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ATSB TRANSPORT SAFETY REPORT
Rail Occurrence Investigation RO-2009-003
Final

Derailment of train 5PS6 near Golden Ridge Western Australia

30 January 2009

Abstract

At approximately 1031[1] on Friday 30 January 2009, freight train 5PS6, operated by Pacific National (PN), derailed near Golden Ridge, (Figure 1) about 43 km east of Kalgoorlie in Western Australia. The two locomotives, the crew van and 18 wagons (including 7 multiple platform freight wagons) derailed.

There were only minor injuries to the train crew as a result of the derailment. However, there was significant damage to the derailed rolling stock and about 200 m of track was destroyed.

The investigation determined that heavy rainfall to the east of Golden Ridge on the morning of 30 January 2009 led to localised flash flooding which damaged the track formation and ballast, resulting in the derailment of train 5PS6. A number of minor safety issues were identified during the investigation and have been brought to the attention of the track manager and train operator. Those issues relate to track drainage, identification of severe weather events, availability of hand-held communication devices and escape from the damaged locomotive cabin. The train operator has taken or proposed safety action in relation to train evacuation and communication issues. In addition, the Australian Transport Safety Bureau has issued three safety advisory notices to the track owner.

1 The 24-hour clock is used in this report to describe the local time of day, Western Daylight Time (WDT), as particular events occurred. Western Daylight Time was Coordinated Universal Time (UTC) + 9 hours.

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- fostering safety awareness, knowledge and action.

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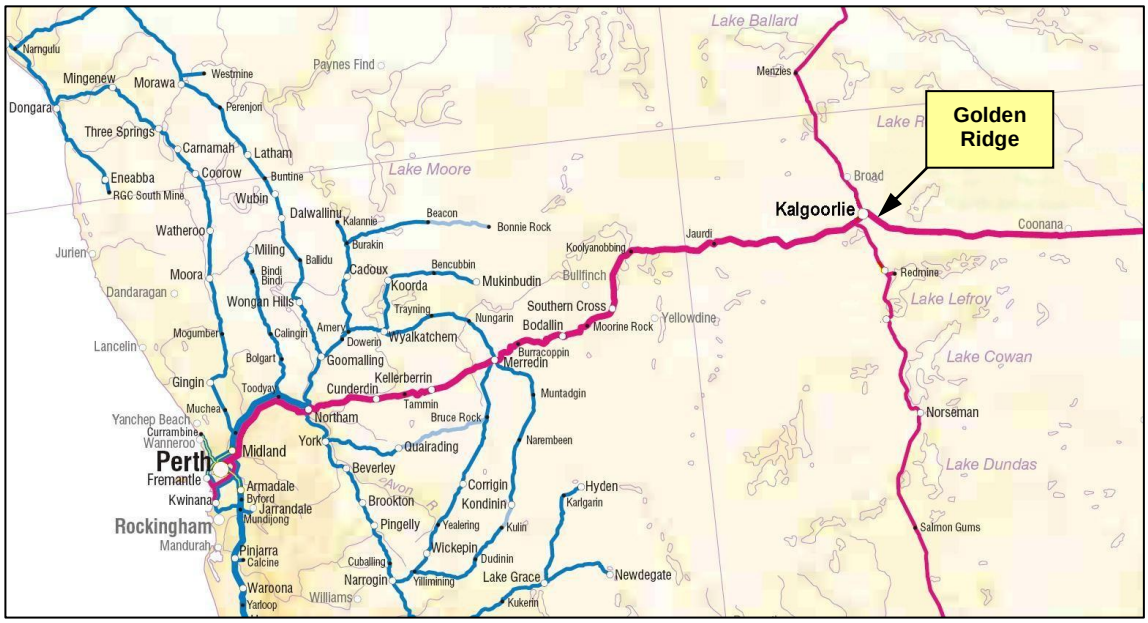
Figure 1: Location of derailment site



Map - Geoscience Australia. Crown Copyright ©.

FACTUAL INFORMATION

Location

The derailment occurred on a straight section of track near the 1,738.750 km[2] point on the Trans-Australian Railway (TAR).

The track near the derailment site passes through slightly undulating terrain intersected by normally dry creek beds.

The surrounding vegetation comprises sparse ground cover with some larger bushes and stunted trees along the water courses.

Following periods of rain, creeks in the area of the derailment flow from south to north, emptying into Lake Yindarlgooda.

Environmental conditions

At the time of the derailment, the temperature recorded at Kalgoorlie, 43 km to the west of derailment site, was 22.0 degrees Celsius. No rainfall was recorded at Kalgoorlie in the preceding 24-hour period; however, there had been significant rain during the period 27 through to 29 January 2009.

Track information

The TAR between Port Augusta and Kalgoorlie was completed by the Commonwealth Railways in 1917. The line was originally managed by the Commonwealth Railways, followed by the Australian National Railways Commission in 1975 and finally the Australian Rail Track Corporation Ltd (ARTC) in 1998. The ARTC is the current track owner.

