Australian Government
Australian Transport Safety Bureau

Collision between Pacific National train 9221 and Aurizon train 9T66

Oonoomurra, Queensland | 27 February 2018

Investigation

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Addendum

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Safety summary

What happened

On the night of 27 February 2018, the Queensland Rail Network Control Officer (NCO) at Townsville planned to cross two freight trains at Oonoomurra on the Mount Isa line, Queensland. Train 9221 had departed Cloncurry at about 2310, travelling in an easterly direction toward its limit of authority at Oonoomurra. Shortly after train 9221 stopped at Oonoomurra, its rail traffic crew advised the NCO that the rear of the train was clear of the track section between Cloncurry and Oonoomurra.

The NCO then issued an authority to the crew of train 9T66, travelling in a westerly direction, to continue through Oonoomurra toward Cloncurry, as train 9221 had reported clear of that track section. The crew of train 9T66 entered Oonoomurra travelling at about 25 km/h. As the train rounded a sweeping left curve at the western end, the crew sighted three empty container wagons at the rear of train 9221, with the last wagon fouling the track. The driver made an emergency brake application but was unable to avoid a collision. The collision caused minor damage to the lead locomotive of train 9T66 and the last wagon of train 9221, derailing its trailing bogie. There was no injury to the rail traffic crew of either train.

What the ATSB found

The on-board information system in the lead locomotive of train 9221 was operating in a degraded state, displaying erroneous speed and distance information to the driver. The driver, unaware of the error, relied on the displayed indication of distance travelled to determine the last wagon of train 9221 was clear of the track section to its rear. The rail traffic crew of train 9221 did not make sure the train was in clear before releasing the track section to the NCO.

Towards the western end of the crossing, the track alignment resulted in the headlight of the lead locomotive on the opposing train projecting light predominately to the right of the track, away from train 9221. The rail traffic crew were observing the top sections of the adjacent bulk wagons but it was not until the track alignment transitioned to straight that the crew then sighted the last of three empty container wagons at the rear of train 9221. By this time, with the train travelling at 25 km/h and despite making an emergency brake application, a collision was unavoidable.

What's been done as a result

Pacific National (PN) verified the accuracy of the Functionally Integrated Railroad Electronics (FIRE) system on each 83-class locomotive in its fleet and the process for advising rail traffic crew to use alternative methods to validate accuracy of displayed information, should a ground radar fault occur. Additionally PN introduced procedures for the maintainer to identify restrictions to a locomotives operation as lead, and reinforced the implementation of procedures associated with the active identification of a stopping location with PN staff.

In the longer term, PN undertook to investigate procedural or locomotive-based system changes to alert rail traffic crew of an inconsistent speed fault, based on deviations greater than 7 per cent and to advise rail traffic crews of this faulty meter counter occurrence and the follow-up action taken. Additionally PN undertook to review the Townsville Bulk and the Coal Depot's risk registers to ensure the identification of hazards associated with faulty FIRE system indications, and the implementation of appropriate control measures

Safety message

Rail traffic crews on both trains undertaking a cross at a directional travel station under the Direct Traffic Control safeworking system must validate rail traffic is complete and in clear prior to releasing the block to the rear of the rail traffic and prior to entering a block following receipt of a proceed authority.

