RAIL SAFETY INVESTIGATION REPORT

DERAILMENT OF PACIFIC NATIONAL’S ORE SERVICE 4835
NEVERTIRE – NYNGAN RAIL SECTION

1 OCTOBER 2006

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ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

The Incident
At approximately 5:46am on 1 October 2006, the trailing locomotive and 14 wagons within Pacific National Limited’s ore container service 4835 derailed four kilometres South-East of a locality known as Miowera, on a Class 3 freight line, between Nevertire and Nyngan in the Central West region of NSW. These rail vehicles, and 22 containers thereon, suffered varying degrees of damage. Fortunately, there were no injuries.

Findings
In relation to those matters prescribed by the Terms of Reference as the principal lines of inquiry, OTSI finds as follows:

a. Causation
   i. 4835 derailed because the track over which it was travelling was in a poorly maintained condition.
   ii. The derailment at 604.120kms occurred when a poorly-supported rail joint snapped under the pressure of the weight of 4835’s approach. When this joint snapped, the exposed rail end was struck by the wheels of 4835’s leading locomotive. Approximately 6m of rail subsequently shattered and as a consequence, the trailing locomotive and 14 wagons derailed.
   iii. The rail-end became exposed when the fishplates that had been used to join two lengths of rail broke. Metallurgical testing established that this breakage was associated with fatigue fractures that had developed in the fishplates over time because of inadequate support underneath the rail joint.

b. Contributory Factors
The limitations in the condition of the track were readily apparent but were not detected in successive track inspections. This meant that ARTC lacked visibility of issues that should have informed its maintenance and track management priorities.
c. **Effectiveness of Risk Management Strategies**

ARTC has established standards, processes and an “Exceedent Control System” to identify and manage the risks associated with track defects and/or failures. However, these standards and processes were not properly applied within the Nevertire-Nyngan rail section and as a consequence, ARTC lacked visibility of, and did not act to address or manage, defects that should have been readily apparent.

d. **Effectiveness of the Emergency Response**

The emergency was effectively managed but the relative remoteness of the area in which the derailment occurred presented some significant challenges during the subsequent recovery operation. However, these challenges were overcome. Importantly, the agencies involved later made a conscious effort to ensure that the lessons learned during the recovery operations were identified and recorded.

e. **Other Matters that would Enhance the Safety of Rail Operations**

i. **Personal Protection Equipment (PPE).** Some of the PPE worn by Southern & Silverton’s staff at the scene of the accident was faded and/or discoloured.

ii. **Event Recorders.** Rail vehicle operators in NSW are still paying insufficient regard to the requirement to ensure event recorders on board their locomotives are properly adjusted and are regularly inspected, serviced and calibrated.

**Recommendations**

In order to prevent a recurrence of this type of accident, the following remedial safety actions are recommended for implementation by the organisations specified below:

a. **Australian Rail Track Corporation**

i. Ensure that all staff involved in the inspection, repair and management of track are properly qualified for their role and understand relevant engineering standards, inspection and repair procedures and documentation requirements.
ii. Ensure that the outcome of track inspections, track maintenance activities and other track management measures are recorded in more specific terms and in a way that more adequately supports its understanding of track condition.

iii. Conduct regular audits of its track management system in order to assure itself of the integrity of that system.

iv. Amend ARTC Network Rule ANTR 400 and Operator “Standard Operating Procedures” to specify that rolling stock should only be moved at the scene of a running line derailment when there is a compelling safety requirement to do so and/or the movement has been approved by OTSI or ITSRR or, if the occurrence has occurred on the Defined Interstate Rail Network, the ATSB, and has subsequently been authorised by Train Control.

b. Southern & Silverton Railway
   i. Ensure that event recorders fitted to its locomotives are correctly adjusted and are regularly inspected, maintained and calibrated.

   ii. Replace faded and/or discoloured PPE throughout its organisation.

c. Independent Transport Safety and Reliability Regulator
   Ensure that the elements of ARTC’s Safety Management System upon which the Corporation relies to monitor and maintain track condition are robust and that the requirements specified therein are being met.
PART 1 FACTUAL INFORMATION

Accident Synopsis

1.1 At approximately 5:46am on 1 October 2006, the trailing locomotive and 14 wagons within Pacific National Limited’s ore container service 4835 derailed four kilometres South-East of a locality known as Miowera, on a Class 3 freight line, between Nevertire and Nyngan in the Central West region of NSW. These rail vehicles, and 22 containers thereon, suffered varying degrees of damage. Fortunately, there were no injuries.

Accident Narrative

Before the Incident

1.2 Ore service 4835 was en route from Morandoo, in Newcastle, to a mine near Cobar\(^1\). The train consisted of a mainline locomotive, a branch line locomotive and 27 flat bed wagons loaded with 54 empty containers which were to be loaded with copper ore concentrate at the mine.

