiar with the crossing. Further, it has been found that some drivers develop a heightened propensity for risk-taking when the frequency of trains using the crossing is low. It has also been established that under such circumstances drivers, over time, can become desensitised to passive warnings such as signs and alarms.¹⁴ These studies also indicate that drivers are often focused on what is happening beyond the level crossing. OTSI notes that in this instance, the driver was very familiar with the level crossing; the frequency of trains using the crossing was low; defences in place were largely passive and the Kamilaroi Highway is located 40m beyond/on the eastern side of the level crossing.
- e. The only obvious source of distraction was traffic on the Kamilaroi Highway, a short distance beyond the crossing. OTST notes that evidence provided by three witnesses attests to the fact that AIQ 58V moved slowly onto the track. Information from the data logger establishes that the train driver made a second and an emergency application of NP23a's horn when he was certain that AIQ 58V was foul of line. Approximately eight seconds later NP23a collided with AIQ 58V. OTSI considers that this extended period of 'dwell time' on the track is inconsistent with the prospect of the driver of AIQ58V having simply been distracted.

5.7 Driver Aware of NP23a's Presence but AIQ 58V Suffered from Mechanical Failure.

- a. Forensic examination of AIQ 58V established that AIQ 58V's engine was running and that the car was in gear at the time of impact. Examination of service records confirms that AIQ 58V was serviced regularly.
- b. Police experts also established that whilst AIQ 58V's brakes and tyres were severely damaged in the collision, the vehicle's brake pads and discs were in a serviceable condition; there was no sign of brake fluid leaks and the tread on the tyres indicated that they had been roadworthy.
- c. OTSI therefore discounted the possibility that the driver of AIQ 58V was aware of the presence of NP23a and judged that she had sufficient time to

¹³ The Police were unable to determine whether AIQ 58V's radio had been on or off immediately prior to, or at the time of, the collision.

¹⁴ Eck 2002; Wigglesworth 2002

negotiate the crossing, but that AIQ 58V suffered some form of mechanical failure in transit.

5.8 ***Driver's Instinctive Actions were in Error***

- a. OTSI considered the possibility that the driver of AIQ 58V was aware of the presence of NP23a and intended to stop, but depressed the accelerator, rather than the brake and in the process fouled the line. However, this is inconsistent with witness descriptions of AIQ 58V rolling onto the crossing and the extended period of time spent on the crossing.
- b. OTSI could not discount the possibility that shortly after commencing to move onto the crossing, the driver of AIQ 58V realised she had made a serious error of judgement and was immobilised by this realisation.

5.9 ***Impairment***

- a. OTSI considered the possibility that the driver of AIQ 58V was affected by alcohol and/or prescribed or non-prescribed drugs and therefore had diminished situational awareness.
- b. OTSI was unable to find any evidence to suggest that the driver was impaired by alcohol and/or drugs. Local residents described her as being of very moderate habits and as a most responsible person. The toxicology report, provided by the Coroner, indicates the presence of a prescribed medication. However, the level detected was consistent with normal dosages and the medication is not known to induce drowsiness or giddiness.

5.10 ***A Consequence of an Intended Action***

- a. Having examined the possibility that AIQ 58V was foul of the line as a consequence of an unintended action, OTSI also examined the possibility that the driver of AIQ 58V might have deliberately placed herself in harm's way.
- b. OTSI notes that three witnesses describe AIQ 58V as having rolled slowly onto the track, with two of the witnesses indicating that the vehicle had stopped before doing so. OTSI also notes that AIQ 58V was foul of the line for an extended period.
- c. Separate information, provided to OTSI by the Police, confirms that the driver of AIQ 58V had been consulting a medical practitioner but as explained in 5.9.b above, there is no correlation between the detected prescribed medication and driver impairment.
- d. Had the driver of AIQ 58V been intent on self harm, her slow approach onto, and the extended time spent within, the crossing would be easily explained. OTSI notes however, that there is an absence of corroborating information or evidence to sustain a contention that AIQ 58V was foul of the line as a consequence of an intended action.

