RAIL SAFETY INVESTIGATION REPORT

FATAL INJURING OF TWO RAIL MAINTENANCE WORKERS

SINGLETON, NSW

16 JULY 2007
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Released under the provisions of
Section 45C (2) of the Transportation Administration Act 1988 and
Section 67 (2) of the Rail Safety Act 2002

Investigation Reference 04375
THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of accidents and incidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

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Once OTSI has completed an investigation, its report is provided to the NSW Minister for Transport for tabling in Parliament. The Minister is required to table the report in both Houses of the NSW Parliament within seven days of receiving it. Following tabling, the report is published on OTSI’s website at www.otsi.nsw.gov.au.

OTSI cannot compel any party to implement its recommendations and its investigative responsibilities do not extend to overseeing the implementation of recommendations it makes in its investigation reports. However, OTSI takes a close interest in the extent to which its recommendations have been accepted and acted upon. In addition, a mechanism exists through which OTSI is provided with formal advice by the Independent Transport Safety and Reliability Regulator (ITSRR) in relation to the status of actions taken by those parties to whom its recommendations are directed.
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ACKNOWLEDGEMENTS

The locality map reproduced on page 1 in this report was used with the permission of Geoscience Australia.
Terms of Reference

The Terms of Reference established by the Chief Investigator for the investigation into the circumstances surrounding the accident in which two rail maintenance workers were fatally injured prescribed that the purpose of the investigation was to:

a. Identify the factors, both primary and contributory, which caused the accident with particular reference to, but not being limited by, the following issues:
   i. the reason the two rail maintenance workers were on the track and the method of worksite protection that was being employed at the time;
   ii. whether the two rail maintenance workers were qualified to undertake the task/s they were performing and their related levels of experience;
   iii. whether the method of worksite protection that was in place was properly followed and whether or not it was an appropriate method to have been employed in the first instance;
   iv. whether the two rail maintenance workers communicated with Train Control prior to commencing, and during, their task/s and, if so, the nature of that communication;
   v. whether the two rail maintenance workers received warning of any known train movements prior to the commencement of, or during, their tasking, and
   vi. whether Train Control alerted train drivers to the related infrastructure maintenance work being undertaken and of the presence of the two rail maintenance workers on the track.

b. Identify whether the accident might have been anticipated and assess the effectiveness of any strategies that are employed by ARTC to manage the related risk/s.

c. Assess the effectiveness of emergency actions in response to the accident.

d. Advise on any matters arising from the investigation that would enhance the safety of rail operations.
# GLOSSARY OF TERMS

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<th>Term</th>
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<tr>
<td>ARTC</td>
<td>Australian Rail Track Corporation</td>
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<td>Blocking</td>
<td>An action taken to prevent the unintended clearance of signals or movement of points. On older type signals, the block may involve the use of a mechanical device but on more modern equipment the block is applied by the Network Controller via his/her computer.</td>
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<td>Crossover</td>
<td>A portion of line which is used to divert trains from one continuing line to another.</td>
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<td>Danger zone</td>
<td>Everywhere within 3m horizontally from the nearest rail and any distance above or below this 3m, unless a safe place exists or can be created.</td>
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<td>Interlocking</td>
<td>The interaction of equipment controlling points and/or signals to prevent conflicting train movements, and to make sure that routes are set correctly.</td>
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<tr>
<td>ITSRR</td>
<td>Independent Transport Safety and Reliability Regulator</td>
</tr>
<tr>
<td>Locking</td>
<td>A process where points can be electrically isolated to ensure that they do not move, or open, while a train is passing over them.</td>
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<td>NCCN</td>
<td>Network Control Centre North</td>
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<td>Network Control Centre South</td>
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<tr>
<td>OTSI</td>
<td>Office of Transport Safety Investigations</td>
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<tr>
<td>Points</td>
<td>The mechanical arrangement by which one railway track can be made to converge or diverge with another thereby allowing trains to be directed from one track to another.</td>
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<td>PN</td>
<td>Pacific National Limited</td>
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<td>TTM</td>
<td>Train Transit Manager</td>
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EXECUTIVE SUMMARY

The Incident
At approximately 5:48am on 16 July 2007, a signal electrician and his assistant (hereafter referred to as “the Electrician” and “the Electrician’s Assistant” respectively and collectively as “the two rail maintenance workers”) were struck and fatally injured by Pacific National’s coal service HV161 at No.56A points approximately 445m South of Singleton railway station. The two rail maintenance workers had been called-out to attend to the points which had malfunctioned earlier in the morning.

OTS1’s analysis of recorded conversations between the Electrician and the Network Controller in charge of train movements through Singleton, together with signal records, revealed that the two rail maintenance workers were working under a method of worksite protection known as NAR (No Authority Required). Under this arrangement, one of them was required to keep a lookout for approaching trains at all times.

At 5:44:09am, the Driver of Pacific National’s (PN) Southbound coal service HV388 observed two workers on an adjacent line near the No.56 points and sounded the horn to alert them to his train’s presence. The Driver indicated that he was slowing his train at the time, in anticipation of having to stop at a signal ahead, and that one of the two workers acknowledged HV388’s presence. At 5:46:22am, the Driver of PN’s Northbound coal service HV161 extinguished his train’s headlight after seeing HV388 ahead, as he was obliged to do under ARTC’s Network Rules. HV388 continued to slow but the signal indications ahead of HV161 were such that its Driver was able to continue to operate his train at its maximum permitted speed of 80km/h and at 5:47:22am the two trains commenced to pass each other. Approximately 39 seconds later, and while the two trains were still in the process of passing each other, the Driver of HV161 was confronted with what appeared to be two workers in the danger zone immediately in front of his train. In what he described as being an instant later, HV161 struck and fatally injured the two rail maintenance workers.

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1 The No.56A points in conjunction with the No.56B points are part of a crossover as can be seen in Photograph 2, with the ‘A’ and ‘B’ ends being 79m apart.

2 Within the rail industry in NSW, work on or about the track must be conducted in accordance with one of five prescribed forms of worksite protection. The purpose of these methods of worksite protection, each having its own specific requirements, is to protect those performing the work from the risk of being struck by a train or track machine.
Findings
In relation to those matters prescribed by the Terms of Reference as the principal lines of inquiry, OTSI finds as follows:

a. Causation
The two rail maintenance workers were working under a method of worksite protection known as NAR and this required that one of them kept a lookout at all times. In the instant before HV161 struck the two rail maintenance workers, the Driver saw one of them crouching or kneeling at the No.56A points while the other was standing with his back towards the train and appeared to be pointing a torch onto the track. Since neither of the workers was keeping a lookout at this time, neither of them saw the approaching HV161 and did not appreciate the need to move to a safe place.

b. Contributory Factors
The following factors contributed to cause the accident:

i. The NAR method of worksite protection employed does not oblige those who employ it to communicate their intentions to others. In this instance, the Electrician did advise the Network Controller of his intentions but the Network Controller was not obliged to, and did not, inform the Drivers of HV161 and HV388 that there were maintenance workers on the track near Singleton station. While the Driver of HV388 ultimately saw the two maintenance workers, the Driver of HV161 had no forewarning of their presence and by the time he saw them, he did not have time to warn them of his train’s presence.

ii. Visual and audible cues that might have alerted the two workers to HV161’s approach were diminished because HV161 was operating with its headlight extinguished and the noise generated by the passing of HV388 on an adjacent line masked the sound of HV161’s approach.

iii. The two rail maintenance workers had worked within the danger zone\(^3\) at night on many occasions and the Electrician was very familiar with the location in which he and his colleague were working. It is possible that

\(^3\) The danger area encompasses everywhere within 3m horizontally from the nearest rail and any distance above or below this 3m, unless a safe place exists or can be created.
these high levels of familiarity lessened the workers’ appreciation of the risks associated with their task.

iv. The Electrician was rostered on-call to respond to events in Whittingham-Muswellbrook-Dartbrook-Gulgong area on the morning of 16 July 2007. However, the Electrician’s Assistant was not on-call and would therefore not have anticipated being called-out in the early hours of the morning. In addition, both workers had worked seven shifts over the preceding seven days. It is therefore probable that both workers were suffering from a degree of fatigue and that this may also have affected their appreciation of the risks associated with their task.

c. Anticipation and Management of Risk

i. ARTC Network Rule ANWT 300 (Planning Work in the Rail Corridor) specifies that all work within the rail corridor⁴ must be preceded by a safety assessment by a qualified Protection Officer and that the protection arrangements that are to be in force while the work is undertaken must be recorded. Both of the rail maintenance workers were qualified Protection Officers but it is clear from recorded conversations that the Electrician was acting in this capacity at the time of the accident. However, OTSI could not find any record of the protection arrangements and therefore had no way of determining whether the work was preceded by a safety assessment.

ii. ARTC’s Network Rule ANGE 204 (Network Communications), and a related Network Procedure, ANPR 721 (Spoken and Written Communication), requires a structured approach to the transmission and receipt of information and obliges those who are communicating to reach a complete and shared understanding of those matters under discussion. The Network Controller and the Electrician conversed on three occasions during the morning of 16 July 2007 but their communication did not conform to ARTC’s requirements. While their manner of communication did not contribute directly to the circumstances that led to the accident, had the Electrician and the Network Controller observed the required communication protocols and communicated in a more structured way, aspects such as the proximity of HV161 and HV388 and the instructions

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⁴ The rail corridor is the area within the fence lines that surround rail track, or 15m from the outside rail where there are no fences.
to clear signals would have to have been repeated by the Electrician and Network Controller respectively and greater significance might have been attached to both of these elements of safety critical information.

iii. Quite apart from those rules that were not observed, there were two further instances where an opportunity to reduce the risks associated with events at the time were missed. While those associated with the following missed opportunities were not under an obligation to have undertaken any of the following actions, had they done so, HV161 might not have struck the two rail maintenance workers:

(a) The Network Controller could have alerted the drivers of all trains scheduled to approach Singleton that No.56 points had malfunctioned and that maintenance workers were/would be on the track to rectify the problem. This might have encouraged the Driver of HV161 to have approached Singleton at a slower speed and would almost certainly have encouraged him to have sounded his train’s horn on the approach to the No.56 points.