1.3 4835 departed Morandoo at approximately 2:00pm on 30 September 2006 and travelled through Muswellbrook, Gulgong and Merrygoen before arriving at Dubbo at 2:20am on 1 October 2006 where the new crew conducted a ‘roll by’ inspection. 4835 departed Dubbo at 2:40am, bound for Narromine. At Narromine, the crew changed the mainline locomotive on the train for another branch line locomotive to comply with axle load restrictions on the line further West. They also conducted various safety inspections of 4835, in accordance with ARTC’s *Network Rules and Procedures*, before departing Narromine at 4:00am. 4835 subsequently stopped at the townships of Trangie and Nevertire.

The Derailment

1.4 4835 then departed Nevertire at 5:15am for Nyngan. The crew recalled the journey from Nevertire towards Nyngan as being uneventful until shortly after passing the 604 kilometre post\(^2\) when they felt the train “jerk and shudder”.

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1 Cobar is located approximately 700km West of Sydney

2 The distances on these posts, which are positioned every 500m, are measured from Central Station in Sydney and allow train drivers to identify their exact location.
The Driver then observed, in rear view mirror on his side of the locomotive’s cabin, dust emanating from underneath the train and noticed that the brake air pressure gauge was indicating a loss of brake pipe pressure. His view to the rear was then obscured by a large dust cloud. These signs typically indicate that some portion of a train has derailed and the Driver therefore applied the train’s emergency brakes. The Assistant Driver, who was seated on the opposite side of the cabin, also recalled the “jerk” and watching the second and third wagon disappear from sight in his mirror before the dust also obscured his view.

After the Incident

1.5 Immediately after the train came to a stand, the crew notified Train Control at Orange of the incident. The Assistant Driver then left the cabin to check on the condition of 4835. It was very quickly apparent that the trailing locomotive and the 14 wagons immediately behind it had derailed and come to rest in various positions on top of an embankment and on the ‘Down’, or Southern, side of the track (see Photos 1 and 2). This was communicated to Train Control who initiated standard response procedures.

1.6 Once they realised the extent of the derailment, the crew of 4835 uncoupled the lead locomotive and used it to drive approximately 500m forward to expedite the placement of detonators on the track. Detonators were also placed to the rear of 4835.3

1.7 ARTC’s Team Manager, who travelled from Nyngan approximately 22kms away, was the first of the response personnel to arrive at the incident site. NSW Police Officers from Nyngan followed and breath-tested and took statements from the Driver and Assistant Driver. Shortly thereafter, a Pacific National Supervisor arrived from Dubbo, followed by an ARTC Risk and Safety Officer from Wagga Wagga. OTSI’s Investigating Officer and recovery gangs from Parkes, Nyngan and Dubbo subsequently arrived.

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3 These actions, which were required under ARTC’s Network Rule ANTR 400, were intended to warn any approaching train that 4835 was disabled.
Photo 1: Wagons standing over the point at which the derailment was initiated

Photo 2: View of wagons derailed to the 'Down' (Southern) side of the track
(Photo by Pacific National)
Site Description

1.8 As shown in Figure 1, the derailment occurred at 604.120kms, approximately four kilometres South-East of the locality of Miowera, in the Central West Region of NSW. Miowera is situated 18km South-East of the township of Nyngan, on the ‘Main Western’ line between Dubbo and Cobar.

Track Information

1.9 The line is owned by the Rail Infrastructure Corporation, Country Rail Division (RICCRD). However, track maintenance and train control functions on the line are managed by the Australian Rail Track Corporation (ARTC) under the Country Regional Network Management Agreement. The track is classified as Class 3 line under ARTC’s Engineering Standard TDS 11 (Standard Classification of Lines) and is used primarily to transport commodities, such as wheat and copper ore concentrate, in bulk. The Nevertire-Nyngan section is predominantly straight and level, with a ‘ruling’, or steepest, gradient of 1:559 and a posted maximum operating speed of 80km/h.

1.10 The derailment occurred atop of a three metre high earthen embankment. The track consisted of 40kg/m (80lb/yard) jointed welded rail (JWR) fixed to timber sleepers by dog spikes, with steel sleepers irregularly interspersed amongst the timber sleepers.
Crew Information

1.11 4835 was operated by an experienced crew from Southern & Silverton Railway\(^4\), based out of Parkes. The Driver had 49 years rail experience, most of which had been spent driving trains. The Assistant Driver had three years rail experience. Both crew members were familiar with, and qualified for, the route and were within the respective medical and competency assessment periods.

Train Information

1.12 4835 consisted of two branch line (48 Class) locomotives and 27 flat-bed wagons loaded with 54 empty ore containers. The train measured 432 metres and had a gross weight of 574 tonnes.

Operations Information

1.13 Train operations within the Nevertire-Nyngan rail section are controlled by the use of the ‘Staff and Ticket’ system of safeworking\(^5\) as described in ARTC’s Network Rule ANSY 506 (Staff and Ticket System). The Driver of 4835 had authority from Train Control to traverse the section and was in possession of the train staff for the section at the time of the incident.