Actions of Driver of NP23a

- 5.11 The train driver's description of his actions was confirmed by the analysis of NP23a data logger. Whilst there is some variation in estimates offered by the driver as to when actions were taken and those recorded, they were not of a magnitude that would cause OTSI to doubt the driver's version of events; rather, they reflect the limitations of human recall in emergency situations. Importantly, the data logger and bench and circuit testing confirmed that:

- a. NP23a approached the level crossing within the authorised speed limit;
- b. the train's head lights and ditch lights were illuminated;
- c. the train's horn was activated in routine and emergency modes;
- d. both the train's normal and emergency brakes were applied, and
- e. the train's brakes, lights and horn functioned when activated.

5.12 It is important to note that even with the emergency brake applied, it takes a train travelling at 140 kph approximately 700m to come to a stop. AIQ 58V became visible at a distance of approximately 380m.

Adequacy of the Emergency Response

5.13 Emergency Services, assisted by local residents, responded quickly and effectively, albeit in the face of a number of obstacles.

5.14 Egress from NP23a, which came to rest on its right side, was complicated by the following matters:

- a. doors on the right side of EA2507 could not be opened because they were in contact with the ground;
- b. doors on the left side were facing skyward;
- c. internal fixtures in the saloon becoming dislodged;
- d. luggage and personal effects, which was not restrained in luggage racks, becoming dislodged;
- e. buffet equipment which came adrift; this included hot water urns, hot and cold food, and bar stock;
- f. vestibule doors which could not be left open because of the absence of latching devices;
- g. the latch to the cabin door being inoperable; this fault was unrelated to the accident but required the crew to use a milk crate to climb through the bulk-head barriers between the cab and the saloon;
- h. the loss of the normal on-board power supply which rendered the main lighting and public address systems inoperable, and
- i. the limitations of emergency lighting and power supply.

5.15 The above matters not only complicated the efforts of crew and passengers, they also impacted upon the efforts of emergency workers. Work was further complicated by:

- a. an initial lack of ladders on the train and on fire rescue vehicles;
- b. the not unexpected limitations of Emergency Service knowledge, in relation to train access points and emergency shut-down points;
- c. the absence of window removal points in the saloon, and
- d. the significant effort required to remove the key rubber and force the driver's cabin's windscreen.

- 5.16 OSTI notes that whilst the loss of the main power supply limited visibility, it also reduced the potential for an electrical short circuit as water entered electrical cabinets.
- 5.17 OTSI notes that, whilst the four RailCorp employees on NP23a (three crew and another person travelling in an official, but non crew-related, capacity) had a total of 96 crew years experience, only the Senior Passenger Attendant (SPA) could recall ever participating in any emergency training. OTSI further notes that unlike airline passengers, the passengers on NP23a did not have the benefit of:
- a. a verbal safety briefing with emphasis on the actions to be taken in the event of an emergency;
 - b. luminescent exit markings, noting that existing arrangements are dependent on power supply, and
 - c. access to clearly marked exits and emergency door release handles.
- 5.18 OTSI also observes that RailCorp’s extant emergency procedures, as contained in its Operator Specific Procedures (OSPs), seem to assume that trains will remain upright after a derailment.



Photo 9: Inside saloon of EA2507 lying on its side



Photo 10: Access along buffet corridor while EA2507 was on its side

- 5.19 RailCorp’s imposition of 100kph and 120km/h speed restriction, for Xplorers and XPTs respectively has reduced both the prospect and consequences of a like accident.¹⁵

¹⁵ Limiting the maximum speed of an Xplorer from 140kph to 100kph effectively halves the distance required to bring the train to rest. Conversely, the force at impact between an Xplorer and a stationary vehicle at 100kph is 50% less than a collision at 140kph. Limiting the XPT to 120kph reduces the braking distance by 27%, or reduces the impact of a collision at 120 kph by 27%.