(b) Had the Driver of HV388 opted to alert the Driver of HV161 to the presence of the two rail maintenance workers after he detected them, which was approximately four minutes prior to their being struck, again the Driver of HV161 would almost certainly have been encouraged to have sounded his train’s horn on the approach to the No.56 crossover.

iv. The effectiveness of NAR as a method of worksite protection is entirely dependent on the siting, and diligence, of those tasked with looking-out. It is also the most commonly-used method of worksite protection within NSW because it is expedient and has the least amount of impact on train running. However, because it only provides a single point of defence, NAR is not used elsewhere in Australia.

v. ARTC’s understanding of the extent to which its worksite protection requirements are being complied with would be improved by an increase in audit activity and by the inclusion of a requirement that before its auditors attend a pre-work safety briefing and go on-site, they must first examine the related risk assessment/s and by requiring that they must subsequently examine the related train control graph/s.
vi. RailCorp undertook a major review of its worksite protection arrangements in 2005. While OTSI appreciates that some of the recommendations were always going to require careful consideration, the fact that the majority of recommendations remain under review suggests to OTSI that RailCorp has been slow to respond to the report.

d. Effectiveness of the Emergency Response
i. The crew of HV161 reported the accident in a timely fashion and the Network Controller alerted Emergency Services to the occurrence without delay.

ii. The first ambulance arrived at the scene within nine minutes of being advised of the accident, but the two workers were already deceased.

e. Other Safety Matters
i. ARTC’s and RailCorp’s Network Rules ANTR 406 and NTR 406 (*Using Train Lights*) require train drivers to extinguish their headlights on approaching another train and, to extinguish or dim them when approaching a motor vehicle on a nearby road, a platform, a signal box or a location where shunting is in progress. While OTSI considers it appropriate for train drivers to dim their lights under such circumstances, it considers that the benefits derived from extinguishing their lights at these times are outweighed by the risks of such an action.

ii. While the two maintenance workers were wearing approved high visibility vests, such vests have little utility unless they are exposed to some form of light which causes them to reflect. The two workers were operating in an area where there was little lighting and HV161 was operating with its headlight extinguished in accordance with ARTC Network Rule ANTR 406. This meant that the two workers would not have been visible to the Driver of HV161 at a distance which would have allowed him to have warned them of his approach.

iii. It was noticed that on some of Pacific National’s locomotives, the spare electrical control jumper cable trunks were stowed in a way that partially obscured their ditch lights.
iv. The data loggers from both HV161 and HV388 were not properly synchronised with respect to time.

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 and RailCorp

i. In consultation with ITSRR, and as a priority, remove Network Rules ANWT 310 and NWT 310 (No Authority Required) and replace them with the Lookout Protection method, but in a modified form which includes specific reference to the requirements that:
   (a) protection arrangements be documented;
   (b) the role of Protection Officer be performed by someone with the requisite qualifications, and
   (c) information pertaining to the presence of workers on the track is passed by Network Controllers to drivers operating rolling stock on the same track.

ii. In consultation with ITSRR, amend Network Rule ANTR 406 and NTR 406 (Using Train Lights) to remove the requirement for train drivers in NSW to extinguish their headlight on approaching another train and the option of their doing the same when approaching a motor vehicle on a nearby road, a platform, a signal box or a location where shunting is in progress, and instead, require them to dim their headlight in all of these circumstances.

iii. Ensure that radio communication within the territory they control in NSW conforms to the requirements of Network Rules ANGE 204/NGE 204 (Network Communications) and Network Procedures, ANPR 721/NPR 721 (Spoken and Written Communication).

iv. Review the range of safety clothing and safety equipment provided to its rail safety workers to ensure that, irrespective of the worksite protection arrangements under which they are working, visibility of them within the
danger zone at night is not solely dependent on external sources of illumination.

v. Investigate, as a matter of priority, the use of existing technologies that automatically alert those that are required to work in the danger zone of an approaching train, or other form of rolling stock, and which also automatically alerts those operating such rolling stock when they are approaching a worksite.

b. **Australian Rail Track Corporation**
   i. Review its SMS (Safety Management System) to ensure that there are adequate control measures therein to properly manage the risks associated with fatigue.
   
   ii. Having satisfied itself that its SMS does contain adequate control measures to properly manage the risks associated with fatigue, or having acted to ensure that it does, ensure that the related controls are being acted upon.
   
   iii. Increase the frequency with which it audits worksite protection and the related documentation.
   
   iv. Improve its process for auditing worksites by the inclusion of a requirement that before auditors attend a pre-work safety briefing and go on-site, they first examine the related risk assessment/s, and by requiring that they must subsequently examine the related train control graph/s.

c. **Pacific National Limited**
   i. Ensure that spare electrical control jumper cable trunks are stowed in a way which does not obstruct visibility of any of its locomotives' lights when they are illuminated.
   
   ii. Ensure that event recorders fitted to its locomotives are properly synchronised and are regularly inspected, maintained and calibrated.

d. **The Independent Transport Safety & Reliability Regulator**
   i. In light of continuing evidence of its limitations, and as a matter of priority, prohibit the use of NAR as an approved method of worksite protection within NSW.

iii. Monitor ARTC’s efforts to ensure that work within the rail corridor in ARTC controlled territory within NSW occurs under arrangements that conform to its revised worksite protection requirements.
PART 1  FACTUAL INFORMATION

Accident Synopsis

1.1 At approximately 5:48am on 16 July 2007, a signal electrician and his assistant (hereafter referred to as “the Electrician” and “the Electrician’s Assistant” respectively and collectively to as “the two maintenance workers”) were struck and fatally injured by Pacific National’s coal service HV161 at the No.56A points, approximately 445m South of Singleton Station.

Location

1.2 Singleton is located in the Hunter Valley region of NSW, 239km North of Sydney. The relative position of Singleton and the accident is depicted in Figure 1.

Accident Narrative

Before the Accident

1.3 At approximately 4:00am on 16 July 2007, the Network Controller operating the Middle Hunter control panel at ARTC’s Network Control Centre North (NCCN) located at Broadmeadow, was confronted with a malfunction of the points at the No.56 crossover at Singleton. The crossover allows Northbound

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5 This is the distance by rail, as measured from Central Station in Sydney.
trains to move from the “Down” track onto the “Up” track and into Singleton station. The location of the accident and the No.56A and No.56B points at either end of the crossover are depicted in Photos 1 and 2 respectively.

Photo 1: Looking South at Singleton Yard arrangements.

1.4 After several unsuccessful attempts to operate the points, the Network Controller contacted an on-call signal electrician at 4:04am, but this electrician advised that he was already en route to repair another fault on the network. The Electrician contacted another colleague, the Electrician, who was on-call to respond to events in the Whittingham-Muswellbrook-Dartbrook-Gulgong area, who in turn contacted the Network Controller, by mobile phone, at approximately 4:13am. The Electrician was advised that the No.56 points

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6 The Network Controller would not have had visibility of this earlier call-out because the related fault had occurred in territory that was not under his control.

7 There is reference to a series of conversations involving the Network Controller throughout this report. The first conversation occurred at 4:04am. The conversation between the Network Controller and the Electrician at 4:13am was the second in the series and is referred to as Conversation 2 later in the report.
had failed to reverse\(^8\) and responded by indicating that he would deploy to the points to rectify the problem.

![Photo 2: Singleton Yard, looking South](image)

1.5 Whilst waiting for the Electrician to arrive at the points, the Network Controller was able to re-route a passenger train (V601\(^9\)) into Singleton Station by crossing it from the ‘Down’ Line onto the ‘Up’ Line using the No.200 points at Whittingham instead of the normal No.56 points at Singleton (refer to Photo 2 and Figures 2 and 3). V601 subsequently departed Singleton station at 4:34am, approximately seven minutes behind schedule. Because the problem with the No.56 points was that they would not reverse, the Network Controller determined that the points would allow normal train running, i.e., that they would not affect the passage of trains straight through Singleton and therefore set the routes for PN’s North-bound coal services: LD123, WK325 and BG143, and Queensland Rail (QR) South-bound coal service MO110. These trains passed through Singleton before the two maintenance workers arrived at the points.

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\(^8\) When points are reversed, it means they are operated to set a movement away from the normal direction of running, e.g., off a main line into a crossing or a turnout, or onto a branch line.

\(^9\) V601 is a regular CityRail passenger service that operates from Newcastle to Scone.

Fatal Injuring of Two Rail Maintenance Workers, Singleton, 16 July 2007
Figure 2: Diagram of route used to divert V601 onto the Up line at Whittingham using No.200 Points.

Figure 3: Diagram of route for V601 through Singleton and back onto Down line towards Muswellbrook.

1.6 Voice logs recovered from NCCN at Broadmeadow indicated that the Electrician called the Network Controller again by mobile, at 5:22am, and in the course of that conversation advised that he had commenced to inspect the points. The significance of this and subsequent communication between the Electrician and the Network Controller is addressed in Part 2 of this report.
1.7 At approximately 5:44am, Pacific National’s HV388, a Southbound coal service, slowed as it was passing through Singleton Station in anticipation of stopping at Signal 147.6 which is approximately one kilometre past the No.56B points. As it did so, the Driver and the Assistant Driver observed a white work vehicle standing in the ‘Up’ side of the rail corridor with an illuminated spot light directed towards their train. They then observed two persons wearing high visibility vests on the ‘Down’ track in the vicinity of the No.56A points. HV388 had its headlights, marker lights and ditch lights illuminated at this time, but the Driver also sounded the horn to alert the two persons who were in the vicinity of the points. The Driver recalled that one of the persons then gestured, which he regarded as an acknowledgement of the train’s presence.

1.8 While HV388 was slowing, another train approached Singleton station travelling North, on the ‘Down’ line, and its Driver saw HV388 ahead. The Driver of this train, HV161, extinguished his headlights on seeing HV388 in accordance with ARTC Network Rule ANTR 406 (Using Train Lights). However, HV161’s ditch, marker and locomotive number lights remained on. HV161 was being operated at approximately 80km/h at this time and the signal settings indicated to its Driver that he would not be required to stop or slow in the vicinity of the station. When the Driver of HV388 failed to extinguish his headlights, the Driver of HV161 flicked his train’s head lights on and off, after which HV388’s headlights were extinguished.

The Incident

1.9 The Driver of HV161 recalled that some time after his train commenced to pass HV388, he suddenly saw what appeared to be two people wearing high visibility vests in the middle of track, i.e., within the “four foot”, immediately in front of his train. One person appeared to be crouching or kneeling and the other was standing in close proximity, with his back to the train, and appeared to be shining a torch onto an area of the tracks near the person who was kneeling. His immediate reaction was to apply the emergency brakes but, as he did, HV161 struck what proved to be the two maintenance workers.