Meteorological Information

1.14 The train crew described the weather conditions at the time of the derailment as dry and clear and the Bureau of Meteorology recorded a minimum temperature of 8.5°C overnight.

Toxicological Information

1.15 Both crew members were breath tested at 7:45am by the NSW Police and returned negative results.

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\(^4\) Southern & Silverton Railway is an accredited rail operator contracted by Pacific National to provide crews and motive power for operation of ore services to and from Cobar.

\(^5\) The Staff and Ticket system is used in bi-directional single line territory, in lieu of rail vehicle detection systems, and provides for a single train to have sole occupancy of a rail section at any given time.
Damage

1.16 The trailing locomotive, 14 wagons, and 22 containers thereon, all suffered varying degrees of damage. The locomotive and five wagons were subsequently re-railed and certified fit for operation, at reduced speed, back to Narromine. The remaining nine derailed wagons were moved clear of the track and subsequently recovered by road to repair facilities at Mittagong and Port Waratah. In addition, 253m of track was renewed before the line was re-opened on 4 October 2006.
PART 2  ANALYSIS

Causation

Train Management and Condition

2.1 Event recordings captured on the two Hasler tapes removed from 4835 indicated that the train had been travelling at 78km/h at the time of the incident. This speed was under the posted speed limit of 80km/h for the immediate area. The recordings also showed that:

   a. 4835 had been operated in accordance with ARTC’s Network Rules and Procedures and within posted track speed limits up until the loss of brake pipe pressure at 5:46am, after which it came to a stand.

   b. A 15 hour time differential existed between the data from the leading locomotive and that from the trailing locomotive due to the clock on the trailing locomotive not being properly wound and set correctly.

   c. The management of 4835 was not at issue.

2.2 An examination of 4835’s documentation indicated that there were no marshalling issues and as previously indicated, the containers on the wagons were not loaded. OTSI inspected the rolling stock and the track, after the derailment, and concluded that the condition of the rolling stock did not cause or contribute to the derailment. This conclusion was based on the following observations:

   a. there was no evidence of brake or other bogie components having dragged along the track;

   b. there were no indications on the wheels of the leading or trailing locomotives that suggested that their condition might have initiated the derailment e.g., that the wheels had skidded, the presence of scale or signs of abnormal wear;

   c. wheel flange and thickness measurements fell within the required parameters;

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6 The ‘management’ of a train refers to the way in which it has been driven and the data recorded on the Hasler tapes did not indicate that the train had been operated at excessive speeds, or that inappropriate braking techniques and/or power settings had been employed.

7 Marshalling refers to the order in which locomotives and wagons are arranged. This is especially significant when mixed loads are being carried or when some wagons are loaded and others are not.
d. there were no abnormal wear patterns on the automatic couplings, bolster gibbs or container twist locks to indicate that the wagons had been hunting prior to the derailment;

e. there was no evidence of binding or seizure within the wagon bogie centre castings to indicate that bogie rotation had been hindered;

f. there was no evidence of suspension defects and the side bearer units on each wagon were in place and correctly adjusted;

g. the couplers between the wagons were not locked; and

h. witness marks on the ‘Down’ side wheels and on the inside of the trailing cow catcher of the leading locomotive were caused by a track defect.

**Track Condition**

2.3 The derailment occurred on the ‘Down’ rail at 604.120kms at an area where two lengths of rail had been clamped together with ‘fishplates’. *Photograph 3* shows that both fishplates had snapped at a point located centrally in the fishplates between the two rail ends and fatigue fractures at the same point. The presence and position of these types of fractures is indicative of the rail flexing vertically over a considerable period of time.

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*Photograph 3: Broken fishplates on the ‘Down’ rail at 604.120kms*

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8 Hunting refers to severe sideways movement of a bogie as it travels along the track.
2.4 ARTC’s Engineering Standard TDS 11 (Standard Classification of Lines) specifies that the spacing between sleepers positioned under rail joints should not exceed 510mm. However, OTSI noted that this standard was not met in the area where the fishplates snapped and that a 900mm gap existed between the two sleepers either side of the joint. The timber sleeper on the approach side of the joint was ‘knocked down’ (see Photo 4) and provided no vertical support to the rail joint. The next nearest supporting sleeper on the same side of the joint was a steel sleeper located some 300mm in advance of the ‘knocked down’ sleeper and some 900mm prior to the rail joint. Thus, there was 1200mm of rail which was unsupported under the joint.

![Photo 4: Area and conditions around the point of initiation of the derailment](image)

2.5 A six metre section of the rail length immediately after the broken joint was shattered with segments of the rail found underneath and to the ‘Down’ side of the 14th wagon (See Photo 5). The remaining part of this length of rail had come adrift from its fastenings, snaking in various directions over and along

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9 ‘Knocked down’ is the term used in TMS 06 to describe the situation where the sleeper has failed or settled into the ballast and does not provide any vertical support to the rail.
the embankment. The other rail, although detached from its fastenings, had remained generally in position.