5.20 OTSI notes that the Xplorer is very similar to the “Turbo” Diesel Multiple Unit train involved in a collision at Ladbroke Grove in the UK in 1999. As a result of this collision and the ensuing fire, which was the consequence of ruptured fuel tanks, 31 people were killed. Fortunately, the Emergency services attending the accident at Baan Baa were not confronted with fire but many of the challenges described in paragraphs 5.14 and 5.15 above, were also identified in the Ladbroke Grove Rail Inquiry Report.

Cause of the Derailment

- 5.21 The leading carriage of NP23a derailed when the left-hand leading wheels rode up and over the left rail. The derailment sequence appears to have been as follows:
- a. The front-facing No. 2 Siding points-lock assembly was struck by either part of the wreckage of NP23a, a part of the points indicator that was struck by the wreckage of AIQ 58V or one of the surge tanks¹⁶ that was dislodged from underneath NP23a.
 - b. One of the surge tanks then came in contact with the inside of the right rail leading into a siding and followed the rail towards the siding (see Photo 10). This created lateral forces on the leading wheels of NP23a, resulting in the left front wheel being pushed onto and subsequently over the left rail.



Photo 11: Track layout at the point of derailment.

¹⁶ The tanks provide air to the carriage’s suspension

5.22 The above assessment is reinforced by the fact that both of the inside rails were rotated outwards (see Photo 12).

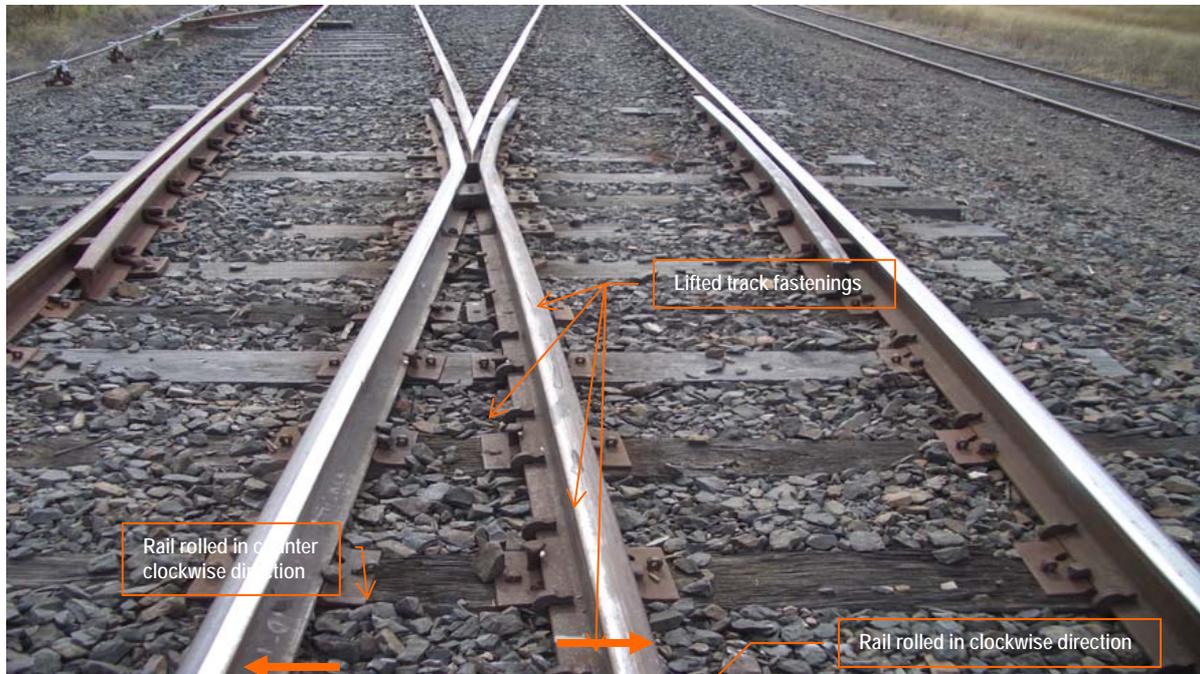


Photo 12: Photo showing rolled rails & lifted fastenings



Photo 13: Location of the surge tanks on an Xplorer car bogie.