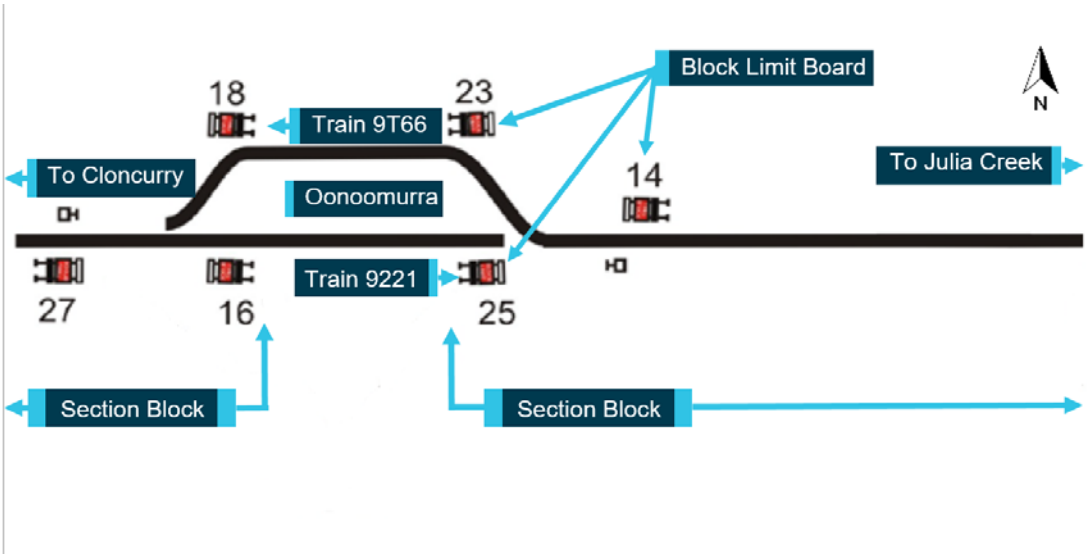
The occurrence

What happened

At about 2310[1] on 27 February 2018, the Queensland Rail (QR) Network Control Officer (NCO) at Townsville issued a direct traffic control (DTC) authority[2] for the rail traffic crew of Pacific National freight train 9221 to depart Cloncurry, Queensland and proceed to Oonoomurra, located about 14.5 km by rail to the east. About the same time, the rail traffic crew of an opposing empty Aurizon fertiliser train 9T66 were departing Undina, Queensland, travelling west toward Oonoomurra (about 39 km by rail). The NCO planned to cross the two trains at Oonoomurra. The rail comprised of a single track with crossing loops.

Later that night at about 2334, the driver of 9221 advised the NCO that the train was approaching Oonoomurra, which was the limit of their authority. The driver reduced the train speed to around 18 km/h, crossed the Landsborough Highway level crossing before entering the western end of the Oonoomurra crossing location. The Oonoomurra crossing location is a directional travel station that is 1,033m long and equipped at each end with a trailable point[3] set to divert an approaching train to the right side track. Directional travel stations between Townsville and Mount Isa are typically of similar length, equipped with trackside location boards that mark the limits of the respective Station and Section blocks and configured to divert an approaching train to the right (Figure 1).

Figure 1: DTC Blocks and position of Block Limit Boards



Source: Queensland Rail annotated by ATSB

As the locomotive cab passed the departure side[4] of trackside location board BLB OA16, the driver selected the length counter feature of the on-board information system[5] to measure the distance the locomotive had travelled after passing the board. The driver had previously set the length counter feature to a distance of 2,500 m, to assist in managing the train's approach to any

1 All times referred to in this report are local time, Eastern Standard Time (EST).
2 An instruction displayed on a computer screen, or on a prescribed form issued for rail traffic movement
3 Point designed to permit a trailing movement through points closed against the intended move. The wheelset opens the points, which spring back to the normal position after the wheelset is through.
4 When on the departure side, the worker can see the back of the board (blacked out) and not the block limit board (BLB) number.
5 Functionally Integrated Railroad Electronics (FIRE) system forming the interface between the operating crew and locomotive computer systems.

temporary speed restrictions.[6] The driver controlled train speed and referred to the distance travelled on the length counter to reduce the potential of overshooting the limit of authority at the eastern end of Oonoomurra and ensure the rear vehicle was clear of BLB OA16.

The driver stopped the train when the length counter readout reduced to 1,431 m. Having travelled 1,069m (according to the counter) and considering train length (rounded to 1,000 m), the driver calculated that the rear wagon should be in clear of the adjacent track by around 70 m. The rail traffic crew crosschecked their location and limit of authority before contacting the NCO to confirm the rear of train 9221 had vacated the Cloncurry to Oonoomurra block[7] behind them.

Shortly after, the rail traffic crew of train 9T66 contacted the NCO advising they were approaching Oonoomurra, the limit of their authority and the cross with train 9221. Having received confirmation from 9221 that they were clear, the NCO subsequently extended the authority of 9T66 from Oonoomurra through to Cloncurry.

Prior to 9T66 entering Oonoomurra, the rail traffic crew of 9221 contacted the crew of 9T66 on the train-to-train radio channel to confirm the trailable points were set for their arrival. Train 9T66 entered Oonoomurra, at speed of 25 km/h; the driver turned the locomotive headlight off as they approached the lead locomotive of 9221 to avoid shining light in the eyes of the opposing train crew.

