Australian Government

Australian Transport Safety Bureau

ATSB TRANSPORT SAFETY REPORT
Rail Occurrence Investigation – RO-2007-005
Final

Level crossing collision
Two Wells, South Australia

6 August 2007

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Postal address: PO Box 967, Civic Square ACT 2608
Office location: 15 Mort Street, Canberra City, Australian Capital Territory
Telephone: 1800 621 372; from overseas + 61 2 6274 6440
Accident and incident notification: 1800 011 034 (24 hours)
Facsimile: 02 6247 3117; from overseas + 61 2 6247 3117
E-mail: atsbinfo@atsb.gov.au
Internet: www.atsb.gov.au

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Location map indicating Two Wells township - Railways of Australia.

Abstract

At about 1135 on Monday 6 August 2007, a loaded sewage truck drove into the path of the south-bound passenger train, *The Ghan* (7DA8), at the Murrow Farm level crossing near Two Wells, South Australia. The driver of the truck was seriously injured and the truck was destroyed. The train's lead locomotive was severely damaged in the collision but the train driver was uninjured. Two minor injuries were recorded by passengers on the train and there was minor damage to the track.

The investigation found that there was insufficient sighting distance for the truck driver to see *The Ghan* approaching from the north before he crossed the railway track. There was vegetation growing adjacent to the rail track which impeded the sighting for the driver of the truck and the maintenance practices for the clearing of vegetation at the Murrow Farm level crossing were inadequate to maintain effective sighting of trains. Programmed works that had identified the vegetation as a sighting hazard which was to be rectified within 28 days, had not been carried out in accordance with the relevant maintenance specification. The maintenance priority had been revised from 28 days to 180 days without a reassessment of the sighting hazard.

As a result of this investigation, the ATSB has identified safety issues primarily related to maintenance practices for the control of vegetation in the rail corridor which require action to reduce the risk of future collisions at this and other level crossings. The ATSB also acknowledges safety action already undertaken by the Australian Rail Track Corporation in response to identified safety issues.

THE AUSTRALIAN TRANSPORT SAFETY BUREAU

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government ATSB investigations are independent of regulatory, operator or other external bodies.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to fare-paying passenger operations.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to enhance safety. To reduce safety-related risk, ATSB investigations determine and communicate the safety factors related to the transport safety matter being investigated.

It is not the object of an investigation to determine blame or liability. However, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to proactively initiate safety action rather than release formal recommendations. However, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation, a recommendation may be issued either during or at the end of an investigation.

The ATSB has decided that when safety recommendations are issued, they will focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on the method of corrective action. As with equivalent overseas organisations, the ATSB has no power to implement its recommendations. It is a matter for the body to which an ATSB recommendation is directed (for example the relevant regulator in consultation with industry) to assess the costs and benefits of any particular means of addressing a safety issue.

TERMINOLOGY USED IN THIS REPORT

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, risk controls and organisational influences.

Contributing safety factor: a safety factor that, if it had not occurred or existed at the relevant time, then either: (a) the occurrence would probably not have occurred; or (b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or (c) another contributing safety factor would probably not have occurred or existed.

Other safety factor: a safety factor identified during an occurrence investigation which did not meet the definition of contributing safety factor but was still considered to be important to communicate in an investigation report.

Other key finding: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which 'saved the day' or played an important role in reducing the risk associated with an occurrence.

Safety issue: a safety factor that (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operational environment at a specific point in time.

Safety issues can broadly be classified in terms of their level of risk as follows:

- **Critical safety issue**: associated with an intolerable level of risk.
- **Significant safety issue**: associated with a risk level regarded as acceptable only if it is kept as low as reasonably practicable.
- **Minor safety issue**: associated with a broadly acceptable level of risk.

EXECUTIVE SUMMARY

On Monday 6 August 2007 at approximately 1135[1], a truck carrying sewage on the Two Wells – Mallala Road, South Australia, turned right into a private road level crossing. The truck driver stopped and changed gear before proceeding up a grade and over the railway line where the truck was struck by *The Ghan* passenger train (7DA8). *The Ghan* was en route to Adelaide after leaving Darwin two days earlier and was travelling at 93 km/h at the time of the collision.

The truck driver was seriously injured and the truck was destroyed. The train driver was not injured but two passengers on the train reported minor injuries. The train's lead locomotive suffered extensive damage to structural and non-structural frontal components. There was minimal damage to the track.

The level crossing where the accident occurred is located about 3 km north of Two Wells on a private road which provides access to 'Murrow Farm'. The crossing is categorised as an 'Occupation'[2] crossing and was fitted with 'Stop' signs.

The investigation found that the truck driver had not stopped at the 'Stop' sign at the level crossing but even if he had, thick vegetation growing beside the road meant that it was not possible for him to adequately sight the approaching train to allow his safe passage across the railway line at the entrance to Murrow Farm. In addition, the following factors contributed to the collision:

- Maintenance practices for the control of vegetation in the rail corridor at the Murrow Farm level crossing were inadequate.
- Tree pruning and clearing works following the identification of a sighting hazard at the Murrow Farm level crossing in March 2007 were not completed within 28 days in accordance with the original assessment and priority maintenance specification.
- The Australian Rail Track Corporation (ARTC) Infrastructure Management System priority rating for the sighting restoration work at the Murrow Farm level crossing was revised from 28 days to 180 days. A reassessment of the status of vegetation at the level crossing and its effect on sighting distances was not undertaken before the priority rating was changed.
- For drivers entering Murrow Farm, the railway 'Stop' sign assembly (RX-2 modified) was approximately 4.6 m from the nearest rail. Although Australian Standard AS 1742.7, recommends sign assemblies should not be placed closer than 3.5 m from the nearest rail, positioning the sign nearer to the 3.5 m point would have assisted the driver in gaining a clearer view of approaching trains.

The report issues six recommendations to address the safety issues identified and acknowledges one safety action already taken by the ARTC.

1 Central Standard Time.

2 An occupation crossing is 'a privately accessible crossing of a track by a roadway at the same or intersecting elevation'. (Glossary for National Code of Practice and Dictionary of Railway Terminolgy-17/06/2004)

1 FACTUAL INFORMATION

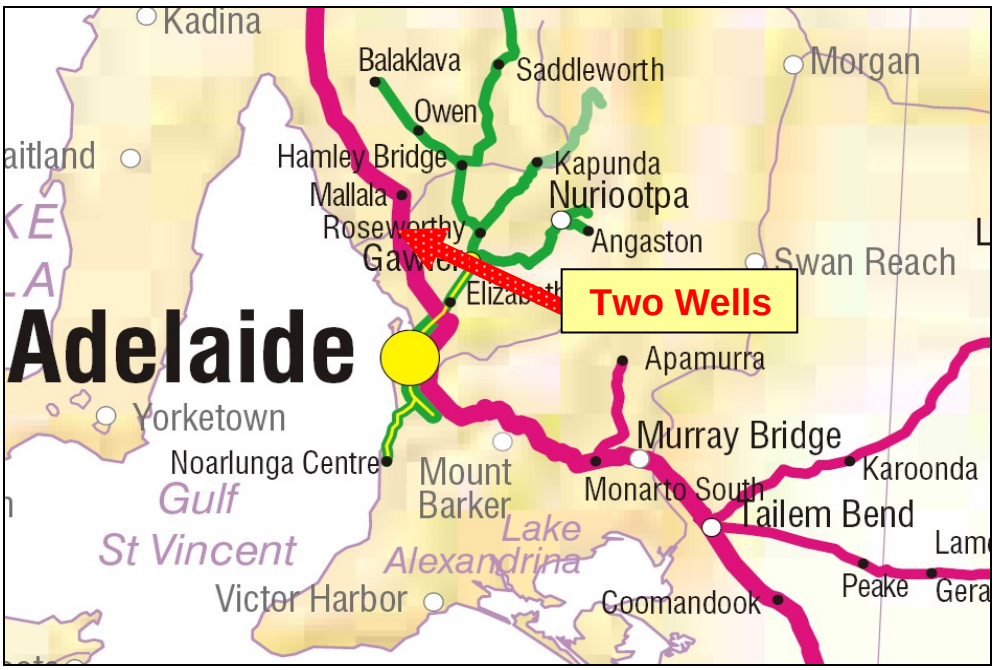
1.1 Overview

At approximately 1135[3] on Monday 6 August 2007, a sewage truck drove into the path of the south-bound passenger train, *The Ghan* (7DA8), at a private road level crossing at the entrance to 'Murrow Farm' near the township of Two Wells, SA. As a result of the collision, the truck driver was seriously injured and the truck was destroyed. The train driver was not injured and there were two reports of minor injuries to passengers on the train. The lead locomotive was extensively damaged.

1.2 Location

The township of Two Wells is located about 40 km north of Adelaide, SA, on the Adelaide Plains (Figure 1). The collision occurred on the Defined Interstate Rail Network (DIRN) at a level crossing located approximately 3 km north of Two Wells and 47.580 track kilometres north of Adelaide[4] respectively.