The standard gauge (1,435 mm) track at this location consists of continuously welded 47 kg/m rail fastened to concrete sleepers using resilient clips. The track is constructed on a formation comprising red sand/clay based soil.

The formation is topped with a capping layer overlaid with a ballast layer that has a nominal depth of 250 mm, thereby forming the track bed. The track bed supports prestressed concrete sleepers that are spaced at about 670 mm centres. The formation through the area includes a number of pipes and bridges that are intended to protect the track from water build-up behind the formation following periods of rain.

Train information and train crew

Freight train 5PS6 was owned and operated by PN. The train originated from the Perth Freight Terminal and the final destination was the Sydney Freight Terminal. The train consisted of two locomotives (NR35 leading and NR51 trailing) hauling one crew van and 32 freight wagons (11

2 Distance in kilometres from a track reference point located at Coonamia in South Australia.

of which were multiple platform freight wagons). The train was 1328 m long and weighed a total of 3502 t. The maximum allowable speed for the train over the section of track where the derailment occurred was 110 km/h.

Several of the derailed wagons were carrying dangerous goods, namely Soluble Lead Compounds (Class 6.1[3] Dangerous Goods - Poisonous) and Ammonium Nitrate (Class 5.1[3] Dangerous Goods – Oxidising Substance).

The train crew consisted of three drivers. Two were located in the locomotive and the third driver was accommodated in a crew van marshalled behind locomotive NR51. The crew were to work the train from Parkeston in Western Australia through to Cook in South Australia.

At the time of the derailment, the driver had about 13 years train driving experience; the second driver had about 3 years experience. Both were appropriately trained, qualified, certified as competent and medically fit.

The occurrence

Preceding events

Train 5PM5, a Perth to Melbourne freight service that preceded 5PS6 (the derailed train), passed through the derailment site at approximately 0545 that morning, about 5 hours before the derailment of train 5PS6. Heavy rainfall was observed by the drivers at the time. However, the crew of 5PM5 stated that they did not observe any build-up of water beside the track or in the adjacent waterways. The crew further stated that they did not consider the weather to be unprecedented, and therefore did not report the rain event to the ARTC train controller as they did not believe it was an issue of concern.

On the same morning, at about 0545, the City of Kalgoorlie-Boulder Manager of Roads and Transport inspected the gravel Trans Access Road[4] in the Golden Ridge area where he observed intense rainfall and 200 to 300 mm of water over the road in places. He subsequently closed the road to prevent vehicles becoming stranded and to protect the saturated road surface from damage.

The road closure was communicated by e-mail and facsimile to approximately 40 recipients. Transfield Services (SA Rail - Parkeston), the organisation that maintains the railway track between Kalgoorlie, Western Australia and Cook, South Australia for the ARTC, received a facsimile at 0728. Transfield arranged a track inspection to be undertaken by staff working at Zanthus (167 km east of the derailment site). Transfield staff departed Zanthus at 0822, travelled along the Trans Access Road to Blamey (1692.000 km) arriving at about 1000. At this time they were 46.75 km to the east of the derailment site and waiting for 5PS6 to pass through Blamey before finalising the track inspection by rail mounted vehicle.

Passage of train 5PS6

On the morning of the derailment the three train drivers rostered to work train 5PS6 booked on duty at 0935 at Parkeston, Western Australia. After completing their paperwork, they received authorisation from train control to depart Parkeston. Train 5PS6 departed Parkeston at 1001 with two drivers in the lead locomotive cabin and the third in the crew van. The train control graph for that day showed the train as having a clear path to Kitchener, a distance of 263 km from Parkeston. The train driver said that after departing Parkeston, he conducted a running brake test to ensure that the train brakes were functional. He said the train responded normally.

The journey of 5PS6 proceeded uneventfully until the train reached Golden Ridge where the two drivers in the front cabin stated that they noted pools of water beside the track. Without warning, while travelling at a speed of about 100 km/h, the lead locomotive NR35 dropped violently, then lurched up and rolled over onto its side. During the derailment sequence the lead locomotive ploughed into the wet ground, finally coming to rest with the drivers' cabin lying on its right side in a depression at a right angle to the track. The rear of the locomotive was resting on the track above, making it higher than the drivers' cabin. The drivers' cabin was distorted by the impact forces which caused the door to the vestibule to jam shut. Also, one of the two external doors (right-side) was hard against the ground.

3 Australian Dangerous Goods Code (6th Edition now superseded by 7th Edition) , Volume 1 Part 2

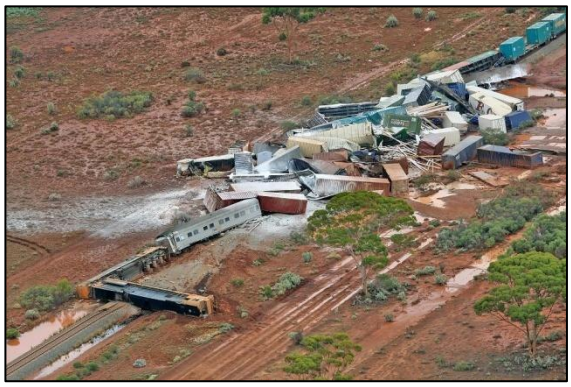
4 Trans Access Road, the road that runs adjacent the Trans-Australia Railway near the derailment site.

