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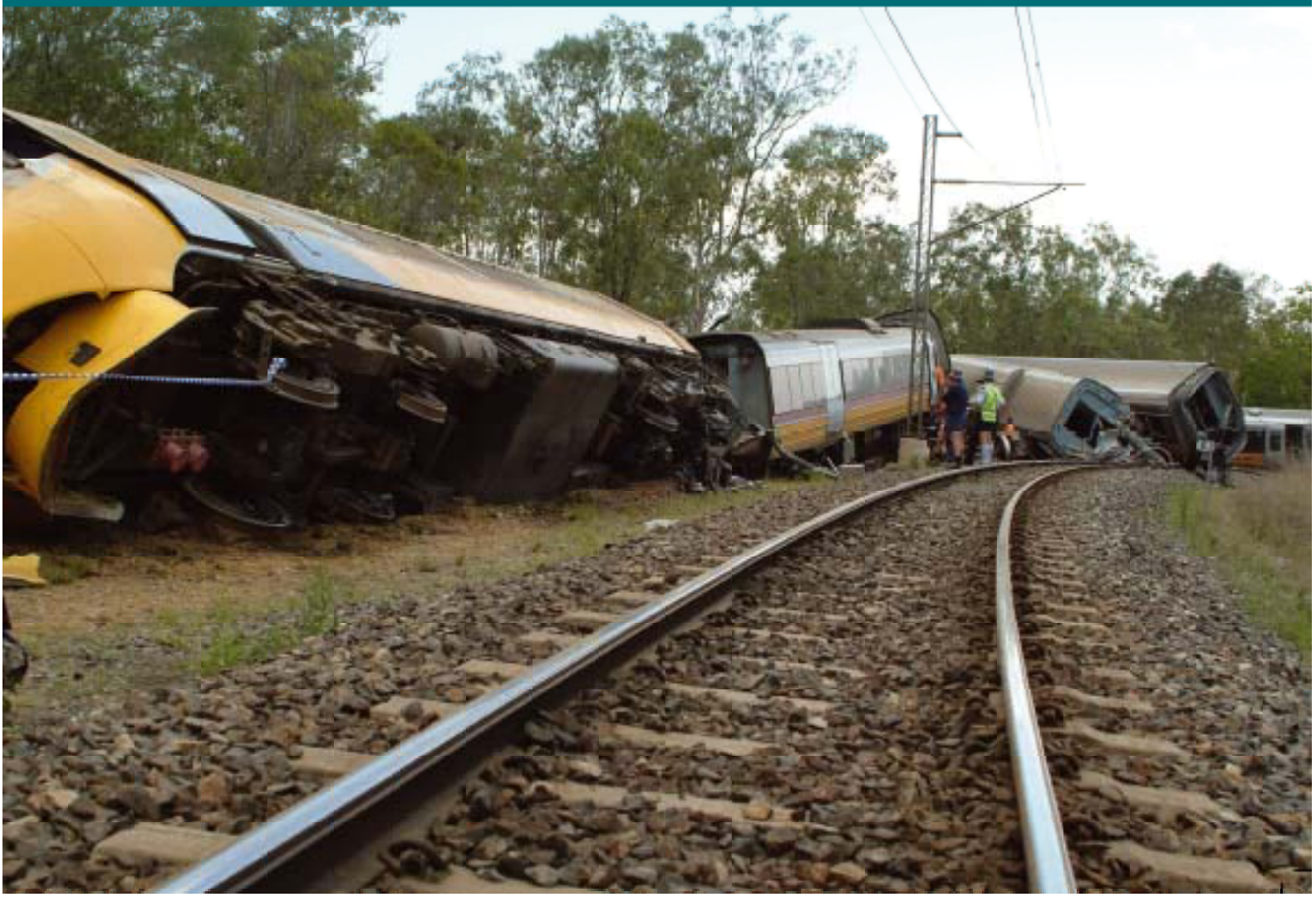
Derailment of Cairns Tilt Train VCQ5

North of Berajondo, Queensland
15 November 2004



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RAIL SAFETY INVESTIGATION
QT1472

Derailment of Cairns Tilt Train VCQ5

North of Berajondo, Queensland
15 November 2004

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Figure 2 Railways of Australia & NATMAP
Cover photo – Queensland Police

Abstract

At 2355 Eastern Standard Time on 15 November 2004, the diesel tilt train, *City of Townsville*, VCQ5, derailed 419.493 km from Brisbane (Roma Street), north of Berajondo on the Bundaberg to Gladstone line. The lead power car, No. 5403 and all remaining seven trailer cars derailed. The trailing power car No. 5404 was the only unit to remain substantially upright although the leading bogie set (in direction of travel) was partially derailed.