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10 This rule requires that a train’s headlights be switched off as it approaches another train and either be extinguished or dimmed as it approaches a signal box, platform, the area where shunting is in progress or a car on a nearby road.
1.10 The Assistant Driver recalled that at the time, he had been making an entry in his memo book and looked up to see a dark form on the track. His realisation that this form was a person occurred in the instant before the impact.

Post Incident

1.11 HV161 came to a stand at 239.314kms at 5:49am, approximately 870m past No.56A points and, as it did so, the two crew members conferred. The Assistant Driver then contacted the Network Controller by mobile phone and advised that there were “two fatalities at Singleton station”\(^{11}\) and requested the attendance of the Emergency Services. HV388, which was still moving at the time HV161 struck the two maintenance workers, came to a stand a minute later at Signal 147.6 which was at ‘Stop’.

1.12 Having been alerted to the accident, the Network Controller immediately called ‘000’ and advised the operator of the circumstances and location of the accident.

1.13 After contacting the Network Controller, the Assistant Driver proceeded back along HV161 on foot to locate the two rail maintenance workers. While doing so, he encountered RailCorp’s Customer Service Assistant (CSA) standing on the station platform and informed him of the accident. Shortly thereafter, Ambulance Officers arrived at the scene and confirmed that both maintenance workers were deceased.

Track and Operations Information

1.14 Singleton station is located between Maitland and Muswellbrook on the Main North Line in rail territory leased by the Australian Rail Track Corporation (ARTC) from the NSW Government. Under the terms of the lease, ARTC is responsible for track maintenance and train control functions within the leased territory.

1.15 Train movement within this, and the adjoining sections, is monitored via a Rail Vehicle Detection System, i.e., the track is circuited, and the related signalling functions are controlled from NCCN at Broadmeadow, in Newcastle.

1.16 The double track through Singleton supports the movement of local and intrastate passenger trains and bulk commodities, such as coal and grain, and

\(^{11}\) The Assistant Driver was not in a position to confirm that the two persons his train had struck had in fact been killed but assumed that they were on the basis of his train’s speed and the fact that they were within the ‘four foot’ when they were struck.
is classified as Class 1XC line under ARTC’s Engineering Standard TDS 11 (Standard Classification of Lines).

1.17 The track in the immediate vicinity of the accident had a posted maximum operating speed of 115/130km/h\textsuperscript{12}.

Train Information

1.18 HV161 consisted of three main line locomotives (8229, 9031 and 9013) and 80 empty coal hopper wagons. The train measured 1338.8 metres in length and was hauling a 2,314 tonne load. HV161 was limited to a maximum operating speed of 80km/h by virtue of the axle loadings on its two 90 class locomotives.

1.19 HV388 consisted of three mainline locomotives (9010, 9015 and 8226) and 80 loaded coal hopper wagons. The train measured 1,350.3 metres in length and was hauling a 9,094 tonne load. It was also restricted to a maximum speed of 80km/h.

Damage

1.20 There was no damage to the rolling stock or infrastructure as a result of the accident.

Employee Information

1.21 The Electrician was a permanent employee of the Rail Infrastructure Corporation (RIC) seconded to ARTC. The Electrician's Assistant was a casual employee of a labour hire company which was contracted to ARTC. Both workers were qualified to perform the role of Protection Officer.

Meteorological Information

1.22 The train crews from both HV161 and HV388 described the conditions at the time of the incident as being cold, dark, dry and clear. The Bureau of Meteorology recordings indicated that sunrise occurred at 6:50am and that the minimum temperature recorded at Singleton on the night was 1.0°C. A heavy frost and low winds were also recorded throughout the Hunter region that night.

\textsuperscript{12} The posted speed of 115km/h applied to certain classes of locomotive-hauled (freight and passenger) trains, while the posted speed of 130km/h was applicable to RailCorp's passenger trains i.e. the XPT, Xplorer/Endeavour or Hunter Railcar.
PART 2  ANALYSIS

Causation

Condition of the No.56 crossover

2.1 The two maintenance workers were killed while they were attending to a problem with the points at the No.56 crossover. Although the points could not be considered to have caused the accident, OTSI examined them and their maintenance history with a view to determining whether the circumstances which required the two workers to be on the track in the first place were avoidable.

2.2 The switches on the points at either end of the No.56 crossover are driven by Nippon KA1200A switch machines. The two switches are connected by front and back rods. Lock and detection rods are also connected to both switches. The lock rod, in conjunction with other components within the points machine, allows the points to be locked in either a normal or reverse setting. The detector rods operate detector slides which in turn operate contacts within the switch machine to electrically inform the signalling system about the position in which the points are set. Some of these components can be seen in Photo 3.

2.3 The points are subjected to periodic inspection and routine maintenance every two months and ARTC’s records showed that the No.56 points had last been serviced on 21 May 2007. Notwithstanding, there had been four reported faults at these points in the preceding six months, the last one being on 5 June 2007. In two of these instances, faults were found in the electrical control circuits located in the nearby relay hut, but no definitive cause was found in the other two instances.

2.4 A wire brush and scraper was found in the vicinity of the No.56A points after the accident indicating that one of the maintenance workers had been cleaning, or intended to clean, the points components or to ensure that they were not obstructed. The access covers for both points machines were found to be padlocked, suggesting that the internal inspection of the points had either been completed, or had not commenced. OTSI noted that when the

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13 The Network Controller can see the setting on a visual display unit.
Electrician conferred with the Network Controller at 5:34am, he advised that he could not find any fault with the operation of the No.56 points after inspecting their detection circuits. However, in the course of the same conversation, he later identified that he had found coal within the points and that he was going to continue to investigate the failure. Subsequent testing conducted by ARTC’s signal engineers, on the day after the accident, failed to locate any definitive fault in the operation of the points and noted that both points machines were in good working order and that the locks for the points were correctly adjusted.

![Photo 3: Equipment arrangement of the No.56A points.](image)

**Adherence to the rules governing maintenance work within the danger zone**

2.5 At an industry level in Australia, the risks associated with working within the rail danger zone are well understood and ‘worksite protection methods’ have been devised to manage those risks. In NSW, these rules are encapsulated within ARTC’s *Network Rules and Procedures* and RailCorp’s “Railsafe” *Network Rules and Procedures*. The Network Rules and Procedures for both corporations are virtually identical and are applicable to the employees of any organisation while they work within the danger zone.

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Although the Electrician did not say so, this was at the No.56B end of the crossover.
2.6 Since it came into being on 1 January 2004, OTSI has examined a significant number of instances in which those working on the track have been exposed to what is termed a ‘near miss’\(^\text{15}\) and the following matters were often at issue:

a. work was not preceded by proper planning and/or a proper assessment of the related risks;

b. those performing the related work were not properly briefed and/or did not have a proper understanding of their roles and responsibilities;

c. an inappropriate form of safe-working had been implemented, or an appropriate form of safe-working had been implemented but not adhered to; and/or

d. communication within the worksite, or between the Protection Officer at the worksite and those controlling train movements or operating trains in the related area, was poor.

2.7 ARTC’s methods of worksite protection, and the related rules, are contained in its *NSW Operations Standards*. ARTC Network Rule ANWT 300 (*Planning Work in the Rail Corridor*) specifies that work in the danger zone must be planned and occur within one of the following specific methods of safe-working;

a. a *Local Possession Authority* (ARTC Network Rule ANWT 302);

b. a *Track Occupancy Authority* (ARTC Network Rule ANWT 304);

c. a *Track Work Authority* (ARTC Network Rule ANWT 306);

d. *Controlled Signal Blocking*, (ARTC Network Rule ANWT 308), and

e. *No Authority Required* (ARTC Network Rule ANWT 310).

2.8 A *Local Possession Authority* (LPA) may only be issued by a Train Controller\(^\text{16}\) and provides for the closure of a portion of the track for a specific period during which time only vehicles associated with the maintenance work can be allowed into the closed portion of the track. The details of the related closure must be advertised seven days in advance.

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\(^{15}\) Such occurrences should more correctly be termed a ‘near hit’ and this terminology has been preferred throughout OTSI’s report.

\(^{16}\) In the ARTC Network in NSW, the Network Controller, whilst undertaking the responsibilities of Signaller as defined by the ARTC Network Rules and Procedures, also fulfils most responsibilities of Train Controller for the management and control of traffic movements and occupancy authorities over prescribed sections of track. Despite these dual roles, the Network Controller must still report to the Train Transit Manager who has overall responsibility for control of the wider territory. In RailCorp territory however, the roles and responsibilities of those termed Signaller (or Area Controller) and Train Controller remain as defined in the Network Rules and Procedures.
2.9 A Track Occupancy Authority (TOA) authorises the occupation of track within specified limits for a specified period and may only be issued by a Train Controller, or a Signaller on the authority of a Train Controller. Again, only vehicles associated with the work that is to occur are permitted within the worksite and the Network Controller must apply blocking facilities to prevent the movement of rail traffic into the worksite. Significantly, the blocking facilities can only be lifted when the Protection Officer has advised that the worksite has been cleared; that all forms of protection that may have been placed at his/her direction, e.g., detonators and/or flags, have been lifted; and the portion of track included in the authority is certified as available for use.

2.10 A Track Work Authority (TWA) is issued verbally and authorises the occupation of a defined portion of track between rail movements, i.e., those performing maintenance tasks do not have exclusive use of the track. A TWA may only be issued by a Train Controller, or a Signaller on the authorisation of a Train Controller. Significantly, the movement of trains through the worksite must be managed, either by signals and/or hand signallers. While TWAs are issued verbally, the Protection Officer and the Network Controller must make a written record of the details associated with the issue of the authority.

2.11 Controlled Signal Blocking (CSB) may be authorised by a Signaller and involves signals either side of the area within which the work is to occur being placed at ‘Stop’. Under such arrangements, only light tools may be used during the associated work and no vehicle movement is permitted on the track. Significantly, before setting signals to ‘Stop’, a Signaller must speak to the Train Controller about the request to exclude rail traffic and before the track work is commenced, the Protection Officer must confirm that the Signaller has placed the related signals at ‘Stop’, applied blocking facilities and that there is no rail traffic approaching the worksite. The Signaller must not clear the related signals until he is advised by the Protection Officer that the work area is clear.