![Photo 5: Portion of the shattered rail recovered, and reassembled, immediately after the failed joint](image)

2.6 ARTC’s records indicated that the track had last been inspected by on 27 September 2006 and that no defects were detected at that time. OTSI gave consideration to the possibility that the broken fishplates that were found at 604.120kms had broken at some point in time after this inspection and prior to the passage of 4835. It discounted this possibility on the basis of its observation that there were no marks on the faces of the fractured fishplates to indicate that other trains had traversed the joint while it was broken; an absence of any trace of rust on the fractured surfaces which would have suggested that they had been exposed for any period of time; and on the expert opinion offered by a metallurgist (extracts of which are discussed in the following paragraph). Having discounted this possibility, OTSI concluded that sequence of events associated with the derailment was as follows:

a. Over time, and in the absence of proper sleeper placement and support, fatigue fractures developed in the fishplates joining the two lengths of the ‘Down’ rail at 604.120kms.
b. The fishplates snapped on the approach of 4835, with witness marks on the ‘Down’ side wheels on the leading locomotive indicating that this occurred before the locomotive passed over the joint.

c. When the fishplates snapped, the corresponding rail end was exposed and was struck by successive wheels on the leading locomotive. The evidence of these wheel strikes on the rail end can be seen in Photos 6 and 7.

d. As a consequence of successive wheel strikes on the exposed rail end, a six metre length of rail shattered leaving witness marks on the rear cow-catcher of the leading locomotive.

e. The trailing locomotive and the 14 wagons immediately behind it derailed because of the gap left when the rail shattered.

Photo 6: Impact markings on rail end recovered from shattered rail section
(Photo by ARTC)
Metallurgical Testing

2.7 OTSI arranged for an independent metallurgist to subsequently examine and test the fractured fishplates and shattered rail. The metallurgist considered that:

a. The steel used in both the rails and the fishplates, although not of the same quality as modern rail, was of a high quality and complied with the standards in force when it was manufactured in March 1924. Its tensile properties were similar to that found in modern rail.

b. None of the rail fractures showed surface or material defects and all the fractures were non-ductile rapid (cleavage) types caused by high strain rate (impact) loading.

c. The fishplates failed due to the presence of fatigue cracks that formed and grew over a period that could have ranged from many months to more than two years. The final failure occurred “due to non-ductile rapid
(cleavage) fracture\textsuperscript{10}, almost certainly caused by normal wheel loading and not an abnormal event”.

d. A significant factor in the failure of the fishplates was a lack of support at the joint, with the nearest adjacent sleepers being located approximately 300mm and 600mm away from the rail ends.

e. The lack of support of the fishplate joint would have allowed substantial downward deflection of the rail on the side approaching the joint, thus presenting the end of the rail on the other side of the joint to oncoming wheels. Witness marks found on the wheels and on the inside of the trailing cow-catcher of the leading locomotive (see Photos 8, 9 and 10) indicated that, whilst several of its wheels had traversed the joint without derailing, they had impacted heavily on the facing rail end. The damage to the rail end that was exposed after the fishplates had snapped also indicated that the rail had initially held its position as the leading locomotive successfully traversed the joint but then shattered.

\textsuperscript{10} In simple terminology, a non-ductile rapid (cleavage) fracture is either a clean snap or break.
Effectiveness of Risk Mitigation Strategies

Track Construction and Maintenance Standards

2.8 The construction of Class 3 tracks conform, as a minimum, to the following standards listed in Table 1:

<table>
<thead>
<tr>
<th>Rail Section</th>
<th>40kg/m (80lb/yard)</th>
<th>Rail Type</th>
<th>Loose welded rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Ballast Depth</td>
<td>200mm</td>
<td>Sleeper Type</td>
<td>Timber/Steel</td>
</tr>
<tr>
<td>Ballast Grade</td>
<td>Standard</td>
<td>Maximum Axle Load</td>
<td>19 tonnes</td>
</tr>
<tr>
<td>Maximum Train Operating Speed (Freight)</td>
<td>80km/h</td>
<td>Sleeper Spacing</td>
<td>623mm</td>
</tr>
<tr>
<td>Spacing Of Sleepers at Rail Joints</td>
<td>510mm</td>
<td>Number of sleepers per Kilometre</td>
<td>1605</td>
</tr>
<tr>
<td>Tolerance (Sleeper Spacing/Skew)</td>
<td>20mm</td>
<td>Sleeper Spacing/Skew Limit</td>
<td>22 per 13.7m</td>
</tr>
</tbody>
</table>

Table 1: Class 3 Track Standards

2.9 Where track does not meet ARTC’s Engineering Standards TDS 13 (Base Operating Condition Standards of Track Geometry) and TDS 14 (Base Operating Condition Standards of Track Geometry – Standing Orders), speed restrictions have to be imposed until the track can be bought to the required standard. Table 2 in Engineering Standard TMS 06 (Timber Sleepers – Maintenance Standard) also stipulates the following remedial actions be undertaken when timber sleepers are found to be providing inadequate vertical support to the rail:
Table 2: Remedial Actions for Timber Sleepers

Track Inspection and Maintenance Regimes

2.10 Table 3 highlights ARTC’s track inspection requirements for Class 3 lines as specified in its Engineering Standard TEP 13 “Track Examination Handbook: System Overview”.