Figure 1: Location of Two Wells, South Australia



Railways of Australia Copyright ©

3 Central Standard Time.

4 The 0 km point is located at Mile End (SA).

1.2.1 Road and rail layout

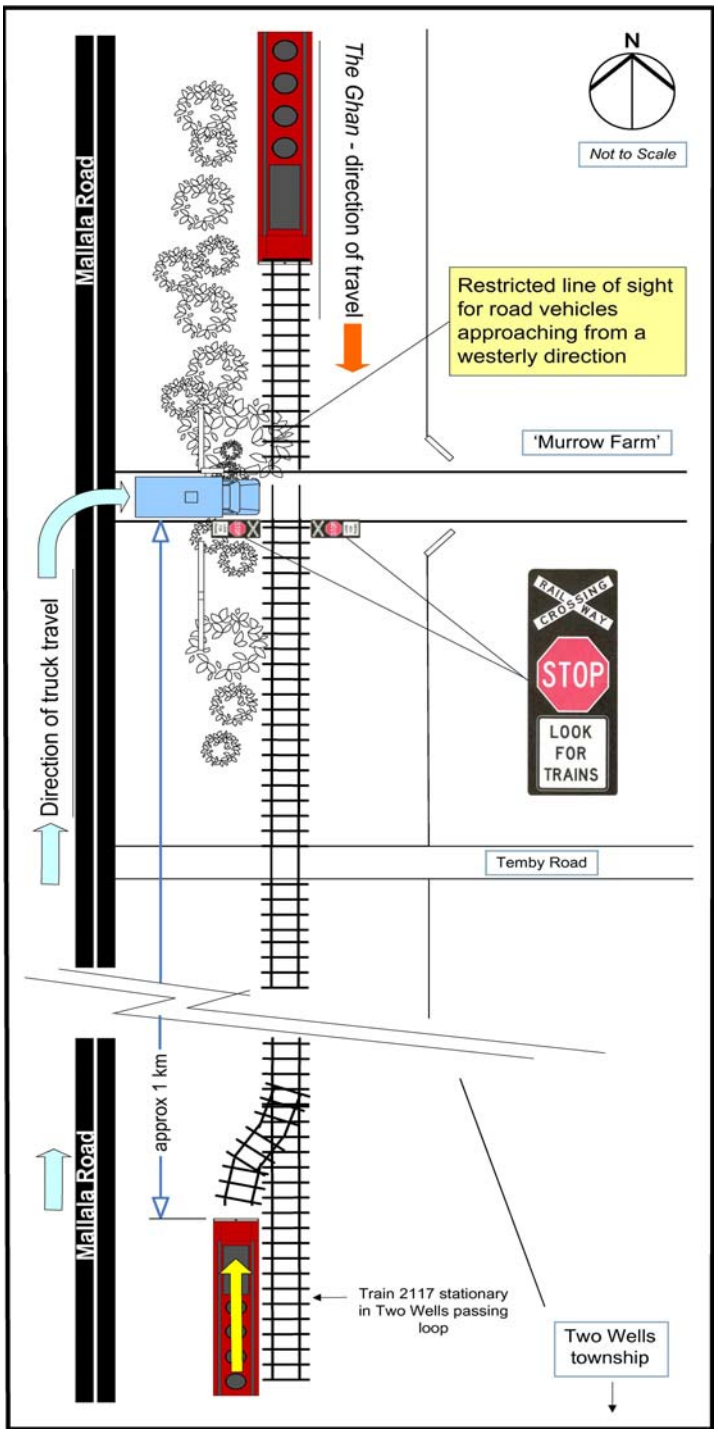
The level crossing at the entrance to Murrow Farm is categorised as an 'occupation crossing'[5] and comprises a single track crossed at right-angles by the roadway (Figure 2).

The road surface consists of compacted quarry rubble with a rising grade from the Mallala Road entrance before it crosses the track and descends toward the farm's boundary gate. The road crossing provides access to Murrow Farm from the Mallala Road between the townships of Two Wells and Mallala. At this location the railway line is positioned approximately 16 m east of, and parallel to, the Mallala Road.

Within the boundaries of the railway corridor and as the owner of the railway infrastructure, the Australian Rail Track Corporation (ARTC) is responsible for the control and management of the railway track, road surfaces over the railway, road traffic warning signs and vegetation control. The ARTC contracts maintenance of the track and civil infrastructure to Transfield Services Limited. To the west of the railway corridor, the District Council of Mallala is responsible for the management and maintenance of the Mallala Road, associated infrastructure, road traffic warning signs and control of vegetation.

5 An occupation crossing is 'a privately accessible crossing of a track by a roadway at the same or intersecting elevation'. (Glossary for National Code of Practice and Dictionary of Railway Terminolgy-17/06/2004)

Figure 2: Road-Rail Layout at Murrow Farm



At the time of the collision, there was a 120 m long row of trees and shrubs beside the railway line. This vegetation effectively obscured the view that a driver of a train travelling south had of a road vehicle travelling along Mallala Road and about to turn into the Murrow Farm road to use the level crossing. Similarly, the view of an approaching train for the driver of the motor vehicle approaching the crossing,

was obscured by the same vegetation. Passive traffic control devices[6] were installed to regulate the behaviour of motorists using the level crossing.

1.2.2 Train and crew information

The Ghan Passenger Train (7DA8)

The Ghan passenger train is operated by Great Southern Rail Limited[7] (GSR) and travels the 2979 km between Adelaide and Darwin in each direction twice a week. International tourists are a significant portion of the patronage for *The Ghan* service which, in the peak season, can consist of up to 24 carriages and upwards of 200 passengers. At the time of the accident, *The Ghan* consisted of two locomotives (NR74 leading and CLP16), 13 passenger carriages, two motorail wagons,[8] two power vans, two crew coaches, and a luggage van. There were 113 passengers, 17 on-train (hospitality) staff and one train driver on board. Including the locomotives, the train was 517 m long and weighed 1182 tonnes.

The normal train driving crew consists of one driver between Port Augusta and Adelaide. The driver at the time of the accident had about 22 years train driving experience and had worked on the Adelaide to Port Augusta rail corridor since 2004. On the day of the collision, the train driver had started his shift in Port Augusta. The evidence shows that he was rested and fit for duty in terms of certification/competency and the national medical standard[9].

The maximum permitted speed for *The Ghan* is 115 km/h.

1.2.3 Sewage truck

The road vehicle involved in the collision was an Isuzu rigid tray top truck that was fitted with a sewage tank and associated equipment for filling and discharging liquid waste. The vehicle was approximately 7 m long and had a total loaded weight of approximately 8 tonnes.

The driver of the truck, also the owner of the business, was a 53 year old male from Two Wells, South Australia. He was appropriately licensed and had approximately 30 years experience driving trucks and other heavy vehicles.

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6 A modified RX-2 assembly combined on a single plate primary warning sign consisting of cross-bucks W7-1, a ‘Stop’ sign R1-1A and ‘Look for Trains’ G9-48.

7 Great Southern Rail Limited (GSR) is an accredited rail organisation providing interstate passenger rail transport linking Sydney, Melbourne, Adelaide, Perth and Darwin. GSR contracts the responsibility for train operations to Pacific National, who provide locomotives and drivers under a ‘hook and pull’ agreement.

8 The motorail wagon is used to transport the passenger’s private vehicles.

9 National Transport Commission (NTC) *National Standard for Health Assessment of Rail Safety Workers.*

1.2.4 The occurrence

On Saturday 4 August 2007, *The Ghan* departed from the Darwin passenger terminal for the 2979 km journey to Adelaide. *The Ghan* arrived at Port Augusta on Monday 6 August at 0754 and, after a scheduled stop of 15 minutes for a driving crew change, departed for Adelaide at 0809. There were 113 passengers, 17 train staff and one train driver aboard.

At 1058, *The Ghan* was diverted into the Long Plains[10] crossing loop to cross a Perth bound freight train (7WP2). *The Ghan* departed from the Long Plains loop at 1115.

About 4 km from Two Wells, *The Ghan* passed through a 70 km/h temporary speed restriction and, once clear, the driver accelerated towards the maximum line speed of 115 km/h.

On the morning of the accident, the truck driver had travelled to Wingfield in Adelaide to have a wheel alignment carried out on his truck. Later that morning he collected a load of sewage at Wingfield and travelled through the township of Two Wells, onto Mallala Road and north towards Murrow Farm.

The driver slowed and turned right (east) at the entrance to Murrow Farm and came to a stop before driving up the gradient to cross over the railway line. Near the top of the grade and with a clear line of sight each side of the crossing (beyond the vegetation beside the railway line), the driver looked to the right and then to the left. When looking left, with the truck part way over the crossing, the driver saw that *The Ghan* was nearly upon him.