2.12 No Authority Required (NAR). It is permissible for qualified personnel to undertake maintenance work without seeking permission from a Train Controller or a Signaller, provided such work does not involve overhead wiring, breaking the track or altering its structure and/or geometry, and the required work only involves the use of light, non-powered hand tools. The
Protection Officer must employ a lookout or a number of lookouts to keep watch for rail traffic that might approach from any direction. The lookout/s must be able to provide immediate warning if such traffic is detected and is/are not permitted to undertake any other work.

2.13 In terms of the worksite protection methods that could have been used, it was apparent that there was insufficient time for a Local Possession Authority to have been issued and advertised. The inspection of, and minor repairs to the No.56 points could have occurred under the provisions of a Track Occupancy Authority, a Track Work Authority or Controlled Signal Blocking if authorised by the Network Controller. Subject to some specific requirements being satisfied, the work was also permissible under the provisions of the more expedient method of No Authority Required.

2.14 There are additional, and quite technical, limitations associated with the application of each of the above five methods of safe-working. However, each method is underpinned by the following requirements:

a. work cannot occur unless the workers have access to a safe place within the rail corridor that can be easily reached in a timely manner;

b. the level of safety must not be reduced to allow train and track vehicle movements, or because of a lack of trained workers;

c. effective communication must be maintained with Network Control Officers;

d. worksites must have a Protection Officer and his/her other duties must not interfere with protection duties; and

e. the Protection Officer must;

i. make a safety assessment before work commences,

ii. ensure work is conducted safely, and

iii. keep a record of the protection arrangements.

2.15 In addition to the five forms of safe-working, there is a specific procedure that must be followed when points do not respond to the settings applied by a Network Controller, which is contained in ANPR 740 (Responding to Faulty Points). ANPR 740 requires the Network Controller to advise both the Train

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17 A person must have obtained specific and formal qualifications before they can be employed in this capacity.
Transit Manager and an on-call signal electrician that a problem exists on the network and that the Controller apply a ‘block’ so that the related signal setting cannot be cleared while the block is in place. Despite the fact that faulty points do have an impact on the network, there is no reference to them being a ‘Condition Affecting the Network (CAN) and OTSI considers that ANGE 206 (Report and Responding to a Condition Affecting a Network) is deficient in this regard. ANPR 740 indicates that faulty points can be inspected and tested under NAR or CSB arrangements, provided the Protection Officer assesses it is safe to undertake such activity, but there is no mention of ANWT 308 or ANWT 310, i.e., the network rules covering CSB and NAR respectively, in ANPR 740.

2.16 In sum, OTSI identified a total of 27 rules within ARTC’s Network Rules and Procedures which were potentially relevant under the circumstances that prevailed in the early hours of 16 July 2007, and these are identified in Table 1. The actions and decisions of the Electrician acting in his capacity as the Protection Officer, the Network Controller and the crew of HV161 were examined with the related requirements inherent in these rules in mind.

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<th>ANGE 200</th>
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<td>Yard Limits</td>
<td>Running Signals</td>
<td>Blocking Facilities</td>
<td>Using Controlled Signal Blocking</td>
<td>Using Infrastructure Booking Authorities</td>
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<td>Using Detonators</td>
<td>Lookouts</td>
<td>Protecting Work From Rail Traffic on Adjacent Lines</td>
<td>Spoken and Written Communication</td>
<td>Responding to faulty points</td>
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Table 1: List of Applicable ARTC Network Rules and Procedures.

2.17 Voice recordings made at NCCN Broadmeadow on the morning of the accident, and phone records over the same period, provided OTSI with significant insights into the extent to which the Electrician and the Network Controller discharged their responsibilities.
2.18 The voice recordings indicated that:

a. At 4:04am (Recorded Conversation No.1), the Network Controller called an on-call electrician advising him that “I've got a points failure at Singleton”. The on-call electrician advised that he was already attending another failure on the Network and could not attend to the problem at Singleton. The Network Controller then asked whether anyone else was available to attend and the on-call electrician advised that he would contact a colleague, the Electrician, to determine if he could assist.

b. At 4:13am (Recorded Conversation No.2), the Electrician called the Network Controller and the latter indicated that “56 points at Singleton failed to reverse” and the Electrician asked whether this was causing delays to “the passenger train”. In response, the Network Controller advised that he was going to send the passenger train (V601) “bi-directional from No.200 points” (at Whittingham)\textsuperscript{18}. The Electrician then undertook to contact the Network Controller again when he arrived on site.

c. At 4:48am, mobile phone records indicate the Electrician contacted his Assistant. This call was not recorded, but presumably involved the Assistant being advised of the need to respond to a problem and discussion on the time and place where the two maintenance workers would meet.

d. At 5:22am (Recorded Conversation No.3), the Electrician phoned the Network Controller and advised that he was on-site at the No.56 points.\textsuperscript{19} During this conversation, the Electrician enquired about the location of trains that might be approaching Singleton and was advised that HV388 was approaching Camberwell, which is approximately 8km North of Singleton, and that there was another train approaching Greta, which is approximately 27km South of Singleton. As he had yet to determine

\textsuperscript{18} The term ‘bi-directional’ is referred to in the ARTC Network Rule and Procedures Glossary as “Allowing for normal travel in either direction according to the infrastructure and system of Safeworking in use”. Figures 2 and 3, on page 4, show V601 crossing onto the “Up” line at No.200 points at Whittingham and running ‘bi-directional’ into Singleton Station under ARTC Network Rule ANTR 418 “Yard Limits” and therefore being able to avoid the problem at No.56 points.

\textsuperscript{19} Footage from CCTV cameras at Singleton Station show the Electrician’s work vehicle heading in a Northerly direction past Singleton Station at 5:08am and then moving past the Station in a Southerly direction at 5:16am. NSW Police advised that the Assistant’s private vehicle was located at the Singleton Maintenance Centre which is approximately 2km North of the Station. OTSI considers that this movement was associated with the Electrician picking up the Assistant from the Maintenance Centre and then returning past the Station towards the access gates to the Singleton Yard. On this basis, OTSI was able to form the view that when the Electrician advised the Network Controller that he was on-site, his Assistant was with him.
what was preventing the points from being able to be reversed, the Electrician advised the Network Controller that he needed the points for “around 10 minutes or so” so he could continue his work and asked the Network Controller to “give me a call when you’ve got trains please”. He then asked the Network Controller to leave the points in reverse and to “put a block on them for me”. This request was followed almost immediately with a request that the Network Controller put “a lock on them for me”. The Network Controller then indicated that the points were “locked” and the call ended at 5:26am.

e. At 5:34am (Recorded Conversation No.4), the Electrician again contacted the Network Controller and requested the No.56 points be operated. Although this was not specified, the Electrician was at the No.56B points at this time. The Network Controller operated the points several times and in each instance they functioned properly. The Electrician then indicated that he had not been able to establish exactly what had caused the earlier malfunction, but that he had found coal within the mechanism of the points. At the same time, the Electrician again sought advice on the movement of trains towards Singleton. In response, the Network Controller indicated that he had “Hunter Valley 161 approaching Minimbah and I’ve got another Hunter Valley on the Up coming up to Singleton so, yeah, I’ll probably want to move a few trains around”. The Electrician remarked “Minimbah; he’s an empty so he’ll be fairly quick from there. OK you clear your roads”, i.e., clear the signals either side of the No.56 points to whatever setting was required and advised that “we’ll keep a lookout for them”. His last words to the Network Controller were “I’ll give you a call back when we’ve had a look in the other end” and the Network Controller subsequently cleared the signals to permit the movement of HV388 and HV161, from the North and South respectively, towards Singleton.

2.19 There was little of significance to be obtained from the recording of Conversation 1, but the following aspects of recorded Conversations 2, 3 and 4 are significant:

a. Recorded Conversation No.2

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20 Minimbah is located approximately 11 kilometres South of Singleton Station
i. There was no discussion about the significance of the malfunction at the No.56 points. Had such dialogue occurred, both parties might have come to the conclusion that, given it was possible to work trains around these points with little delay, rectification of the problem might be attended to during daylight. In making this point, OTSI is not suggesting that the decision to attend to the problem before first light was inappropriate, but rather that the option of delaying the work until after daybreak was never considered.

ii. There was no discussion about the method of worksite protection that might be employed.

iii. The Electrician undertook to contact the Network Controller when he had arrived at the vicinity of the No.56 points.

b. Recorded Conversation No.3

i. The Electrician was advised that trains were approaching Singleton from both the North and South and sought to be assured that he would be contacted again when these trains were closer.

ii. The Electrician’s request that the Network Controller “put a block on them” and the request that followed almost immediately thereafter that he “put a lock on them” could have been construed as a request for the No.56 points not to be moved by the Network Controller, or for CSB to be put into effect. The Network Controller’s response indicated that he had locked the points. Had the Electrician wanted the signals to have been blocked, there was a requirement for him to have specified exactly what signals he wanted blocked and for the Network Controller to have repeated this safety critical request and the voice records establish that this did not occur. Phoenix records also establish that if this was what was meant, that the Network Controller did not apply any block.

iii. Again, there was no specific reference to the form of safe-working that was in place.

c. Recorded Conversation No.4.
i. The Electrician again sought, and was provided with, an update on the movement of the approaching trains and specifically acknowledged HV161’s proximity.

ii. Irrespective of whether the Electrician used the terms “blocked” and “locked” during his previous conversation with the Network Controller correctly or synonymously, in indicating to the Network Controller that he could “clear your roads”, the Electrician would have been absolutely aware that the only form of protection available to him thereafter would be that being provided by his lookout.

2.20 As discussed in paragraph 2.15, ANPR 740 requires Network Controllers to apply blocking facilities on points when they malfunction. This is to ensure that the related signals are placed at ‘Stop’ and cannot be inadvertently cleared. When OTSI reviewed the signal system’s replay function, it confirmed that at no stage were blocking facilities applied to the No.56 points. That said, the indications that were presented to the Network Controller at the time the points malfunctioned were such that he was able to establish that while the points could not be locked in the reverse position, they could be locked in the ‘normal’ position. It was on this basis that the Network Controller made a decision not to block the No.56 points at the time and to allow PN services LD123, WK325 and BG143, and QR service MO110 to pass over them while the points were in the ‘normal’ position.