<table>
<thead>
<tr>
<th>Inspection Type</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
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</table>
| Track Patrol          | Weekly (8 days Max)  | Conducted by track vehicle to ensure:  
• There are no obstructions to train movements or signalling equipment within (or potentially within) the structure gauge.  
• There is continuity of rails (i.e. no broken rails or joints, or loose or foul joints)  
• There are no imminent failures of track fastenings  
• There are no major geometry exceedents (of derailment potential) without suitable protection  
• There are no major deficiencies in supporting track structure (resulting from earthworks, bridges, structures, culverts, etc.)  
• That permanent & temporary speed signs are visible to train/track vehicle operators (are present, facing the right direction, not obscured by vegetation, graffiti, etc) & that temporary speed boards have been placed correctly, are accurate (have the right plates in the right order & working lights) & are standing securely. |
| Front of Engine       | Monthly (Dep. on trn) | Non specific examination to assist in the assessment of track by enabling the reaction of trains to the track structure to be observed (preferably at maximum allowable speed). |
2.11 In addition, a number of other inspections or actions are also required on either an annual or bi-annual basis. These include:

a. an annual track geometry recording by a track recording train to:
   i. graph the condition of the track,
   ii. identify locations where the track geometry parameters are exceeded,
   iii. categorise the severity of the exceedents, and
   iv. indicate the extent of the temporary speed limit that should be placed on areas where exceedences have been detected;

b. an annual inspection of sleepers to confirm their condition and to identify those in immediate need of replacement;

c. an annual ultrasound test, using a specialised vehicle, to identify internal defects such as flaws or fractures within the rail; and

d. an annual Welded Track Stability Analysis (WTSA) to verify the track’s ability to withstand the stresses caused by extremes in temperature during summer and winter.

<table>
<thead>
<tr>
<th>Inspection Type</th>
<th>Frequency</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Detailed Walking | Bi-annually | Thorough examination of the components of the track structure & the right of way to ensure that the components are satisfactory & contribute to a safe railway. Items examined include, but are not limited to:
• Track geometry and adjustment
• Track components, including rails, fastenings, ties, joints, insulated joints, ballast profile and condition, lubricators
• Turnouts and special track work
• Bridge and structure conditions effecting track integrity
• Earthworks & drainage including geotechnical hazards
• Right of Way including:
  o Fencing & gates
  o Weed & vermin control
  o Firebreak condition, fire hazard control, access roads
  o Vegetation fouling, or with the potential to foul the track
  o Drainage including waterways & flooding
  o Check of any undermining of track or structures
  o Visibility, security & clearances of Permanent & Temporary Speed signs & other trackside safety signs. |
2.12 *Table 4* provides a summary of the last results obtained from inspections conducted by ARTC prior to the derailment at the location where the derailment subsequently occurred.

<table>
<thead>
<tr>
<th>Inspection Type</th>
<th>Last Date Conducted</th>
<th>Inspection Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track Patrol</td>
<td>25/09/2006</td>
<td>• No defects reported in vicinity of point of derailment.</td>
</tr>
<tr>
<td>Front of Engine</td>
<td>27/09/2006</td>
<td>• No defects reported in vicinity of point of derailment.</td>
</tr>
<tr>
<td>Detailed Walking</td>
<td>21/03/2006</td>
<td>• No defects reported in vicinity of point of derailment.</td>
</tr>
<tr>
<td>Track Geometry (AK Car) Recording</td>
<td>22/08/2006</td>
<td>• Noted a single Category 4 short twist at 604.116kms, four metres prior to point of derailment.</td>
</tr>
<tr>
<td>Sleeper Inspection &amp; Marking</td>
<td>-</td>
<td>• No records supplied</td>
</tr>
<tr>
<td>Ultrasonic (Speno car) Testing</td>
<td>05/12/2005</td>
<td>• No defects reported in vicinity of point of derailment.</td>
</tr>
<tr>
<td>WTSA</td>
<td>22/09/2006</td>
<td>• Indicated that there were no defective (frozen, fully open, stretched, pumping or fully closed) joints detected within the section between 601.500kms to 607.500kms.</td>
</tr>
</tbody>
</table>