At about this time, the train driver was preparing to record the time of crossing freight train 2117 which was stationary in the Two Wells crossing loop. He checked the track was clear ahead and could not see any road vehicles before he momentarily turned to reach for his paperwork, pen and reading glasses. He then looked up and saw the truck crossing the track directly in front of the train. There was insufficient time to sound the horn, so the driver swiftly made a full emergency brake application.[11] Almost immediately the train collided with the truck at a speed of 93 km/h.

The train struck the truck tray behind the driver's cabin (Figure 3). The truck was flung in a south-easterly direction and down the railway embankment. The truck then slewed through a fence into the adjacent paddock coming to rest approximately 45 m from the point of impact and rotated through approximately 190 degrees from its original direction of travel.

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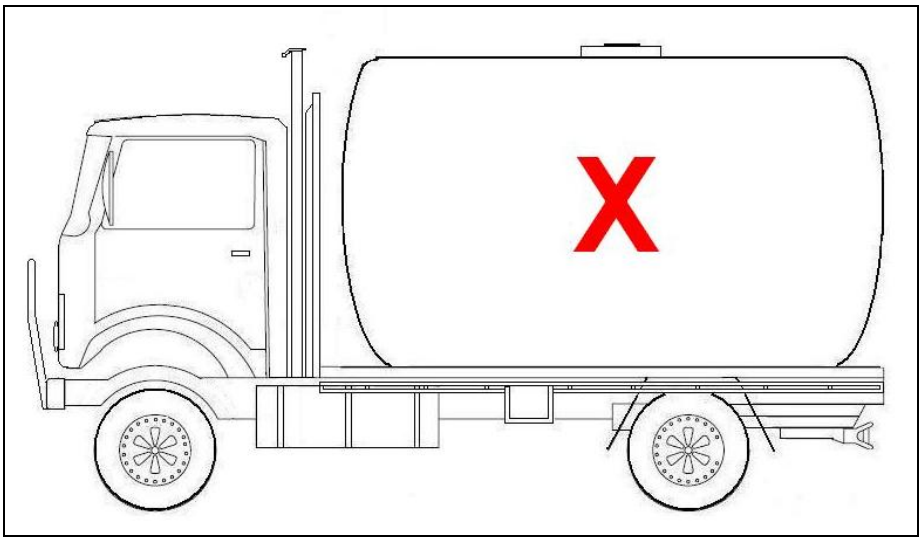
10 Long Plains is located about 32.5 km north of Two Wells and 77 km from Adelaide.

11 The type of brake application made when a train must be stopped in the minimum distance possible (Glossary for National Code of Practice - 2004).

Figure 3: Location of impact on truck



Following the collision, the train quickly slowed and stopped at the Temby Road level crossing, approximately 650 m from the point of impact. At this time, the train driver contacted the Pacific National Operations Control Centre and the ARTC train controller to advise them of the collision and request emergency services assistance. Contact with both control centres was made using a mobile telephone as the train driver's console had been damaged by the collision and the radio system had become partially inoperative and only allowed communications with the train manager on *The Ghan*. Although the driver chose to use his mobile telephone to advise of the emergency, train radio communications could have been accessed through the second driver's console that was not damaged during the collision.

The driver of the truck suffered serious injuries and two train passengers suffered minor injuries in the collision. One passenger reported some 'whiplash' to the neck and another struck their head on a bunk when the train suddenly stopped. The train driver was not injured.

1.2.5 Witnesses to the collision

On the morning of the collision, two train enthusiasts planned to photograph and video *The Ghan* near Two Wells where it would cross a north-bound freight train (2117) on its approach to Adelaide.

Just before the arrival of *The Ghan*, the two train enthusiasts started to set up their photographic equipment adjacent to the Temby Road level crossing (about 650 m south of the Murrow Farm level crossing). Before their photographic equipment was completely set up, they noticed *The Ghan* travelling towards them. Seconds later they saw the truck drive into the path of the train and the subsequent collision with debris and sewage waste sprayed in all directions. One of the train enthusiasts immediately telephoned train control and the other telephoned emergency services on '000' to report the accident.

1.3 Post occurrence

After the train stopped at the Temby Road crossing, a railway maintenance worker, who had been waiting to recommence track work after *The Ghan* had passed him near Two Wells, arrived to find out what had happened. He was informed by the train enthusiasts that a collision with a truck had occurred at the next crossing north. The track worker then drove along the railway access track to assist at the accident scene and report further details to ARTC train control.

About 10 minutes after the collision, emergency services started to arrive at the accident site to assist in the treatment and rescue of the truck driver. Assistance was provided by the South Australia Police who stayed with the truck driver, reassuring him until South Australia Ambulance Service officers arrived.

On board the train, the Train Manager coordinated buses to transport passengers to the Adelaide Interstate Passenger Terminal. Country Fire Service and Ambulance Service staff assisted with the detraining of passengers who were evacuated from the train without incident.

The section of track near Two Wells was closed to all traffic from the time of the collision until 1540 when the train was cleared to complete its journey to Adelaide.

1.4 Toxicology tests

The train driver was tested for the presence of alcohol. The breath test, administered by an officer of the South Australia Police at the scene, returned a zero reading. A drug test was later conducted with a negative reading. Toxicology test results showed that the truck driver was not driving under the influence of alcohol or illicit drugs.

1.5 Loss and damage

The sewage truck was destroyed in the collision with the cabin, chassis and septic tank separating. On impact with the truck, both locomotives were sprayed with sewage and lead locomotive NR74 suffered extensive damage to its upper and lower structural and non-structural components. The train's passenger carriages and other wagons were not damaged.

Track and infrastructure damage was limited to a minor 'kick'[12] in the track requiring replacement of a length of rail at the Murrow Farm level crossing.

12 A horizontal misalignment of the track.

2 ANALYSIS

On 6 August 2007, a team from the Australian Transport Safety Bureau (ATSB) was dispatched to investigate the collision between *The Ghan* and a sewage truck at the Murrow Farm level crossing.

The investigators examined and photographed the accident site, the road approach to the accident site, and the train and truck in situ.

Evidence was sourced directly from witnesses including the train driver, truck driver and the two train enthusiasts who witnessed the collision. Other evidence was sourced form the Australian Rail Track Corporation (ARTC), Great Southern Rail Limited (GSR) and Pacific National (PN). This evidence included train control records, locomotive data logs, train driver and truck driver employment histories, relevant standards and railway maintenance records.

Initial investigation revealed that the vehicles (train and truck) involved in the collision had no mechanical defects or deficiencies which would have contributed to the accident. Train driver fatigue was considered not to be causal in the collision. Similarly, an examination of the truck driver's work-sleep pattern established that fatigue was unlikely to have contributed to the accident.

2.1 Sequence of events analysis

2.1.1 Train data logger

Locomotive NR74 data logger records show that on 6 August 2007, *The Ghan* departed Port Augusta, SA, at 0809 for its destination of Adelaide. At Long Plains, the data logger shows a series of events consistent with *The Ghan* entering the crossing loop in preparation to cross a Perth-bound freight train. After leaving Long Plains (about 32.5 km north of Two Wells), the train passed through a temporary speed restriction and gradually accelerated.

On approach to Two Wells, 70 seconds before the collision, train speed was 67 km/h and increasing. At this time, the locomotive's main headlight was turned off in preparation to cross freight train 2117 stopped in the Two Wells crossing loop.

At the train whistle board, approximately 500 m from the Murrow Farm level crossing, train speed was 84 km/h. The data logger does not record that the train horn was sounded near this point. At 11:34:31, 383 m from the crossing, with train speed slowly increasing, the train driver acknowledged the vigilance control system[13].

At 1134:46, when the train collided with the sewage truck, *The Ghan* had reached a speed of 93 km/h. The train driver had made an emergency brake application just before impact with the truck and data shows that 75 m after the collision, train

13 A system provided to detect whether the driver is conscious and alert, typically by the periodic activation of an audible and/or visual indication to the driver that requires a positive response. (CoP for the DIRN Vol 5: Rollingstock Part 1 Introduction RCP-1011)

speed had decreased to 91 km/h. The train came to at stop 43 seconds and 649 m later.

2.1.2 Site examination

Examination of truck tyre skid marks on the road surface over the level crossing showed that the sewage truck had been struck in the centre region of the tray before being thrown from the path of *The Ghan* towards the eastern side of the rail track.

There was no evidence of truck tyre skid marks indicating heavy braking before the collision occurred. On the western side approach to the crossing, it was observed that the private road leading into Murrow Farm from the Two Wells to Mallala road was unsealed and narrowed by the overgrowth of shrubs and small trees. ATSB investigators noted this vegetation would severely restrict the sighting of trains approaching from a northerly direction. In addition, vegetation growth between the Two Wells and Mallala road within the railway corridor restricted the truck driver's ability to see a train approaching from his left side.

The evidence is that the train driver did not see the truck until it was on the level crossing and also that the truck driver did not see the train until just before it collided with his truck.

