



Australian Government

Australian Transport Safety Bureau

Derailment of freight train 3MP9

East of Malbooma, South Australia, 10 April 2014

ATSB Transport Safety Report

Rail Occurrence Investigation

RO-2014-006

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The occurrence

The information contained in this Preliminary report is released in accordance with section 25 of the Transport Safety Investigation Act 2003 and is derived from the ongoing investigation of the occurrence. Readers are cautioned that new evidence will become available as the investigation progresses that will enhance the ATSB's understanding of the accident as outlined in this Preliminary report. As such, no analysis or findings are included in this report.

In early April 2014, a slow moving low-pressure trough generated a broad rainband across the Northern Territory and South Australia. The Bureau of Meteorology (BoM) forecast heavy rainfall and issued flood warnings for various areas of the South Australia, including locations around the Malbooma region.

At about 1742 on 9 April, Specialized Container Transport train 3MP9 departed Port Augusta (Figure 1). It was raining on departure and continued to rain as the journey progressed. At Kultanaby, a crew change occurred. The new driving crew travelled toward Tarcoola with rain continuing to fall.

Figure 1: Location map - South Australia



Source: NatMap Railways of Australia

At 2350, when train 3MP9 departed Tarcoola, there was only intermittent rain falling. As the train travelled downhill towards the base of a grade near the 532 km post¹, the crew observed water running swiftly in the cess drain² down the south side of the track.

¹ Distance in kilometres from the reference point located at Coonamia, South Australia.

As the train climbed the next grade, the driver slowed the train in preparation for entering the crossing loop at Malbooma. The train crew then saw water overtopping the track ahead, so the second driver contacted the network control officer (NCO) to advise that the train had encountered a lot of water flowing down the south side and across the track and suggested that all trains be held until the track was inspected for damage.

Soon after, at about 0006 on 10 April, and shortly after the train crossed a culvert at the 535.150 km mark at speed of about 90 km/h, the crew heard a 'big bang' and felt the locomotive pitch sharply. Soon thereafter, the train's brakes were automatically applied and the lead locomotive came to a stop near the 536.035 km mark.

The second driver alighted from the locomotive and walked back along the northern side of the train to check for damage. He found that the air line and jumper cable between the trailing locomotive and the refuelling tanker were uncoupled. He reconnected the couplings, but the train brake system did not re-establish a reading from the end of train monitoring system³ (ETMS).

The second driver, accompanied by another driver who had been resting in the crew van, then walked further back along the train and found another separation between wagons and a wagon that had derailed a wheel. In the distance, they could also see a further series of wagons lying on their sides to the north of the track (Figure 2).

Figure 2: Derailed wagons north side of track.



Source: ATSB

At about 0014, the crew of train 3MP1 contacted the NCO to report their departure from Lyons (about 30 km west of the derailment location). The NCO asked if the crew had observed water near the track at the 535 km post when they passed that area. The driver replied '...water was encroaching on the ballast but it wasn't up to the ballast to wash it away'.

At about the same time, the drivers of 3MP9 returned to the front of the train and reported to the NCO that train 3MP9 had derailed and provided details of the known damage.

Events post derailment

At 0045, the crew of 3MP9 carried out a further inspection of the train and reported to the NCO that about 20 wagons had rolled on their side. The NCO advised the train crew that a track supervisor had been dispatched from Tarcoola to inspect the damaged track.

² Cess drain: refers to the surface drain provided outside the sleepers to drain water from the ballast.

³ End of train device which forms part of the end of train monitoring system (ETMS). Sends a signal to the in-cab integrated function display (IFD).

About 1 hour after the train derailed, the drivers reported that all the water that had been flowing down the south side of the track had dispersed through the culverts and into streams to the north of the track.

At about 0124, the track supervisor arrived at the derailment site and reported to the NCO that approximately 40 sleepers were undercut, the ballast had been washed away by the floodwaters and sections of the train remained suspended on skeletal track (Figure 3).

Figure 3: Well wagons suspended on skeletal track near point of derailment.



Source: ATSB

At about 1115 on 11 April, Australian Rail Track Corporation (ARTC) staff and Australian Transport Safety Bureau (ATSB) investigators arrived at the derailment site to assess damage to track infrastructure and rolling stock and to commence the investigation.

The crew of train 3MP9 remained with the train until about 1300, when they were transferred by road-rail vehicle to Tarcoola before travelling back to their home depots.

Track and train maintenance crews commenced recovery and restoration works on 12 April and the railway was re-opened to traffic at about 1052 on 17 April.