Fuel lines supplying diesel to locomotive NR35 had ruptured and diesel was flowing out of the fuel tanks, through the locomotive compartments, along the ground and into the depression caused by the derailment. Diesel was pooling in the lower right side of the drivers' cabin.

The train drivers, who had suffered only minor injuries, were trapped within the cabin and unable to exit the lead locomotive.

The second locomotive had rolled onto its side but remained parallel to the track. The crew van derailed but remained upright and parallel to the track. The following 18 wagons (including 7 multiple platform freight wagons) derailed in a tangled pile (Figure 2).

Figure 2: Aerial view of derailment site



Photograph – Kalgoorlie Miner. Copyright ©

Post occurrence

Following the derailment, the train driver was able to contact and advise train control of the occurrence using the onboard train radio.

During the derailment sequence, the right front windscreen of the lead locomotive had 'popped' open about 15 cm. The third driver was able to exit the crew van and further prise this windscreen open to allow the two drivers to exit the cabin. By this time, a considerable amount of diesel fuel had leaked into the drivers' cabin.

PN and Transfield Services maintenance staff were contacted by train control and responded by travelling towards the site using four wheel drive vehicles.

The train crew was evacuated by four wheel drive along flooded access roads to a point accessible to an ambulance. They were then taken to the Kalgoorlie Hospital for a medical assessment and treatment.

Following the derailment, track patrol staff found extensive flood damage to sections of the track over a distance of about 12 km to the east of the derailment site, much of which was impassable.

On Sunday 1 February 2009, the rear of the train was detached from the derailed wagons and moved to Kalgoorlie. A deviation was constructed around the derailment site, concurrent with the repair work on washaway locations to the east of the site. Heavy cranes were able to access the site from Wednesday 4 February 2009, once the ground had dried sufficiently, and commenced removing the wagon wreckage and damaged locomotives.

The line was reopened to traffic, at a reduced speed through the deviation, at 1115 on Friday 6 February 2009, some 7 days after the derailment.

