OTSI Office of Transport Safety Investigations

RAIL SAFETY INVESTIGATION REPORT

DERAILMENT OF PACIFIC NATIONAL TRAIN 7SP5

CONOBLE TO IVANHOE SECTION

16 OCTOBER 2005

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GLOSSARY

Alignment	The horizontal position of a track measured in relation to survey marks. The measurement of alignment is from survey marks to the line rail.
AK Car	A track-recording vehicle, which incorporates an inertial system fitted to a modified passenger vehicle, to measure track geometry continuously along the track. The AK car measures the tracks vertical (top) and horizontal alignment, gauge, cross level and twist.
Anchors	Devices (other than resilient fastenings) interfacing between a rail and the supporting ties or bearers designed to prevent longitudinal movement of the rail relative to the ties.
'B' end	The end of a wagon nearest to the handbrake.
Ballast	Crushed rock packed under and around sleepers to hold track in position, spread weight, and provide drainage.
Block	A portion of the line with defined limits between which only one train is allowed at any one time.
Bogie	A structure incorporating suspension elements and fitted with wheels and axles, used to support rail vehicles at or near the ends and capable of rotation in the horizontal plane. It may have one, two or more axle sets, and may be the common support of adjacent units of an articulated vehicle.
Bolster	The main transverse structural member, through which load is transferred to a wagon's suspension and side frames.
Constant Contact Side Bearers (CCSB)	CCSBs provide rotational resistance between the bogie and the vehicle body to stabilise the bogie and thus prevent a three-piece bogie from hunting. A CCSB uses rollers, which provide almost no rotational resistance and only act as a constraint to the rolling motion of the wagon body, typically above 80km/h.
Dogspike	A round spike that is driven into a pre-drilled hole in a sleeper to fasten the rail to the sleeper to restrain vertical and lateral movement.

Down and Up Rail Lines	Trains that run away from Sydney are Down trains. The lines that carry them are Down lines. Trains that run towards Sydney are Up trains. The lines that carry them are Up lines. The 'Down' rail in NSW is the right hand rail facing in the direction that a train would travel to reach Sydney; conversely the 'Up' rail is the left hand rail.
Flange (Wheel)	The larger diameter, inner part of the train's wheel. It is used as the primary means of guidance, steering the train along the track through the interaction between the gauge face of the rail and the wheel flanges.
Formation	The base under the track consisting of soil packed firmly or compacted in layers.
Gauge	The distance between the inside running (or gauge) faces of the two rails, measured between points 16 mm below the top of the rail heads. Standard gauge is track gauge measuring 1435mm, broad gauge measures 1600mm and narrow gauge measures 1067mm.
Hunting	The excessive side to side movement of a bogie during travel, attributed to worn or defective components.
Kilometrage	The distance by rail as measured from Central Station in Sydney.
Network Controller	A qualified worker who monitors and controls train movements from a Control Centre.
Surface	The relationshipof opposite rails to each other in cross level and profile.
Top and Line	Describes two rail parameters; *top* refers to the surface (straightness, or continuity) of the top of the rail; *line* refers to the correct alignment of the side (or gauge face) of the rails. They are related to the 'base operating conditions' or standards that identify the vertical and horizontal alignment limits that would affect rolling stock ride and, if excessive, could cause derailment.
Tread	Rail tread is the area of the wheel's circumference which is in contact with the rail head during normal running conditions.

EXECUTIVE SUMMARY

At approximately 7:54am on 16 October 2005, a Pacific National (PN) freight train, designated 7SP5, derailed one unladen flat wagon in the vicinity of the township of Conoble in the Western Region of NSW. After travelling a further 34.803km the wagon re-railed itself in the vicinity of the township of Ivanhoe. The train driver was not aware of what had happened, but stopped the train some 133km later because he did not feel that it was as responsive as it should be. He found that a brake pipe isolating cock, located between the 30th and 31st wagon, was in the 'up' (closed) position and that there was extensive damage to the rear wheel-set of the 30th wagon in the consist.

In addition to the damage to the wheel-set, the track suffered extensive damage with 11,672 sleepers needing to be replaced and rail needing to be repaired or replaced in 150 locations over the 34.8km affected by the derailment. The Australian Rail Track Corporation (ARTC) effected the necessary repairs and reopened the line four days later.

The derailment of the rear wheel set of the rear bogies of wagon RQKY 02034E was due to excessive lateral movement of the bogie, known as 'hunting'. The constant contact side bearer components of the bogie should have countered the tendency to 'hunt' but they had been fitted with incorrect resilient blocks when the wagon underwent a major service less than four months prior to the derailment.

The fitting of the incorrect type of resilient blocks, RB 35 instead of RB 27, was attributable to human error. Three factors contributed to the error: the maintenance crew were fitting RB 35 type blocks to other types of wagons during the previous week; both types of blocks are the same colour and shape; and block storage arrangements at the maintenance facility were inadequate for effective stock management.

The train was not marshalled in accordance with PN's Train Inspection Manual which requires that "*Lightly loaded wagons shall, where possible, be marshalled to the rear*

of the train". Given the ambiguity in the statement of requirement, wagon RQKY 02034E could be considered as being "*to the rear*" in that it was the 30th of 38 wagons. However, the empty 8th, 9th, 10th and 13th wagons cannot be considered as having been "to the rear".

The investigation found no evidence of train handling or track condition having contributed to the derailment. However, PN had been critical of the standard of the track and its effect on ride quality between Parkes and Broken Hill for some years, though the results of testing conducted before and after the derailment have proven inconclusive and remain contested between PN and ARTC. The problem can be attributed to a system that focuses on measuring a variety of parameters related to track geometry rather than the impact the combined effect of those parameters might have on ride quality.

In response to the incident PN has addressed key issues associated with train marshalling, maintenance performance, storage arrangements in its maintenance facilities, and pre-departure train examination procedures. It is recommended that PN:

- continue to emphasise its requirement that empty wagons are placed at the rear of trains;
- examine the feasibility of differentiating the colours of resilient blocks and/or modifying resilient block 'housing' so that only the correct type of block can be fitted; and
- continue to emphasise the need for regular and thorough rolling stock inspections.

It is also recommended that ARTC:

- review maximum operating speeds between Parkes and Broken Hill;
- investigate the practicality of integrating accelerometers into its track testing regime; and
- review the effectiveness of its AK car and the conditions under which it is operated during track testing.

PART 1 FACTUAL INFORMATION

Incident Synopsis

1.1 At approximately 7:54am on 16 October 2005, a Pacific National (PN) freight train derailed one unladen flat wagon whilst travelling between Conoble and Ivanhoe in the Western Region of NSW (see *Figure 1*). The train, designated 7SP5, continued for a further 34.803km before the wagon re-railed itself. The driver of the train was not aware of the wagon derailing and then re-railing, but stopped the train some 133km later because he did not feel that it was as responsive as it should be. He found that a brake pipe isolating cock, located between the 30th and 31st wagon, was in the 'up' (closed) position and that there was extensive damage to the rear wheel-set of the 30th wagon.

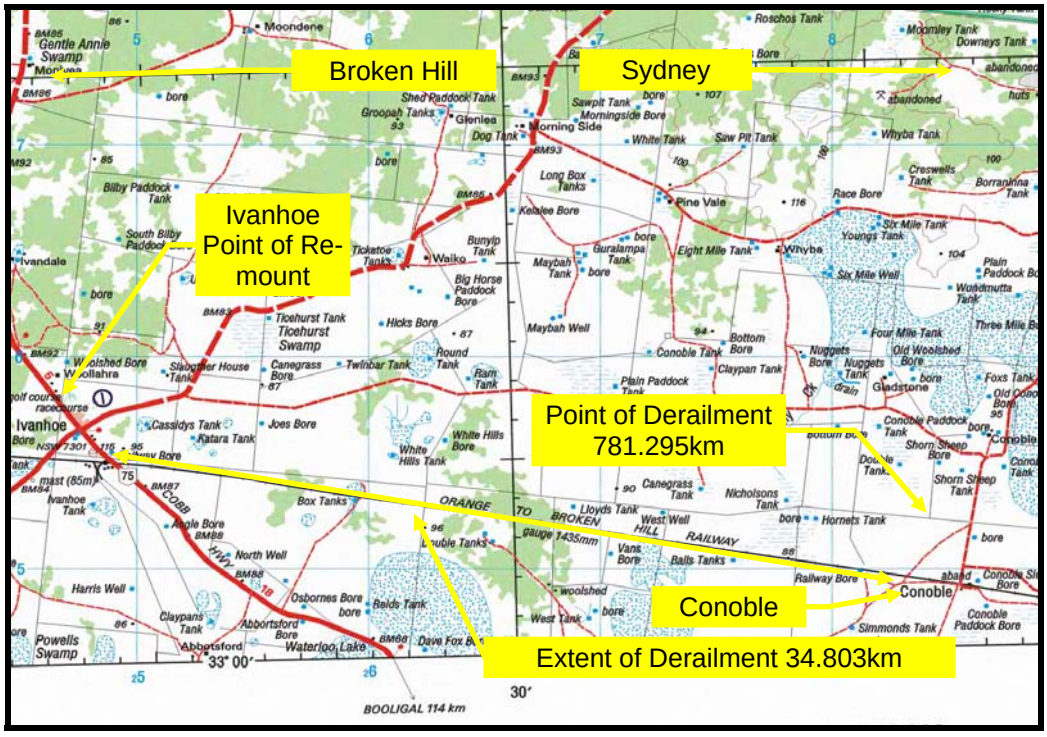


Figure 1: General Location Map

1.2 Subsequent investigation established that the 30th wagon (RQKY 02034E) had derailed at 781.295km, approximately 20m before the Holey Bore level crossing in the vicinity of the township of Conoble. The unladen flat wagon

had re-railed at 816.098km as it passed over the Cobb Highway level crossing in the vicinity of the township of Ivanhoe (see also *Figure 1*).