After turning the headlight back on, the crew of 9T66 continued through Oonoomurra observing the wagons on 9221. As 9T66 transitioned into a sweeping left curve at the western end of Oonoomurra, with the headlight orientation ahead, the rail traffic crew could distinguish only the upper profile of the adjacent bulk wagons. The rail traffic crew sighted the end of the last bulk wagon, which appeared clear of their track.

As they continued through the curve, the rail traffic crew sighted three empty container wagons at the rear of train 9221, with the last wagon (RNDY 20927-S) fouling the track.

The driver made an emergency brake application shortly before locomotive 2838 collided with the middle of the last wagon of train 9221 (Figure 2). Locomotive 2838 was travelling at 25 km/h at the time of the collision and travelled about 104 m after the brake application.

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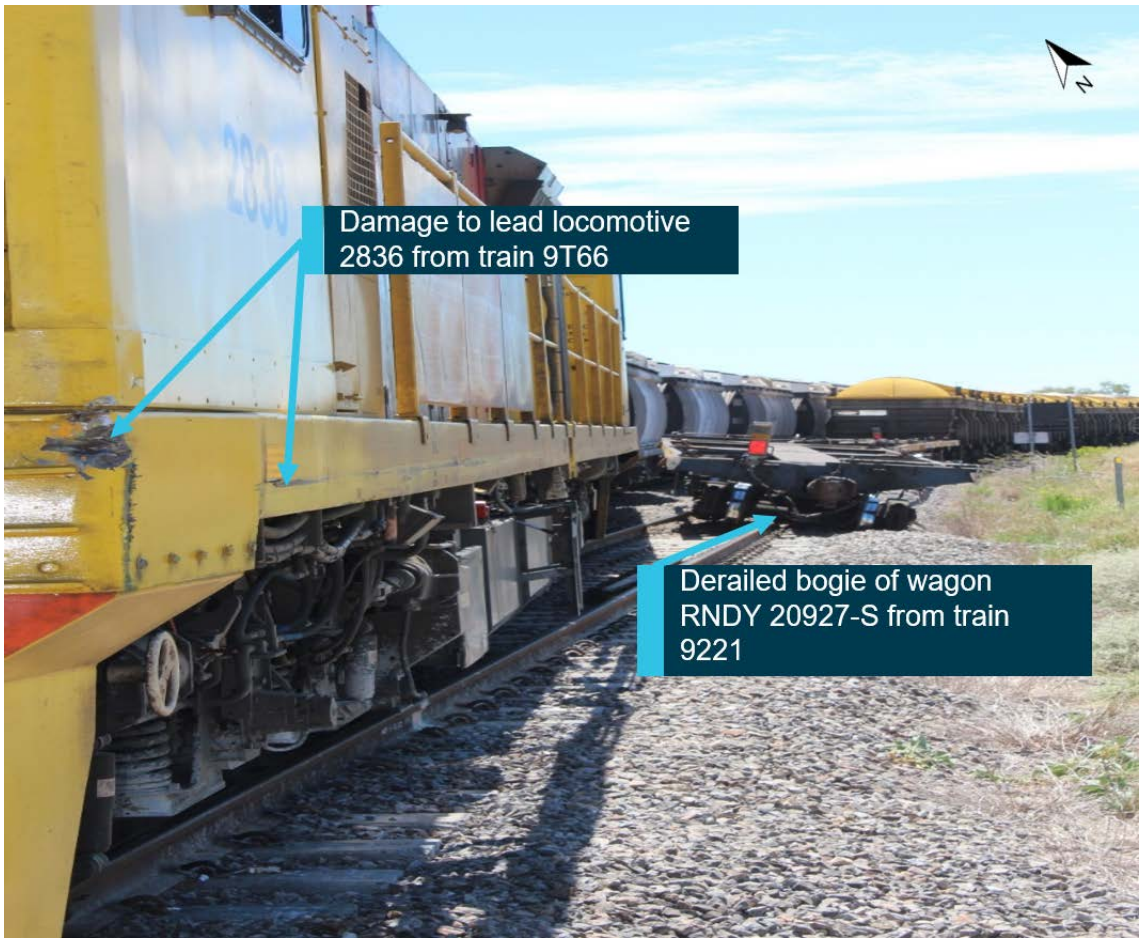
6 A Caution board is placed 2,500 m in advance of any temporary speed restriction Slow board.

7 A portion of line with defined limits between two adjoining Block Limit Boards, which only one rail traffic movement is permitted at any one time.