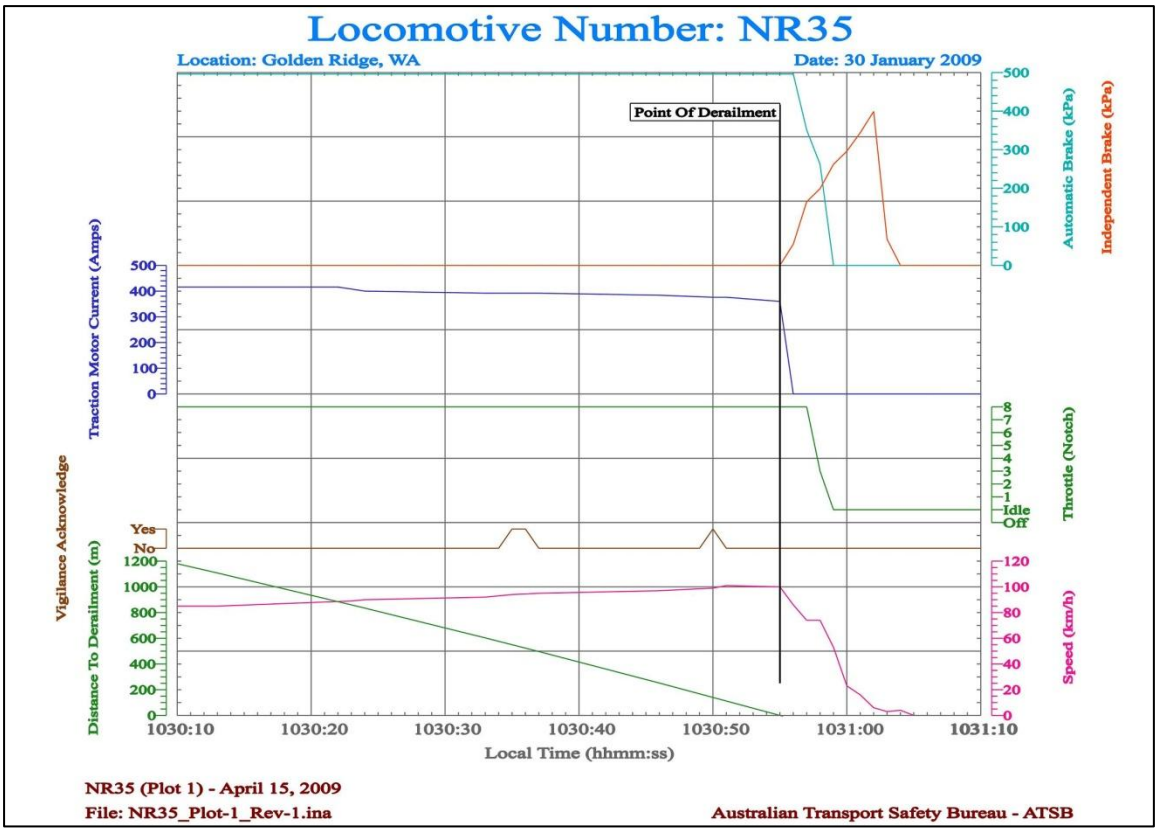
ANALYSIS

An investigation team from the Australian Transport Safety Bureau (ATSB) travelled to the derailment site on 30 January 2009. Evidence was sourced from the train drivers, the Australian Rail Track Corporation, the Bureau of Meteorology (BoM), the City of Kalgoorlie-Boulder, Pacific National and the Office of Rail Safety, Western Australia. Evidence included interviews, photographs, train running information, voice and data logs, engineering documentation, site surveys, historical weather data and other relevant material.

Sequence of events analysis

At the time of the derailment, train 5PS6 was under the direction of the ARTC train controller located in Adelaide. The train driver had the correct authority to occupy the section of track between Parkeston and Kitchener, which includes Golden Ridge. When authorised to enter the section at 0936 nobody, including the ARTC train controller, was aware of the washaway near Golden Ridge.

Figure 3: Extract from locomotive NR35 data log



An examination of the locomotive data log for NR35 confirmed that the driver conducted a running brake test after departure from Parkeston. In the 60 seconds before the derailment, the data log showed that the train had accelerated from 90 km/h to 101 km/h under full power. At the point of derailment, the train was travelling at 101 km/h (Figure 3). The data log also indicated that the vigilance control was operated 5 seconds prior to the derailment and that no braking occurred before the derailment. The derailment started at the head-end of the train.

Evidence from the data log supports the drivers' statements concerning their actions and the sequence of events leading up to the derailment in that there was nothing unusual about the journey prior to the derailment. Site observations confirmed that track washaway damage was unlikely to have been visible to the drivers as they approached the derailment site.

The drivers' roster gave no indication of work related fatigue and post-accident breath tests returned zero readings for alcohol.

The actions of the train driver are considered unlikely to have been a factor that contributed to the derailment.

Examination of the track

The track leading into the derailment site was intact with no evidence of track degradation through washaway. The first evidence of any track washaway was at the culvert where the train derailed. This supports the train drivers' accounts that, although they were looking forward, they did not see the washaway and were not aware of it even as the train derailed. The photograph at Figure 4 provides some indication of the magnitude of flooding that was visible to the drivers of 5PS6 as they travelled towards the derailment site. The two drivers stated that they were debating the need to report their observations to train control at the time of the derailment. Figure 4 was taken at the 1745.600 km point (6.85 km before the derailment site) at about 1423, some 4 hours after the derailment.

Examination of the derailment site established that the track and ballast profile where not damaged by the flood event or derailment and were in good condition.

Figure 4: Extensive flooding observed 6.85 km before the derailment site

Aerial Photograph – Kalgoorlie Miner. Copyright ©.

The culvert at the 1738.860 km point (Figure 5), 110 m before the derailment site, was found to be in good condition with little evidence of blockage or debris build-up at the culvert inlet/outlet.

Figure 5: Culvert 110 m before the derailment site

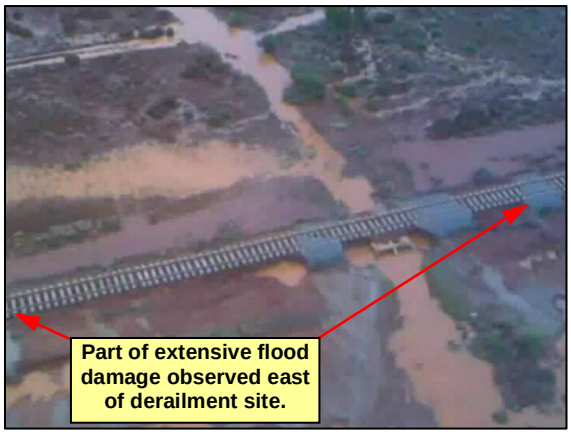
Track to the east of the derailment site had been visibly overtopped by significant floodwaters and had lost both ballast and capping layer materials for considerable distances. The photograph at Figure 6 is representative of damage to the track over a 12 km distance east of the derailment site.

Track flooding

A review of BoM data established that a 'Flood Watch' warning was in place for the Goldfields area covering the period 28 and 29 January 2009. The warning, due to thunderstorm activity and the associated risk of localised flooding, was cancelled at 0932 on the 30 January 2009 about an hour before the derailment.

> Cancellation of Flood Watch
> for the Goldfields
> Issued at 9:32 AM on Friday the 30th of January 2009
> Western Australia Flood Warning Centre
> Rainfall totals have been below 10mm for the past 24 hours. Isolated rainfall totals for the next 24 hours are expected to be below 20mm. No flooding is expected.

Figure 6: Flood damage to track east of derailment site



Aerial Photograph – Kalgoorlie Miner. Copyright ©.