The following analysis is focused on the factors which may have influenced the actions of the drivers of the truck and train, the effectiveness of the level crossing traffic control system, the maintenance regime for the management of vegetation in the rail corridor, and the effectiveness of train horns for warning road vehicle users.

2.2 Level crossing traffic control

The road traffic control devices installed at the Murrow Farm level crossing consisted of 'Stop' signs. At the time of the accident, the signs on both sides of the crossing were in a clean and serviceable condition (Figure 4).

Figure 4: Murrow Farm road entrance looking east

A ‘Stop’ sign is commonly used where it may be difficult for a motorist to sight an approaching train when approaching a level crossing. ‘Stop’ sign control requires motorists to stop in order to sight a train and thereby make an informed decision as to whether it is safe to proceed over the crossing.

Given the size and weight of most trains, it is not possible for them to brake and decelerate at anywhere near the rate of even the largest road vehicles. Heavy freight and locomotive hauled passenger trains may take several kilometres to slow from high track speeds.

A train driver is unlikely to sight a motor vehicle approaching a level crossing and determine its intent to stop, or not, until both vehicles are relatively close to the crossing. If the road vehicle fails to stop, the train driver is unable to take any effective action to prevent the collision other than sounding the horn and (if time permits) make an emergency brake application. Even if the train is travelling at relatively low speed and the driver initiates emergency braking, the train will probably traverse the crossing well before the braking effort becomes effective.

By comparison, a road vehicle (including heavy trucks) can stop relatively quickly. It is for this reason that, regardless of the type of level crossing traffic control at the crossing, the onus to take appropriate action is very much on the motorist. Consequently, it is important that road signs are effective in warning a motorist that they are approaching a level crossing and also provide sufficient distance to stop safely. Similarly, it is important that from the stopped position, there is sufficient sighting distance available in each direction along the railway line for the motor vehicle driver to clearly see an approaching train.

2.2.1 Level crossing compliance

At the time of the collision, Australian Standard AS 1742.7-2007 *Manual of uniform traffic control devices Part 7: Railway crossings* prescribed the standard for traffic control devices that were to be used at public road and pedestrian level crossings throughout Australia.

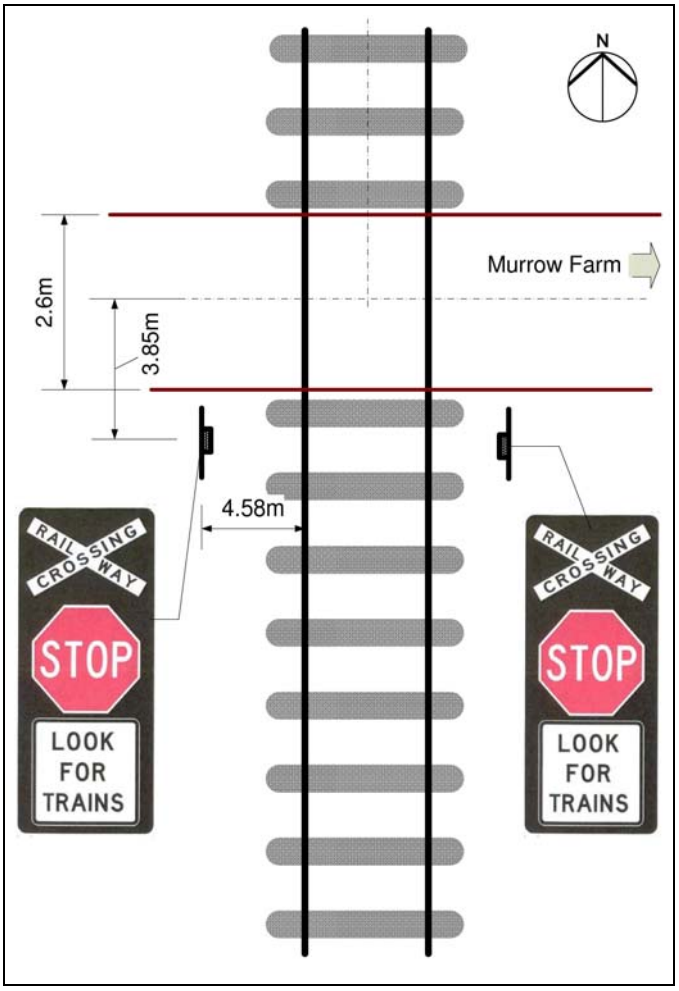
AS 1742.7-2007 has no specific requirements for signage at private level crossings and it states:

> The requirements of this Standard are not applicable to railway crossings provided for the exclusive use of the occupier of private land or by other people with the knowledge and agreement of the occupier (sometimes known as ‘occupation’ crossings).

The road into Murrow Farm is considered a private access road and therefore the requirements of AS 1742.7-2007 are not necessarily applicable. However, at the time of the collision, the Murrow Farm level crossing had a single plate sign assembly (modified RX-2) erected at the approach to the crossing, on each side of the railway track (Figure 5). This sign was developed by the ARTC and the SA Department for Transport, Energy and Infrastructure (DTEI) in 2000 as an alternative to mounting separate ‘Railway Crossing’, ‘Stop’ and ‘Look For Trains’ signs on a single post used at public road crossings. The sign was designed primarily for use at low volume occupation type crossings and complies with the *ARTC Code of Practice Engineering Specification - Track & Civil – Establishing Minimum Protective Measures at Level Crossings.*

The signs used at Murrow Farm were consistent with the intent of AS 1742.7-2007, but all sign elements are printed on a single metal plate. The LOOK FOR TRAINS (G9-48A) and the STOP (R1-1A) elements both conform to the dimensions of the standard. The RAILWAY CROSSING element (R6-24A) has been modified to fit the width of the plate and is 53.5% of the standard specified size. The sign is reflectorized and has a black background with a white border.

Figure 5: Signs at Murrow Farm level crossing on 6 August 2007



The single plate sign assembly for drivers entering the farm was placed on the right-hand side of the roadway and about 4.6 m from the nearest rail. Although it is unlikely to have contributed to the accident as the sign was clearly visible to a road vehicle driver, it is standard practice to position 'Stop' sign assemblies on the left side of the road not closer than 3.5 m from the nearest rail.

It is noted that the previous version of the standard, AS1742.7-1993 prescribed the use of particular level crossing signage at private roads and indicated that the standard was:

> …applicable to crossings on private land which may be used by other members of the public such as visitors to the land or site.

As the Murrow Farm road is considered to be a low volume private access road, the installation of approach warning signs for motorists on Mallala Road is not considered necessary. Approach warning signs are generally limited to intersections

posing a greater hazard. This methodology is applied nationally to maintain warning sign credibility and effectiveness by reducing sign clutter on a public road approach to the intersection of a road that presents minimal public risk.[14] The absence of signs on a public road approach to a private road is also a cue that discriminates a public road from a private road.

The management of the risks at private occupation level crossings rests jointly with the land owner/occupier and the railway owner. In this case, as the railway owner, the ARTC's level crossing safety risks are broadly overseen by the relevant rail safety regulator through the ARTC's accreditation as a railway owner and operator under the applicable state rail safety legislation. A condition of the ARTC's accreditation states that it shall 'upgrade all classes of wayside signs that are inconsistent to the NCoP [15]on all of its territory…' The provision and maintenance of these signs was to be in accordance with the ARTC *Track & Civil Code of Practice – Vol 4* on all interstate main lines in South Australia. In South Australia, the ARTC has met this accreditation condition by completing its upgrading program of wayside signs in accordance with the NCoP and the ARTC track and civil specifications.

The *ARTC CoP Engineering Specification Track & Civil – Establishing Minimum Protective Measures at Level Crossings*, specifies that:

> **Private Crossings**
>
> Private crossings may be either for accommodation, that is those which provide access to the public road system from private dwellings, or occupational, that is which provide access within a property.
>
> The level of protection at private crossings will depend on the individual circumstances of the crossing. The options can vary from lockable gates through whistle boards to treatments provided for in AS 1742.7, including a requirement for the licence holder to obtain a clearance from train control prior to using the crossing.
>
> The ARTC modified RX-2 'Stop' Sign Assembly should be used unless a higher level of protection is indicated by a risk assessment…….
>
> The sighting distance provisions in the ARTC Specification for Sight Distance Provisions at Level Crossings may be varied for private crossings subject to appropriate risk assessments.

Although the current AS 1742.7-2007 no longer includes a requirement for traffic control devices for private railway crossings, the ARTC continues to specify a minimum treatment of RX-2 'Stop' sign assemblies at these locations.

In 2003, when the ARTC installed the RX2 'Stop' sign assemblies at Murrow Farm, the level of warning and control was compliant with AS 1742.7-2007 and sighting distance in both directions was assessed as adequate. Therefore, there were no issues identified at the crossing that would have instigated a specific 'risk assessment' (as per the ARTC CoP for Private Crossings) with

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14 AS1742.2-1994 *Manual of uniform traffic control devices* - Traffic control devices for general use.