Figure 2: Damage to locomotive 2838 and wagon RNDY 20927-S



Source: Queensland Rail annotated by ATSB

The collision caused minor damage to the headstock of the locomotive and side frame of the wagon and the derailment of the wagon's trailing bogie. There was no injury to the rail traffic crew of either train.

Train information

Train 9221

Train 9221 was 984 m long with a gross mass of 6,422 t comprising locomotives 8316, 8315 and 8317, a crew accommodation van and 79 freight wagons (the last three were empty). Train 9221 provided a freight service, conveying mineral products between Mount Isa and Townsville.

Post occurrence inspection identified two end-of-train marker devices mounted on train 9221 (Figure 3). One marker, installed at the rear of the last wagon, was in use and connected to the brake pipe and the electronically controlled pneumatic braking system of the train. The other marker was not in use, but mounted at the rear of the fourth wagon from the end of the train. The operator had placed the additional (unused) end-of-train marker device to facilitate its operational requirements for that train service.

Figure 3: End-of train marker devices located on train 9221

Source: Queensland Rail annotated by ATSB

The QR interface standard[8] specified the requirement for operators to install at least one red tail light, or an approved end-of-train marker device to indicate the rear of the last vehicle of each train. However, the standard did not clearly preclude an operator placing additional (unused) markers in train. Post occurrence QR commenced a review into the phrasing of the interface standard to ensure their end-of-train marker device requirements are clear and operators do not place end-of-train marker devices on any part of the train apart from the last wagon.

Train 9T66

Train 9T66 was 887.96 m long with a gross mass of 1,154 t comprising locomotives 2838 and 4028 with 57 empty freight wagons. Train 9T66 provided a bulk fertiliser service between Phosphate Hill and Townsville.

[8] Queensland Rail Standard MD-10-194, Interface standard, Version 4.1, s 2.3.4.

Procedures for Directional Travel Stations

The safeworking system of Direct Traffic Control (DTC) used on the Mount Isa railway operates on the principle of absolute block working which provides that only one rail traffic movement will be authorised on any one block, at any one time. The DTC Standard[9] identifies limitations in that while the system design validates and creates authorities for issue by the NCO, it cannot:

- detect if blocks that are currently occupied, or to be occupied are released:
  - by the rail traffic crew
  - or by the NCO
- detect if a block which is available to the NCO is physically unavailable for traffic for any reason such as a track defect.

For trains to cross/pass at a directional travel station, the NCO is therefore reliant on the rail traffic crew stopped at the location to confirm their train is complete and in clear of the block to the rear (in this instance, train 9221). Following receipt of confirmation and the release code from the rail traffic crew, the NCO then issues an electronic authority for the opposing/following train (in this instance, 9T66) to proceed and occupy the vacated block.

The General Operational Safety Manual also requires the rail traffic crew of each train undertaking a cross/pass at a station to:

- ensure that the other train is in clear and complete by checking:
  - the other rail traffic is in clear
  - last vehicle (wagon) has the rear of train signal fitted and working
- tell other rail traffic crew, if possible, the rail traffic is complete.

If the opposing rail traffic is not clear, the rail traffic crew are required to

- stop clear of other traffic
- tell rail traffic crew of other rail traffic their train is not in clear

Additionally if the opposing rail traffic is not complete, the rail traffic crew are required to:

- tell rail traffic crew of opposing train
- tell the NCO
- not proceed into the block until authorised by the NCO.

[9] Queensland Rail MD-10-113, Direct Traffic Control Manual, Version 2.5, Module DT-1 General, s 1.6 Computer Operations

Safety analysis

Train 9221 lead locomotive serviceability

The lead locomotive 8316 on-board information system used a Doppler speed sensor (ground radar) and Global Positioning System to calibrate the speed and distance measurement. The ground radar on locomotive 8316 had malfunctioned about a week earlier (23 February 2018) and the locomotive returned to the maintainer's Townsville facility on the 25 February 2018. The locomotive re-entered service, on the 26 February 2018, with the ground radar equipment disconnected.

There was no record of the initial ground radar fault documented in the operator's locomotive logbook, the daily-automated report, or other maintenance records issued by the maintenance provider to Pacific National.