There were 150 passengers, the two drivers and five passenger service staff on board the train at the time of derailment. Although there were no life threatening injuries or fatalities there were some severe injuries.

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INTRODUCTION

At 2355[1] Eastern Standard Time on 15 November 2004, the diesel tilt train, *City of Townsville*, VCQ5, derailed 419.493 km from Brisbane (Roma Street), north of Berajondo on the Bundaberg to Gladstone line. The lead power car, No. 5403 and all remaining seven trailer cars derailed. The trailing power car No. 5404 was the only unit to remain substantially upright although the leading bogie set (in direction of travel) was partially derailed.

There were 150 passengers, the two drivers and five passenger service staff on board the train at the time of derailment. Although there were no life threatening injuries or fatalities there were some severe injuries.

Due to the serious nature of the derailment, the Queensland Government invited the Australian Transport Safety Bureau (ATSB) to be the lead agency involved in undertaking a full and joint independent accident investigation in conjunction with Queensland Transport (QT). This investigation has been executed in accordance with the legal framework defined by Queensland's *Transport Infrastructure Act 1994*, (as amended), herein after referred to as The Act.

The Australian Transport Safety Bureau (ATSB) was formed in July 1999 and is an operationally independent multi-modal Bureau within the Australian Government Department of Transport and Regional Services. The bureau is entirely independent of transport regulators and service providers. The ATSB's objective is safe transport. It seeks to achieve this through: independent investigation of transport accidents and other safety occurrences; safety data research and analysis; and safety communication and education.

Rail safety in Queensland is regulated by QT. All railway managers and/or railway operators within Queensland are required to be accredited in accordance with The Act. QT's role in rail safety also includes investigation of transport accidents and other safety occurrences.

It is acknowledged that the Department of Industrial Relations (DIR) through the Division of Workplace Health and Safety and Electrical Safety Office also plays a role in the regulation of rail safety in Queensland. DIR administers the *Workplace Health and Safety Act 1995* and the *Electrical Safety Act 2002*, which includes enforcement of obligations owed by all railways to workers engaged in railway activities and activities on works of an electrical entity, other workers and members of the public using, or affected by, railway activities or works of electricity entity. In accordance with a Memorandum of Understanding (MOU) made between QT and DIR it was agreed that QT would take the lead agency role in the investigation into the cause of the derailment.

1 Throughout this report, the time of derailment is generally referred to as having occurred at 2355, however the actual time of derailment based on evidential data should be read as having occurred at 2355:27.

The publication of this report is authorised for release by the Director-General of Queensland Transport.

The investigation was conducted for the sole purpose of enhancing rail safety. Consequently, this report is confined to matters of safety significance and should not be used for any other purpose. Reports released under The Act are not admissible as evidence in any civil or criminal proceedings.

TERMS OF REFERENCE

In pursuance of the powers given to me under Section 216(2) of the *Transport Infrastructure Act 1994*, I hereby require you to (investigate/chair) an independent investigation and report on the circumstances and cause of the accident involving the derailment of QR's diesel tilt train which occurred on the main north coast line approximately 63 km north of Bundaberg and report your findings in writing to the Executive Director, Land Transport & Safety Division, Queensland Transport by 16 February 2005 (should a full report be unable to be provided by this date an interim report must be submitted).

The investigation will:

- Clearly establish the factual circumstances of the accident.
- Identify the direct cause or causes of the accident and any other contributing factors.
- Assess human factors to identify any underlying matters which may have caused or contributed to the accident.
- Provide an estimate of direct and associated costs with the accident.
- If necessary make appropriate recommendations designed to prevent a recurrence.

The investigation report should be based on a systemic style investigation approach and should not be written in a manner that apportions blame.