A review of weather data for that day, including weather radar images from the BoM, provided the following synopsis:

> Inspection of the vertical structure of the thunderstorms in the vicinity of 31 S 122 E using 3-D radar imagery suggested that the storms were of moderate intensity and not at an intensity consistent with severe thunderstorms.
>
> Available computer model forecast guidance for the morning of the 30th indicated that while thunderstorms and rain were likely, the atmospheric environment was not expected to be conducive to severe thunderstorm development.
>
> The BoM issues severe thunderstorm warnings when thunderstorms are expected to produce one or more of the following: tornadoes, hail of 2 cm diameter or greater, wind gusts to 90 km/hr or greater, or very heavy rainfall conducive to flash flooding.

On this occasion, the magnitude of the rain event was such that the BoM did not consider there was a need to re-issue a severe weather warning for the area near the derailment site.

While neither the ARTC nor Transfield Services, the contracted track maintainer, were on the direct distribution list for BoM severe weather warnings, such warnings are widely publicised through facsimile, e-mail, radio and television broadcast warnings. On the day of the derailment, the only information provided to the organisations responsible for rail operations in the area was a

facsimile sent by the local council at 0728, that advised of the closure of the Trans Access Road (see section on Track Management).

An examination of topographic information supplied by Landgate Western Australia[5] for the area drained by culverts at the derailment site, established that the effective catchment area was approximately 600 hectares (Figure 7).

Figure 7: Catchment area

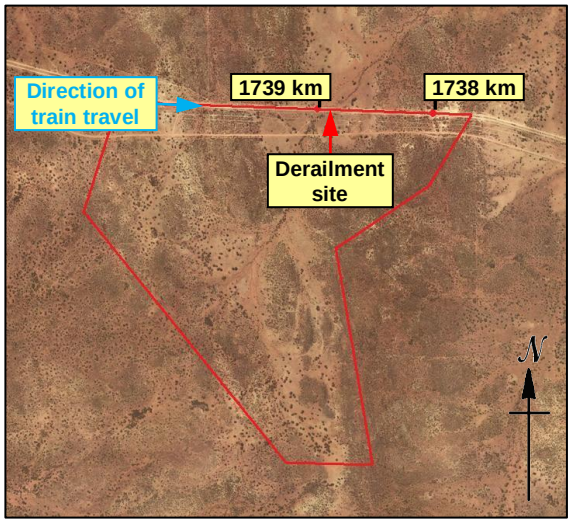


Image - reproduced by permission of Western Australian Land Information Authority (2010), P456/2010.

If the water inflow from the catchment area exceeds the culvert capacity during periods of very heavy rainfall/runoff, the excess water will back-up behind the rail embankment and then flow through the ballast and over the track at its lowest point.

This overflow would remove the ballast, and eventually the embankment, due to the hydraulic pressure of the moving water. Observations near Golden Ridge confirmed that water had flowed over the embankment for significant distances and washed away the ballast and parts of the embankment itself. Figure 8 shows the embankment at the derailment site.

Figure 8: Culvert at derailment site

Following analysis by a hydrology specialist[6], it was concluded that:

> The flood runoff resulted from extreme rainfall falling on a wet catchment over a three hour period. In the absence of recorded data it is impossible to assign a definite average recurrence interval (ARI) to the rainfall, but the limited available evidence suggests that the rainfall could have had an ARI of between 50 and 100 years.

While this analysis was carried out for the catchment where the train derailed, track damage further to the east (different catchment area) was more extensive. This would indicate that the total storm event that occurred was likely to have been more severe than that indicated by the analysis at the derailment site, possibly exhibiting a higher average recurrence interval.

The ARTC Code of Practice[7] (CoP) states that 'minor under track bridges' and 'under track culverts and drains' should be designed to be adequate for a '50 year precipitation event'. The hydrological analysis[5] estimated that a 1 in 50 year peak flow rate at this site would equate to about 25 m^3/sec.

The overall culvert flow capacity was estimated to be 28 m^3/sec[8] and therefore the culverts at the site of the derailment appear to comply with the requirements of the ARTC CoP (ETG-10-01).

5 Landgate Western Australia is the State Government mapping authority for this area.

6 Analysis undertaken by an independent professional engineer with extensive experience in flood hydrology.

7 ARTC Track & Civil Code of Practice General Appendix clause ETG-10-01 Flooding, May 2006, Paragraph 10.7.1.

8 Analysis assumed high water ponding to the top of the formation layer, that is, just below ballast layer .

ETG-10-01 is silent with respect to a range of hydrological design parameters, including the height of water ponding against the formation layer. By lowering ponding height, culvert flow capacity can be reduced to a point where it does not satisfy the ARTC CoP for a 50 year precipitation event. However, the flood runoff resulting from the precipitation event near Golden Ridge on 30 January 2009 was calculated as having substantially exceeded the flow capacity of the culverts. The estimated peak flow was calculated as being at about 40 m^3/sec[9] and therefore well above reasonable design requirements.

Figure 9 shows a similar culvert (1736.500 km) within the flood affected area exhibiting extensive damage to the ballast and track formation.