15 National Code of Practice for the Defined Interstate Rail Network.

alternative/additional protections, for example, clearance from train control prior to using the crossing.

2.2.2 Sighting distance

At the time of the investigation, the ARTC had not developed the document *Specification for Sight Distance Provisions at Level Crossings* referred to in their *CoP Engineering Specification Track & Civil – Establishing Minimum Protective Measures at Level Crossings -Engineering Specification ETF-16-01*. In the absence of this specification, there was no internal procedure or standard stipulating what sight distance requirements were applicable for level crossings under their management, on either public or private roads. Track inspectors employed by Transfield Services Limited (the ARTC's maintenance contractor) used their experience and professional judgement to assess sight distances at level crossings and prioritise items of non-compliance that were then recorded in a program for future works.

More broadly, however, the *Code of Practice for the Defined Interstate Rail Network – Operations and Safeworking - Rules* specifies that level crossings on the DIRN must comply with AS 1742.7-2007 with respect to crossing controls. With regard to sighting distance, the Rules state:

> **Road/Pedestrian Crossing Requirements**
>
> The following apply:
>
> (c) Warning of approaching trains **shall** be provided to those about to cross the railway so that they can either stop prior to the crossing or clear the crossing before the train arrives. This warning **shall** be achieved either by:
>
> (i) providing direct viewing of the approaching train at passive controlled crossings; or
>
> (ii) providing a timely warning at active controlled crossings.

The provision of 'direct viewing of the approaching train at passive controlled crossings' means that the sighting distance for such level crossings, by inference, must be in accordance with Australian Standard 1742.7-2007 which states:

> Stop sign control The sight distance shall be sufficient for the road vehicle driver stopped at the railway crossing stop line to be able to start off and clear the crossing before the arrival of a previously unseen train.

At the time of the collision, the single lane road leading into the farm from Mallala Road was approximately 16 m long and 4 m wide. It passed through a short section of dense low to medium height shrubs (about 6 m from the nearest rail) narrowing the road width to approximately 2.6 m for a distance of about 2 m before reaching the 'Stop' sign.

For a road vehicle driver stopped at the 'Stop' sign, the greatest sighting distance is required when the approaching train is travelling at maximum line speed, in this case, 115 km/h. Under these conditions, the calculated minimum required sighting distance for the road vehicle driver using the appropriate formula in AS 1742.7-2007, is about 600 m. Visibility to the south of the crossing met this requirement

and was clear with a view of approaching trains from the 'Stop' sign for about 600 m.

However, at the time of the collision, the growth of the vegetation adjacent to the crossing meant the actual sighting distance for a train approaching Murrow Farm level crossing from the north was approximately 60 m (Figure 6A). For a vehicle moving forward from the 'Stop' sign, clear visibility of the approaching train could probably be only achieved when the front of the vehicle was in a position that obstructed the rail line and would result in a collision (Figure 6B).

Figure 6: Sighting distance looking north at the Murrow Farm level crossing

Although it is not normal practice for the DTEI to carry out risk assessments of occupation/private level crossings, in September 2003, a site survey was made at Murrow Farm. An assessment of the level of risk at the crossing was carried out using the Australian Level Crossing Assessment Model (ALCAM)[16]. The calculation of the sighting distances was in accordance with the provisions of AS 1742.7-2007[17]. At that time, a road vehicle driver stopped about 5 m from the rail looking for an approaching train was determined to be at low risk as there was no vegetation obscuring the line of sight in either direction.

Over the period of 4 years since the ALCAM assessment in 2003, the vegetation at the level crossing had progressively grown without a regular reassessment of the adequacy of the sighting for road vehicle users. At the time of the accident, and probably for a considerable period of time before, the sighting distance to the north

16 ALCAM is a tool used to uniformly assess the level of risk at railway level crossings. Crossing site survey data is gathered using a standardised procedure.

17 The DTEI's ALCAM survey and assessment program is a five year rolling program, and does not include occupation crossings. Rail and road owners should not rely on the DTEI to identify deficiencies and should rely on their own inspection, monitoring and maintenance programs.

was inadequate for a road vehicle driver travelling in an easterly direction to see an approaching train and allow their safe passage over the crossing.

The sighting distance of approaching trains had deteriorated to the point where the problem was readily identifiable which should have prompted swift maintenance action to prune the vegetation at the crossing. In addition, once the problem had been identified, other interim measures should have been put in place in accordance with the relevant ARTC CoP for private crossings until the maintenance was performed, for example, clearance to use the crossing from train control.

The day after the collision at Murrow Farm (7 August 2007), the DTEI re-surveyed the crossing using the ALCAM risk assessment process. Although the frequency of train and motor vehicle traffic movements over the crossing remained at no more than 14 trains and 10 road vehicles per day, the same level as for the 2003 assessment, the significant growth in the vegetation on the north-western side of the crossing meant the risk to road vehicle users had raised substantially. Where level crossing site surveys and ALCAM assessments determine an increase in the level of risk above the intervention limit score[18], the DTEI advises the road and railway track owners of the safety hazards that require priority attention.

At 1138, when the collision occurred, the sun was at an angle about 70 degrees from the eastern horizon. The sun's elevation in the north and the angle are unlikely to have contributed to any significant level of glare or have affected the truck driver's ability to sight the approaching train. The level crossing was observed at about the same time the following day. The environmental conditions were similar to the day of the collision and verified that the effects of the sun were unlikely to have contributed to a reduction in sighting at the Murrow Farm level crossing.

2.2.3 Maintenance of occupation level crossings

The ARTC has an obligation to provide and maintain crossing controls and associated infrastructure at designated level crossings in a serviceable condition. In January 2003, the ARTC and the owner of Murrow Farm made a 10-year licence agreement to allow authorised users access to the farm via the level crossing spanning the rail corridor. The agreement stipulated that the ARTC was responsible for the maintenance of the road surface over the crossing and 3 m each side of the rail track. The agreement also stated that the licensee was not allowed to interfere with signs erected by the ARTC.

As Murrow Farm is located on the eastern side of the DIRN, the vegetation, consisting mainly of trees and shrubs located between the rail corridor and Mallala Road, is growing on land managed by the ARTC and the District Council of Mallala. Vegetation control within the boundaries of the rail corridor, which extends to approximately 12 m either side of the rail lines, is the responsibility of the ARTC. Vegetation control on the western side of the rail corridor adjacent to Mallala Road is the responsibility of the District Council of Mallala and on the eastern side of the rail corridor it is the responsibility of the owner of Murrow Farm.

18 'The Intervention Limit Score indicates a level above which there is likely to be safety hazards the require priority attention to mitigate the level of risk to road and rail users.' *ALCAM Crossing Assessment Handbook v1_01.doc*

The vegetation affecting the line of sight from the crossing to the north was within the rail corridor and was therefore the responsibility of the ARTC. The investigation was advised that prior to the collision, the tenants of Murrow Farm had asked the District Council of Mallala for the trees adjacent to the level crossing to be pruned back but were advised that this was not the council's responsibility.

The ARTC *Track and Civil Code of Practice* states that scheduled grade crossing general inspections are to be carried out at intervals not greater than 12 months.

Maintenance records from the ARTC and Transfield Services Limited did not show any requests for tree pruning by the council or members of the public. Two entries in the ARTC infrastructure management system, one on 7 June 2001 and another on 5 March 2007, recorded sighting faults at the location. The first item required the cutting back of a bush hiding a sign and this work was completed in July 2002.

The second and most recent fault recorded in the ARTC infrastructure management system (5 months before the accident) showed that line of sight was impaired for the driver of a train to see road vehicles approaching the crossing. It indicated that to restore an effective line of sight, vegetation near the crossing would need to be removed using a chainsaw and front-end loader. A report from the system showed an original priority rating for this fault of P2, requiring the response time to be less than 28 days. Some time later, the fault was re-prioritised to P4 indicating a response time of less than 180 days.

There was no evidence as to when and why the maintenance priority was downgraded. From the records and data held by the ARTC's maintenance contractor, it was not possible to ascertain why the maintenance priority was downgraded and whether or not line-of-sight inspections were carried out before the maintenance priority was downgraded. Had the vegetation been removed within 28 days of the time that the original sighting fault had been identified on 5 March 2007, it is very likely that the driver of the sewage truck would have seen *The Ghan* approaching the crossing on 6 August 2007 with sufficient time to stop and thus avoid the collision.

Approximately 2 days after the collision, the trees and shrubs inside the ARTC corridor were pruned back to restore effective lines of sight for road and rail traffic.

Interface agreements

During the investigation it was noted that the ARTC and the District Council of Mallala did not have an Interface Agreement covering their respective maintenance responsibilities for the level crossing and land adjoining the rail corridor and Mallala Road. While there is currently[19] no obligation on the part of road authorities (in this case the Mallala District Council) to enter into such an agreement, and while it had no bearing on the accident, maintenance responsibilities for level crossings need to be clearly defined.