The inquiry team will be comprised of members of the Australian Transport Safety Bureau (ATSB) and Queensland Transport. The investigation is to be chaired by the ATSB.

A/Executive Director (Land Transport & Safety)
Queensland Transport

INVESTIGATION METHODOLOGY

The purpose of this investigation is to enhance rail safety on the Queensland Rail network by determining the sequence of events that led to the derailment of the diesel tilt train *City of Townsville*, VCQ5 on 15 November 2004, and then determine why those events occurred. Of particular importance is the need to establish the cause or causes, contributory factors and associated deficiencies which have the potential to adversely affect rail safety and make recommendations to mitigate future risk.

The conduct and analysis of this accident investigation is based on the recognised international safety investigation methodology as developed by Professor James Reason and others.

The investigation was conducted as a joint independent accident investigation under the chairmanship of the Australian Transport Safety Bureau (ATSB) in conjunction with Queensland Transport (QT). The investigation was conducted in accordance with the legal framework as defined in the *Queensland Transport Infrastructure Act 1994*.

During the investigation, information was obtained and analysed from many sources, without being limited this included:

Interviews with personnel both directly and indirectly involved with the accident:

- Driver
- Co-driver
- Passenger Service Staff
- Passenger survey and further questioning where considered appropriate or requested
- Management, Medical and Safety Staff.

Technical Information:

- Visit to the accident site
- Photographic and video evidence
- Review of risk/hazard reports, management reports and associated documentation
- Inspection of rollingstock, design and maintenance records, train information, modelling of train characteristics
- Inspection of fixed infrastructure, design and maintenance records (communications, track, signalling, etc)
- Train Control information (audio tapes, running schedules, etc)
- Timetable performance & running times
- Queensland Rail & Queensland Transport Category A and B 'Rail Safety Incidents'.

Conclusions are based on the evidential data as available to the investigation team at the time of finalising this report.

The investigation team acknowledges the cooperation received from all parties to this investigation, both individuals and organisations.

EXECUTIVE SUMMARY

At 2355 Eastern Standard Time on 15 November 2004, the diesel tilt train, *City of Townsville*, VCQ5, derailed 419.493 km from Brisbane (Roma Street), north of Berajondo on the Bundaberg to Gladstone line. VCQ5 derailed on the first of the 60 km/h curve speed restrictions while travelling at a recorded speed of 112 km/h. The lead power car, No. 5403 and all remaining seven trailer cars derailed. The trailing power car No. 5404 was the only unit to remain substantially upright although the leading bogie set (in direction of travel) was partially derailed.

There were 150 passengers, the two drivers and five passenger service staff on board the train at the time of derailment. There were no life threatening injuries or fatalities; however, there were some severe injuries.

The section of track from Bundaberg through to Gladstone is undulating with curves and straight sections; there is opportunity for high speed operations of up to 160 km/h over certain sections of the track. For a little over 1.7 km before the accident site, speeds of up to 150 km/h are posted, but there is a need to reduce the train speed to 60 km/h at 419.410 km before a series of curves in advance of Cabbage Tree Creek.

Damage to the rollingstock was extensive but indications are that all cars are repairable. Approximately 120m of track, sleepers and ballast was damaged, three overhead traction support poles and associated overhead wiring was destroyed and required replacement.

On the night of the accident, QR became aware that a major accident may have occurred by 0002, seven minutes after the derailment. Emergency services were despatched and recovery strategies put in place at that time. Police arrived at the scene by 0044, followed by emergency services personnel and QR recovery teams. Passengers were initially treated on site and then transported to local area hospitals on a priority basis, dependent on injury type and severity. All passengers and crew were evacuated from the site by 0555.

Given the extent of the accident, its remote locality and time of night it is considered that the Police, Emergency Services and QR recovery teams were effective and efficient in their handling of the event.

Prima facie the principal cause of the derailment was excessive speed. The lead power car No. 5403 rolled at 112 km/h and then dragged the remaining trailer cars off the track before all units came to rest. From a systemic point of view, the accident is complex and although the principal causal factor relates to 'Human Performance', better organisational controls may have prevented this accident.