Incident Narrative

Before the Incident

1.3 On 14 October, train 6BA6 departed Brisbane Freight Terminal (BFT) for Sydney where a large proportion of its wagons would become part of train 7SP5. One of these wagons was RQKY 02034E which travelled empty within the consist. It had been loaded initially but had to be unloaded when it was discovered the load exceeded height limits.[1] The error was not detected before loading as PN's Train Management System[2] was inoperative at the time and timetabling constraints prevented alternative cargo being identified and loaded.

1.4 Train 7SP5 was formed within Sydney Freight Terminal (SFT) at Chullora on 15 October 2005. Wagon RQKY 02034E remained unladen and was positioned as the 30th wagon in the consist. The train departed SFT at 2:50pm on 15 October 2005 destined for Perth, via Cootamundra West, Goobang Junction and Broken Hill.

1.5 On arrival at Goobang Junction, one of the locomotives was detached and, after re-marshalling, the train departed at 4:27am on 16 October 2005. As it departed, the train was subjected to a roll-by inspection by its crew but no problems were identified.[3] At approximately 7:51am, the train entered the section of track between Conoble and Ivanhoe.

The Incident

1.6 At 781.295km and unbeknown to the crew, wagon RQKY 02034E derailed and continued in this state for a further 34.803km before it re-railed as it passed over the Cobb Highway level crossing at Ivanhoe. Some time later,

[1] The load was of a type that needed to be placed onto a specialised type of wagon and RQKY 02034E was not of this type.

[2] The TMS is a computer based train consist recording system that records details of crews, loads, wagons, dangerous goods, tare tonnes, gross tonnes and other matters pertaining to a train consist. It identifies rolling stock that is overdue for maintenance or which has recorded defects which have not been rectified. It also identifies potential loading issues e.g., loads which exceed height, width and weight limits, containers that are incompatible with the type of wagon onto which they have been/are to be loaded, etc.

[3] Roll by inspections are conducted as trains depart a yard to ensure the integrity of their load and to detect any apparent wagon defects.

in the vicinity of the 949.650km point, the Driver stopped the train because it felt less responsive (heavier) than it should be. He suspected that the train's brakes might be sticking.[4]

1.7 An inspection of the train by the Driver revealed that the brake pipe isolating cock between the 30th wagon (RQKY 02034E) and the 31st wagon (RQSY 34342U) was in the 'up' (closed) position. This disrupted the supply of air necessary to hold the brakes 'off' which resulted in the progressive application of the brakes on the wagons behind the 30th wagon. The Driver also observed that the rear wheels on the 30th wagon were severely damaged (see *Photo 1*) and noticed ballast and debris on the following wagon. These two conditions were consistent with the 30th wagon having derailed at some point.

Photo 1: Damage to wheel on RQKY 02034E

1.8 The Driver secured the train then attempted to notify PN's Divisional Control Centre (DCC) in Adelaide of the incident via satellite telephone. Being unable to establish contact due to a lack of satellite coverage, the Driver instead contacted the Australian Rail Track Corporation's (ARTC) Train Order Control at Orange (TOCO) by radio at approximately 9:51am. In fact,

[4] Sticking brakes occur when brakes are inadvertently applied due to a lack of air pressure, the incorrect release of the brake or some other form of mechanical failure.

this should have been his first response so as to allow TOCO to put blocks on the movement of other trains into the section at the earliest possible time.

Incident Response

1.9 In response to the call from the Driver, the Network Controller at TOCO blocked the movement of other trains into the section occupied by 7SP5. He also arranged for the deployment of representatives from ARTC to inspect the track between Trida, 200km West of the train, and the rear of the train. The Network Controller was able to contact the DCC and notify them of the circumstances. In response, PN dispatched a maintenance crew from Broken Hill to inspect the damaged wagon.

1.10 The representatives from PN and ARTC arrived on site at approximately 1:00pm and 3.30pm respectively. The damaged wagon was subsequently certified as being fit to travel, at reduced speed, the 57km to Menindee where it was removed from the train. It was monitored all the way by PN's maintenance crew who travelled alongside it in a motor vehicle. The train was able to recommence its journey at 6:25pm.

Train Information

1.11 7SP5 consisted of two NR Class locomotives and 38 container-carrying wagons. It measured 1,536m in length and weighed 3,018t (including the locomotives), 1,093t of which was trailing the 30th wagon. There were four other unladen wagons which were positioned 8th, 9th, 10th and 13th in the wagon consist. A copy of the the train's consist ex-Goobang Junction is at *Appendix 1*.

1.12 Though the maximum track speed permitted in the Conoble to Ivanhoe section was 115km/h, the train was limited to a maximum operating speed of 110km/h due to the type of wagons it was hauling.

Crew Information

1.13 The Driver had been driving trains since 1991 and had reached the driving grade of Level 14, a senior driving grade within PN, in September 2005. The Driver had also been check-listed (recertified) in 2004. The Assistant Driver had also been check-listed in 2004 and had progressed to Level 7 which

allowed him to shunt and marshal rolling stock and to drive under the supervision of a fully qualified driver.

1.14 The crew were appropriately qualified for and familiar with the route. A check of their rosters for the previous 14 days showed they had been rostered within the limits applicable in the rail industry in NSW.

Track Information

1.15 The track between Parkes and Broken Hill is standard gauge, bi-directional, single line, with a maximum gradient of 1:200. The line is classified as Class 1 main line and consists of 53kg/m rail on a mixed steel and timber sleeper track base. The ratio of steel sleepers to timber in the area leading up to the Point of Mount (POM) (approximately 780km to 781.286km), where the derailment occurred, varied from as high as 1:2 to as low as 1:10. The track was secured to the steel sleepers by Rex Lok ® fastenings and to the timber sleepers by a mixture of Pandrol ® clips and dog spikes. The track was also anchored by "Fair" type anchors in a ratio varying from 1:2 to 1:5 on timber sleepers. [5]

Damage & Disruption

1.16 There was significant damage to the 'B' end (RJYD 422) bogie wheel set on the 30th wagon. The damage to the track was extensive with 11,256 steel and 416 timber sleepers having to be replaced and continuously-welded rail having to be repaired or replaced in 150 locations over the 34.803km affected by the derailment.

1.17 The corridor between Broken Hill and Parkes was closed for four days, resulting in the cancellation of several freight and passenger services. It was reopened at 10:09pm on 20 October 2005, albeit with speed restrictions in place in a number of areas.

[5] Fair type anchors are employed to control rail creep and to ensure track stability.

PART 2 ANALYSIS

Derailment

2.1 An inspection of the track revealed markings on the 'Down' rail consistent with a wheel mounting the rail at 781.286km (point of mount (POM)) and dropping off the rail at 781.295km (point of derailment (POD)) (see *Photo 2*). The damage to the wagon showed that it was only the rear wheel set of the rear bogie, RJYD 422, that derailed. The train travelled a further 34.803km before the wheel set re-railed as revealed by marks on the pavement at the Cobb Highway level crossing near Ivanhoe.

2.2 In a derailment it is expected there will be evidence, in the form of marks or gouging, of the derailing wheel/s climbing the rail at and prior to the POM. No such signs or marks were found during an inspection of the site by both ARTC and PN representatives.