*Table 4: Previous Track Inspection Results*

2.13 OTSI noted the following matters when it examined ARTC’s records for the same area over a longer period:

a. While the track inspections were generally conducted at the required intervals, inspection reports contained little, if any, information or detail regarding the condition of the track or the nature of repairs conducted.

b. There were no recent reports by train crews regarding the condition of the track.

c. Resurfacing works had been carried out between 602.000kms to 604.000kms and 604.500kms to 607.000kms during September 2006.

d. Ballast tamping throughout the section had been conducted between October and November 2004.

e. A broken rail was detected and repaired on the ‘Up’ rail at 604.109kms during December 2005.

f. There had been a previous derailment in the same general area in February 2006, but the cause of this derailment was attributed to defective wheels on a locomotive.
Actual Track Condition

2.14 OTSI spent considerable time examining the track between 603.500kms and 604.500kms, i.e., 500 metres either side of the derailment. It also examined the track in other locations within the Nevertire-Nyngan section and observed that:

a. The track generally consisted of 40kg/m (80lb/yard) jointed welded rail (JWR) fixed to timber sleepers by dog spikes, with steel sleepers irregularly interspersed between the timber sleepers.

b. There were no markings or other indications on the rails to indicate that bogies had been oscillating excessively.\(^\text{11}\)

c. Although there was the occasional ‘poor’, ‘failed’ or ‘knocked down’ sleeper, most sleepers were in either ‘fair’ or ‘good’ condition, as defined in TMS 06.

d. The ballast was clean and sharp and there was no evidence of sleepers ‘pumping’\(^\text{12}\) or of bog holes. The shape of the ballast formation was even and within standard.

e. The gap measurements between the rail ends at joints were within specifications.

f. The horizontal alignment of the track was satisfactory (see Photo 11 on page 19).

g. There was no evidence of sleepers being marked for replacement, or of new sleepers.

h. The positioning of rail anchors within the timber sleepered sections was irregular.

i. While most sleepers were in either ‘fair’ or ‘good’ condition, TMS 06 stipulates that “restraint must allow no lateral movement of the fastenings relative to the timber” and there were many instances where fastenings were loose and were able to be rotated or extracted with ease. As a consequence, there was little to prevent lateral, longitudinal or vertical movement.

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\(^{11}\) This phenomenon is usually referred to as ‘hunting’ which causes accelerated wear on both rails and bogies and increases the risk of derailment.

\(^{12}\) ‘Pumping’ is a common used term to describe the situation were a sleeper is not supported against vertical movement.
movement of the rails. There were also pockets where the limit of five consecutive ineffective sleepers on tangent (straight) track, as specified in *TMS 06*, was exceeded.

2.15 In essence, *TMS 06* specifies that if track ties are sufficient to hold the track gauge for a period of 28 days and there are no more than two ineffective sleepers where rail lengths are joined, the track can be considered to be “tied” i.e., of a standard that permits normal running. Where, defects are found at rail joints, the following actions are specified:

a. “consider requirement for speed restrictions…” up to a maximum of 30km/h and 50km/hr for loaded and unloaded freight trains respectively, or 40km/h in the event where a sleeper is missing or knocked down, or where sleeper spacing is more than 900mm or less than 1200mm at a rail joint (refer to Table 2 on page 15);

b. “repair within 28 days”;

c. “monitor each patrol until repaired”, meaning that the defect should be monitored by all patrols deployed during that 28 day period; and
d. record in ARTC’s “Exceedent Control System”.

2.16 During its inspection of the track, OTSI also paid close attention to areas where the rail was joined. A number of the joints were found to be ineffective because they were supported by a single sleeper only, had defective fastenings, had defective fishplates or because the sleepers had been spaced too far apart. *TMS 06* specifies that sleepers should be not more than 510mm apart on Class 3 line where track is joined. At the point of derailment, OTSI observed that only a single sleeper had been supporting the joint 300mm from the centre of the joint and that a 600mm gap existed between the centre of the joint and the nearest edge of the previous sleeper (See Figure 2). At other nearby joints, OTSI also observed that a number of other fishplates had fractured in the area of the bolt holes or that the fastenings at the joints were ineffective. These conditions are depicted in Photos 12 and 13.

![Figure 2: Diagram indicating position of the failed rail joint and the sleeper marks on the shattered rail section.](image)

![Photo 12: Example of poorly supported and maintained rail joint near the derailment site](image)
2.17 The defects described in paragraph 2.16 were sufficiently serious to have warranted them being recorded in ARTC’s *Exceedent Control System*, the imposition of temporary speed restrictions and priority being attached to their rectification. OTSI also observed irregularities in the placement of sleepers, with sleepers being bunched in some instances and spaced too far apart in others. ARTC’s *TDS 11* (Standard Classification of Lines) stipulates that the distance between sleepers should be measured from the centre line of one sleeper to the centre line of the next sleeper and this should be 623mm, although a tolerance of +/-20mm is permitted. The standard also specifies sleepers should not be ‘skewed’, or be out of parallel, although some skewing is permissible provided the alignment remains within the 20mm tolerance referred to immediately above. OTSI found that in some instances the distance between sleepers was up to 1100mm. An example of one area where sleepers were spaced too far apart, bunched or skewed is depicted in *Photo 14*. 