Based on the analysis of available evidence it is concluded that the driver became distracted from the driving task which resulted in him failing to recognise the train's geographic position along the track. This occurred during the period when the co-driver was in the adjacent vestibule thus removing one of QR's defence strategies, of having two drivers observing the status of the track. Other possible prompts that may have alerted the driver to danger, such as the vigilance system and track magnets, were ineffective. On the night the moon had set and the driver was reliant

upon the train headlight for external vision ahead and for peripheral vision. The details on the warning speed board, which was positioned at the start of the 60 km/h curve, would not have been picked up by the train's headlight until train VCQ5 was close to the curve. At the time of the derailment QR was in the process of reviewing the use of advance speed boards to provide drivers with advance warning of speed reductions of over 40 km/h.

The emergency services and QR reacted quickly to the accident and given the time of day and the relative remoteness of the site, the emergency response was quick and effective. The local residents, the police, emergency services and QR's response team should be commended for their handling of events associated with this derailment.

The vehicle structure was demonstrated to be strong and effective in terms of crash worthiness. No mechanical or infrastructure defect contributed to the accident.

The report recommends (not in order of priority):

1. QR should review the use of vigilance systems to determine whether a random time based system or similar would improve the train operating risk profile.
2. QR should report on its findings and proposed future strategy with respect to its review of the use of 'Advance' speed warning boards.
3. QR should conduct a thorough risk assessment into the procedures that permit a co-driver vacating the co-driving position.
4. QR should explore the possibility and advisability of providing differentiation or specific identification of individual station magnets.
5. QR should review the effectiveness of emergency communication strategies[2] on the North Coast Line and/or consider alternative communication strategies that provide enhanced coverage in the event of an accident/incident.
6. QR should review the risks associated with train evacuation in any location where electrical equipment may be live.
7. QR should review the effectiveness of 'Safety Briefings' given to passengers on joining 'Tilt Train' services, particularly in mid-sections, where it may be difficult to provide information to the extent necessary.
8. QR should review the crash survivability of the current 'Emergency Exit' systems installed on the 'Tilt Train' including emergency lighting and the ability to communicate with passengers during an emergency.
9. QR should review and undertake a risk assessment regarding the benefits of a passenger restraint system on tilt train services.

2 This may for example include provision of an 'Electronic Position Indicator Radio Beacon' (EPIRB) system or equivalent. QR should give consideration to consulting with the State Emergency Services when developing strategies to enhance its emergency communication capabilities.

10. QR should review its monitoring and ongoing training of drivers that have been involved in nonconforming situations in the operation of trains. Strategies[3] that enhance driver performance should be investigated and implemented.

11. Following the publication of this report, QR should provide QT with a response to this report, as relates to tilt train services, outlining all proposed risk mitigation strategies including time frames for implementation. The Rail Safety Unit of Queensland Transport should regularly review this plan and report its status to the Director-General of Queensland Transport.

Observations:

1. During the early stage of the investigation it was noted that QR intended to expand the use of its Automatic Train Protection (ATP) for tilt train services. The use of ATP for tilt train services was being progressively worked through and further tests were prescribed/underway at the time of the derailment. These tests are continuing. This strategy is supported with the proviso that if the present system cannot be effectively modified/used a further review should be undertaken to determine additional mechanisms to enhance/enforce driver vigilance, including the use of alternative positive train control systems.

2. All personnel who responded to the emergency, including local residents, QR passenger service staff, emergency services personnel and QR response teams should be commended for their prompt response and post accident management of this derailment.

3. Information provided by passengers who were involved in the derailment is acknowledged. This information was extremely useful, constructive and enhanced the value of the final report.

3 Strategies should be developed in consultation with employee and union groups to ensure that high risk employees are identified and effectively managed. To assist with this strategy, it is considered that it may be beneficial for QT to work with the other State Regulators in developing a nationally consistent approach for the monitoring and handling of safeworking breaches.

1 OVERVIEW

Queensland Rail (QR) is the principal manager/operator of rail transport services in Queensland with major business units comprising:

- Freight and logistics services;
- Commuter and long-distance passenger services;
- Track access for their narrow, standard and dual gauge network; and
- Rail-specific expert services.

As part of its regular passenger services QR operates two high speed diesel tilt trains the *City of Cairns* and the *City of Townsville* on the North Coast Line between Brisbane and Cairns over a distance of 1,655 km with a scheduled journey time of approximately 24 hours 55 minutes.