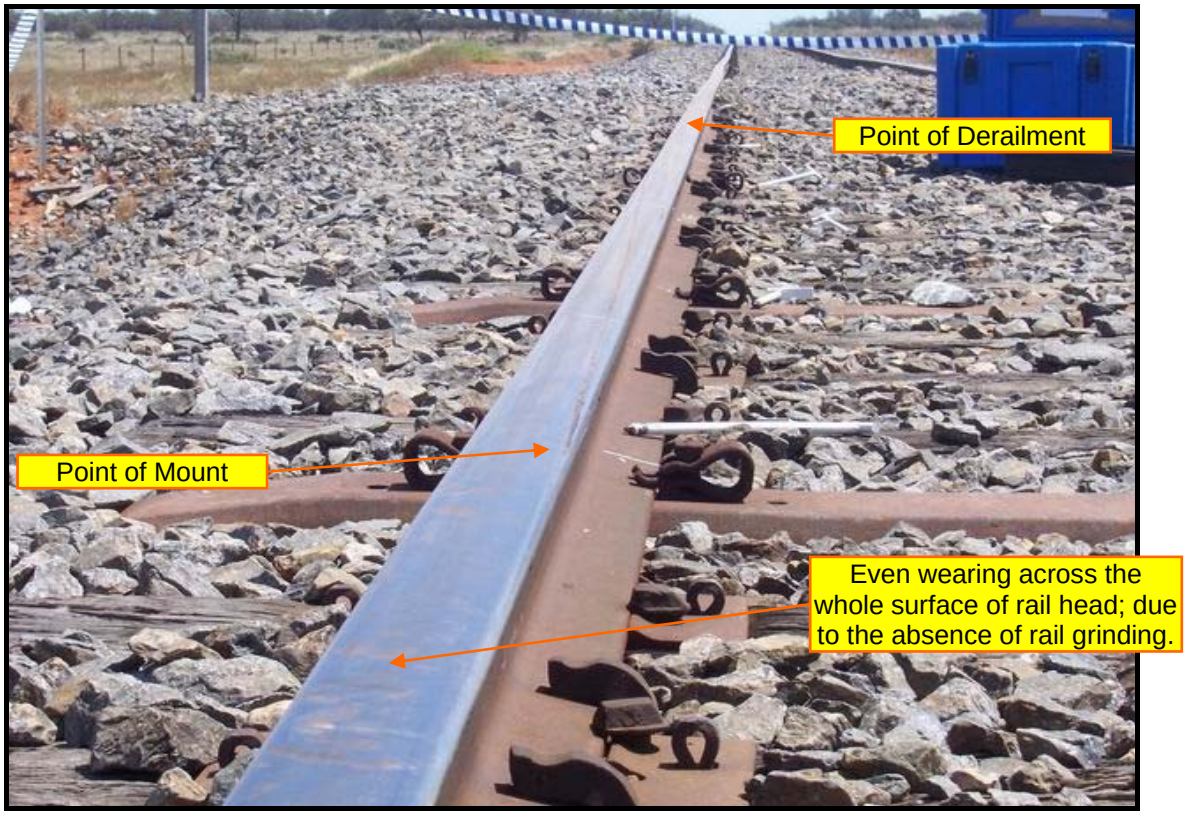


Photo 2: Points of Mount and Derailment

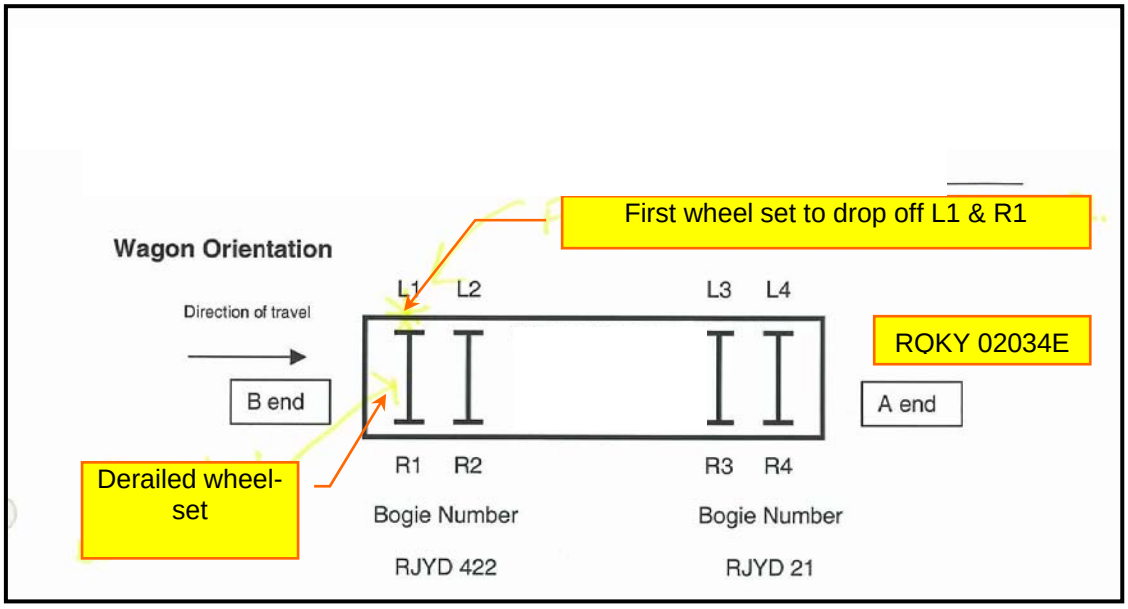


Figure 2: Diagrammatic representation of the wheel sets on the two bogies beneath wagon RQKY 02034E

Photo 3: Level Crossing at which wagon re-railed

Wagon Condition & Maintenance

2.3 Wagon RQKY 02034E is typical of the type of flat top wagons utilised for the transportation of containers (see Specifications at *Appendix 6* and bogie details at *Photo 4* and *Figure 3*).

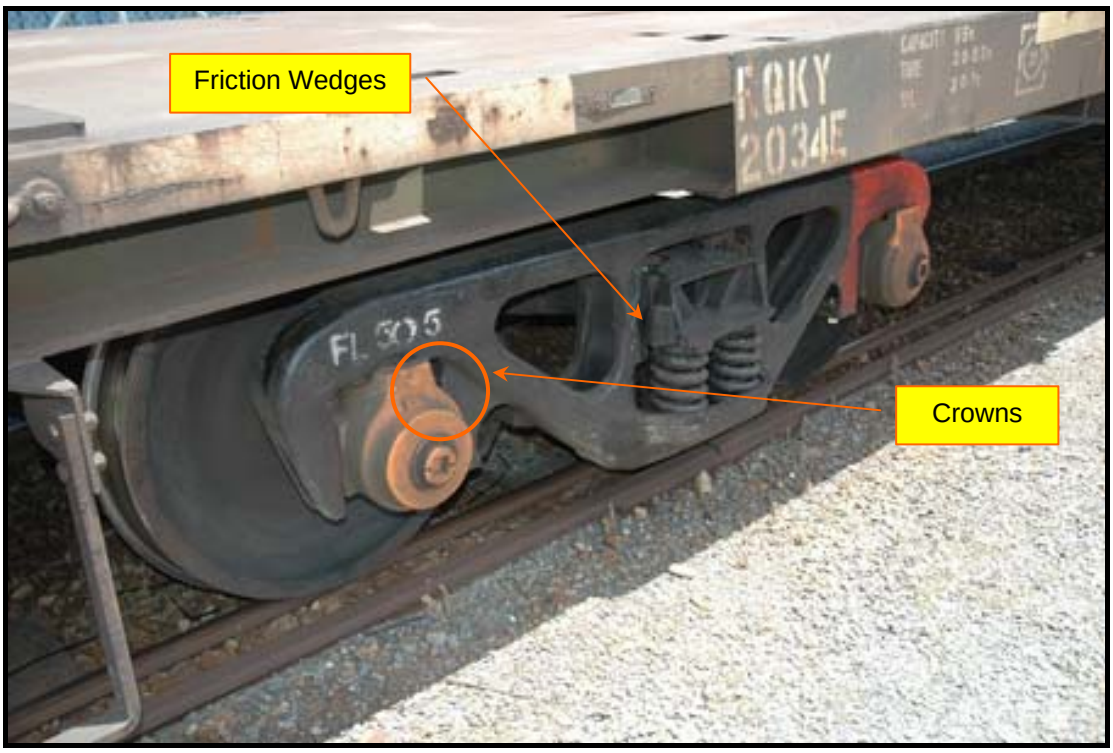


Photo 4: Wagon RQKY 02034E after repairs in December 2005

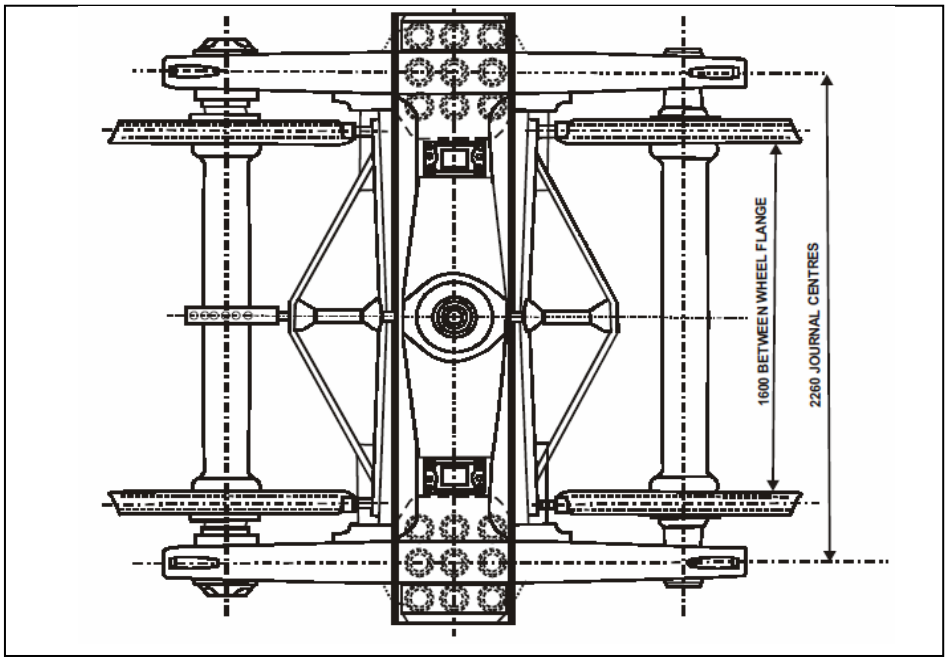


Figure 3: Bogie schematic showing location of constant contact side bearers

2.4 The flanges of the wheels of the rear wheel set of the rear bogie of the wagon were worn but within the required tolerances. The flange wear was consistent with the application of considerable lateral forces acting on the wagon over time.

2.5 On request, PN completed a report on the condition of the bogie (see *Appendix 7*) which included the following points of note:

- almost all bolster gibs showed signs of contact and wear (see *Figure 4* and *Photo 5*);
- the sides of all (friction) wedges were highly polished;
- twist lock surfaces were marked and worn (see *Photo 6*)*;*
- tie-down loops on the sides of the wagon were highly polished and worn from continual contact with the side walls of containers;
- excessive wear in the side bearer pockets;
- slight hollowing of the wheel-sets although the wheels remained within the specified parameters;
- nine of the bogie springs were not to full specification as per PN's maintenance manuals;
- an incorrect brake beam was fitted to the vehicle, leading to the incorrect brake shoes being fitted;
- the derailed wheel-sets were quite worn in comparison to those that remained on the rails; and
- the opposite bogie, which had not derailed, also showed signs of worn crowns[6].

[6] The 'crown' refers to the area in which the bogie frame and axle come into contact.

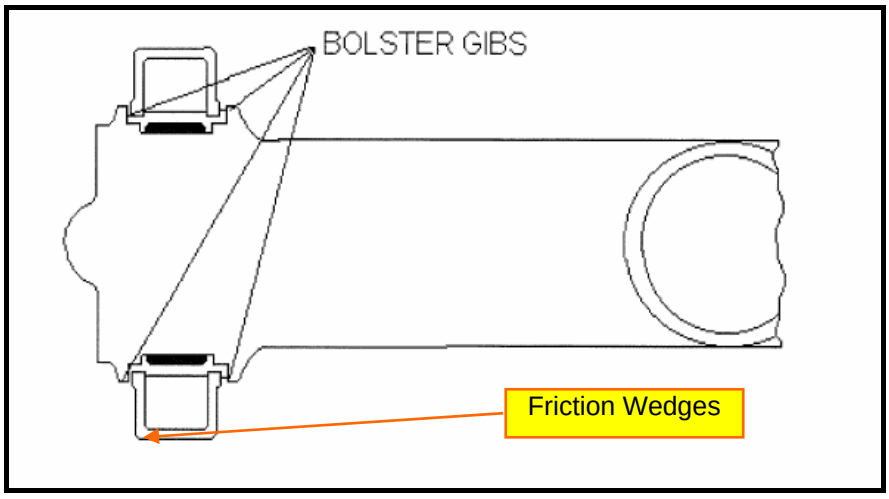


Figure 4: Top view of bolster gibs

Photo 5: Indication of wear to the bolster gib and bogie side frame

2.6 Some of the wear marks on the gibs might have been caused by the forces imparted while the wagon was derailed. However, other indications, such as the wear marks from twist locks on top of the wagon deck (see *Photo 6*) and the extensive wear to the gibs, are consistent with longer term wear.