PART 6 FINDINGS

- 6.1 OTSI finds that the collision at the level crossing was the consequence of a failure of the driver of motor vehicle AIQ 58V to observe NSW traffic rules 121 and 123. OTSI was unable to determine whether this failure was the consequence of an unintended act (an error), or an intended act (a violation).
- 6.2 OTSI also finds that:
- a. there were limited defences to warn drivers of motor vehicles on their approach to the level crossing, or to assist them to remain clear of the rail line when necessary;
 - b. the driver of NP23a observed all of the warning requirements on approach to the level crossing and executed the appropriate emergency measures when it became apparent that AIQ 58V was in harm's way;
 - c. design features on the Xplorer, under certain circumstances, inhibit emergency egress;
 - d. whilst Emergency Services and RailCorp responded quickly and effectively, their efforts to evacuate passengers were complicated by a number of the Xplorer's design features;
 - e. Emergency Services were inhibited by a lack of specific knowledge in relation to emergency access points and power shut-down;
 - f. passengers on NP23a did not have the benefit of a safety brief that specified the actions required in the event of an accident;
 - g. whilst the crew of NP23a responded positively in the wake of the collision, not all members had the benefit of recent emergency training;
 - h. additional safety equipment is required aboard services operated by RailCorp;
 - i. the ruptured fuel tank created the potential for a fire which in concert with other design aspects, specific limitations in crew and Emergency Services knowledge and the absence of a safety briefing to passengers, might have resulted in an even more tragic incident , and
 - j. RailCorp's imposition of blanket speed restrictions throughout most of regional NSW has reduced the prospect, and consequences, of collisions at level crossings.

PART 7 RECOMMENDATIONS

7.1 To prevent a recurrence of similar accidents, the following safety recommendations are made in relation to:

a. **RailCorp:**

- (1) reviews the arrangements for emergency egress on both its diesel and electric rolling stock fleets and gives specific consideration to the following matters:
 - (a) the containment of luggage and equipment in roll-over situations;
 - (b) the provision of latching arrangements on all doors;
 - (c) the provision of improved emergency signage and illumination;
 - (d) the provision of an improved emergency power supply;
 - (e) the fixed installation and leak-proofing of appliances and equipment in the buffet, and
 - (f) the addition of a ladder and a rubber mallet to the emergency equipment schedule;
- (2) improves the identification of emergency access points on its diesel and electric fleets;
- (3) provides and distributes relevant information in relation to emergency access and power shutdown to Emergency Services;
- (4) provides safety briefings, similar to those provided by airlines, to its passengers on interstate and intrastate services;
- (5) requires all train crew to participate in initial and refresher emergency/evacuation training and enforces such a requirement;
- (6) reviews its procedures for the setting/calibration, testing, removal and storage of voice-recording and data-logging equipment and records;
- (7) reviews its Operator Specific Procedures (OSPs);
- (8) reviews the design, positioning and protection of fuel tanks on its diesel fleet, and
- (9) in the light of the similarity in circumstances, reviews the recommendations arising out of the Ladbroke Grove Rail Inquiry Report, particularly those pertaining to the positioning and construction of fuel tanks, emergency power, egress arrangements and the provision of safety information, i.e., recommendations 61, 69, 70, 71, 74 and 78.

- b. **ARTC.** Notwithstanding any decisions that the NSW Joint Parliamentary Level Crossing Committee might make in respect of the Baan Baa level crossing, ARTC and the Narrabri Council act immediately to upgrade the crossing in accordance with the minimum standards required for passive crossings.