The establishment of consistent standards/practices is necessary to ensure that all parties are aware of their responsibilities and accountabilities. For example, where

19 The national model for rail safety legislation will introduce a requirement for road and rail authorities to have an Interface Agreement defining organisational responsibilities. It is anticipated that the model provisions will be introduced in South Australia in late 2008, through amendments to the Rail Safety Act 2007.

approach warning signage for public road level crossings is necessary these are generally provided by road authorities. However, it has not always been clear who should provide and maintain such signage. Therefore, the lack of a formal agreement potentially exposes organisations to risk, particularly where items are not provided or maintained in accordance with industry standards because the responsibilities between the parties are unknown or ill-defined and therefore not being addressed.

It is therefore highly desirable that the ARTC and the District Council of Mallala have an agreement in place that clearly defines their responsibilities in relation to all level crossings in the council's jurisdiction and that it should be compliant with AS 4292.1-2007 Section 7 Interface Management.

2.3 Truck driver behaviour

Analysis of the truck driver's actions during the time leading to the collision focused on two main issues:

- the truck driver's expectation that a train would be approaching the level crossing; and
- his decision not to stop at the 'Stop' sign when negotiating the level crossing.

Familiarity and expectation

The truck driver had lived in the Two Wells district for approximately 23 years. He was familiar with most roads in the area including the Murrow Farm level crossing as he regularly travelled over it, often more than once a day. He was also aware of the vegetation that restricted the sighting of trains approaching from the north.

In the township of Two Wells, approximately five minutes before the accident, the truck driver had seen a stationary north-bound freight train (2117) in the Two Wells crossing loop. Shortly after, when leaving Two Wells and travelling along Mallala Road, he observed that the wheels of the same freight train were now turning. He assumed that this freight train (2117) and another train had now crossed each other in the Two Wells crossing loop and train 2117 would now be heading in the same direction as himself (north). When the truck driver made these observations in the township, and when driving along Mallala road, train 2117 had been moving slowly towards the stop signal located at the northern end of the Two Wells crossing loop.

The truck driver said he expected that the freight train he saw in the Two Wells crossing loop would approach the Murrow Farm level crossing from his right-hand side (south) and this was the train he particularly needed to look out for. This knowledge, combined with previous observations of how trains would wait in the crossing loop for another train to pass in either direction, may have led to the false assumption on the part of the truck driver that it would be too soon for another southbound train to be approaching from his left-hand side (from the north) at the Murrow Farm level crossing. This familiarity with past train movements in the area and his expectation that no train would be approaching the crossing from his left-hand side may have lulled the driver into a state of complacency regarding the risk associated with using the level crossing.[20]

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20 Caird, Creaser, Edwards, and Dewar (2002) *A human factors analysis of highway-railway grade crossing accidents in Canada* TP 13938E.

Failure to stop at the 'Stop' sign

At the Murrow Farm level crossing, the 'Stop' sign was clearly visible even though it was placed on the right side of the single-lane entrance road. The truck driver was familiar with the road, travelled it regularly and was aware that a 'Stop' sign was located at the level crossing.

Loaded heavy vehicles can be subjected to severe driveline stresses when accelerating from rest, particularly when loaded and on steep grades. Under these conditions, driveline components such as the clutch, transmission, differentials and axles, are most at risk of a failure. Inappropriate driving or clutch operation can add to these stresses. Consequently truck drivers will, at times, attempt to avoid a complete stop and commonly execute a 'rolling stop'. A rolling stop at a 'Stop' sign is where a driver slows their vehicle such that they believe they can make a decision about whether it is safe to proceed without coming to a complete stop.

Travelling from Mallala Rd into the Murrow Farm entrance road, there is a short section of level surface before the road rises at a grade of about 1 in 8.5 for a distance of approximately 16 m. The road is level where it crosses the track and it then descends at a grade of about 1 in 12 towards the farm entrance gates.

With the short approach to the crossing, the truck driver stated that he stopped at the bottom of the grade, changed into second gear, then slowly accelerated up towards the railway crossing to gain visibility of approaching trains. Near the position of the 'Stop' sign he looked to the right, from where he expected to see the train from the Two Wells crossing loop, but saw no train. Continuing to move forward, he passed the line of trees on his left allowing a clear view to the north and then saw *The Ghan* rapidly approaching. At this time, the truck was already fouling the track. Realising there would be no time to stop, select reverse gear and clear the track without a risk of the train colliding with the truck cabin, he accelerated forward. Moments later, the train collided with the truck tray and sewage tank located behind the driver's cabin.

The two witnesses to the collision positioned near the Temby Rd level crossing had observed the truck heading along Mallala Rd towards Murrow Farm. Shortly after, one witness stated that he saw the truck appear from behind the shrubs and trees at the Murrow Farm entrance road about 3 m before crossing the track. Both witnesses observed the truck travel slowly across in front of the train and both mentioned that they observed the truck cross the track without stopping.

The truck driver probably believed the safest strategy was to carry out a rolling stop over the Murrow Farm level crossing. This was based on his experience of regularly using the crossing, knowledge that it was a steep and narrow access road, and awareness that vegetation obscured his view to the north. The truck driver was also aware that large freight and passenger trains regularly travelled through Two Wells. He did not mention any previous near miss occurrences at the Murrow Farm level crossing even though he used it a couple of times a day.

2.4 Train conspicuity

Conspicuity refers to an object's ability to capture attention. Physical factors that affect the conspicuity of an object include size, contrast and movement.

At passively controlled level crossings, the primary sense for detecting a train, whether it be at a crossing controlled by 'Give-way' or 'Stop' signs, is sight. In order to determine whether there is a train present, and its location, the road user must visually scan the track in both directions.

About 1.6 km before the Murrow Farm crossing, the lead locomotive's headlight had been turned off[21] in preparation for the crossing of the freight train in the Two Wells crossing loop. Both locomotive ditch lights[22] remained on after the headlight had been turned off in compliance with operational procedures.

However, from the truck driver's perspective when looking to the north at the Murrow Farm crossing, none of these cues was clearly visible until the front of the truck had passed the 'Stop' sign. At this location, the truck driver's primary sense of vision to detect the train was made ineffective by the vegetation growing along the rail corridor and because the truck driver did not stop immediately before he crossed over the railway track. Therefore, it fell to his secondary sense, that of hearing, to detect the presence of a train from the north.

The locomotive data logger record showed that the horn was not sounded near the whistle sign (located about 500 m before the Murrow Farm level crossing) or at any time immediately before the collision. The train driver said he was unable to see the truck as it approached the crossing because it was completely obscured by the trees between Mallala Road and the railway line. With the train speed of 93 km/h, it would have taken about 19 seconds for the train to travel between the whistle sign and the level crossing. Using the witness and truck driver statements, it was calculated that the position of the truck at this time was between 75 and 110 m away from the level crossing. Had the truck driver heard the horn at this time he may have been alerted to the presence of the train with sufficient time to stop or at least exercise additional caution when negotiating the crossing. In the moments before the collision, when the train driver saw the truck, there was insufficient time to sound the horn and his immediate reaction was to make an emergency brake application[23].

Although the locomotive horn was not sounded by the train driver as required, the effectiveness of locomotive horns in this context needs to be examined.

2.4.1 Audible devices

Historically, audible devices have been considered an important component in the systems used to warn motorists of an approaching train. However, soundproofing,

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21 In accordance with *Operations and Safeworking Rules (5.6.1) - Code of Practice for the Defined Interstate Rail Network*.

22 Also known as visibility lights (other than headlights) fixed on front lower region of an NR class locomotive to provide forward visibility.

23 The type of brake application made when a train must be stopped in the minimum distance possible (Glossary for National Code of Practice (NCoP) - 2004).

air conditioning and entertainment systems in modern vehicles raise questions as to how effective level crossing bells and train horns are in the current environment.

Research carried out in the USA shows two points of view regarding the sounding of train horns at level crossings.

Research supporting effectiveness of train horns

From the late 1970s, numerous communities across the United States were imposing bans on the sounding of train horns at actively protected level crossings. By 2005, roughly 2000 bans were in place in 260 localities[24]. A Florida-based study carried out in 1990 by the US Federal Railroad Administration (FRA), found that where train horns were not sounded, night-time accidents had increased at a rate three times that of non-ban locations while the day-time accident rate remained almost unchanged. In 1991, the FRA identified the bans as a safety risk and issued a directive ending the bans in Florida. Two years later, night-time accidents had reduced by 68.6 per cent which was almost a return to pre-horn ban levels. On 25 June 2005, the FRA issued a rule that now requires locomotive horns be sounded at all public level crossings except where there is no significant risk to persons, where supplementary safety measures fully compensate for the absence of the warning provided by the horn, or where the sounding of the horn as a warning is not practicable.[25]

Research refuting effectiveness of trains horns

Another study carried out by the US National Transportation Safety Board (NTSB, 1998), investigated 60 accidents at passive level crossings over a 9-month period. One of the warning systems looked at was the train horn. The NTSB found that in 55 of the 60 accidents, the train horn was sounded prior to impact. In 10 of the 14 cases where the horn was sounded and the road user was interviewed, they did not hear the train horn. Three of these indicated however, that they were still aware of the train's presence prior to impact. Eight of the 10 road users who did not hear the train stated either internal and/or external sounds distracted them from the horn's audibility. The types of distractions included passengers, stereo, and traffic. In seven cases, drivers reported having their windows down, however four of these drivers still did not hear the train horn. Two of these four drivers reported other distractions.