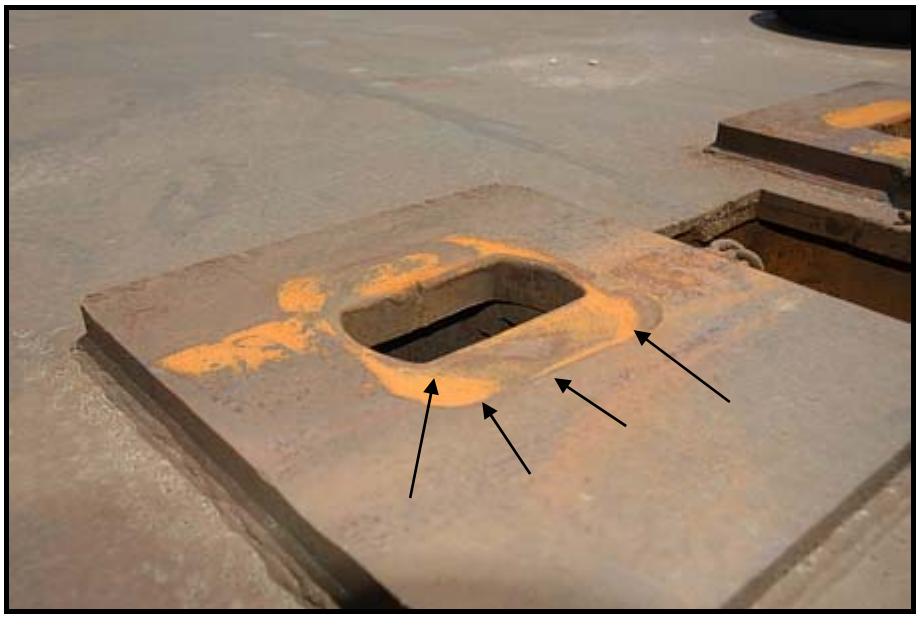


Photo 6: Twist lock wear-marks showing the effects of 'hunting'

2.7 The Stucki resilient blocks were badly worn. These blocks are intended to ensure that pre-load tensions are appropriate and that lateral forces acting on wagons during running are dampened. The blocks, in conjunction with other components and, in particular, a manganese cap often referred to as a 'wear' or 'friction block', form the constant contact side bearer (CCSB) assembly. In addition to providing dampening, the assembly is also intended to stiffen the bogie against lateral forces.

2.8 Further investigation established that the blocks were of the wrong type and that RQKY 02034E had travelled approximately 65,000km fitted with RB 35 instead of RB 27 Stucki resilient blocks (see *Figures 5 and 6*). This explains the extent of the wear apparent on the resilient blocks. It also means that effectively there was very little, if any, dampening of lateral forces acting on the wagon by the CCSBs and that the body of the wagon would have moved laterally in a vigorous manner, causing further instability.[7] Using RB 35 blocks almost halved the required preload for the wagon.[8]

2.9 Maintenance documentation supplied by PN indicated that both the 'A' and 'B' end bogies (RJYD 21 and RJYD 422 respectively) had been serviced at a PN maintenance facility in Perth in June 2005 and that all of the wheels were

[7] Some bogies are not fitted with CCSBs, but these wagons are not permitted to travel above 80km/h.

[8] Preload is an upward force upon the wagon to prevent it from moving excessively in a lateral manner.

replaced as part of the service. The levels of wear shown by wagon components were excessive given the extent of the service and only four months of running before the derailment. However, it was during this service that the incorrect Stucki resilient blocks were fitted even though PN's wagon maintenance manual, WMM 08-01_2, clearly specifies that RQKY wagons are to be fitted with RB 27 resilient blocks.

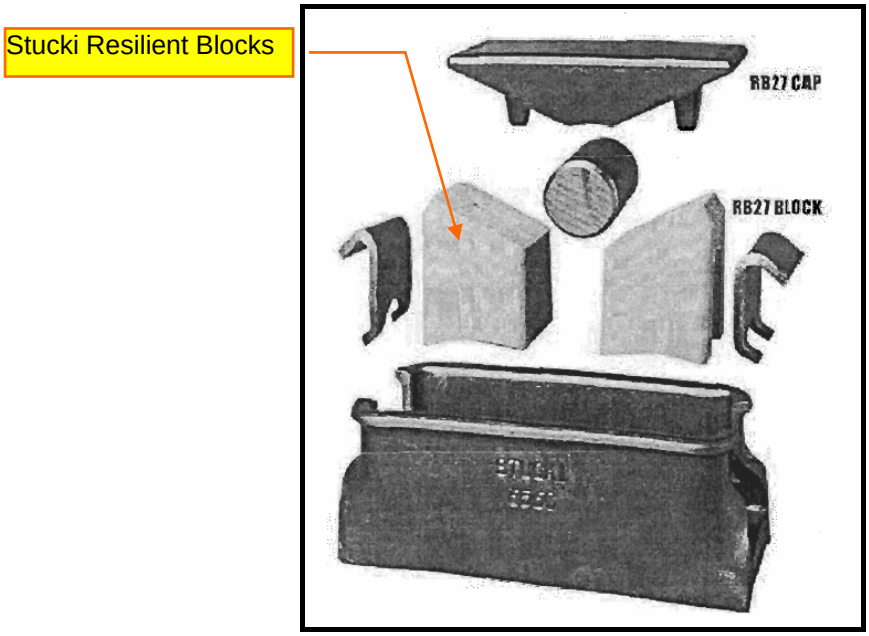


Figure 5: Placement of Stucki resilient blocks

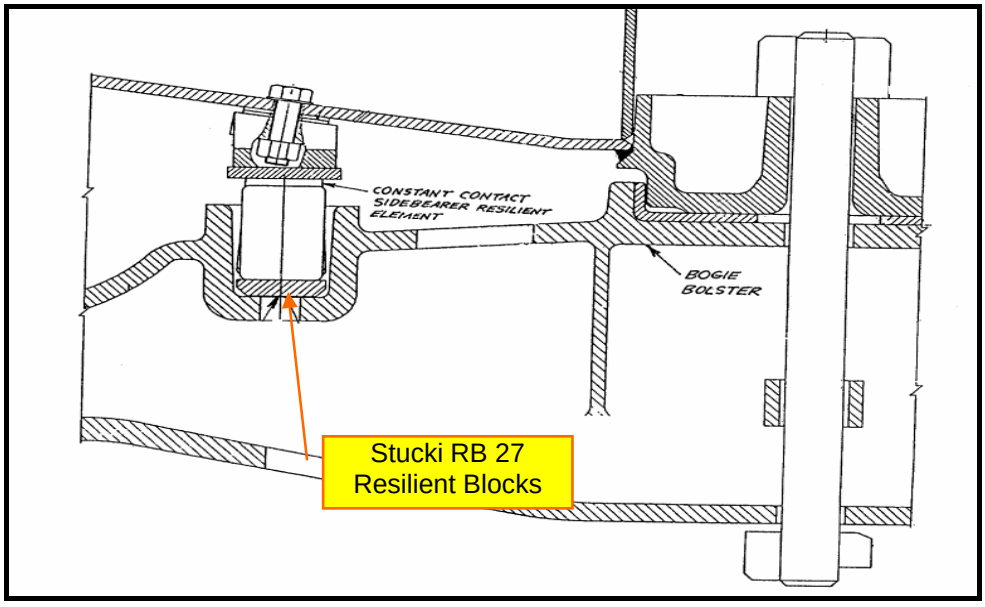


Figure 6: Diagram of Constant Contact Side Bearer utilised in RQKY type wagons

2.10 An examination of the circumstances under which the maintenance work was undertaken revealed that the replacement of the resilient block on this bogie and others at the same location had been undertaken by a team of three employees, one of whom was relatively inexperienced. In the previous week, this team had been installing RB 35 resilient blocks exclusively, albeit to another type of wagon. There was considerable scope for error in mistaking RB 27 and RB 35 resilient blocks for one another in that they were the same colour and shape. Further increasing the potential for error was the rudimentary manner in which these parts were stored (see *Photo 7*). In addition to improving storage arrangements and quality assurance measures in the maintenance facility, it may be possible to make blocks more readily distinguishable from one another by colouring them differently or by altering the 'housing' within which they fit in a way such that only the correct block will fit.

Photo 7: Storage of resilient blocks at PN's Perth Maintenance Facility

Train Handling

2.11 The train was travelling at approximately 104km/h on a slight downhill grade when the 30th wagon derailed. At that time the leading locomotive was being operated in the 8th throttle notch position (full power), and had been for the previous 18 minutes (see Data Logger Chart at *Appendix 2*). From the point

at which the derailment occurred (781.295km) to the point at which the 30th wagon re-railed (816.098km), the train's speed ranged between 55km/h and 105km/h which was in accordance with both track and train speed restrictions.

2.12 The recordings also showed that the train had been handled appropriately with the exception of one instance where the headlight had been switched off. This is contrary to PN policy but not relevant to this investigation.

Train Marshalling

2.13 Train 7SP5 was not marshalled in accordance with the "good practice" specified in PN's Train Inspection Manual TIM 05_02_04 *Loading and Marshalling Requirements of Intermodal Wagons* which requires that "*Lightly loaded wagons shall, where possible, be marshalled to the rear of the train*". Given the ambiguity in the statement of requirement, Wagon RQKY 02034E could be considered as being "*to the rear*" in that it was the 30th of 38 wagons. However, the empty 8th, 9th, 10th and 13th wagons, three of which were '3 packs', cannot be considered as having been "to the rear". [9] Further, as the train was marshalled at SFT, it would seem reasonable to expect it to have been "*possible*" to meet the requirements of the TIM.