Context

The location

The derailment occurred about 7 km east of Malbooma at the 535.170 km mark⁴ on the Defined Interstate Rail Network (DIRN) in South Australia (Figure 1). Malbooma is located approximately 450 rail km west-northwest of Port Augusta.

Track information

The ARTC manages the railway where the derailment occurred, with the movement of rail traffic controlled from the ARTC's Network Control Centre located at Mile End in South Australia.

The standard gauge (1435 mm) track at the derailment location consisted of 47 kg/m rail fastened to concrete sleepers by resilient clips. The track formation comprised sand/clay based soil, topped with a capping layer and overlaid with ballast to a nominal design ballast depth of 250 mm forming the track bed. The track bed supported prestressed concrete sleepers spaced at about 667 mm centres.

Approaching from Tarcoola, the track near the derailment site was tangent⁵ and the terrain undulating. The track gradient leading to the derailment site transitioned from a falling grade⁶, to a rising grade of 1:300 through the point of derailment. The posted maximum track speed was 100 km/h.

Train and train crew information

Train 3MP9 was a freight service operated by Specialized Container Transport between Melbourne and Perth. At the time of the derailment it consisted of two locomotives (SCT002 leading and SCT011 trailing) hauling an in-line fuel wagon, a crew van and 73 freight wagons. The train was 1782.5 m in length and had a trailing mass of 5502.4 t.

The crew consisted of four qualified drivers who had commenced duty at Spencer Junction at about 1630 on 9 April. The plan was for the drivers to work the train in pairs, operating in rotating relay shifts through to Perth, Western Australia.

The driver and co-driver in charge at the time of derailment had about 23 and 39 years' experience respectively in the rail industry. They had been assessed as fit for duty in accordance with the requirements of the National Standard for Health Assessment of Rail Safety Workers.

On-site inspection and examination of train data indicated that there was no anomaly in the train speed, train handling, rolling stock condition or operational performance leading up to the derailment.

While the consignment of train 3MP9 included dangerous goods, there was no loss of containment of these goods as a result of the derailment.

Environmental conditions

Prior to the derailment, rainfall was generated by an inland surface trough that triggered thunderstorms and rain in the Kimberley region of Western Australia. By 8 April, a band of storms extended from the northern tropics to a cold front in South of Australia, causing a band of heavy rain between the Kimberley's and southern Victoria.

⁴ Distance in track kilometres from a reference point located at Coonamia near Port Pirie, South Australia.

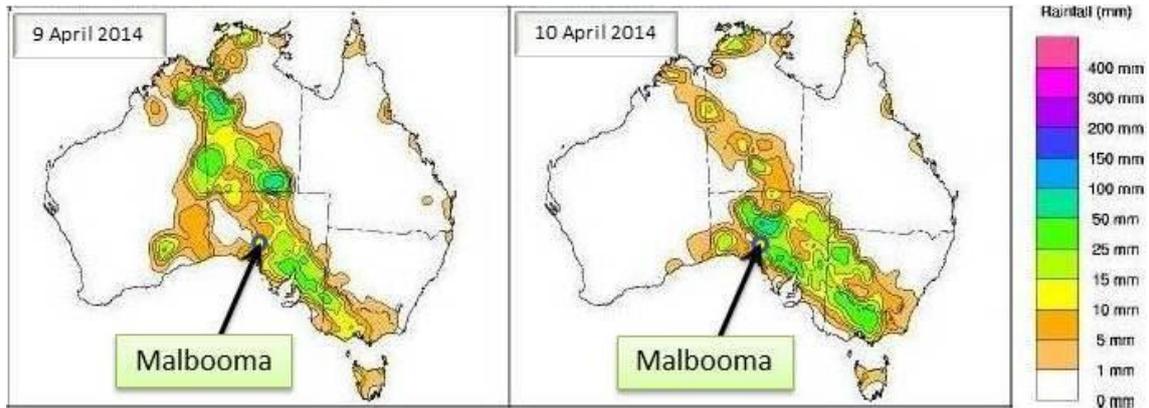
⁵ Straight track with no applied cant.

⁶ A measure of the rate at which the railway is inclined (rising or falling). Gradients are signed +ve (rising) or -ve (falling) in respect of the direction of travel.

A low pressure system formed on a trough crossing South Australia on the 10 April which then moved over Victoria and out to the southeast. Rainfall intensity was sporadic across the northwest pastoral district of South Australia. While significant rainfall was recorded at Coober Pedy, about 190 km north-northeast of Tarcoola, only 20 mm was recorded at Tarcoola Aerodrome, about 31 km from the derailment site, over the period 9 to 10 April.

The rainfall persisted, breaking April daily rainfall records over many inland areas of South Australia (Figure 4). The BoM data showed that rainfall in South Australia was 257% above average in April 2014.