The NTSB carried out further testing to measure the sound pressure levels inside passenger cars, a school bus and a cab-over truck. A three-chime train horn with a sound level of 96 dB (A) was placed 30.48 m from each of the test vehicles in accordance with FRA regulations[26]. The project measured, firstly, the insertion loss

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24 There are about 153000 public level crossings (referred to as 'grade crossings') in the USA. The level crossings where the sounding of train horns had been banned accounted for about 1.3 per cent of the total number of public level crossings.

25 *The Federal Railroad Administrator's Train Horn Rule*, Congressional Research Service, 20 April 2007.

26 The applicable Australian Standard is contained in the Draft Code of Practice (CoP) for the Defined Interstate Rail Network – Volume 5: Rolling stock. Part 5 – Specific requirements for locomotives (Section 10.3.2), which stipulates 88 dB(A), for a steady tone, at 200 m from the front of the vehicle when it is in the 'country' setting.

of each road vehicle[27], secondly, the audibility of the train horn when the vehicle's engine was at idle and, thirdly, the audibility of the train horn when the vehicle's engine was at idle and the air conditioning set on high.

The tests revealed a maximum insertion loss of 33 dB in a 1986 Chevrolet Corvette, compared to a minimum insertion loss of 17 dB in a 1986 Freightliner cab-over tractor[28] (for full details see NTSB, 1998 report number PB98-917004). Under the condition of engine at idle (air conditioning fan off) the sound level of the train horn in a 1997 Thomas/Ford school bus was not audible (a dB level of -2 was obtained). In seven of the 13 vehicles, the train horn was not audible above the idling engine and fan noise. Furthermore, when the engine was at idle and the fan on high, the train horn did not meet the 10 dB difference needed above ambient noise levels necessary to alert the motorist in any of the vehicles. For example, the sound level in the 1986 Freightliner cab-over tractor reached 8 dB, whereas the 1997 Thomas/Ford school bus sound level was -11 dB.

The NTSB also concluded that the tests underestimated the level of interior noise that would occur in normal driving conditions as they didn't account for additional sources of ambient noise such as road surface texture, radio/music players and conversations.

Nevertheless, the NTSB noted, sounding train horns is an important element of level crossing safety, and should be done unless effective substitutes are in place[29].

Summary

Considering the sound excluding performance of most modern passenger cars and trucks, a suitable sound pressure level inside the vehicle requires a significantly higher sound pressure level at the source of the sound. Achieving this sound pressure level at the source would possibly exceed the pain threshold for human hearing and would not generally be acceptable on health and environmental grounds. Consequently, it is more likely that audible warnings are more effective at warning bicycle riders and pedestrians, and a substantial increase in the loudness of train horns is possibly not a viable option. It should also be noted that portable entertainment devices (iPods etc) are also reducing the effectiveness of audible warning devices for bicycle riders and pedestrians.

While the 1984 Isuzu sewage truck may not be considered modern, its sound excluding performance and any interior cabin noise (due to the engine or road surface) would have made the locomotive horn much less effective at warning the truck driver of the approaching train. The truck driver recalled that immediately prior to the collision the passenger side window was wound up and that the radio was off. He could not recall whether or not the driver's side window was open or closed nor could it be ascertained from the wreckage of truck. Had the train horn been sounded at the whistle board, it is quite likely given that the truck was

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27 Insertion loss refers to the difference between the measured sound values from an exterior sound source taken outside the highway vehicle and inside the vehicle (NTSB, 1998).

28 A truck where the driver's cabin is mounted over the engine.

29 Mark V. Rosenker, Acting Chairman, National Transportation Safety Board, Testimony before the Subcommittee on Railroads, Committee on Transport and Infrastructure, United States House of Representatives, July 21, 2005, p. 2-3.

approximately 600 m away, that the train horn would not have achieved the 10 dB difference needed above ambient noise levels necessary to alert the truck driver to the presence of the train.

2.5 Incident reporting procedure

After the train stopped near the Temby Rd level crossing, the train driver smelled a strong diesel odour. He alighted from the locomotive as he suspected the locomotive fuel tank had been ruptured. The train driver then attempted to initiate the emergency response by radio. He tried to change radio frequency from the locomotive console that, at the time, was switched to the train manager, but as the driver's console had been damaged in the collision and remained locked to the train manager's frequency, the driver then used a mobile telephone to call the Pacific National Intermodal Divisional Control Centre (IDCC). Immediately after, the driver contacted the ARTC train controller by mobile telephone to ensure emergency services were notified to attend the accident site.

Although notification of the accident was timely and accurate, the ARTC train controller performs the incident management function in this part of the rail corridor and, as such, is tasked with notifying the emergency services in the event of an accident.

In most emergency situations, the IDCC will liaise with the ARTC train controller or train transit manager but the ARTC train controller shall be the first point of contact in accordance with the ARTC incident management manual.

> **Australian Rail Track Corporation Incident Management Manual TA 44**
>
> The employee is to immediately advise the Train Controller / Area Controller / Signaller of the nature and location of the incident and provide all relevant details. The Train Controller / Area Controller / Signaller shall immediately advise the Train Transit Manager / Train Control Centre Manager or nominee.

In this instance, there were no consequences as a result of the train driver failing to contact the train controller first as this had already been done by a witness/train enthusiast located near the Temby Road level crossing. In other circumstances, any delay in communicating directly with the train controller would delay the emergency response and the protection of the site by train control.

2.5.1 Other accidents

There was no record of any previous significant level crossing occurrences at the Murrow Farm level crossing. However, there are many occupation level crossings on the DIRN in South Australia, which are controlled by 'Stop' signs. The train driver stated that he and his colleagues often experienced 'near-misses' while operating in this rail corridor, especially in relation to vehicles failing to give way at passively controlled public road crossings between Adelaide and Port Augusta.

About 3 and 4 months respectively after the accident near Murrow Farm, two similar accidents occurred at the nearby Moloney Rd level crossing at Virginia. This level crossing also had passive traffic control in the form of 'Stop' signs. In the first of the accidents a 'people mover' van collided with a freight train which resulted in the death of the two occupants of the van. In the second collision at the same site, a truck drove into the side of the *Indian Pacific* passenger train and the

truck driver was seriously injured. Both accidents were investigated by the ATSB and final reports have been released (RO-2007-007 and RO-2007-008).

Other ATSB investigations[30] that have highlighted issues of failing to stop or give way at level crossings include Back Creek, NSW (10/03/07); Ban Ban Springs, NT (12/12/2006); Elizabeth River, NT (20/10/2006); and Lismore, Vic (25/05/2006).

30 ATSB investigation reports are available at: http://www.atsb.gov.au/

3 FINDINGS

3.1 Context

At about 1135 on 6 August 2007, a tray-top truck carrying a sewage tank drove into the path of a south-bound passenger train, *The Ghan* (7DA8), at a level crossing near Two Wells, SA.

Based on available evidence, the following findings are made with respect to the collision but should not be read as apportioning blame or liability to any particular individual or organisation.

3.2 Contributing safety factors

- The advanced growth of trees and shrubs within the rail corridor and along the Mallala Road verge, prevented the truck driver from seeing the train on his approach to the Murrow Farm road entrance where the locomotive lights may have been visible.
- Although the truck driver had stopped at the bottom of the grade at the entrance to the Murrow Farm road, he carried out a rolling stop and did not stop as required before crossing the railway track.
- When positioned at the 'Stop' sign, the vegetation adjacent to the rail line to the north of the Murrow Farm level crossing would not have allowed the truck driver adequate sighting distance to see *The Ghan* approaching with sufficient time to make a decision and then proceed safely across the level crossing.
- Maintenance practices for the control of vegetation in the rail corridor at the Murrow Farm level crossing were inadequate. *[Safety Issue]*
- Tree pruning and clearing works following the identification of a sighting hazard at the Murrow Farm level crossing in March 2007 were not completed within 28 days in accordance with the original assessment and priority maintenance specification. *[Safety Issue]*
- The downgrading of the ARTC Infrastructure Management System priority rating for sighting restoration work at the Murrow Farm level crossing, in this case from 28 days to 180 days, without a reassessment of the status of vegetation at the level crossing and its effect on sighting distances, increased the risk of a collision. *[Safety Issue]*.