Experience, Competency and Condition of the Maintenance Workers

2.21 Both of the track-workers had been employed in the rail industry for over 30 years. The Electrician had undertaken his apprenticeship as a signal electrician with State Rail and had remained in its employ until it was replaced by RIC. He was seconded to ARTC from RIC when ARTC assumed responsibility for the Hunter Valley Network in 2004 and his trade qualifications and his qualifications as a Protection Officer were recognised by ARTC at that time. The Electrician recertified in the application of the Network Rules and Procedures in 2006 and was also assessed at the supervisory level in Occupational Health and Safety in the same year. His co-workers described him as being very competent, cautious and as having a very good knowledge of local conditions.
2.22 The Electrician’s Assistant was normally based in Tamworth where he was employed by a labour hire company which supplies qualified workers to the rail industry in NSW. In the normal course of his employment, he was required to operate over large areas of ARTC’s network and in this instance had been deployed to Singleton for a week to replace an ARTC employee who was on a leave. He also held the requisite Certificate of Competency and had recertified as Worksite Hand Signaller and Worksite Protection Officer, Level 1–4, in April 2007.

2.23 When OTSI examined the time sheets of the two maintenance workers, they showed that both workers had worked seven shifts in seven days, with the last two involving overtime on the weekend. The five shifts worked by the Electrician during the period 9-13 July 2007 had commenced at 7:00am and concluded 4:00pm. The two overtime shifts he worked on 14 and 15 July 2007 commenced at 6:00am and concluded at 3:00pm. The five shifts worked by the Electrician’s Assistant during the period 9-13 July 2007 and his two overtime shifts on 14 and 15 July 2007 all commenced at 6:00am and concluded at 2:30pm.

2.24 Using the Fatigue Audit InterDyne (FAID) software program, which was developed at the University of South Australia’s Centre for Sleep Research, OTSI calculated that the Electrician’s fatigue score was 80.8 on the day preceding the accident and 87.8 on the morning of the accident. The Assistant’s score on the morning of the accident was 82.1 and was 80.2 on the day of his previous shift, which was on 15 July 2007. The FAID fatigue index suggests that scores in the range 40-80, 80-100 and 100-120 indicate a modest, high and very high level of fatigue respectively. The related research which underpins this index indicates that a score of 80 reflects a fatigue level of approximately 200% for that obtained for a standard working week.21 Research has also established that basic human biological functions vary according to a 24 hour cycle which has been termed the body’s ‘circadian rhythm’22. It has also been established that during the periods 3:00-6:00am and 2:00-3:00pm there is a dip in the body’s circadian rhythm and that though

21 FAID is a commercially available product that is widely used within the rail industry in Australia and that is why OTSI has made use of the same application. However, FAID scores are based on a series of averages and as such cannot be used to definitively establish an individual’s actual level of fatigue at a given point in time.

22 For further information on the circadian rhythm refer to Flinders University website at http://som.flinders.edu.au/FUSA/NEUROSCIENCE/sleep.htm
we may be awake during these periods, we are less alert and more prone to error. OTSI therefore attaches some significance to the fact that both workers were working for an 8th consecutive day when they were called-out on the morning of 16 July 2007 and that were operating during the first of these two periods of circadian ‘low’. OTSI also attaches some significance to the fact that the Electrician had worked seven full shifts in succession in the seven days that preceded the early morning call-out of 16 July 2007,23 and notwithstanding that call-out, was due to commence another rostered shift at 7:00am on the same morning.

2.25 An examination of the Electrician’s roster over the preceding period revealed that he had worked 13 consecutive days in the period 15-27 April 2007 and 26 consecutive days during the period 7 May-1 June 2007. In some instances some of the days worked were of a short duration, because the hours worked were in response to a call-out. Nevertheless, such a workload suggests that ARTC has either a staffing or a rostering problem, or both, in the Hunter Valley.

2.26 Members of the family of the two maintenance workers indicated that neither worker had any form of secondary employment. The Electrician’s wife stated that her husband was used to being called out at “all hours”. However on the morning of the accident, and despite going to bed at approximately 9:00pm the night before, she thought that her husband appeared “sluggish” and slow to get moving after he was first contacted. OTSI was provided with a statement from the daughter of the Electrician’s Assistant within which she indicated that her mother had travelled from Tamworth to Singleton to spend the weekend (14-15 July 2007) with her husband and that he did not appear to be under any form of stress.

2.27 OTSI considers it significant that while the Electrician was on-call on the morning of 16 July 2007, the Assistant was not, which meant that he would not have anticipated an early morning call-out.

2.28 Toxicological testing was not conducted until March 2008 and the results were provided to OTSI in June 2008. While the tests indicated a higher than

23 The related time sheets show that the Electrician worked a total 63 hours in the period 9-15 July 2007 and that his Assistant worked 59.5 hours over the same period.
permissible level of alcohol in the two samples, with two different readings being recorded, the tests did not positively establish that the two samples were from both the Electrician and his Assistant; indeed, there was some evidence to suggest that the two samples may have come from only one of the rail maintenance workers. The Police advised that DNA testing was being undertaken to try to clarify this matter but further advised that there was no guarantee that the DNA testing would produce positive identity results.

2.29 On the basis of the toxicology tests alone, it was not possible to make a determination whether or not the judgement or concentration of both, or one, of the rail maintenance workers might have been affected by the consumption of alcohol. If DNA testing establishes that both samples were from one of the workers and can positively identify the tissue as belonging to either the Electrician or his Assistant, OTSI believes that, given the actual readings, any judgement about whether or not one of the workers should have reasonably been expected to have detected that his colleague might have been affected by alcohol, and therefore acted to dissuade him from commencing work, would be highly subjective.

2.30 In the face of inconclusive evidence in relation to the elevated alcohol reading in the tissue samples, it might be seen as significant that the Electrician was on-call but his Assistant was not. The Electrician’s wife has stated that her late husband did not consume alcohol on the evening of 15 July, and staff at the hotel where the Electrician’s Assistant was resident have stated that they have no recollection of seeing him drinking in the hotel on the evening of Sunday 15 July after his wife’s departure for their home in Tamworth.

2.31 Because no positive attribution could be made in relation to the toxicological finding, and on the basis of witness evidence, OTSI is unable to determine whether the consumption of alcohol contributed to the accident.

Experience, Competency and Condition of the Network Controller

2.29 The Network Controller had a total of 12 years experience in the rail industry. He commenced employment with ARTC as a signaller in June 2005 and had occupied his position as Network Controller at NCCN Broadmeadow since January 2007. ARTC’s personnel records indicated that the Network
Controller was fully qualified and had been certified as being fully conversant with its systems of safe working. The records also show that he had been deemed competent to operate various Hunter control panels, including the Middle Hunter panel (see Photo 4), at NCCN.

2.30 Rostering documentation indicated that the Network Controller worked five day shifts, two afternoon shifts (overtime) and five night shifts in the preceding fortnight and OTSI calculated that his fatigue score was 81.1 of the morning of the accident.

![Photo 4: The Middle Hunter Network Controller's panel at NCCN.](Image)

**Experience, Competency and Condition of the Drivers of HV161 and HV388**

2.31 The Driver and Assistant Driver of HV161 had 21 years and 23 years experience respectively of driving trains. The Driver and the Assistant Driver on HV388 had 38 years and 19 years experience respectively as train drivers. Both crews were within the required medical and competency assessment periods and both were familiar with, and qualified for, the route over which they were operating. OTSI examined the rosters of the crew of HV161, i.e., the train crew involved in the accident and calculated that the Driver had a
fatigue score of 67.2 on the morning of the accident, but that the Assistant Driver had a score of 89.3.

2.32 When OTSI examined the data loggers on HV161’s three locomotives, it found that there was a 168 second differential between the three data loggers and a 156 second differential between the data from the leading locomotive, 8229, and the track circuit data recorded by ARTC. Notwithstanding that the data recorders were not properly synchronised, the data logger on its leading locomotive indicated that HV161 was being operated at a speed of 81km/h at the moment it struck the two maintenance workers and this was consistent with the data obtained from the other two locomotives. It also showed that the leading locomotive’s headlights had been switched off at 5:46:22am and that the train’s emergency brake was applied at 5:48:10am, all of which is consistent with the Driver’s account of the accident.

2.33 Similarly, there was a 520 second differential between the three data loggers on HV388 and an 82 second differential between the data from the leading locomotive, 9010, and the track circuit data. Significantly, at 5:44:09, this locomotive’s horn was sounded which is consistent with its Driver’s advice that he had sounded his train’s horn on seeing the two track workers.

2.34 Notwithstanding the fact that the data loggers on HV388 and HV161 were not properly synchronised, the data indicates that both trains were being driven appropriately and that their lights and whistles (horns) were operated in accordance with Network Rules ANTR 406 and 408 respectively.

2.35 In addition to examining the data loggers, OTSI paid particular attention to the lights on the leading locomotive on HV161. Lighting standards for headlights and visibility lights on locomotives operating in Australia are specified in the Rail Industry Safety Standards Board (RISSB) Standard “AS 7531.1: Lighting and Rolling Stock Visibility – Locomotive – Dec 2007”. While non-binding, this standard requires headlights on locomotives to be positioned at least 2.3m above the rail, have a peak intensity of 200,000 candelas and a focal range of 240m. The standard also requires that visibility (ditch) lights be positioned between 600mm and 1200mm above the rail; that they be separated from the

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25 The times in this paragraph and 2.30 have been adjusted to be consistent with that track circuitry as indicated on ARTC’s Phoenix Signal Replay System.

26 HV388 was travelling at 23km/h and had its headlights switched on at this time. Its headlights were extinguished at 5:46:11.
headlights by at least 1500mm; that they have a peak intensity of 20,000 candelas and a focal range of 25m. The headlights on HV161 complied with these requirements. However, OTSI did observe while it was in situ that the spare control jumper on the leading locomotives of a number of PN’s trains partially obscured the ditch light on the driver’s side of the locomotive (refer to Photo 5).

Photo 5: Example of a control jumper partially obstructing a ditch light

Local operating environment in the vicinity of No.56 crossover

2.36 OTSI examined the area of the accident, by both day and night, and found that there was no shortage of areas to which the two maintenance workers could have safely relocated. ARTC’s track workers are issued with a Warning Times Calculator, which is a ‘ready reckoner,’ and it identifies that where the posted track speed is 130km/h NAR should not be applied unless a minimum sighting time of 17 seconds can be achieved. OTSI noted that any train approaching the No.56A points on the ‘Down’ track at night should have been visible to a lookout at a distance of 1240m, provided its headlight was illuminated. Given that some trains are permitted to operate at 130km/h in the
area, this would have afforded a lookout with 34 seconds in which to detect a train travelling on the ‘Down’ line at this speed and 51 seconds to detect a train travelling at 80km/h, warn his/her fellow track workers and for all of them to move to a safe place. As such, OTSI concluded that the Electrician’s Assistant was placed at a location that met the sighting distance specified by ARTC as being required when working under NAR.