2.14 Further clouding the issue of 'good practice' marshalling is the provision in Table 1 of the TIM which provides for significant loads to trail empty wagons is specified circumstances. This provision only applied to 7SP5 between Sydney and Parkes and permitted the empty wagons to be located where they were in the consist.

2.15 While it is appreciated there can be physical and operational limitations on the extent of re-marshalling, such as was the case at BFT and Goobang Junction, the requirements of the TIM are ambiguous in providing guidance on where empty wagons should be positioned in a consist. It is also of concern that PN's requirements were framed when trains were shorter and loads were lighter. However, the matter of 'good practice' in train marshalling is an issue for the rail industry and not just PN.

[9] The term '3 Pack' is commonly used in the rail industry throughout Australia to describe a configuration which sees three wagons permanently coupled by a solid steel shank. Therefore each three pack is effectively equal to three wagons.

Track Condition

2.16 On 18 October 2005, ARTC used an NR Class locomotive, operated at a speed of 80 km/h, to conduct a depression test from 780.786km to 781.286km, the POM.[10] The purpose of the test was to establish the extent to which the track distorted under load. Measurements were taken at 2m intervals and the details recorded by ARTC and PN representatives. The results are shown at *Appendix 4*. There were no indications of any significant problems with the track: the gauge, top, surface and profile were within specified parameters; there was minimal evidence of twist; the formation was firm; and the ballast was in good condition.

2.17 ARTC's records for the area in which the derailment occurred indicated that the most recent AK Car inspections had been completed in May 2004, December 2004 and August 2005. During these inspections, the gauge, alignment and top were checked and the track was further examined to determine whether there was any evidence of twist. The track had also been subject to the relevant inspection schedule and standards for Class 1 lines stipulated in ARTC's Engineering Standards TEP 13 *Track Examination Handbook: System Overview* and TMS 11 *Civil Technical Maintenance Plan*.

2.18 OTSI reviewed the results of these tests, assisted by subject matter experts from the Australian Transport Safety Bureau (ATSB) and the Independent Transport Safety Reliability Regulator (ITSRR). In each instance, the results indicated that the track geometry in the area was within the tolerances specified in ARTC's Engineering Standards TDS13 *Base operating condition standard of track geometry*, TSS01 *Operating Safety Standards for Track* and TDS14 *Base operating condition standard of track geometry - Standing Orders*. The traces generated by the AK Car in August 2005 included the area of the POM and indicated that the track in the area of the derailment conformed to these standards (see *Appendix 5*).

2.19 An inspection of the track over approximately 1km leading up to the POM revealed a higher proportion of steel to timber sleepers than the one in four specified in ARTC Engineering Standard TCS 10 *Steel Sleepers – Usage*

[10] This type of locomotive has a much higher axle loading than an empty RQKY type wagon and as such would have been a quite demanding test.

and Installation Standards. In the area 20m prior to the POM there were seven consecutive steel sleepers. The high proportion of steel sleepers, in conjunction with the good condition of the formation and ballast, meant that the track in the immediate area would have been 'tighter' (i.e., would hold gauge more rigidly and so constrain lateral vehicle movement) than most other areas within the section.

2.20 The track prior to the POM had not been 'ground'. Grinding is the process in which a purpose-built track machine re-profiles the rail head to ensure an optimum interface between wheels and the rail, thereby minimising wear on both the track and rolling stock. There were signs of wear across the top of the rail head, evidence of lateral movement by wagons over time. Notwithstanding, 7YN2, also operated by PN, had passed over the area earlier in the day without incident and without its crew reporting any rough riding. However, 7YN2 had only operated at a maximum speed of 80 km/h and so would not have been subjected to the same levels of lateral and vertical accelerations as trains operating at higher speeds. [11]

2.21 OTSI could find no evidence to suggest that the condition of the track contributed to the derailment in the location where it occurred. However, throughout the course of the investigation, PN expressed concern in relation to the condition of the track between Parkes and Broken Hill.

Alternative Opinion of Track Condition

2.22 The Parkes to Broken Hill section of track has been the subject of criticism by PN over a number of years. PN conducted its own investigation into load shifts over the period 1 September 2003 to 31 August 2005 and concluded that this section of rail was the worst between Perth and Sydney, being responsible for more lost or damaged loads than any other section of rail on which it operated throughout Australia. From an examination of this very detailed investigation report, OTSI concluded that, even though PN had provided sufficient data to indicate that this section was overrepresented in the number of load shift incidents occurring on the East-West route, the

[11] The inertial force exerted on containers as the wagon changes direction. Inertia causes a moving object to try to keep the same speed and direction of travel. Any change in direction creates some amount of acceleration.

condition of the route could not be definitively established as the sole or major cause of the load shifts during the period. This conclusion was based on the fact that load shifts can occur for reasons other than just track condition, and that these other reasons had not been sufficiently considered within the report.

2.23 In December 2005 and March 2006, PN conducted a series of tests, using accelerometers, to measure ride quality throughout a number of areas, including the Parkes to Broken Hill secion. The results were inconclusive, but indicated that PN's concerns were not without some foundation.

2.24 In May 2006, ARTC, PN and an independent engineering company participated jointly in the testing of various sections of track between Port Augusta and Parkes partly in response to issues raised after PN's earlier testing. The test involved several AK Cars and two instrumented wagons supplied by PN. Although PN had reservations about the fact that the test train operated below the posted track speeds for most of the testing and that its consist was unlike that of a normal consist, its representative agreed that the results obtained did not indicate that this section of track was defective.

2.25 This testing focused on track geometry, measuring individual parameters, rather than the effect all of the factors together might have had on ride quality. It was therefore very difficult to compare the results obtained by PN in December 2005 and March 2006 with those obtained from the May testing or to reconcile the views of PN and ARTC as to the condition of the track. It is relevant to note that, in an investigation report into the derailment of a freight train at Benalla on 23 September 2004, the ATSB recorded their experience with a similar situation in the conclusion: "*The data collected by the AK car … did not reflect the apparent severity of the dips in the track and led to a significant loss of data integrity, utility and relevance*".

2.26 Subsequently, PN undertook a series of ride quality tests, and PN and ARTC have conducted some joint testing of ride quality within the section. However, the significance of the results of these tests remains contested because of the absence of an agreed track/ride testing methodology.

2.27 In its examination of all the factors presented in relation to the condition of the track between Parkes and Broken Hill, OTSI was able to conclude that there is a fundamental problem with the system that measures a variety of parameters related to the geometry of the track, but that does not take into account the combined impact of those parameters on the rolling stock that travels on it.

Summary

2.28 Derailments can occur because of problems associated with the condition of the track or the rolling stock; poor train management, marshalling, loading, and/or lashing; or a combination of any of these factors. In some derailments, the cause is readily apparent, e.g., the track was broken or misaligned, or some part of a bogie, such as a wheel has failed. In many occurrences however, the cause/s are less apparent and it becomes necessary to examine the interaction between the condition of the track, rolling stock and the way in which a train was configured, loaded and operated.

2.29 This derailment was such an instance. There is nothing to suggest that the train was poorly managed, but in relation to the loading of the train, it is concerning that there were several occasions Pacific National had the opportunity to remarshal the empty 30th wagon but did not.

2.30 Tests performed at the site of the derailment shortly after the event indicated that there were no problems with the geometry of the track and the sleepers and the ballast was also found to be in good condition.

2.31 An inspection of the derailed wagon identified indications that were consistent with ‘hunting’. On closer examination, it was also found that the wagon had been fitted with incorrect resilient blocks. These blocks are intended to dampen forces that impact on the wagon and that can potentially cause it to derail. OTSI concluded that the 30th wagon, which was unloaded and which would have been subjected to additional forces from the loaded wagons that were trailing it, had been hunting and that the forces that had induced the hunting were exacerbated when the wagon passed over an area where there was a high incidence of steel sleepers and where, as a

consequence, the gauge would have been tighter, in relative terms, than the rest of the track.

2.32 OTSI believes that the most important requirement arising out of its investigation is the need for an ongoing assessment and remediation of track condition between Parkes and Broken Hill and of the efficacy of the electronic track testing that is conducted throughout NSW.

Remedial Actions

2.33 ARTC undertook the necessary work to repair the damaged track.

2.34 As a direct result of this incident, PN have:

- provided all terminal managers with additional guidance on its Train Inspection Manual and the requirement to ensure that trains are marshalled in accordance with its *Loading and Marshalling Requirements of Intermodal Wagons*;
- reviewed storage arrangements at its maintenance centre in Perth and in other locations throughout Australia;
- inspected the condition of CCSBs across its fleet;
- issued new procedures to all of its maintenance centres which include advice as to the competencies required of those tasked with replacing CCSBs;
- issued a Local Safety Notice to all terminal staff reinforcing the requirement to inspect CCSBs and look for signs of 'hunting' as specified in their Train Inspection Manual;
- audited maintenance work undertaken by its own maintainers and that undertaken by contractors on its behalf; and
- revised its pre-departure train examination procedures to require that both sides of a train be inspected.

PART 3 FINDINGS

Causation

3.1 The derailment of the rear wheel set of the rear bogies of wagon RQKY 02034E occurred because the wagon was 'hunting'. This was the result of the inability of the rear bogie components to prevent or control excessive lateral movement of the bogie.

Contributory Factors

3.2 The wagon's CCSB's were fitted with incorrect resilient blocks when it underwent a major service less than four months prior to the derailment. The blocks wore very quickly to a state where they were not providing effective dampening of the forces acting on the wagon.

3.3 The fitting of the incorrect type of blocks, RB 35 instead of RB 27, was attributable to human error. Three factors contributed to the error: the maintenance crew were fitting RB 35 type blocks to other types of wagons during the previous week; both types of blocks are the same colour and shape; and block storage arrangements at the facility were inadequate for effective stock management.