On Monday 15 November 2004, the diesel tilt train *City of Townsville*, VCQ5, departed Brisbane, Roma Street Station at 1825 as scheduled. The first part of the journey, Brisbane to Bundaberg was operated by two drivers. A rostered crew changeover occurred at Bundaberg at 2258.

The train departed Bundaberg at 2311 with 150 passengers, the two drivers and five passenger service staff on board the train. The section of track from Bundaberg through to Gladstone is undulating with curves and straight sections; there is opportunity for high speed operations of up to 160 km/h over certain sections of the track.

For a little over 1.7 km before the accident site, speeds of up to 150 km/h are posted, but there is a need to reduce the train speed to 60 km/h at 419.410 km before a series of curves in advance of Cabbage Tree Creek. The train entered the first of these curves at a speed of 113 km/h.

At 2355 Eastern Standard Time on 15 November 2004, VCQ5 derailed 419.493 km from Brisbane (Roma Street), north of Berajondo on the Bundaberg to Gladstone line. The lead power car, No. 5403 and all remaining seven trailer cars derailed. The trailing power car No. 5404 was the only unit to remain substantially upright although the leading bogie set (in the direction of travel) was partially derailed.

Although there were no life threatening injuries or fatalities there were some severe injuries.

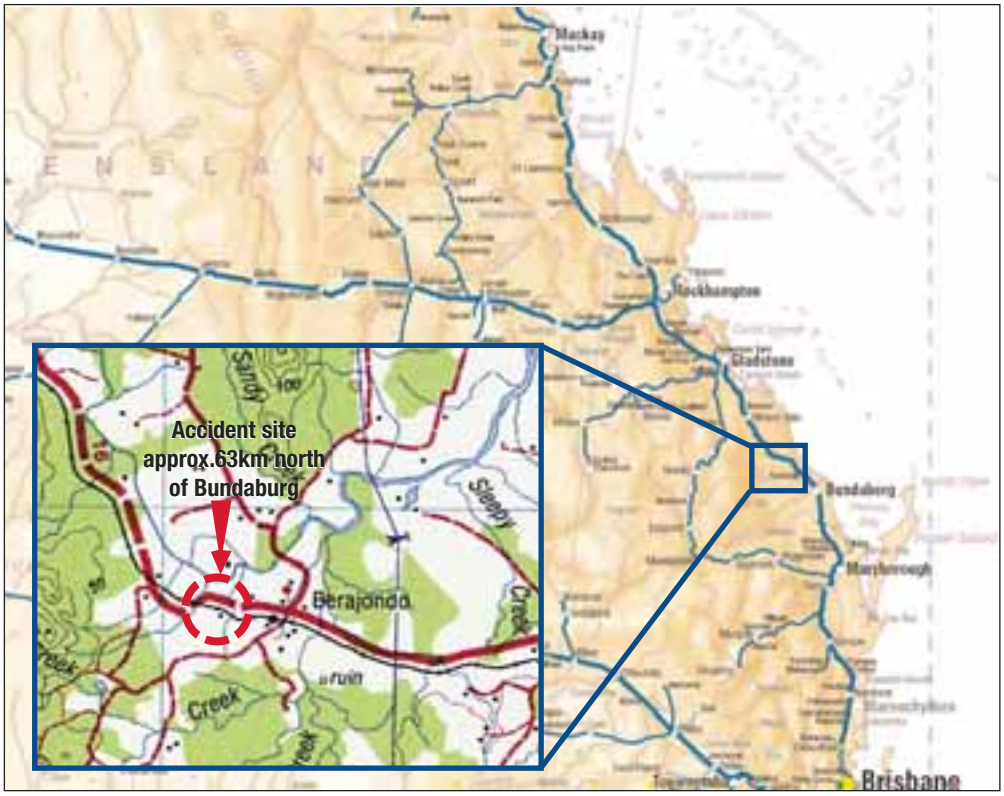
At the time of the accident, it was dark with no background lighting, the moon was below the horizon and there was no other source of external illumination, other that the train's headlight. The weather in the vicinity of Berajondo was fine. Temperature was approximately 24.5 degrees Celsius, wind speed was low and visibility was good.