2.37 OTSI arranged for similar train movements to those of HV388 and HV161 through Singleton on 16 August 2007, at approximately the same time and under the same conditions of illumination that prevailed at the time of the accident on 16 July 2007. During this re-enactment and while positioned within the danger zone, but at a safe place, it noted that:

a. The Driver of HV161 would have had very little warning of the presence of the two maintenance workers because although they were wearing high visibility jackets, these were only visible if there was a light source to cause them to reflect. On the night of the accident, the new moon had set and while lighting had been installed in the yard in the vicinity of the No.56 points, OTSI was advised by ARTC’S local safety manager that the yard was rarely used and that its lighting had not been used for a number of years.

b. The nearest, unobstructed lighting to the worksite at the time of the accident was from street lighting to the West. There was lighting to the East from private premises backing onto the rail corridor and also from the spot light fitted to the workers’ maintenance vehicle. However, the light emanating from these sources would have been largely obstructed by the passing wagons of HV388.

c. Trains approaching Singleton in the ‘Down’ direction with only their ditch lights illuminated appeared similar to, and could therefore be confused with, Northbound road traffic travelling on the New England Highway between Range Road and Cemetery Road at Whittingham.

d. The noise caused by the wheels of a slowing train on the rail head was sufficient to drown the sound of another train approaching in the opposite direction at a speed of approximately 80km/h until that train was approximately 50m away.
2.38 Had a proper safety assessment been undertaken prior to the commencement of work at the No.56 points, the two maintenance workers should have identified that there would be limited lighting in the area in which they would be working and that approaching trains could be operating with their headlights extinguished (refer to Photo 6). Had the Electrician reflected on the advice given to him during Conversation No.4, that two trains were nearing the area in which he was working but from opposite directions, he might also have decided to halt work at the time and to have moved to a safe place until the two trains had passed the No.56 points.

![Photo 6: Lighting conditions in Singleton Yard, at approximately 5:40am on 17 July 2007 n.b. the fact that the foreground and safety vests can be clearly seen is a consequence of the camera’s ‘flash’ light.](image)

**Risk Mitigation Strategies and their Effectiveness**

2.39 As previously indicated, ARTC attempts to manage the risks associated with working within the rail corridor through the application of safe-working rules contained in its NSW Operations Standards and Network Rule ANWT 300 (*Planning Work in the Rail Corridor*) which specifies that all work within the rail corridor must be preceded by a safety assessment and that the protection arrangements that are to be in force while the work is undertaken must be recorded. An examination of the Electrician’s documentation for the 12
months preceding the accident revealed that he had only compiled such a record on 24 occasions, with all but five of these instances occurring in 2006. The last occasion when he had compiled this form of record was on 20 May 2007. Most significantly, none of the related documentation that had been raised by the Electrician pertained to tasks that had been undertaken at night. This suggests that the Electrician was observing the requirements of ANWT 300 selectively. OTSI appreciates, however, that the Electrician would have been required to respond to points that had malfunctioned on many occasions throughout his career and in many instances the related problems would have been very readily resolved. It also appreciates that he had considerable knowledge of the local operating environment. In the absence of any record of the protection arrangements, however, OTSI had no way knowing what risk factors the Electrician may have taken into account before he and the Assistant Electrician commenced work at the No.56 points. The act of documenting protection arrangements may seem to be an unnecessary impost at times by highly experienced rail maintenance workers but the process is intended, in part, to ensure that even the most experienced of practitioners think about the task that confronts them in advance and in a structured way and, in so doing, to guard against complacency.

2.40 In addition to examining the Electrician’s documentation, OTSI examined ARTC’s internal audit documentation to identify whether the Corporation was monitoring the extent to which its workers were observing its safe-working rules and policies. This examination revealed that nine ARTC Risk and Safety Officers had conducted a total of 21 field worksite audits throughout NSW during 2006-2007. Given that there would have been few days throughout this period in which some form of track work was not performed in ARTC controlled territory throughout NSW, OTSI considers that this reflected a low level of audit activity with respect to worksite protection. The audit documentation that was able to be provided to OTSI indicated that audits were generally being conducted by day and the auditors’ comments suggested that Protection Officers appeared to be generally complying with ARTC’s requirements. While these audits included observations about activity within worksites, and examined safety plans and pre-work briefing forms pertaining to a given day’s activity, it is significant that there was no examination of any of the risk assessment/s that preceded the work. In
addition, there was no evidence to suggest that ARTC’s audits were giving consideration to whether, or not, key safety requirements associated with the related work were being recorded on train graphs, e.g., such detail as whether or not signals were being blocked, the time at which blocks were requested or lifted, and the method of worksite protection being applied in response to unplanned events. Given that the use of train graphs is mandated and their importance, both in assisting a Network Controller to maintain situational awareness and as a record of train working arrangements at any given time, OTSI was surprised to find when it reviewed a sample of six train graphs compiled at NCCN Broadmeadow during the period 9-23 September 2007, 19 instances where important information which should have been annotated on a train graph was not. All of the missing information pertained to conditions affecting the network, revised train working and/or matters affecting worksite protection. This suggests that there is room for improvement in the maintenance of train graphs within NCCN Broadmeadow and further indicates the need for improved auditing in relation to worksite safety protection by ARTC.

**No Authority Required (NAR)**

2.41 NAR is the most frequently employed method of worksite protection in NSW. However, NAR is not permitted elsewhere in Australia because it is considered that there is no ‘redundancy’ within this method of worksite protection, in that Train Drivers and Network Controllers may be oblivious to the presence of those working on the track and the onus for protection rests entirely with the Protection Officer and the lookout/s he/she deploys. A form of NAR (Standard 38) was used until recently in Queensland, but only for the purposes of inspection. Once the need for maintenance work was identified, even that requiring the use of light tools only, a higher form of worksite protection was required. However, Standard 38 was recently withdrawn as a result of the deaths of two track workers who were struck by a train while they were undertaking track maintenance under Standard 38 at Mindi, Southwest of Mackay, in December 2007. The minimum requirement that must be observed before track work can be undertaken elsewhere in Australia is that the Protection Officer must communicate his/her intentions to Train Control and must be provided with information pertaining to train movements in the
area where the work will be undertaken (under NAR in NSW, these two requirements are not mandatory).

2.42 The frequency with which NAR is employed in NSW is a consequence of its expediency in that it lends itself readily to circumstances where work could not have been pre-planned and because it does not impact on train running. OTSI has reviewed many reported occurrences involving some form of safe-working incident throughout NSW since it came in to being on 1 January 2004 and such review indicates that it is not uncommon for NAR to be used when the circumstances should have dictated that a higher level of protection was required and that even when it is an appropriate form of worksite protection, the associated procedural requirements are not always met. OTSI’s observations are re-enforced by the results of detailed analysis undertaken by RailCorp in 2005. An overview of this analysis is provided later in this report.

2.43 In the two months immediately after this accident, OTSI received two reports from operators where employees were involved in ‘near hit’ situations in ARTC territory in NSW while working under NAR. Disturbingly, in one case, the members of an ARTC work gang denied any involvement in the incident for a number of days before evidence confirmed their presence at the site on the day and at the time of the incident. The second incident occurred when a RailCorp worker was not alerted to the presence of an approaching train by a lookout.

2.44 On 1 October 2007, an OTSI investigator observed two surveyors standing in the danger zone in the middle of the bridge over Mudies Creek at Whittingham (refer to Photo 7). OTSI suspected that their work was being conducted under NAR and contacted ARTC’s local risk and safety officer to express concern about the fact that neither of the two workers appeared to be looking-out. In the course of this conversation, it was established that the work was occurring under NAR.

2.45 ARTC’s maintenance staff at Singleton advised OTSI that following the accident at the No.56A points, they implemented a local procedure which requires that a minimum of three maintenance workers be deployed to attend to any problem within the danger zone, by day or night. This is to ensure that if NAR is being used, the person performing the inspection or maintenance can be assisted without the lookout being compromised. Where assistance is
not required, it allows for the provision of two lookouts. While OTSI considers that while this is a positive step and while there is safety in numbers, there are situations where two lookouts are required and in such situations there is no guarantee that one of the lookouts will not become involved in assisting in the inspection or repair of equipment. OTSI also considers that, even with additional numbers of personnel, the use of NAR will remain especially problematic at night when judging distance becomes significantly more difficult. If a train has its headlight extinguished, there is also scope for lookouts to associate its ditch lights with the movement of a motor vehicle.

Photo 7: Two maintenance workers observed at Whittingham on 1 October 2007 using NAR
n.b. both workers are looking inwards

2.46 It is important to note that the application of NAR in NSW is not just problematic in territory controlled by ARTC. Throughout 2004-2005, RailCorp undertook a “Work Site Protection Project” which involved its own subject matter experts and consultants with risk management, human factors and safety science expertise. In the course of this project, 344 incident reports relating some form of breach of worksite protection that had occurred in NSW
during the period August 2001 to August 2004 were examined. This examination revealed that:

a. 71 of the instances were the result of an inappropriate form of safe-working being employed;

b. 65 instances could be attributed to poor communication between the Protection Officer and the Network Controller;

c. 64 instances could be attributed to there being no safe place, or the track worker/s not moving to a safe place;

d. 35 instances could be attributed to the lookout failing to identify an approaching train or there being no lookout; and

e. in 19 instances, blocking facilities on signals were either not applied when they should have been, or were lifted when they shouldn’t have been.

2.47 The project team also reviewed in further detail 77 of the 344 reported instances in which worksite safety requirements were breached. 24 of these instances involved situations where those working in the danger zone were nearly hit by a train or track machine. It is highly significant that all of these 24 instances occurred under NAR, of which 18 involved errors during the planning or execution of the work, or ‘tolerated’ violations of the rules.