Other Issues

3.4 The train was being operated in an appropriate manner by a qualified and experienced crew so train handling could be eliminated as potentially contributing to the derailment.

3.5 PN's train marshalling requirements were ambiguous especially in their guidance to marshall lightly loaded wagons to the rear, where possible. 7SP5 left SFT where its consist was formed with four empty wagons which were very close to the front of the consist. Wagon RQKY 02034E was arguably 'towards the rear' but could have been positioned closer to the rear in Sydney. Whether or not the positioning of the wagon contributed to the derailment cannot be determined but, at least, there is scope for more definitive guidance on train marshalling.

3.6 No evidence was identified to suggest that the condition of the track contributed to the derailment in the location where it occurred. The track structure was found to be sound with the only 'deficiency' being that the rail leading up to the POM needed grinding. The track in the vicinity of the POM was 'tight' because of the higher proportion of steel sleepers than provided for in governing engineering standards.

3.7 PN expressed concern about the condition of the track between Parkes to Broken Hill. In the seven months after the derailment, several tests of the track geometry in this section did not identify any parameters to be outside specifications. The same had been the case during scheduled track inspections in the 17 months leading up to the derailment. The limitation with this testing is that it focuses on measuring individual parameters rather than the impact all of them together might have on ride quality.

Remedial Actions

3.8 PN has addressed the following key issues that have arisen from the investigation into the derailment of wagon RQKY 02034E:

- train marshalling through the provision of additional guidance to staff;
- storage arrangements in its maintenance facilities;
- CCSB inspection and maintenance;
- maintenance performance (through audit); and
- pre-departure train examination procedures.

PART 4 RECOMMENDATIONS

4.1 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. Pacific National

i. Continue to emphasise its requirement that empty wagons are placed at the rear of trains.

ii. Examine the feasibility of differentiating the colours of resilient blocks and/or modifying resilient block 'housing' so only the correct type of resilient block can be fitted into the housing.

iii. Continue to emphasise the need for regular and thorough rolling stock inspections.

b. ARTC

i. Review maximum operating speeds between Parkes and Broken Hill.

ii. Investigate the practicality of integrating accelerometers into its track testing regime.

iii. Review the effectiveness of its AK geometry recording car and the conditions under which it is operated during track testing.

PART 5 APPENDICES

Appendix 1 - 7SP5's Train Consist, ex- Goobang Junction

Indication: CONFIRMED Train Id: 7SP5 Origin Date: 15/10/2005
Train Type: SUPERFREIGHT Location: GOOBANG JUNCTION
Origin: SYDNEY FREIGHT TERMINAL Destination: PERTH FREIGHT TERMINAL

****

Loco: 1 NR18 ST: A Loco Phone No: (02)94246000
2 NR52 A

Crew: Home Depot:

Total Wagons: 38 Total Dangerous Goods: 12 Tonnes per Operative Brake: 23.4
Train Weight: 3018.74 Total Out of Gauge : 0 HP per trailing tonne : 2.66
Train Length: 1536.204 EOTM Id : 9999 Air Brake Test Certificate:
Air Brake Cut Out Vehicles: 0

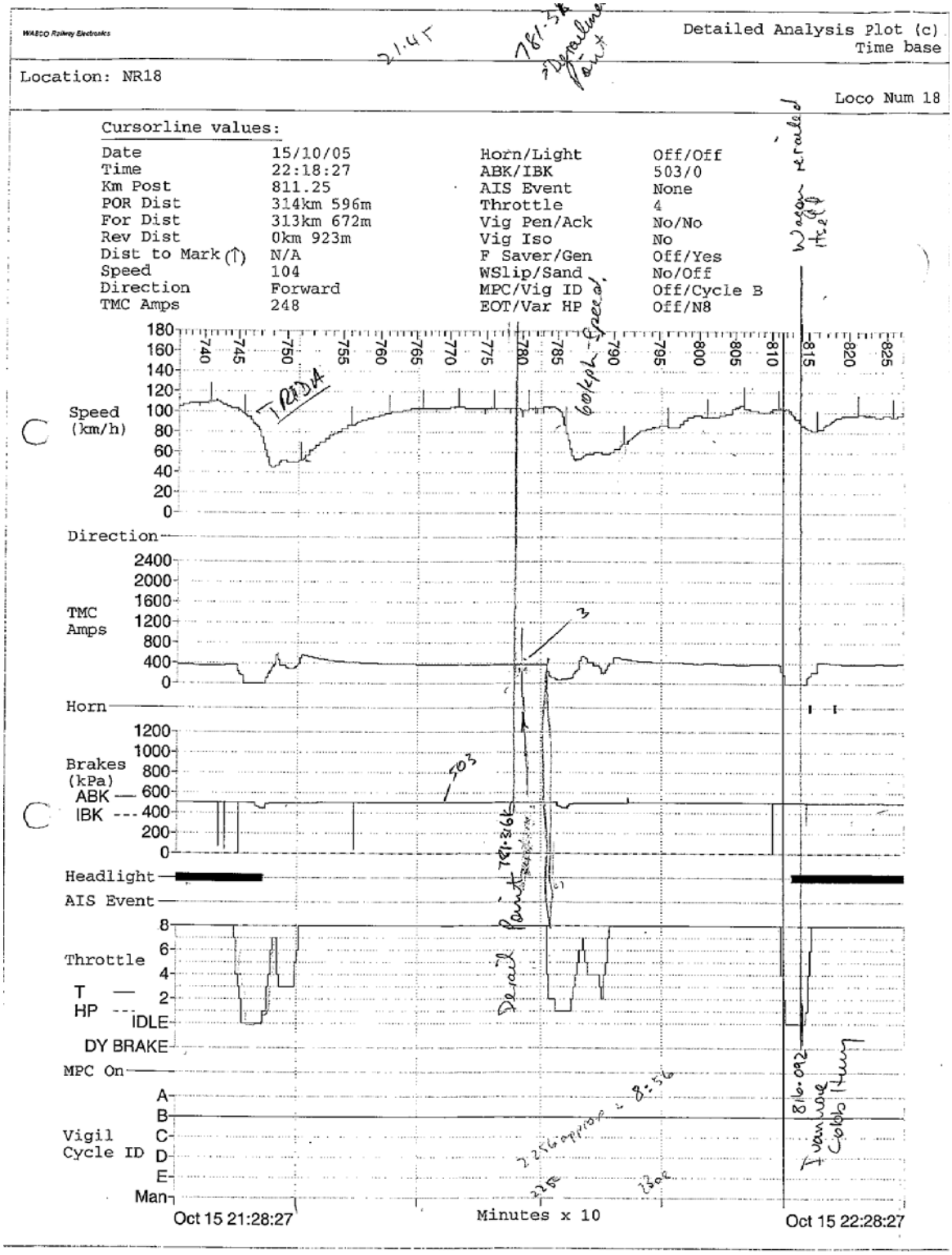
Unit Number: EXPRESS, INTERMODA, SMS3
Location out of which consist is confirmed : GOOBANG JUNCTION
Phone No: (02)94246000

****

ROLLINGSTOCK

DG	OOG(mm) Height	Width	Seq	Rollingstock	Length	Mass	ST	Cond	Freight	Orig	Att	Consignee	Dest
			1	NR18	22		A			SFT	SFT		PFT
			2	NR52	22		A			SFT	SFT		PFT
			3	RQKY02357W	20.1	39.25	L		CONT	GBJ	GBJ	FCLTRNNM	PFT
			4	RRKY04342G	20.1	42.4	L	PM	CONT	GBJ	GBJ	FCLTRNNM	PFT
			5	PRXY05004Y	76.991	142.38	L		CONT	SFT	SFT	NRCCASHNM	PFT
X			6	RRGY07127E	73.1	138.79	L		CONT	SFT	SFT	NRCCASHNM	PFT
X			7	RQEY01872E	27.6	80.29	L		CONT	SFT	SFT	NRCCASHNM	PFT
			8	RQGY34321F	20.1	67.9	L		CONT	SFT	SFT	NRCCASHNM	PFT
X			9	RRGY07137M	73.1	145.9	L		CONT	SFT	SFT	NRCCASHNM	PFT
			10	RRQY07340B	76.971	60	E			GBJ	GBJ		SCJ
			11	RRQY07332L	76.971	60	E			GBJ	GBJ		SCJ
			12	RRQY07317R	76.971	60	E	P1		GBJ	GBJ		SCJ
			13	RRGY07145C	73.1	163.87	L		CONT	SFT	SFT	NRCCASHNM	PFT
			14	RQJW60039K	25.6	40.92	L		CONT	BFT	SFT	NRCCASHQM	PFT
			15	NQYY20979T	15.1	18.6	E		EMTY	BFT	SFT	NRCCASHQM	PFT
X			16	NQOY14935J	20.1	56	L		CONT	BFT	SFT	NRCCASHQM	PFT
			17	RQFY00014H	20.1	48.71	L	PM	CONT	BFT	SFT	NRCCASHQM	PFT
X			18	RQPW60052E	25.8	52.95	L		CONT	BFT	SFT	NRCCASHQM	PFT
X			19	RQGY34441F	20.1	33.58	L		CONT	BFT	SFT	NRCCASHQM	PFT
			20	RQSY34455Q	20.1	37.5	L		CONT	BFT	SFT	NRCCASHQM	PFT
			21	NQOY14938N	20.1	56.47	L		CONT	BFT	SFT	NRCCASHQM	PFT
			22	RQFY00076E	20.1	66.22	L		CONT	BFT	SFT	NRCCASHQM	PFT
			23	RQBY15038N	20.1	52.26	L		CONT	BFT	SFT	NRCCASHQM	PFT
			24	RQKY04250K	20.1	47.92	L	PM	CONT	BFT	SFT	NRCCASHQM	PFT
			25	RQJW21990D	25.6	56.48	L		CONT	BFT	SFT	NRCCASHQM	PFT
			26	RQGY34474K	20.1	35.6	L		CONT	BFT	SFT	NRCCASHQM	PFT
			27	RQJW22075V	25.6	59.58	L		CONT	BFT	SFT	NRCCASHQM	PFT
			28	RQIW60303T	14.6	47.66	L		CONT	BFT	SFT	NRCCASHQM	PFT
X			29	RQSY35033G	20.1	62.28	L		CONT	BFT	SFT	NRCCASHQM	PFT
			30	RQFY00037E	20.1	62.94	L		CONT	BFT	SFT	NRCCASHQM	PFT
			31	RQCY00884S	20.1	69	L		CONT	BFT	SFT	NRCCASHQM	PFT
			32	RQKY02034E	20.1	20	E		EMTY	BFT	SFT	NRCCASHQM	PFT
			33	RQSY34342U	20.1	75.82	L		CONT	BFT	SFT	NRCCASHQM	PFT
			34	RQDY00009P	25.7	31.72	L		CONT	BFT	SFT	NRCCASHQM	PFT
			35	RRAY07224M	73.1	179.73	L		CONT	BFT	SFT	NRCCASHQM	PFT
			36	RQLY01013W	67.4	185.77	L		CONT	BFT	SFT	NRCCASHQM	PFT
			37	RRGY07120K	73.1	155.97	L		CONT	BFT	SFT	NRCCASHQM	PFT
X			38	RQQY07075B	77.9	154.46	L		CONT	BFT	SFT	NRCCASHQM	PFT
			39	RRAY07221X	73.1	150.78	L		CONT	BFT	SFT	NRCCASHQM	PFT
X			40	RRAY07162T	73.1	159.24	L		CONT	BFT	SFT	NRCCASHQM	PFT