![Photo 13: Fractured fishplate used in post incident repairs poorly positioned over the sleeper](image)
2.18 OTSI noted that even when the track that was damaged during the derailment was repaired and certified as fit for normal running, numerous defects were still apparent in an area approximately 100m prior to the point at which the rail had shattered: including ballast between the rail and the sleeper plates, ineffective fastenings, unsupported rail joints, and fractured fishplates; yet the track was certified as fit for normal speed.

2.19 The derailment occurred because the track had not been maintained to the required standard. In reaching this conclusion, OTSI appreciates that ARTC faces many challenges as it tries to modernise the rail infrastructure in some of those areas under its control throughout NSW and to, simultaneously, maintain others and that its priorities often have to be adjusted. In order to deal with these challenges, ARTC has to have an effective track inspection and monitoring regime in order to inform its priorities and to determine how
best to manage those areas that require work until the work can be effected. If ARTC had fully appreciated the condition of the Nevertire-Nyngan section, it should have, as a minimum, imposed restrictions on train running until the track met the standards for unrestricted running. The defects identified by OTSI were not recent and were readily apparent, yet the records of successive inspections of the same area and a Welded Track Stability Analysis (WTSA) undertaken by ARTC in the weeks immediately prior to the derailment made no mention of these defects. This suggested to OTSI that either the checks had not actually been done; that they had been done, but only cursorily; or that those conducting the checks had a limited understanding of what they were doing.

**Adequacy of the Emergency Response**

2.20 As indicated in paragraph 1.6, the crew of 4835 uncoupled the lead locomotive and used it to drive approximately 500m forward to expedite the placement of audible warning devices on the track. While this action was permitted under ARTC’s Network Rule ANTR 400 (Protecting Trains), it could have disturbed important evidentiary material and a more appropriate course of action in this instance would have been to have secured the locomotive where, and as, it had come to rest.\(^{13}\)

2.21 The Train Controller at Orange made his initial response call to a Police call centre which redirected his call to Police at Bourke, some 220km from the scene, rather than to the Police at Nyngan who were only 22km from the accident. However, the Police at Bourke quickly relayed the information they had received to their colleagues in Nyngan.

2.22 The relative remoteness of the area where the accident occurred meant that personnel, equipment and materials had to be sourced, and then transported over considerable distances. This build-up took some time and, in combination with the prevailing high temperatures, exposed the limitations of equipment and supplies carried within the vehicles of the first responders. The presence of spectators, who departed the nearby highway and at times

\(^{13}\) OTSI acknowledges that in some instances it might be necessary to move a locomotive e.g., such as on a bridge if it is not possible for the crew to walk around the locomotive; where the crew might be threatened by dangerous cargo to the rear of the locomotive; or in the event that the locomotive or crew is threatened by fire.
inadvertently placed themselves in harm’s way to witness the response and recovery efforts, also added to the challenges faced by the responders. Nonetheless, these challenges were overcome and, importantly, the lessons learned in the process were identified and recorded at a subsequent debriefing session.

Other Safety Matters

2.23 Event Recorders. OTSI’s consideration of the circumstances of this accident was complicated to an extent by a 15 hour differential on the data obtained from the two locomotives. This differential was the consequence of the event recorder clock on the trailing locomotive not being wound during the preparation of the locomotive. OTSI has made similar observations in previous investigation reports\(^{14}\) which led to ITSRR conducting compliance inspections of event recorders during their audits of operators. However, because the only formally-stipulated requirement in respect of data loggers in NSW is specified in the access agreements that rolling stock operators enter into with the operators of the rail network i.e., there is no regulatory requirement for data loggers to be fitted, there is a limit to which ITSRR can pursue this matter with rolling stock operators. OTSI also notes that while the access agreements specify that locomotives must be fitted with a data logger, they make no mention of a requirement that they be operable and properly calibrated and adjusted. However, ITSRR has recently developed preliminary industry guidelines for train data loggers which it has forwarded to the National Transport Commission in favour of establishing a nationally consistent requirement in this area. OTSI understands that the Commission and the rail industry also favour a national approach in this regard.

2.24 Personal Protection Equipment (PPE). A number of Southern & Silverton’s personnel at the incident site were seen wearing PPE that was faded and/or discoloured. This practise should be actively discouraged because the requirement for people and heavy equipment to operate within relatively confined areas during response and recovery operations presents its own risks and those who wear discoloured or faded PPE are placed at additional

\(^{14}\) See OTSI’s reports into derailments at Bethungra on 22 December 2004 and Old Burren on 6 April 2005 at www.otsi.nsw.gov.au
risk, and especially so at night, because there is a reduced prospect that they will be seen.