2.48 The project team made a total of 37 principal recommendations to improve protection arrangements at work sites within the rail corridor, but significantly, and notwithstanding that it identified track-workers working under NAR failing to reach a safe place as being the second most likely scenario in which a rail worker was likely to be fatally injured, it did not recommend that NAR be abandoned as a method of safe-working. However, it did recommend, amongst 14 other matters that should be adopted within six months, that Protection Officers be required to contact the relevant Signaller before they entered the danger zone with the intention of working under NAR, and that the Signaller be required to document the location where the related work was to occur and to pass on that advice to train drivers and other Protection Officers who may be operating in nearby areas. OTSI considers it not unreasonable to posit that if the Driver of HV161 had received prior warning of the presence of the two track workers on the morning of 16 July 2007, he is likely to have
sounded his train’s horn and ensured the train’s headlights were illuminated on approach to No.56 points and this would have been sufficient to have alerted the two track workers to the train’s presence.

2.49 The project team made 39 sub-recommendations that it considered should be implemented within a timeframe of two years. Perhaps the most significant in the context of OTSI’s investigation was that RailCorp develop the capacity to program the location of worksites into its Metronet Train Radio system, so that drivers would be automatically alerted in the event they were approaching a worksite. OTSI notes that this would be an extremely useful development, but that it pertains to circumstances where work has been pre-planned and where planning is being centrally coordinated. In addition to these 39 sub-recommendations that it was felt needed to be adopted in the “mid term”, the project team recommended that within five years, RailCorp investigate other automated train warning systems, including the option of installing receiver units in locomotive cabs that warn train drivers when they are approaching a worksite. Such systems are already in widespread use in other countries and OTSI considers that if NAR is going to be continued to be used, the use of such warning equipment should be mandatory.

2.50 When OTSI recently sought an update on the status of actions being taken in response to the report’s recommendations, it was advised that a newly formed Project Control Group is currently re-examining the recommendations. While it appreciates that some of the recommendations were always going to require careful consideration, the fact that the majority of recommendations remain under review suggests to OTSI that RailCorp has been slow to respond to the report.

2.51 In April 2008, the Rail Industry Safety and Standards Board listed a range of draft safe-working rules and procedures on its website and invited comment on those rules. The draft rules and procedures have been designed within the construct of a project that the RISSB hopes will result in a national set of rules and procedures. It is significant that there is no reference to NAR and that the minimum method of work-site protection that is proposed is ‘Lookout Protection’. A copy of that proposed method is included at Appendix 1. If adopted, this method would addresses OTSI’s major reservations about NAR in that:
a. it would be employed by day only, which reduces the degree of difficulty associated with the requirement for Protection Officers and lookouts to judge distances at night and improves the prospect of track workers being seen; and
b. it requires communication between the Protection Officer and the Network Controller and the exchange of train running information before work is commenced, thereby improving the situational awareness of both parties.

2.52 OTSI considers that the Lookout Protection method of work-site protection as proposed by the RISSB could be further improved by specific references to the requirement that:

a. safety/risk assessments be documented;
b. the role of Protection Officer must be performed by someone with the requisite qualifications, and
c. that information pertaining to the presence of workers on the track is passed by Network Controllers to drivers operating rolling stock on the same track.

Adequacy of the Emergency Response

2.53 The two rail maintenance workers died instantly when they were struck by the train. Accordingly, OTSI's interest in relation to the emergency response focused primarily on the timeliness of notification of the accident and of any subsequent response by relevant agencies. Voice recordings and agency records indicate that:

a. The Assistant Driver of HV161 notified the Network Controller of the accident at 5:48am while his train was coming to a stand and that the Network Controller then immediately contacted ‘000’.

b. The NSW Ambulance Service was notified of the accident at 5:53am and it dispatched three ambulance vehicles\(^{27}\), the first of which arrived at Singleton Station at 6:02am.

c. NSW Police were notified of the accident at 5:54am and arrived on site at approximately 6.20am.

\(^{27}\) These vehicles carried a range of equipment to facilitate a proper search and recovery of the deceased workers.
2.54 OTSI also noted that while present on the platform at the time of the accident, RailCorp’s Customer Service Assistant at Singleton would not have been well placed to render assistance in this or any other emergency situation as he had not been required by RailCorp to undertake any form of First Aid training.

**Other Matters Which Would Improve Rail Safety**

**High Visibility Vests**

2.55 The two rail maintenance workers were wearing high visibility safety vests while they worked at the No.56 crossover and these conformed to Australian/New Zealand Standard AS/NZ 4602:1999 Class D/N, with the D/N classification indicating that the vests were deemed suitable for both day and night use. However, Appendix B of the standard contains the warning that “any selection of garments should be based on the identification of all possible risks to the wearer not being adequately seen by approaching traffic in time for a collision to be avoided”. This warning is salutary because during the re-enactment it was noted that when the approaching trains extinguished their headlights, and given low levels of lighting in the yard and nearby streets, the standard safety vest worn by those within the danger zone was very difficult to detect. Given that HV161’s ditch lights had an effective range of 25m, at 80km/h its crew are likely to have had just over one second’s warning of the presence of the two rail maintenance workers. While such safety vests are not intended to be the only form of protection afforded to rail workers during the hours of darkness, OTSI considers that the rail industry needs to identify a new range of high visibility clothing which emits its own light and notes that such apparel is available within Australia.

**Summary**

2.56 The two rail maintenance workers were called-out by a Network Controller in the early hours of the morning to respond to a set of points that could not be reversed. The Electrician was not rostered for duty in Singleton but he was on-call to respond to events in another area. The Electrician’s Assistant was not on-call and therefore would not have anticipated being requested to respond to a problem on the network in the early morning. However, because the personnel who were on-call to respond to events in the Singleton area were responding to another event, and notwithstanding that they had
worked seven shifts in the preceding seven days, the Electrician and his Assistant deployed to the No.56 crossover and were subsequently struck at the No.56A points by HV161.

2.57 The two rail maintenance workers were highly experienced; the Electrician was very familiar with the area in which he and his colleague were operating and both workers would have regarded their task as routine. However, they would also have been aware that ARTC’s rules require that any track work, no matter how routine, must be preceded by the conduct of a safety assessment by a qualified Protection Officer, and that the protection arrangements to be employed must be documented. Both workers were qualified to conduct the safety assessment and voice recordings established that the Electrician acted as the Protection Officer. In the absence of any record of the protection arrangements, OTSI had no way of determining whether a safety assessment was undertaken. However, the voice recordings establish that the Electrician was concerned about the presence of trains approaching him and was provided with information pertaining to their movement by the Network Controller.

2.58 The Electrician employed the NAR method of worksite protection and this meant his safety, and that of his colleague, was entirely dependent on one of them being able to detect an approaching train in sufficient time to alert the other and for the two workers to then move to a safe place. However, both of the workers became engaged in attending to the No.56A points and immediately prior to being struck, neither of them was maintaining a lookout. This error might not have been fatal had either of the workers heard HV161 approaching for even a few seconds because there were safe places in very close proximity. Unfortunately, the sound of HV161’s approach was masked by the noise of the braking of HV388 on the adjacent line.

2.59 Had the Driver been operating HV161 with its headlights on, he may have detected the two maintenance workers in sufficient time to have alerted them by sounding his train’s horn. However, on seeing HV388, the Driver of HV161 extinguished his train’s headlight, as he was required to do. Having passed the leading locomotive of HV388, and given his proximity to Singleton Station, the Driver of HV161 had the option of either continuing to operate with his headlight extinguished or turning the light back on, in the dimmed (low beam)
position, and opted for the former. While HV161’s headlight was extinguished, the train’s ditch lights remained illuminated. However, their effective range was 25m which meant that the Driver could not have seen the two workers in sufficient time to have sounded his horn. In the absence of a light cue and because of the noise being generated by HV388 on the adjacent line, the two rail maintenance workers remained oblivious to HV161’s presence.
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
The two rail maintenance workers were working under a method of worksite protection known as NAR and this required that one of them kept a lookout at all times. In the instant before HV161 struck the two rail maintenance workers, the Driver saw one of them crouching or kneeling at the No.56A points while the other was standing with his back towards the train and appeared to be pointing a torch onto the track. Since neither of the workers was keeping a lookout at this time, neither of them saw the approaching HV161 and did not appreciate the need to move to a safe place.

b. Contributory Factors
The following factors contributed to cause the accident:

i. The NAR method of worksite protection employed does not oblige those who employ it to communicate their intentions to others. In this instance, the Electrician did advise the Network Controller of his intentions but the Network Controller was not obliged to, and did not, inform the Drivers of HV161 and HV388 that there would be maintenance workers on the track near Singleton Station. While the Driver of HV388 ultimately saw the two maintenance workers, the Driver of HV161 had no forewarning of their presence and at the time he saw them, he did not have time to warn them of his train’s presence.

ii. Visual and audible cues that might have alerted the two workers to HV161’s approach were diminished because HV161 was operating with its headlight extinguished and the noise generated by the passing of HV388 on an adjacent line masked the sound of HV161’s approach.

iii. The two maintenance workers had worked within the danger zone at night on many occasions and the Electrician was very familiar with the location in which he and his colleague were working. It is possible that
these high levels of familiarity lessened the workers’ appreciation of the risks associated with their task.

iv. The Electrician was not rostered for duty in the Singleton area but he was on-call to respond to events in the area Whittingham-Muswellbrook-Dartbrook-Gulgong on the morning of 16 July 2007. However, the Electrician’s Assistant was not on-call and would therefore not have anticipated being called-out in the early hours of the morning. In addition, both workers had worked seven shifts over the preceding seven days. It is therefore probable that both workers were suffering from a degree of fatigue and that this may also have affected their appreciation of the risks associated with their task.

c. Anticipation and Management of Risk

i. ARTC Network Rule ANWT 300 (Planning Work in the Rail Corridor) specifies that all work within the rail corridor\(^ {28} \) must be preceded by a safety assessment by a qualified Protection Officer and that the protection arrangements that are to be in force while the work is undertaken must be recorded. Both of the maintenance workers were qualified Protection Officers but it is clear from recorded conversations that the Electrician was acting in this capacity at the time of the accident. However, OTSI could not find any record of the protection arrangements and therefore had no way of determining whether the work was preceded by a safety assessment.

ii. ARTC’s Network Rule ANGE 204 (Network Communications), and a related Network Procedure, ANPR 721 (Spoken and Written Communication), requires a structured approach to the transmission and receipt of information and obliges those who are communicating to reach a complete and shared understanding of those matters under discussion. The Network Controller and the Electrician conversed on three occasions during the morning of 16 July 2007 but their communication did not conform to ARTC’s requirements. While their manner of communication did not contribute directly to the circumstances that led to the accident, had the Electrician and the Network Controller observed the required

\(^{28}\) The rail corridor is the area within the fence lines that surrounds rail track, or 15m from the outside rail where there are no fences.
communication protocols and communicated in a more structured way, aspects such as the proximity of HV161 and HV388 and the instructions to clear signals would have to have been repeated by the Electrician and Network Controller respectively and greater significance might have been attached to both of these safety critical instructions.

iii. Quite apart from those rules that were not observed, there were two further instances where an opportunity to reduce the risks associated with events at the time were missed. While those associated with the following missed opportunities were not under an obligation to have undertaken any of the following actions, had they done so, HV161 might not have struck the two maintenance workers:

(a) The Network Controller could have alerted the drivers of all trains scheduled to approach Singleton that No.56 points had malfunctioned and that maintenance workers were/would be on the track to rectify the problem. This might have encouraged the Driver of HV161 to have approached Singleton at a slower speed and would almost certainly have encouraged him to have sounded his train’s horn on the approach to the No.56 points.