Appendix 2 – Data Logger Chart 7SP5's Leading Locomotive



Appendix 3 - Extract from Pacific National's Train Inspection Manual (TIM 05_02_06) (Applicable at date of incident)

PACIFIC NATIONAL | Train Inspection Manual | TIM 05-02_06

Table 1 Maximum Trailing Loads for Adelaide-Melbourne-Sydney-Brisbane and Sydney-Parkes

Wagon Type	Payload Range (tonnes) Per wagon	Gross Mass Range (tonnes) Per wagon	Notes	Maximum Gross Trailing Load (tonnes) Adel-Melb-Syd-Br is Cootam-Parkes	Maximum Gross Trailing Load (tonnes) Syd-Lithgow-Parkes
Single wagons					
4 slot (jumbo)	Empty to 4	Tare to 28		2600	2300
	>4 to 10	>28 to 34	single 20' container not allowed on slots 1 or 4	2700	2450
	>10 to 20	>34 to 44		2900	2600
	>20	>44		Train limit	Train limit
2 and 3 slot (including single well wagons)	Empty to 10	Tare to 28		2600	2600
	>10 to 14	>28 to 32		3700	3300
	>14 to 20	>32 to 40		4200	Train limit
	> 20	> 40		Train limit	Train limit
Drawbar Connected Wagons					
5 pack well RQZY, RRZY, RQWY, RRCY, RRXY, RRRY 3 pack well RRFY	Per platform	Per platform			
	Empty to 4	Tare to 22		1600	1400
	>4 to 10	>22 to 28	Each platform is treated as an individual wagon and limit applies to trailing load behind each platform	2000	1650
	>10 to 15	>28 to 33		2300	1900
	>15 to 20	>33 to 38		2600	2150
	>20 to 25	>38 to 43		3000	2500
	>25 to 30	>43 to 48		3500	2900
	>30 to 35	>48 to 53		3900	3300
	>35 to 40	>53 to 58		4300	Train limit
	>40	>58		Train limit	Train limit

Wagon Type	Payload Range (tonnes) Per wagon	Gross Mass Range (tonnes) Per wagon	Notes	Maximum Gross Trailing Load (tonnes) Adel-Melb-Syd-Br is Cootam-Parkes	Maximum Gross Trailing Load (tonnes) Syd-Lithgow-Parkes
Articulated wagons					
RRAY, RRGY, RQJY, RQLY, RQQY, RRQY, RQYY, PRXY, TRAY, RRYY	Empty to 10	Tare to 59		2600	2300
	>10 to 50	>59 to 106	where two adjacent platforms are empty maximum is 2600 tonnes Adel-Melb-Syd-Br is and Cootam-Parkes or 2300 tonnes Syd-Lithgow-Parkes, otherwise as shown	2700	2450
	>50 to 105	>106 to 160		3250	2700
	>105 to 107	>160 to 163		3150	2750
	>107 to 110	>163 to 166		3400	3000
	>110 to 115	>166 to 171		3650	3200
	>115 to 120	>171 to 175		4050	Train limit
	>120 to 130	>175 to 186		4500	Train limit
	>130	>186		Train limit	Train limit
RQEY	Empty to 4	Tare to 34		2600	2600
	>4 to 50	>34 to 80		3600	3150
	>50	>80		Train limit	Train limit
RQUY, RQVY	Empty to 10	Tare to 48		2600	N/A
	>10 to 50	>48 to 88	where two adjacent platforms are empty maximum is 2600 tonnes, otherwise as shown	3500	N/A
	>50 to 55	>88 to 93		3700	N/A
	>55 to 58	>93 to 96		3900	N/A
	>58 to 62	>96 to 100		4100	N/A
	>62	>100		Train limit	N/A

Wagon Type	Payload Range (tonnes) Per wagon	Gross Mass Range (tonnes) Per wagon	Notes	Maximum Gross Trailing Load (tonnes) Brisbane – Cairns & return
RNAY	Empty to 10	Tare to 45		1600
RNBY RNCY	>10 to 50	>45 to 85	Each end platform must have a minimum of 4 tonne payload	1600
	>50 to 100	>85 to 135	Each end platform must have a minimum of 10 tonne payload	2100
	>100	>135	Each end platform must have a minimum of 20 tonne payload	2500

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Approved By: Adam Boughton, Engineering Manager | Section TIM 05-02, Page 4 of 4

Appendix 4- Results of ARTC's Depression Testing, 18 October 2005

Track Geometry Mtce Standards per TS3105 class 1 track V4.0)
Deviation in super (should be 0) = +/-6

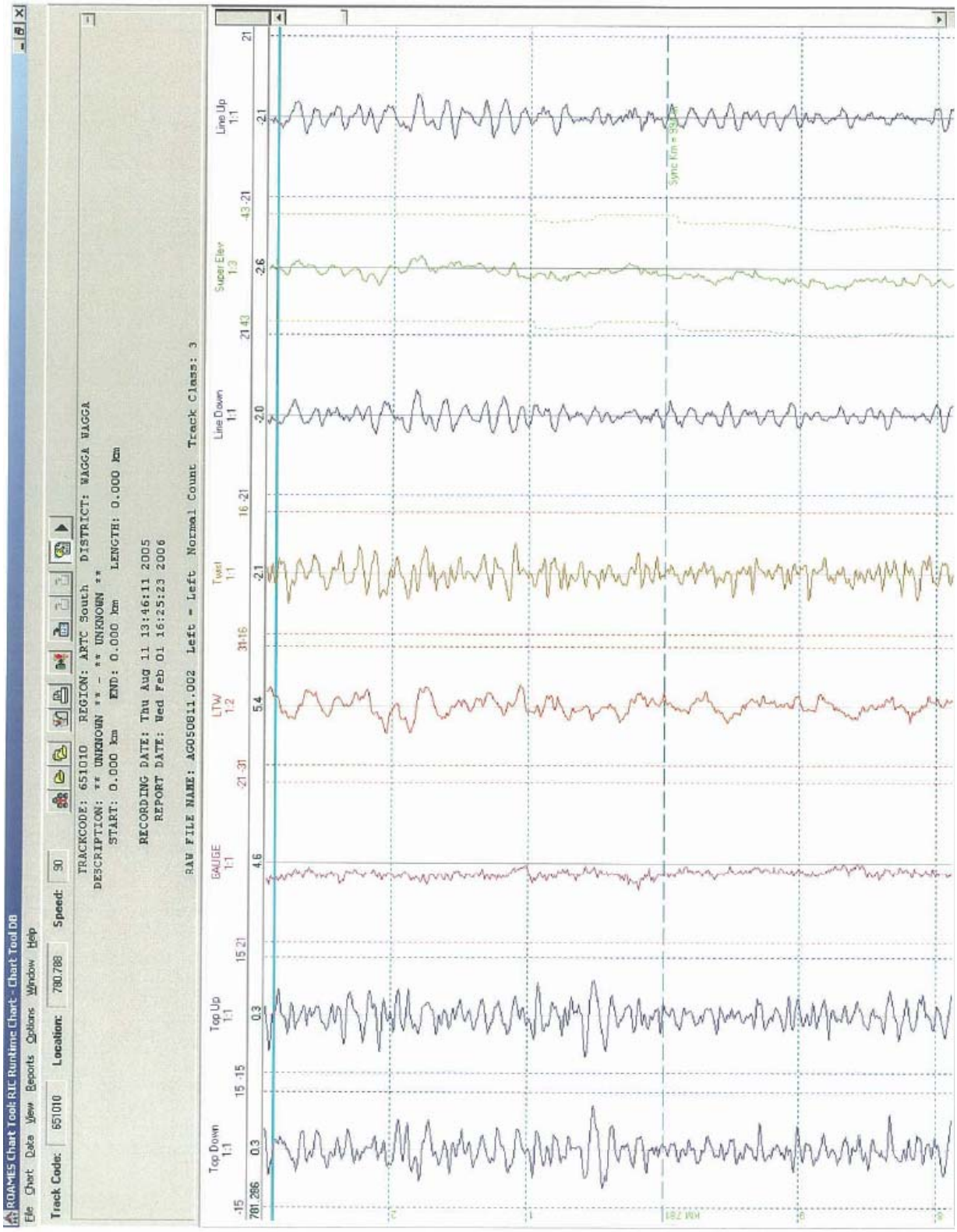
2m short twist not to exceed 1 in 500 = 6mm

14m long twist not to exceed 1in 500 = 12mm

Base operating standard C 2009 and C2011
Super max difference to design = 0-30mm ranks cat 5
Twist (short) 0-11mm ranks as a cat 5
Twist (long) 0-32mm ranks as a cat 5
Cat 5 = no speed restriction, and no mtce required