- c. **Independent Transport Safety and Reliability Regulator (ITSRR):**
- (1) in conjunction with the NSW Joint Parliamentary Level Crossing Committee and the Rail Industry, give consideration to the installation of remotely activated proximity warning systems that can be activated by drivers on the approaches to, and at, level crossings, and
 - (2) monitors the nature, and progress, of actions taken by RailCorp in response to the recommendations in paragraph 7.1.a above.

PART 8 OVERVIEW OF TEST RESULTS

Test	Conducted By	Summary of Results/Remarks
Train Horns	Worley	<ul style="list-style-type: none"> • One horn occasionally functioned intermittently • The sound pressure level of each horn was satisfactory. • The pitch of each horn tested was marginally lower than expected. • Each horn had the same air flow rate, calculated to be 539 L/min.
Train Lighting	Bombardier	<ul style="list-style-type: none"> • All circuits nominated for testing operated as designed. • All globes within circuits functioned when tested. • The strobe light circuit functioned when the horn circuit was activated.
Wheel Slide Units	Bombardier	<ul style="list-style-type: none"> • The wheel slide control units were tested and found to be operating satisfactorily. However, the magnetic pick-up unit to No.4 axle of EA2507 could not be tested because of the extent of the damage caused during the accident.
Nominated Train Brake System Components	SAB Wabco	<ul style="list-style-type: none"> • Test results varied marginally against specified requirements, but these were of insufficient magnitude to affect the train's braking.
Data Loggers	RailCorp	<ul style="list-style-type: none"> • The two data loggers were not properly synchronised and this complicated the data analysis. • Different wheel wear compensation factors were applied and this also complicated the data analysis.
Train Wheels	Bombardier	<ul style="list-style-type: none"> • All wheel profiles and sizes were within specifications
Sighting	OTSI/NSW Police/RailCorp	<ul style="list-style-type: none"> • There was a clear line of sight between AIQ 58V and NP23a at the level crossing. • The train headlights & ditch lights were conspicuous from the crossing for in excess of 500m in daylight conditions. • The strobe lights fitted to Xplorer trains lose intensity and meld into the headlights when operated by day and night. • The insulation qualities of modern cars are such that train horns are becoming less audible. In this instance, the horn was barely audible at 500m to a road motor vehicle driver and was not alerting at distances less than 500m.
Voice Analysis	RailCorp	<ul style="list-style-type: none"> • The recording equipment at NRM Broadmeadow did not record the related communication because it had been accidentally unplugged by a cleaner. • Although the train's radio communications were not recorded, calls made by crew on the train's mobile phones were captured on a separate recording system.
Phone Distraction	NSW Police	<ul style="list-style-type: none"> • Checks established that the driver of AIQ 58V was not using her mobile phone at the time of the accident.
AIQ 58V	NSW Police	<ul style="list-style-type: none"> • Both air bags inflated • All tyres were in a serviceable condition although damaged as a result of the collision. • The throttle system operated freely although the accelerator cable was missing at the time of inspection. • The brake pads and discs were in a serviceable condition with no fluid leaks present. • The major brake system components in the engine bay were severely damaged as a result of the collision. • The dash controls, electrical components, electrical system and headlights were extensively damaged and could not be tested. • The ignition barrel was found on the car floor attached to the wiring and with the key in the lock position and slightly bent. The switch functioned with slight downward pressure. • Tests established that the engine was running and the car was in gear at the time of the collision • The maintenance history of AIQ 58V confirmed repairs carried out to the brakes previously complied with standard maintenance practices. • Vehicle was not subject to any recall by the manufacturer.
Toxicology	NSW Coroner /Police	<ul style="list-style-type: none"> • Car Driver's Blood Alcohol Content – zero • Train Driver's Blood Alcohol Content - zero