Both the driver and co-driver were experienced operators and trained to QR requirements. Both the driver and co-driver were medically fit, and the driver tested negative for impairment by alcohol and drugs. The co-driver was not tested.

1.1 Location

The derailment site was approximately 63 km north of Bundaberg, a regional Queensland town, which is located approximately 350 km north of Brisbane (Fig. 1).

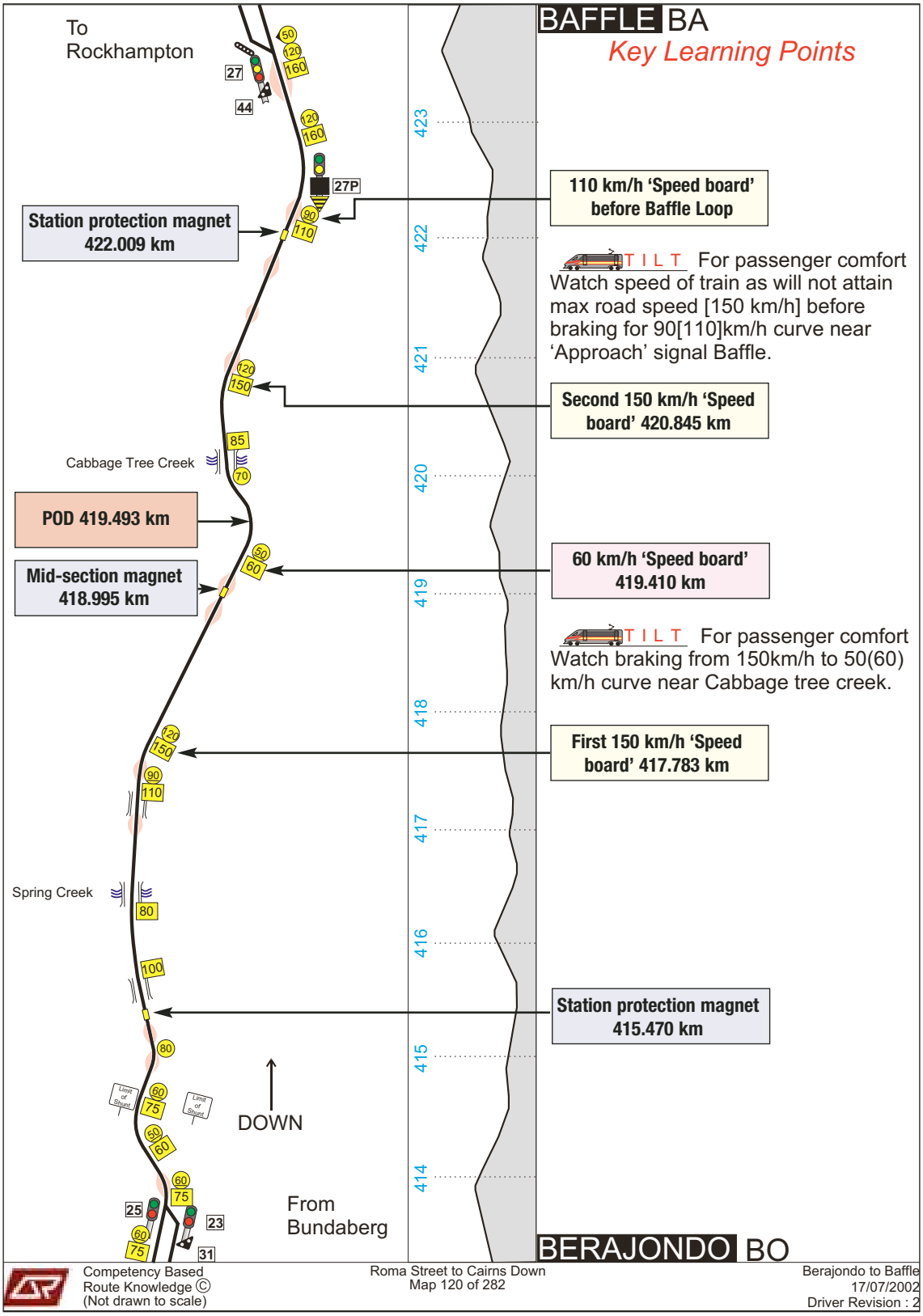
FIGURE 1: Location of Berajondo Accident Site, Queensland