	Effective super	Short twist 2m	Long twist 14m	Distance from MP
	-1	1	-11	
	-2	2	-9	
	-4	-5	-10	
	1	-7	-6	
	8	-3	2	
	11	-1	4	
	12	2	8	
Point of mount (MP)	10	3	7	
	7	1	7	2
	6	-1	5	4
	7	1	1	6
	6	-1	-1	8
	7	3	-2	10
	4	1	-5	12
	3	3	-5	14
	0	-1	-7	16
	1	-5	-5	18
	6	-1	-2	20
	7	-2	0	22
	9	0	5	24
	9	1	7	26
	8	1	7	28
	7	1	4	30
	6	-2	3	32
	8	1	4	34
	7	3	0	36
	4	2	-2	38
	2	1	-3	40
	1	-2	-3	42
	3	0	1	44
	3	-1	2	46
	4	-3	2	48
	7	1	3	50
	6	1	1	52
	5	1	1	54
	4	2	4	56
	2	1	4	58
	1	-1	4	60
	2	-2	2	62
	4	-1	4	64
	5	1	6	66
	4	4	8	68
	0	2	6	70
	-2	1	-2	72
	-3	-3	-4	74
	0	0	-5	76
	0	1	-7	78
	-1	3	-7	80
	-4	2	-10	82
	-6	-6	-9	84

Appendix 5- AK Car Trace: taken in the area of the Derailment



This trace was recorded during AK testing conducted on 11 August 2005 i.e., approximately eight weeks before the derailment. The aqua line is at 781.286km.

Appendix 6 - RQKY Wagon Specifications

WAGON DETAILS

Class: RQKY

GENERAL

Designer:	Comm. Railways
Builder:	Comeng/Perry Engineering
Built For:	Comm. Railways
Build Date:	1969/72
Built As:	RMX
Drg No (GA)	AW 16366
Modifications:	None
Dates of Mods:	N/A

BOGIES

Bogie Type:	50 tonne Stucki Pocket
Std Designation:	AAR Class 2D
Axle load:	20 tonne
Load Springs:	AAR D4 or D5 x 5 (Outer) AAR D4 or D5 x 5 (Inner)
Wedge Springs:	RF1/134 (RC5 Outer)
Wheel Diameter:	920 mm
Journal Centres:	2184 mm
Wheelbase:	1750 mm
Centre Plate:	Flat, 305 mm dia.
Journal Bearings	5 1/2" x 10"
Brake lever ratio:	6:1
Side Bearers:	CCSB Type Assembly - Bogie Cage - Stucki Pocket Blocks - RB-27 Roller - 2" Steel Cap - RB-27
Ride Control / Barber	N/A

COUPLERS

Draftgear spec:	AAR M-901 E
Coupler type:	A 171B
Coupler length:	991 mm
Artic connector:	No

BRAKES

Brake cylinder:	356/254 x 178 UC (nos 2017 to 2036 incl) 356 x 305 AF/F) (nos 2041 to 2075 incl - otherwise 305 x 305 AF/F)
Mounting:	Body
Relay valve:	27/50 (nos 2017 to 2036 incl, 2041 to 2075 incl, 3038 to 3087 incl and 4200 to 4399 incl - otherwise none)
Triple valve:	WHB 14" WF3 M/Bulb (nos 2017 to 2036 incl) WHB 6" WF2 EL M/Bulb (nos 2041 to 2075 incl, 3038 to 3087 incl and 4200 to 4399 incl) WHB 12" WF3 M/Bulb (nos 2688 to 2732 incl, 2773 to 2787 incl and 2336 to 2385 incl)
Load comp.	Multi Lever (nos 2688 to 2732 incl, 2773 to 2787 incl and 2336 to 2385 incl - otherwise none)
Grade control:	WHB D1 14" (If WHB 14" WF2 M/Bulb Triple Valve fitted) WHB D1 12" (nos 2688 to 2732 incl, 2773 to 2787 incl and 2336 to 2385 incl - otherwise WHB D1 6")
Slack adjuster:	WH J2B (If 356/254 x 178 UC or 356 x 305 AF/F Brake Cylinders fitted – otherwise DRV 2A 450)
Park brake:	Transverse
Brake block:	Medium friction
BP bifurcated:	Yes
Brake % tare	61% nos 4200 to 4399 incl and 3038 to 3087 incl 73% nos 2336 to 2385 incl, 2773 to 2787 incl, 2041 to 2075 incl and 2017 to 2036 incl 70% nos 2688 to 2732 incl
Brake % gross	30% nos 4200 to 4399 incl and 3038 to 3087 incl 40% nos 2336 to 2385 incl, 2773 to 2787 incl, 2041 to 2075 incl and 2017 to 2036 incl 37% nos 2688 to 2732 incl
Brake % park	45%

NOTE: Brake % calculated with no losses. Park % assumes 560 N applied to wheel/lever @ gross.

Main reservoir:	No
"B" wagon:	No

RQKY Wagon Specifications (continued)

Wagon Type: CONTAINER WAGON **Class:** RQKY

Fleet Data:		Operational Data:*	
Previous Classes:	AQMF, AQSY, AQMX, RMX	Route availability:	ROA Plate A
Number in Class:	203	Unit length (Over Couplers):	20,091 mm
Date first built:	1968	Tare mass:	22 tonnes
Usage:	Containers	Gross mass:	80 tonnes
Volumetric Capacity:		Payload capacity:	58 tonnes
Comments:		Maximum speed:	115 km/h @ 76 tonne 110 km/h @ 80 tonne

*Note: Not for operational purposes. Refer Wagon Data for Train Operations

Appendix 7 - Results of Pacific National's Inspection of RQKY 02034E

BOGIE FROM WAGON NUMBER	RQKY 2034E	A end B end ÿ
BOGIE CODE AND SERIAL NUMBER	RJYD 422	

INSPECTION ITEM	DETAILS
Maintenance dates on bogie frame	FL 0505
Wheelset back to back dimensions	No 1 wheelset 1360 mm No 2 wheelset 1360 mm (both OK)
Wheel diameters	L1 – 870 mm R1 – 870 mm L2 – 850 mm R2 – 850 mm (all OK)
Condition of wheel discs Serial numbers	No 1 – 761867 No 2 – R5A4S 11748
Thickness of wheel flanges	All OK (Flange steepness OK with PN gauge)
Condition of wheel treads (skids, thermals, spalls, hollows etc)	Wheelset 1 – severe damage to tread and flanges Wheelset 2 - OK
Condition of axles	OK
Description of wheel bearings	9R axleboxes
Dates on package unit bearings	N/A
Colour of axleboxes & package units (if applicable)	Orange
Condition of bearing adaptors & sideframe seating	Badly worn crowns on axleboxes most likely due to the derailment.
Condition & dimensions of axlebox guides (1 & 2 piece)	N/A
Axlebox guide clearances (1 & 2 piece)	N/A
Condition of axlebox springs (1 & 2 piece)	N/A
Free heights of axlebox springs (1 & 2 piece)	N/A
Condition of axlebox damping (1 piece)	N/A
Condition of damping plunger (1 piece)	N/A
Condition of sideframes (3 piece)	OK
Matching of sideframes (3 piece)	Left 3 pips, Right 4 pips OK
Condition of bogie frame (1 & 2 piece)	N/A

BOGIE INSPECTION (continue)

BOGIE FROM WAGON NUMBER	RQKY 2034E	A end B end ÿ
BOGIE CODE AND SERIAL NUMBER	RJYD 422	

INSPECTION ITEM	DETAILS
Condition of bogie bolster (2 & 3 piece)	OK
Condition of gibs & rotation stops (3 piece)	L1 – 12 mm total R1 – 16 mm total L2 – 13 mm total R2 – 10 mm total (all OK but some excess wear due to derailment)
Condition of lateral stops (2 piece)	N/A
Description of side bearers	Stucki recessed constant contact
Condition of side bearers	Badly worn – incorrect resilient blocks fitted (RB35 rather than RB27)
Condition of bogie centre bearing (queen casting)	OK
Condition of wagon centre bearing (king casting)	OK
Condition of centre bearing liner	OK
Condition of centre pin	OK
Condition of bolster springs (2 & 3 piece)	Should have been all D4 springs but 9 of the 20 were D5.
Free heights of bolster springs (2 & 3 piece)	D4: Highest 247 mm – Lowest 240 mm (all OK min > 230) D5: Highest 262 mm – Lowest 253 mm (all OK min > 245)
Condition of friction wedge springs (2 & 3 piece)	OK
Condition of friction wedge liners (2 & 3 piece)	R1 liner plate broken off. Probably due to the derailment. Rest OK
Type & condition of wedges (2 & 3 piece)	Ride control
Height of friction wedges (2 & 3 piece)	L1 – 35 mm R1 – 35 mm L2 – 40 mm R2 – 25 mm (All OK – avg for side < 46 mm)
Effectiveness of friction wedges (bolster drop test)	L1 – OK R1 – not done due to broken liner
Condition of bolster/side frame liners (2 & 3 piece)	See above
Condition and thickness of brake shoes	L1 & R1 blocks had been replaced after the derailment L2 & R2 had high friction blocks fitted due to wrong brake beam
Condition of brake beams	No 1 – OK No 2 – incorrect brake beam
Condition of brake rigging (split pins, safety loops etc)	'R' clip fitted incorrectly to pin of live lever to brake beam.
Condition of brake beam hangers and/or slides	Slides OK

Appendix 8: Sources and Submissions

Sources of Information

- Pacific National
- Australian Rail Track Corporation

References

Transport Administration Act 1988 (NSW)

Rail Safety Acts 2002 and 2008 (NSW)

Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (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:

- The Independent Transport Safety and Reliability Regulator
- Pacific National
- Australian Rail Track Corporation

Submissions were received from all of the Directly Involved Parties.

The Chief Investigator considered all representations made by DIPs and where appropriate reflected those representations in this Final Report.