3.3 Other safety factors

- The railway 'Stop' sign assembly (RX-2 modified) for drivers entering Murrow Farm, was not located on the left side of the road to assist with driver familiarity and standard placement of signs as shown in Australian Standard AS 1742.7-2007. *[Safety Issue]*
- The railway 'Stop' sign assembly (RX-2 modified) positioned approximately 4.6 m from the nearest rail instead of nearer to 3.5 m as recommended in Australian Standard AS 1742.7, made it more difficult for the driver to gain a clear view of approaching trains. *[Safety Issue]*

- At the time of the accident the Australian Rail Track Corporation and the District Council of Mallala did not have an 'Interface Agreement' defining each organisation's responsibilities with respect to the maintenance of level crossings and land adjoining the rail corridor in the district. *[Safety Issue]*
- The train driver did not activate the train horn at the whistle sign, approximately 500 m before the Murrow Farm level crossing, in accordance with the National Code of Practice - Operations and Safeworking Rules.
- The train driver did not immediately notify the ARTC train controller after the accident, as prescribed, so that the appropriate protections of the site and notification to emergency services could occur.

3.4 Other key findings

- The train's power, braking and handling performance were considered normal and effective.
- The train driver was appropriately trained and competent and was assessed medically fit for duty.
- Testing for alcohol and illicit drugs of the truck and train drivers returned zero readings.
- The truck was in a roadworthy condition prior to the collision.

4 SAFETY ACTIONS

The safety issues identified during this investigation are listed in the Findings and Safety Actions sections of this report. The Australian Transport Safety Bureau (ATSB) expects that all safety issues identified by the investigation should be addressed by the relevant organisation(s). In addressing those issues, the ATSB prefers to encourage relevant organisation(s) to proactively initiate safety action, rather than to issue formal safety recommendations or safety advisory notices.

All of the responsible organisations for the safety issues identified during this investigation were given a draft report and invited to provide submissions. As part of that process, each organisation was asked to communicate what safety actions, if any, they had carried out or were planning to carry out in relation to each safety issue relevant to their organisation.

Depending on the level of risk of the safety issue, the extent of corrective action taken by the relevant organisation, or the desirability of directing a broad safety message to the rail industry, the ATSB may issue safety recommendations or safety advisory notices as part of the final report.

4.1 Australian Rail Track Corporation

4.1.1 Rail corridor vegetation control

Safety Issue

Maintenance practices for the control of vegetation in the rail corridor at the Murrow Farm level crossing were inadequate.

Safety action taken by the Australian Rail Track Corporation

The ARTC and Transfield Services (the ARTC's contractor) have assessed the quantity of vegetation growing in the rail corridor at the entrance to Murrow Farm. Trees and shrubs that obstructed the clear sighting of approaching trains have been pruned back. In addition, Transfield Services has implemented a procedure for the inspection, assessment and recording of sighting distances at 'Stop' sign controlled level crossings.

4.1.2 Failure to clear vegetation within 28 days

Safety Issue

Tree pruning and clearing works following the identification of a sighting hazard at the Murrow Farm level crossing in March 2007 were not completed within 28 days in accordance with the original assessment and priority maintenance specification.

ATSB Safety recommendation RR20080032

The Australian Transport Safety Bureau recommends that the Australian Rail Track Corporation take action to address this safety issue.

4.1.3 Revision of maintenance work priority

Safety Issue

Downgrading of the ARTC Infrastructure Management System priority rating for sighting restoration work at the Murrow Farm level crossing, in this case from 28 days to 180 days, without a reassessment of the status of vegetation at the level crossing and its effect on sighting distances, increased the risk of a collision.

ATSB Safety recommendation RR20080033

The Australian Transport Safety Bureau recommends that the Australian Rail Track Corporation take action to address this safety issue.

4.1.4 Level crossing sign placement

Safety Issue

The railway 'Stop' sign assembly (RX-2 modified) for drivers entering Murrow Farm, was not located on the left side of the road to assist with driver familiarity and standard placement of signs as shown in Australian Standard AS 1742.7-2007.

ATSB Safety recommendation RR20080034

The Australian Transport Safety Bureau recommends that the Australian Rail Track Corporation take action to address this safety issue.

4.1.5 Proximity of level crossing sign to track

Safety Issue

The railway 'Stop' sign assembly (RX-2 modified) positioned approximately 4.6 m from the nearest rail instead of nearer to 3.5 m as recommended in Australian Standard AS 1742.7, made it more difficult for the driver to gain a clear view of approaching trains.

ATSB Safety recommendation RR20080035

The Australian Transport Safety Bureau recommends that the Australian Rail Track Corporation take action to address this safety issue.

4.1.6 Road/rail interface agreement

Safety Issue

At the time of the accident the Australian Rail Track Corporation and the District Council of Mallala did not have an 'Interface Agreement' defining each organisation's responsibilities with respect to the maintenance of level crossings and land adjoining the rail corridor in the district.

ATSB Safety recommendation RR20080036

The Australian Transport Safety Bureau recommends that the Australian Rail Track Corporation take action to address this safety issue.

4.2 District Council of Mallala

4.2.1 Road/rail interface agreement

Safety Issue

At the time of the accident the District Council of Mallala and the Australian Rail Track Corporation did not have an 'Interface Agreement' defining each organisation's responsibilities with respect to the maintenance of level crossings and land adjoining the rail corridor in the district.

ATSB Safety recommendation RR20080037

The Australian Transport Safety Bureau recommends that the District Council of Mallala take action to address this safety issue.

APPENDIX A : SOURCES AND SUBMISSIONS

Sources of information

- Great Southern Rail Limited
- Pacific National
- The Australian Rail Track Corporation
- The Department for Transport Energy & Infrastructure – SA
- *The Ghan* train driver
- The South Australia Police Major Crash Investigation Unit
- The truck driver
- Two witnesses to the accident

References

- ARTC CoP Engineering Specification Track & Civil – ETF-16-01 Establishing Minimum Protective Measures at Level Crossings
- ATSB report 20060015 - Level Crossing Collision between The Ghan Passenger Train (1AD8) and a Road-Train Truck, Ban Ban Springs, NT, 12 December 2006
- Australian Level Crossing Assessment Model, Crossing Assessment Handbook V1.01 (9 February 2007)
- Australian Standard 1742.7-1993: Manual of uniform traffic control devices – Railway crossings.
- Australian Standard 1742.7-2007: Manual of uniform traffic control devices – Railway crossings.
- Austroads Rural Road Design – A guide to the Geometric Design of Rural Roads AP-G1 03, eighth edition 2003.
- Code of Practice for the Defined Interstate Rail Network – Operations and Safeworking - Rules Issue 2 – ARTC annotated version May 2002
- Federal Railroad Administration. (1995a). Florida train whistle ban. U.S. Department of Transportation.
- Federal Railroad Administration. (1995b). Nationwide study of train whistle bans. U.S. Department of Transportation. Office of Safety. Washington, DC 20590.
- National Transportation Safety Board (1998a). Safety at passive grade crossing. Volume 1: Analysis. Safety study NTSB/SS-98/02. Washington DC.
- Rapoza, A.S., Raslear, T.G., and Rickley, E.J. (1999). Railroad horn systems research (ref. No. DOT/FRA/ORD-99/10). Washington DC: U.S. Department of Transportation, Federal Railroad Administration.
- Transport SA, Operational Instruction 7.1, Railway Level Crossing Signing and Pavement Marking. Edition 3 Revision 1. (8/3/2001)

4.3 Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003*, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to:

- Great Southern Rail Limited
- Driver of truck
- Driver of train
- Pacific National
- The Australian Rail Track Corporation
- The Department for Transport Energy & Infrastructure - SA
- Two witnesses

Submissions were received from the following organisations in response to the draft report.

- Great Southern Rail Limited
- One witness
- Pacific National
- The Australian Rail Track Corporation
- The Department for Transport Energy & Infrastructure - SA
- Driver of train

These submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

APPENDIX B : MEDIA RELEASE

Investigation of collision between sewage truck and *The Ghan*

The ATSB has found that a collision between *The Ghan* passenger train and a loaded sewage truck occurred when the driver of the truck drove into the path of the train at a private road level crossing at 'Murrow Farm' near Two Wells in SA.

The Australian Transport Safety Bureau has today released its final investigation report into the collision which occurred on 6 August 2007 seriously injuring the truck driver. At the time of the accident road traffic at the level crossing was controlled by 'Stop' signs.

The ATSB found that the truck driver did not stop and did not see the train until he was on the level crossing. However, vegetation adjacent to the crossing had grown to the point where the truck driver could not see the approaching train even if he had stopped as required. Had the vegetation been adequately maintained, the truck driver would have been able to clearly see *The Ghan*, stop and then proceed safely over the crossing when the train had passed.

As a result of this investigation, the ATSB has identified safety issues primarily related to maintenance practices for the control of vegetation in the rail corridor which require action to reduce the risk of future collisions at this and other level crossings. Six safety recommendations have been issued. The ATSB also acknowledges safety action already undertaken by the Australian Rail Track Corporation in response to identified safety issues.