The section of track from Bundaberg through to Gladstone (Fig. 2) comprises a single line with 'passing loops' to facilitate the crossing of trains. There is a 'passing loop' at Berajondo (413.5 km) and Baffle (424.2 km). The track between the two 'passing loops' is undulating with nine curve sections linked by straights. Speeds of up to 150 km/h are permitted over two straight sections, the first starting at 417.783 km and the second at 420.854 km respectively; however there is a need to significantly reduce speed to 60 km/h at 419.410 km before a series of curves in advance of Cabbage Tree Creek.

The site of the derailment was on the first 60 km/h curve commencing at 419.411 km. The accident site was contained by soft earth embankments with the right-of-way bounded by a stock-proof fence; low level undergrowth existed within the right-of-way, with fairly young eucalypt trees located close to the boundary fence. Good access was available at the accident site, from the adjacent Bundaberg to Lowmead Road.

FIGURE 2: QR Route Map, Berajondo to Baffle



Note: Added are key items of interest, shown in arrowed boxes.

1.2 The occurrence

The *City of Cairns* and the *City of Townsville* operated three times a week, Monday, Wednesday and Friday, Brisbane to Cairns and Sunday, Wednesday and Friday, Cairns to Brisbane.

The *City of Townsville* had an overall length of 196.8m and consisted of a leading Power Car No. 5403, hauling seven trailer cars designated A-G, comprising a Baggage Car 7408, three Sitter Cars 7409, 7410 and 7411, a Club Car 7412, a further two Sitter Cars 7413 and 7414 with a trailing Power Car 5404.

On Monday 15 November 2004, the *City of Townsville* departed Brisbane, Roma Street at 1825 as scheduled with power car 5403 leading. The first part of the journey, Brisbane to Bundaberg was operated by two drivers. The second section, Bundaberg to Mackay was also operated by two drivers. The rostered crew changeover occurred at Bundaberg at 2258 with the previous drivers reporting the earlier part of the journey as uneventful. No vehicle defects were identified.

On boarding the train at Bundaberg, the two new drivers took up positions as driver and co-driver respectively. During the interview process it was established that the driver had placed his carry bag under the co-driver seat; his normal habit was to place his carry bag under the seat he was occupying. The carry bag contained personal effects including some food and bottled water.

The train departed Bundaberg at 2311, two minutes early, with 150 passengers, the two drivers and five passenger service staff on board. On departure from the main station at Bundaberg, the train passed over the Burnett River and then along Station Street at low speed, 40 km/h, before clearing the township and entering QR's dedicated right-of-way. The train reached Berajondo at 2350. Shortly after departing Berajondo, at about 2351 when passing through the first of a series of speed curve restrictions, the co-driver left his seat and entered the adjacent vestibule area to tidy-up and make a 'brew' for the driver. Data from the locomotive data logger shows that the driver maintained a speed a little below the maximum permitted through the first series of curves.