(b) Had the Driver of HV388 opted to alert the Driver of HV161 to the presence of the two maintenance workers after he detected them, which was approximately four minutes prior to their being struck, again the Driver of HV161 would almost certainly have been encouraged to have sounded his train’s horn on the approach to the No.56 crossover.

iv. The effectiveness of NAR as a method of worksite protection is entirely dependent on the siting, and diligence, of those tasked with looking-out. It is also the most commonly-used method of worksite protection within NSW because it is expedient and has the least amount of impact on train running. However, because it only provides a single point of defence of defence, NAR is not used elsewhere in Australia.

v. ARTC’s understanding of the extent to which its worksite protection requirements are being complied with would be improved by an increase in audit activity and by the inclusion of a requirement that before its auditors attend a pre-work safety briefing and go on-site, they must first
examine the related safety assessment/s and by requiring that they must subsequently examine the related train control graph/s.

vi. RailCorp undertook a major review of its worksite protection arrangements in 2005. While it appreciates that some of the recommendations were always going to require careful consideration, the fact that the majority of recommendations remain under review suggests to OTSI that RailCorp has been slow to respond to the report.

d. Effectiveness of the Emergency Response
   i. The crew of HV161 reported the accident in a timely fashion and the Network Controller alerted Emergency Services to the occurrence without delay.

   ii. The first ambulance arrived at the scene within nine minutes of being advised of the accident, but the two workers were already deceased.

e. Other Safety Matters
   i. ARTC’s and RailCorp’s Network Rules ANTR 406 and NTR 406 (*Using Train Lights*) require train drivers to extinguish their headlights on approaching another train, and to either extinguish or dim them when approaching a motor vehicle on a nearby road, a platform, a signal box or a location where shunting is in progress. While OTSI considers it appropriate for train drivers to dim their lights under such circumstances, it considers that the benefits derived from extinguishing their lights at these times are outweighed by the risks of such an action.

   ii. While the two maintenance workers were wearing approved high visibility vests, such vests have little utility unless they are exposed to some form of light which causes them to reflect. The two workers were operating in an area where there was little lighting and HV161 was operating with its headlight extinguished in accordance with ARTC Network Rule ANTR 406. This meant that the two workers would not have been visible to the Driver of HV161 at a distance which would have allowed him to have warned them of his approach.
iii. It was noticed that on some of Pacific National’s locomotives, the spare electrical control jumper cable trunks were stowed in a way that partially obscured their ditch lights.

iv. The data loggers from both HV161 and HV388 were not properly synchronised with respect to time.
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 and RailCorp
      i. In consultation with ITSRR, and as a priority, remove Network Rules ANWT 310 and NWT 310 (No Authority Required) and replace them with the Lookout Protection method, but in a modified form which includes specific reference to the requirements that:
         (a) protection arrangements be documented;
         (b) the role of Protection Officer be performed by someone with the requisite qualifications, and
         (c) information pertaining to the presence of workers on the track be passed by Network Controllers to drivers operating rolling stock on the same track.
      ii. In consultation with ITSRR, amend Network Rule ANTR 406 and NTR 406 (Using Train Lights) to remove the requirement for train drivers in NSW to extinguish their headlight on approaching another train and the option of their doing the same when approaching a motor vehicle on a nearby road, a platform, a signal box or a location where shunting is in progress, and instead, require them to dim their headlight instead in all of these circumstances.
      iii. Ensure that radio communication within the territory they control in NSW conforms to the requirements of Network Rules ANGE 204/NGE204 (Network Communications) and Network Procedures, ANPR 721/NPR 721 (Spoken and Written Communication).
      iv. Review the range of safety clothing and safety equipment provided to its rail safety workers to ensure that, irrespective of the worksite protection arrangements under which they are working, visibility of them within the danger zone at night is not solely dependent on external sources of illumination.
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v. Investigate, as a matter of priority, the use of existing technologies that automatically alert those that are required to work in the danger zone of an approaching train, or other form of rolling stock, and which also automatically alerts those operating such rolling stock when they are approaching a worksite.

b. **Australian Rail Track Corporation**
   i. Review its SMS (Safety Management System) to ensure that there are adequate control measures therein to properly manage the risks associated with fatigue.
   
   ii. Having satisfied itself that its SMS does contain adequate control measures to properly manage the risks associated with fatigue, or having acted to ensure that it does, ensure that the related controls are being acted upon.
   
   iii. Improve its process for auditing worksites by the inclusion of a requirement that before auditors attend a pre-work safety briefing and go on-site, they first examine the related risk assessment/s, and by requiring that they must subsequently examine the related train control graph/s.

c. **Pacific National Limited**
   i. Ensure that spare electrical control jumper cable trunks are stowed in a way which does not obstruct visibility of any of its locomotives' lights when they are illuminated.
   
   ii. Ensure that event recorders fitted to its locomotives are properly synchronised and are regularly inspected, maintained and calibrated.

d. **The Independent Transport Safety & Reliability Regulator**
   i. In light of continuing evidence of its limitations, and as a matter of priority, prohibit the use of NAR as an approved method of worksite protection within NSW.
   
iii. Monitor ARTC’s efforts to ensure that work within the rail corridor in ARTC controlled territory within NSW occurs under arrangements that conform to its revised worksite protection requirements.
PART 5 APPENDICES
Appendix 1: Draft Network Rule (Lookout Protection),
as proposed by the RISSB

<table>
<thead>
<tr>
<th>1 Purpose</th>
<th>To prescribe the rules for working in the Danger Zone without a work on track authority using the Lookout Protection method.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 General</td>
<td>If a safety assessment shows that it is safe, some kinds of work may be done in the Danger Zone without a work on track authority. Lookout Protection is one of those methods of working.</td>
</tr>
</tbody>
</table>

**WARNING**

If the safety assessment shows that a work on track authority is necessary, work must not be done using the Lookout Protection method.

If *absolute signalling* or other engineered systems are available, where practicable the use of Absolute Signal Blocking (ASB), Engineered System Blocking (ESB) or Blocking Protection (BP) is preferred.

<table>
<thead>
<tr>
<th>3 Restrictions</th>
<th>Work in the Danger Zone using Lookout Protection method must be done:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• in daylight hours only, and</td>
</tr>
<tr>
<td></td>
<td>• in locations that allow adequate sighting of approaching rail traffic, and</td>
</tr>
<tr>
<td></td>
<td>• for a maximum of two hours.</td>
</tr>
</tbody>
</table>

*Network Control Officers* must treat requests for additional time as a new request for access.

**WARNING**

The Lookout Protection method must not be used for work on the overhead wiring, work that breaks the track or alters track geometry or structure.

<table>
<thead>
<tr>
<th>3.1 Tools</th>
<th>Only <em>light non-powered hand tools</em> that can be removed easily and immediately from the track by one person without mechanical assistance may be used for work using the Lookout Protection method.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>4 Safety measurere</th>
<th>Lookouts are the only safety measure used in this method of working on track.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Safe places</td>
<td>An easily-reached <em>safe place</em> must be available where Lookout Protection is used for work on track.</td>
</tr>
</tbody>
</table>

Workers must be able to remove themselves, tools and materials.
5 Protection Officer

There must be a Protection Officer for the period of the work. A Protection Officer's primary duty is to keep the worksite and workers safe. A Protection Officer must be satisfied that other work will not interfere with protection duties. A Protection Officer must:

- use the safety assessment to determine the number of Lookouts needed, and
- tell workers about the locations of safe places, and
- the kinds and limits of safety measures in place, and
- be the only person to speak to Network Control Officers about safety arrangements.

6 Lookouts

Lookouts must:

- keep watch for rail traffic approaching the worksite from any direction, and
- warn workers immediately if rail traffic approaches the worksite.

**WARNING**

Lookouts must be alert for rail traffic which is unpredicted or comes from the wrong-running direction.

Lookouts must not:

- manage the passage of rail traffic, or
- do any other work.

7 Communication

Work must not begin until the Protection Officer has:

- spoken to the Network Control Officer about the work and safety arrangements, and
- obtained Train Running Information.

The Protection Officer must tell the Network Control Officer when work is completed.

8 ANRP Procedures

<table>
<thead>
<tr>
<th>ANRP NRP 711</th>
<th>Using Lookout Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANRP NPR 712</td>
<td>Protecting work from rail traffic on adjacent lines</td>
</tr>
</tbody>
</table>
Appendix 2: Sources and Submissions

Sources of Information

- ARTC Network Controller (Middle Hunter)(NCCN)
- ARTC Train Transit Manager NCCN
- Australian Railway Association
- Bureau of Meteorology
- Crew members of HV161
- Crew members of HV388
- Driver of CityRail Passenger Service V602
- Members of Deceased Workers’ Families
- Officers of the NSW Ambulance Service
- Officers of the NSW Police, Hunter Valley Command
- RailCorp Customer Service Attendant, Singleton
- Singleton Signal Maintenance Team

References

- ARTC Network Rules and Procedures
- Australian Standard AS/NZ 4602:1999
- Passenger Transport Act 1990 (NSW)
- RailCorp Network Rules and Procedures
- Rail Safety Act 2002 (NSW)
- 2005 RailCorp “Work Site Protection Project”

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:

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

Submissions were received from the following Directly Involved Parties:

- Australian Rail Track Corporation
- Independent Transport Safety and Reliability Regulator
- RailCorp

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.