In conclusion, the ARTC CoP does not specify hydrological design parameters, including the height of water ponding against the formation layer, and this could lead to under specified track drainage arrangements and an increased risk of track damage arising from flash flood events. However, the precipitation event near Golden Ridge well exceeded the requirements of a 1 in 50 year peak flow rate specified in the ARTC CoP.

Figure 9: Culvert at 1736.500 km.

Track management

The appropriate design of track is fundamental in running a safe railway as is the routine maintenance and inspection of the track to mitigate the risk of track failure and possible train derailment. Derailments as a result of track flooding and consequent damage following high rainfall events, although relatively rare, are a known risk. Management of this risk therefore requires that the track is designed and built to an adequate standard. The track manager must also maintain the drainage arrangements in a serviceable condition and should periodically review the adequacy of infrastructure standards, including those pertinent to flooding.

In 1998, the ARTC took over management of the track where the derailment occurred. The current ARTC CoP, based on historical/previous standards, prescribes a 50 year precipitation event for culvert design. Although the culvert capacity at the derailment site was found to exceed the requirements of the ARTC CoP, no documented evidence, including recent audits or reviews, were available to verify that the actual culvert capacity met or exceeded these requirements.

It is considered that a review of culvert capacity is desirable and should include consideration of the adequacy of the existing standard, the risk to current/future rail traffic loadings/types[10], available rainfall data, potential changes in climatic conditions[11] and the history of any flood damage to the line which could indicate that remedial action is required in a particular area.

The ARTC advised that it did not have records of flooding and/or maintenance events in the area or along the Trans-Australian Railway since taking over management of the track in 1998 that may have triggered the need for a review of the existing track drainage arrangements and/or the flooding standard. However, it is likely that such events occurred prior to that time. Individuals who were employed by the Australian National Railways Commission to manage bridges in the area did recall isolated instances of flooding, but

9 The flow rates were estimated with consideration of both known and inferred information.

10 Given the current/future importance of the TAR it may be appropriate that the flood standard/protection afforded be reviewed with a long-term aim of upgrading the line to a higher standard.

11 If short duration rainfall events increase (as predicted by some climate change analysts) consideration should be given to raising the required culvert design standard to a higher average recurrence interval and specifying how high floodwaters can rise in relation to the track structure for the design event.

they had not retained any records post-employment (nor would they be expected to).

Maintenance of the track was contracted to Transfield Services. The CoP requires that the track maintenance contractor undertake regular track inspections twice weekly and protect/repair the track as appropriate. Those inspections are supplemented when required for severe weather. ARTC manage the risk of track flooding/damage using this inspection regime. It was established that Transfield had dispatched an inspection team from Zanthus at 0822 following receipt of the facsimile from the City of Kalgoorlie-Boulder Manager of Roads and Transport regarding the closure of the Trans Access Road. They travelled along the Trans Access Road arriving at Blamey, 46.75 km to the east of the derailment site, at about 1000. They were waiting for 5PS6 to pass through Blamey before finalising the track inspection by rail mounted vehicle.

Identifying severe weather events

There are limited means of detecting severe weather events for much of the TAR. Automatic weather stations that transmit half-hourly rainfall data are located at Port Augusta, Woomera, Tarcoola, Eucla, Forrest, and Kalgoorlie.

The derailment site was 43 km to the east of Kalgoorlie. On the day of the incident, no rainfall was recorded in Kalgoorlie and the BoM analysis concluded that the storm event near the derailment site had only been of moderate intensity.

The BoM cancelled a severe weather warning that was in place for the Goldfields area at 2305 on 29 January 2009 and although a 'Flood Watch' warning was in place, it was also cancelled at 0932 on 30 January 2009, indicating a perceived reduction in flood risk. It is therefore reasonable to conclude that the BoM did not foresee that weather conditions were conducive for flash flooding near Golden Ridge.

At the time of the derailment, the ARTC was not on the direct distribution list for severe weather warnings issued by the BoM and was dependent on secondary information issued through local electronic media.

The City of Kalgoorlie-Boulder Manager of Roads and Transport, while a witness to the weather conditions, could not be expected to provide warning to the rail operators of the full extent of the flood event. The employee concerned would have been unable to assess either the actual intensity of the storm, nor the implications for train operations. His facsimile simply communicated the closure of the Trans Access Road, to a number of recipients, including Transfield Services, and did not identify the intensity of the event or give third parties reason for concern. The facsimile simply indicated:

> The following road is CLOSED to all traffic
>
> TRANS ACCESS ROAD
>
> All other unsealed roads are open to all traffic
>
> All non essential travel on these roads should be delayed for 24 hours to allow the road surface to dry back. Forecast storms may change road conditions quickly. Please take care when travelling these roads.
>
> Recent heavy rain means that this road is slippery with water lying across the road with minor washouts in places. Road users are urged to exercise caution when travelling on this road.