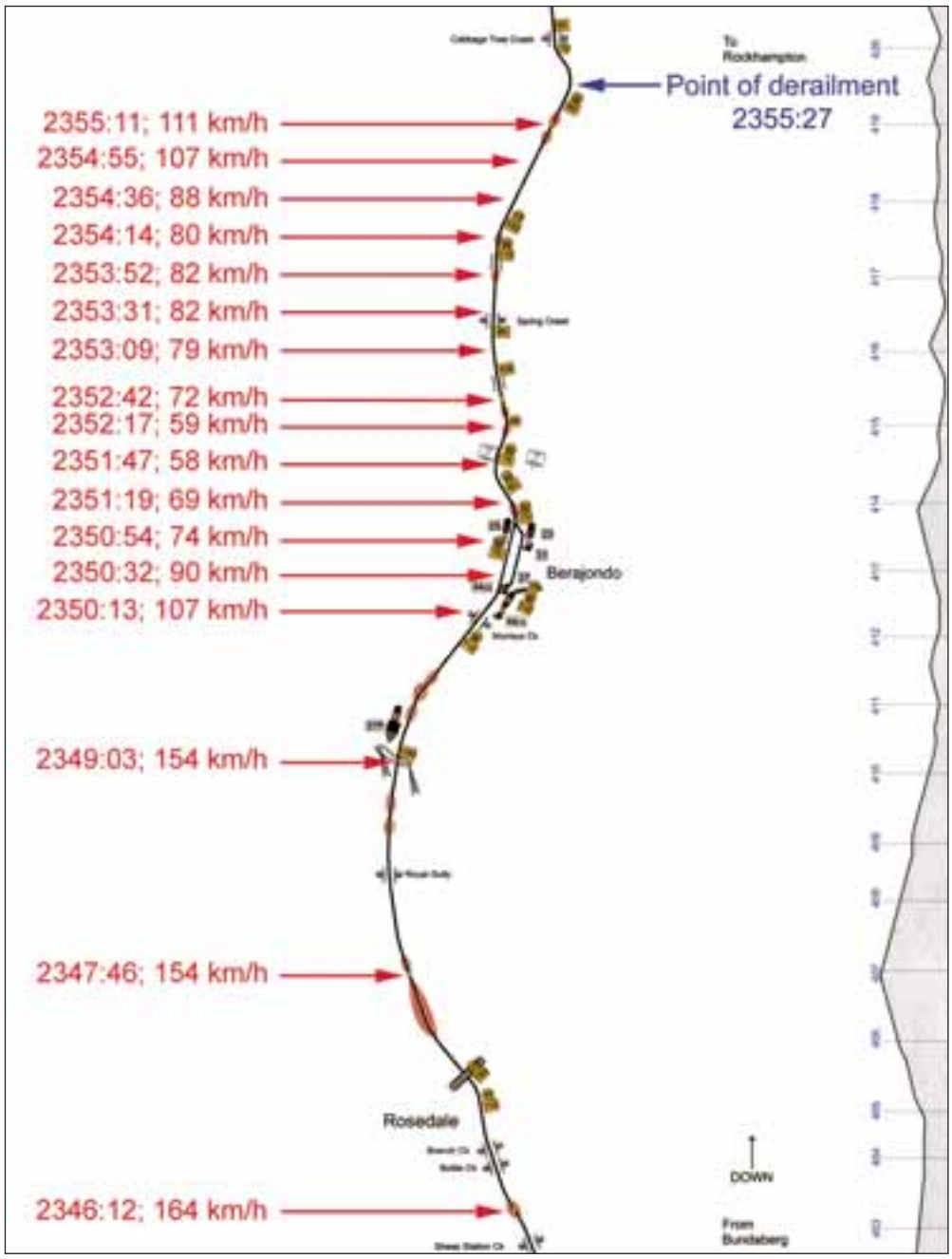
At 2352:41 (Fig. 5) the power car passed over the Berajondo 'up' station protection magnet, located at 415.470 km at a speed of 72 km/h, about 3 km/h below the maximum permitted speed. The driver increased power until reaching a speed of just over 81 km/h at 2353:13. The train was maintained close to this speed through 800m of track designated as 100 km/h and then through a 900m section of track from 416.480 km to 417.380 km designated as 80 km/h. At 2354:26 (Fig. 3) the driver placed the throttle at 100 per cent power and the train accelerated and reached a speed of 105 km/h, at 2354:52 (Fig. 4) the throttle was placed at about 60 per cent power.

The evening was dark, with no background lighting from external sources.

FIGURE 3: **Train approx at 417.783 km, location of 150 km/h 'Speed Board'. Train accelerates from 82 km/h under full power**

FIGURE 4: **Driver feathers power to 60%; train maintains a constant speed of approximately 110 km/h up to and including accident site**

FIGURE 5: Extract from Locomotive data logger – Speed/Geographic Position of Train



At 2355:11 (Fig. 6) the power car had passed over the 'mid-section' magnet at 418.995 km, the driver immediately acknowledged the alarm. A speed of between 111 km/h and 113 km/h was then maintained at a throttle setting of about 60 per cent. At 2355:24, 13 seconds after acknowledging the 'mid-section' magnet alarm, the throttle was moved rapidly to zero and within one second was put to full emergency braking (Fig. 7, train in full emergency brake).