**Summary**

2.25 4835 derailed because the track over which it was being operated had not been maintained to the required standards. Deficiencies in the condition of the track were readily apparent to OTSI and should have been obvious to ARTC’s staff. This suggests that those who were inspecting the track and monitoring the results of such inspections were either lacking in competence or were discharging their responsibilities in a cursory manner.
PART 3  FINDINGS

3.1 In relation to those matters prescribed by the Terms of Reference as the principal lines of inquiry, OTSI finds as follows:

a. Causation
   i. 4835 derailed because the track over which it was travelling was in a poorly maintained condition.
   ii. The derailment at 604.120km occurred when a poorly-supported rail joint snapped under the pressure of the weight of 4835’s approach. When this joint snapped, the exposed rail end was struck by the wheels of 4835’s leading locomotive. Approximately 6m of rail subsequently shattered and as a consequence, the trailing locomotive and 14 wagons derailed.
   iii. The rail-end became exposed when the fishplates that had been used to join two lengths of rail broke. Metallurgical testing established that this breakage was associated with fatigue fractures that had developed in the fishplates over time because of inadequate support underneath the rail joint.

b. Contributory Factors
   The limitations in the condition of the track were readily apparent but were not detected in successive track inspections. This meant that ARTC lacked visibility of issues that should have informed its maintenance and track management priorities.

c. Effectiveness of Risk Management Strategies
   ARTC has established standards, processes and an “Exceedent Control System” to identify and manage the risks associated with track defects and/or failures. However, these standards and processes were not properly applied within the Nevertire-Nyngan rail section and as a consequence, ARTC lacked visibility of, and did not act to address, defects that should have been readily apparent.
d. Effectiveness of the Emergency Response

The emergency was effectively managed but the relative remoteness of the area in which the derailment occurred presented some significant challenges during the subsequent recovery operation. However, these challenges were overcome. Importantly, the agencies involved later made a conscious effort to ensure that the lessons learned during the recovery operations were identified and recorded.

e. Other Matters that would Enhance the Safety of Rail Operations

i. Personal Protection Equipment (PPE). Some of the PPE worn by Southern & Silverton’s staff at the scene of the accident was faded and/or discoloured.

ii. Event Recorders. Rail vehicle operators in NSW are still paying insufficient regard to the requirement to ensure event recorders on board their locomotives are properly adjusted and are regularly inspected, serviced and calibrated.
PART 4 RECOMMENDATIONS

4.1 It is recommended that the following remedial safety actions be undertaken by the specified responsible entity.

a. Australian Rail Track Corporation
   i. Ensure that all staff involved in the inspection, repair and management of track are properly qualified for their role and have a proper understanding of relevant engineering standards, inspection and repair procedures and documentation.
   ii. Ensure that the outcome of track inspections, track maintenance activities and other track management measures are recorded in more specific terms and in a way that more adequately supports its understanding of track condition.
   iii. Conduct regular audits of its track management system in order to assure itself of the integrity of that system.
   iv. Amend ARTC Network Rule ANTR 400 and Operator “Standard Operating Procedures” to specify that rolling stock should only be moved at the scene of a running line derailment when there is a compelling safety requirement to do so and/or the movement has been approved by OTSI or ITSRR or, if the occurrence has occurred on the Defined Interstate Rail Network, the ATSB and has subsequently been authorised by Train Control.

b. Southern & Silverton Railway
   i. Ensure that event recorders fitted to its locomotives are properly adjusted and are regularly inspected, maintained and calibrated.
   ii. Replace faded and/or discoloured PPE throughout its organisation.

c. Independent Transport Safety & Reliability Regulator
   Ensure that the elements of ARTC’s Safety Management System upon which the Corporation relies to monitor and maintain track condition are robust and that the requirements specified therein are being met.
PART 5  APPENDICES

5.1  Appendix 1: Sources and Submissions.

Sources of Information

- ARTC
- Bureau of Meteorology
- Crew members of 4835
- Officers of the NSW Police, Darling River Local Area Command
- Members of the Dubbo Track Maintenance Team
- R&T Reliability Technologies Pty Ltd

References

- Rail Safety Act 2002 (NSW)
- Passenger Transport Act 1990 (NSW)
- ARTC Network Rules and Procedures
- ARTC Infrastructure Engineering Standards

Submissions

The Chief investigator forwarded a copy of the Draft Report to the DIPs to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Australian Rail Track Corporation
- Independent Transport Safety and Reliability Regulator
- Pacific National Limited
- Southern & Silverton Railway

Submissions were received from the following Directly Involved Parties:

- Australian Rail Track Corporation
- Independent Transport Safety and Reliability Regulator
- Asciano (on behalf of Pacific National Limited)
The Chief Investigator considered all representations made by DIPs and responded to the author of each of the submissions advising which of their recommended amendments would be incorporated in the Final Report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.