The period between when the previous train 5PM5 passed through Golden Ridge (0545) and when 5PS6 derailed (1031) was about 5 hours. There were no scheduled track maintenance inspections rostered for the 5-hour period and the information available to the ARTC and Transfield Services at the time was insufficient to trigger an immediate inspection to check the track near Golden Ridge for a washaway. Nonetheless, Transfield had dispatched an inspection team from Zanthus to check the track through to Kalgoorlie. Although Transfield Services was advised by fascimile of local road closures as they occurred, local roads in the area are designed without culverts and are regularly submerged. Vehicles are prevented from travelling on submerged roads as they cause damage to the roads and risk becoming bogged. The advice is therefore only relevant in terms of road maintenance vehicle access and not to any measurement of flood risk for the railway itself.

Based on the available evidence, it is apparent that the BoM cannot always accurately predict or satisfactorily detect severe weather events in isolated locations. Similarly, on-site personnel cannot always be relied upon to appreciate the magnitude of a severe weather event or even be expected to be in the vicinity of an event to provide observations.

However, a primary defence in mitigating the risks to rail operations associated with severe weather events is for the track owner, in this case ARTC, to have timely access to reliable weather information; this was not the case at the time of the derailment. The ARTC may therefore benefit by building closer relationships with the BoM and local observers (councils, farmers, etc.) who could pass information to assist them with the identification of localised severe weather events that may potentially affect the safety of their track.

Train crew evacuation

The locomotive cabin and the crew van (a converted passenger carriage) provided sufficient crash protection to the train crew for this accident.

The lead locomotive came to rest on its side following the derailment with the right-side external door and second driver's window firmly on the ground. The locomotive structure was distorted during the derailment with the result that the door to the vestibule and the left-side window were jammed shut. This meant that the drivers could not access the left-side door via the vestibule nor could they gain access to the tool compartment that is located in the vestibule.

In effect, the two drivers were trapped in the locomotive cabin with diesel fuel pooling in the lower side of the cab, adjacent to a number of potential ignition sources. The tool compartment (in the vestibule) contained equipment such as hammers, heavy spanners, hacksaws etc. that may have been of assistance to the drivers in their efforts to vacate the locomotive cabin, however, these tools were not able to be accessed by the drivers as they could not gain entry to the vestibule.

In this instance though, the crew were able to exit with the assistance of the third crew member who managed to force the displaced windscreen (that had come ajar about 15 cm) open enough for the crew to escape.

Train communications

The NR class locomotive AWARE train radio system is designed to allow train crew to have direct voice (and to some extent, data) communication with the relevant train control centre and the PN Service Delivery Centre in Adelaide. In addition to the AWARE train radio system, each NR class locomotive has a portable hand-held UHF radio that is normally stored (with a battery charger) in the locked tool compartment that is located in the locomotive cab vestibule.

Had the AWARE radio system in NR35 been rendered inoperable as a result of the derailment the hand-held radio would not have been available to the train drivers. Fortunately in this instance the AWARE train radio continued to function. As such, the drivers were able to communicate with the Adelaide train control centre and were not dependent on the hand-held radio for emergency communications.

Dangerous goods

Freight train 5PS6 was transporting dangerous goods, being Soluble Lead Compounds (Class 6.1 Dangerous Goods - Poisonous) and Ammonium Nitrate (Class 5.1 Dangerous Goods – Oxidising Substance), which were loaded on wagons that derailed. Consequently, there was release or spillage of a small quantity of Ammonium Nitrate at the derailment site.

Access was restricted until the emergency services had assessed the derailment site. It was found that the Ammonium Nitrate had not mixed with any of the spilled diesel (a potentially explosive mixture), and that the Soluble Lead Compounds had not spilled from their containers. After receiving clearance from the emergency services, and advice on managing the dangerous goods, access was permitted to start derailment assessment and the recovery processes.

An examination of the measures enacted indicates that the management of the risks posed by the dangerous goods being carried on train 5PS6 was effective.

FINDINGS

Context

At about 1031 on Friday 30 January 2009, freight train 5PS6 derailed near Golden Ridge approximately 43 km east of Kalgoorlie in Western Australia.

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

Contributing safety factors

- Heavy rainfall to the east of Golden Ridge on the morning of 30 January 2009 led to localised flash flooding. The floodwater overtopped the track, caused scouring of the track ballast and associated damage to the track at various locations over a 12 km distance.
- Flood damage to the track at the 1738.750 km point caused the derailment of train 5PS6.
- The culverts at the point of derailment were inadequate to cope with the runoff from the storm event that occurred on 30 January 2009.
- Neither train control nor the drivers of train 5PS6 had any knowledge of the flash flood event or the associated track damage. Consequently, train 5PS6 entered the Golden Ridge area at normal speed.