Figure 4: Daily rainfall intensity maps - April 2014



Source: Bureau of Meteorology

Track drainage

The under track drainage system installed between Tarcoola and Malbooma consisted of culverts of varying types including concrete box, rail deck, corrugated steel pipe and reinforced concrete pipe. The type of culvert installed near the point of derailment was a double span 1500 mm concrete box culvert (Figure 5).

Figure 5: Derailment location showing barrier wall, diversion channel and culvert near 535.150 km.



Source: Google Maps and ATSB

To protect the track formation from water scouring, the ARTC had constructed a barrier wall embankment parallel to the track and about 6 m from its southern side. The embankment was formed using compacted earth and was about 1.5 km long, 4 m wide and 1 m high (Figure 8) with wing walls (Figure 7) constructed at intervals of about 250 m to direct water away from the track structure. Near the east end of the barrier wall, a mounded end wall was constructed to re-direct water at an angle of about 90 degrees toward the railway and the double box culvert located at the 535.150 km mark.

Between 9 and 10 April, the significant water run-off from the catchment flowed towards the barrier wall on the south side of the track. As the water accumulated and flowed along the barrier wall in an easterly direction, the volume of water increased to the point where the wing walls were unable to interrupt and divert the flow. As a consequence, the water over-topped and eroded the barrier wall allowing excess water from the diversion channel to flow between the barrier wall and the track formation (Figure 6). The barrier wall was breached in two places between the 536 km post and the culvert, allowing the water to flow against the railway track formation.

Figure 6: Water diversion channel and barrier wall near the point of derailment



Source: 7 News

About 8 m before the double box concrete culvert at the 535.150 km mark, it was evident that an eddy current⁷ had formed before the water was redirected through the culvert. The circular motion of the eddy current progressively eroded the track formation and ballast, weakening the track structure and causing it to slump. The water level continued to rise with excess water flowing over the track and into the stream exiting the culvert on the north side. The track formation continued to erode after the train had derailed, leaving a double stacked container well wagon suspended on a 13 m section of skeleton track structure (Figure 3).

Other weather related rail occurrences

The ATSB has investigated three similar weather related flood occurrences. These occurrences happened near Golden Ridge⁸ in Western Australia on 30 January 2009 (ARTC managed track),

⁷ A current of water that moves against the main current in a circular pattern.

⁸ ATSB investigation number, RO-2009-003 - Derailment of Train 5PS6 near Golden Ridge WA 30 Jan 2009.

Edith River⁹ in the Northern Territory on 27 December 2011 (Genesee and Wyoming Australia managed track) and at Roto New South Wales on 4 March 2012¹⁰ (ARTC managed track).

In each case, the ATSB made recommendations in relation to managing the safety risk to rail operations due to extreme weather events.

Ongoing investigation activities

The ATSB's investigation is continuing and will focus on:

- The ARTC's actions in response to the severe weather warning information received prior to the derailment
- The ARTC's policies and procedures to monitor and mitigate the risk to infrastructure and operations from severe weather events
- The ARTC's actions to assess and implement infrastructure improvements in response to previous ATSB investigations.

⁹ ATSB investigation number, RO-2011-019 - Derailment of freight train 7AD1 at Edith River near Katherine NT on 27 December 2011.

¹⁰ ATSB investigation number, RO-2012-002 - Derailment of freight train 7SP3 near Roto NSW on 4 March 2012.

General details

Occurrence details

Date and time:	10 April 2014 – 0006 CST	
Occurrence category:	Serious incident	
Primary occurrence type:	Derailment - Running Line	
Location:	Trans Australian Railway near 535.170 km - Malbooma	
	Latitude: 30° 41.18.0' S	Longitude: 134° 14.52.7' E

Train details

Train operator:	Specialized Container Transport	
Registration:	3MP9	
Type of operation:	Rail Freight	
Persons on board:	Crew – 4	Passengers – Nil
Injuries:	Crew – Nil	Passengers – Nil
Damage:	Substantial	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Specialized Container Transport
- The Australian Rail Track Corporation

References

Bureau of Meteorology - Daily Rainfall, Tarcoola Aero

Bureau of Meteorology - Monthly Weather Review, Australia, April 2014

Bureau of Meteorology – Weather Alerts – SA Severe Weather Warnings: Heavy Rain - 9 April 2014

Bureau of Meteorology, Weather Services Handbook

RISSB Glossary of Railway Terminology - Guideline

Australian Transport Safety Bureau

The Australian Transport Safety Bureau (ATSB) is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

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 identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, 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 initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.