Other safety factors

- The ARTC Code of Practice, with respect to Flooding, 'ETG-10-01', does not specify hydrological design parameters, including height of water ponding against the formation layer for a design precipitation event, and this could lead to under specified track drainage arrangements and an increased risk of track damage arising from flash flood events. *[Minor safety issue]*
- The ARTC had not undertaken an audit of track drainage arrangements for the Trans-Australian Railway to verify that the track complied with the relevant standard and that the standard was appropriate. *[Minor safety issue]*
- At the time of the derailment the ARTC did not have timely access to reliable weather information and may benefit by building closer relationships with the Bureau of Meteorology and local observers (councils, farmers, etc.) who could pass information to assist them with the identification of localised severe weather events that may potentially affect the safety of their track. *[Minor safety issue]*
- There is no equipment stored in the drivers' cabin of an NR class locomotive that can be used to assist the crew to exit the cabin in the case of train crew entrapment in the cabin. *[Minor safety issue]*
- On an NR class locomotive, the hand-held radio is normally located in a locked equipment cabinet in the vestibule rather than in the drivers' cabin, making it inaccessible in cases of train crew entrapment in the cabin. *[Minor safety issue]*

Other key findings

- The operation of the train in terms of speed, and train handling was appropriate. 5PS6 was travelling at a speed of 101 km/h, 9 km/h below the allowable track speed, as it approached the derailment site.
- There were no scheduled track inspections for the 5-hour period between the passage of train 5PM5 and 5PS6. However, Transfield had dispatched an inspection team from Zanthus to check the track through to Parkeston. This was triggered by the fascimile received from the City of Kalgoorlie-Boulder regarding the closure of the Trans Access Road. At the time of the derailment the team was waiting at Blamey (46.75 km east of derailment site) for the passage of 5PS6 before finalising the track inspection by rail mounted vehicle.
- The ARTC Code of Practice specifies that culverts be designed to manage a 50 year precipitation event. However, the rainfall on 30 January 2009 was estimated to have substantially exceeded this level and was likely to have had an average recurrence interval of between 50 and 100 years.
- The management of the risks posed by the dangerous goods that were being carried on train 5PS6 was effective.

SAFETY ACTION

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.

Australian Rail Track Corporation

Code of Practice

Minor Safety Issue

The ARTC Code of Practice, with respect to Flooding, 'ETG-10-01', does not specify hydrological design parameters, including height of water ponding against the formation layer for a design precipitation event, and this could lead to under specified track drainage arrangements and an increased risk of track damage arising from flash flood events.

ATSB safety advisory notice RO-2009-003-SAN-019

The Australian Transport Safety Bureau advises that the Australian Rail Track Corporation should consider the implications of this safety issue and take action where considered appropriate.

Track management

Minor Safety Issue

The ARTC had not undertaken an audit of track drainage arrangements for the Trans-Australian Railway to verify that the track complied with the relevant standard and that the standard was appropriate.

ATSB safety advisory notice RO-2009-003-SAN-018

The Australian Transport Safety Bureau advises that the Australian Rail Track Corporation should consider the implications of this safety issue and take action where considered appropriate.

Identifying severe weather events

Minor Safety Issue

At the time of the derailment the ARTC did not have timely access to reliable weather information and may benefit by building closer relationships with the Bureau of Meteorology and local observers (councils, farmers, etc.) who could pass information to assist them with the identification of localised severe weather events that may potentially affect the safety of their track.

ATSB safety advisory notice RO-2009-003-SAN-020

The Australian Transport Safety Bureau advises that the Australian Rail Track Corporation should consider the implications of this safety issue and take action where considered appropriate.

Pacific National

Train crew evacuation

Minor Safety Issue

There is no equipment stored in the drivers' cabin of an NR class locomotive that can be used to assist the crew to exit the cabin in the case of train crew entrapment.

Response by Pacific National

Pacific National has advised it will investigate the most practical arrangements to enable train crews to exit the locomotive in the case of entrapment.

ATSB assessment of action taken

The ATSB is satisfied that the action proposed by Pacific National will adequately address the safety issue.

Train communications

Minor Safety Issue

On an NR class locomotive the hand-held radio is normally located in a locked equipment cabinet in the vestibule rather than in the drivers' cabin.

Response by Pacific National

Pacific National has advised that it will identify an appropriate position within the locomotive drivers' cab to locate a hand held radio.

ATSB assessment of action taken

The ATSB is satisfied that the action taken and proposed by Pacific National will adequately address the safety issue.

SOURCES AND SUBMISSIONS

Information for this report was obtained from:

- Australian Rail Track Corporation

- Bureau of Metoerology
- City of Kalgoorlie-Boulder
- Independent professional engineer with extensive experience in flood hydrology
- Office of Rail Safety, Western Australia
- Pacific National (Asciano)
- The train drivers
- WestNet Rail

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

A draft of this report was provided to:

- Australian Rail Track Corporation
- Bureau of Meteorology
- City of Kalgoorlie-Boulder
- Independent professional engineer with extensive experience in flood hydrology
- Office of Rail Safety, Western Australia
- Pacific National (Asciano)
- The train drivers
- WestNet Rail.

Submissions were received from the ARTC, Bureau of Meteorology, City of Kalgoorlie-Boulder, Office of Rail Safety Western Australia, Pacific National and WestNet Rail. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

References

ARTC CoP Section 10: Flooding.

ARTC CoP ETG-10-01: Flooding General Appendix.

Australian Bridge Design Code.

Institution of Engineers, Australia (1987) Australian Rainfall and Runoff: a guide to flood estimation.