The disconnection of the ground radar meant that the on-board information system would not automatically calibrate speed and distance measurements. Although a calibration error existed, the maintainer considered it was within the allowable tolerance of 1 to 10 per cent. Testing by the operator found the error resulted in a lower than actual speed indication and a longer than actual length measurement. In this case, the displayed length measurement was around 120 m further than actually travelled.

There was no information displayed on the on-board information system or conveyed during the pre-start briefing or available in the locomotive to alert the rail traffic crew of the disconnection of the ground radar or the implications to the accuracy of the speed and distance information displayed on the systems monitor.

The practice of rolling stock operators operating longer trains on the Mount Isa railway has required drivers to bring their lead locomotive closer to the limit of authority to ensure the rear wagon of the train is in clear.

It is likely that the rail traffic crew in undertaking this action, and complying with the operators signal passed at danger (SPAD) mitigation procedures, place an increasing dependence on the on-board information system to identify the location of the rear of the train. Errors in the distances displayed on the on-board functions therefore have the potential to increase operational risk to that train and other trains required to cross/pass at directional travel stations operated under the Direct Traffic Control safe working system.

Crossing of trains 9221 and 9T66

Train 9221

To facilitate the cross with train 9T66, the driver of 9221 was required to stop the 984 m long train within the 1,033 m track section between block limit boards OA16 and OA25. Pacific National procedures for signal passed at danger SPAD mitigation[10] applicable to Direct Traffic Control (DTC) safeworking areas also required the driver to stop the train no closer than 50 m from the block limit board marking the limit of authority (BLB OA25), before moving forward to ensure the rear of the train was in clear. To determine the stopping point for train 9221 to be in clear, the rail traffic crew relied on the length counter function to identify the location of the last vehicle with respect to BLB OA16.

Based on the displayed distance information, the driver stopped about 82 m from the limit of authority BLB OA25 (Figure 4) believing locomotive 8316 travelled around 1,070 m into the loop and the rear of the train was therefore in clear of BLB OA16.

[10] Pacific National, Active Identification of a Stopping Location, PN-SPL-SAF, Single Point Lesson, Version 1

Figure 4: Stopping location of train 9221 relative to limit of authority

Source: Pacific National annotated by ATSB

After stopping, the rail traffic crew prepared to release their authority for the Cloncurry-Oonoomurra block to the rear. The Standard General Operational Safety Manual[11] required the rail traffic crew to undertake a number of actions, including ensuring rail traffic is in clear and complete[12] from the adjacent track. To make sure the rail traffic is in clear required the rail traffic crew to compare the length of the rail traffic to the capacity of the main line or loop and, although not expressly stated, should include consideration of the distance between the lead locomotive and the BLB ahead. The rail traffic crew, in this instance, relied solely on the displayed indication of distance travelled to determine their train was in clear before releasing the block to the Queensland Rail Network Control Officer (NCO).

A validation check comparing the indicated distance travelled against the available loop length, train length, and distance between the stopping point of locomotive 8316 and BLB OA25 may have alerted the rail traffic crew to the error in the displayed information and that the rear wagon of train 9221 was fouling the adjacent track. Information on the loop lengths, including Oonoomurra was available to rail traffic crew through the operator's route competency training and in a 'run sheet' carried on board that identified the length of the loop against the location name.

Train 9T66

After receiving an authority to proceed, the rail traffic crew of 9T66 entered Oonoomurra to cross train 9221. As the trains passed, the crews checked the other train to identify the end-of-train maker to determine if the opposing train was complete and in clear. The rail traffic crew of 9221 identified the end-of-train marker on 9T66 and advised its crew.

The rail traffic crew of 9T66 were traversing a left curve at the western end of Oonoomurra. The track alignment resulted in the headlight of the lead locomotive projecting light predominately to the right of the track, away from train 9221. The rail traffic crew were observing the top sections of the adjacent bulk wagons (ROAF class) from train 9221 and were looking for the end-of-train marker on train 9221 and BLB OA16 on the adjacent track, but could not see it.

It was not until the track alignment transitioned to straight, approaching the Landsborough Highway level crossing, that the crew then sighted the last of three empty container wagons (RNDY class) at the rear of train 9221; the last was foul of their track (Figure 5). By this time, with

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[11] Queensland Rail, MD-10-107, Module GS 2, Version 2.4, Rail Traffic Movements, s 2.9 - Rail Traffic in Clear and Complete

[12] Clear and Complete - Rail traffic where the last vehicle of a consist has passed beyond a location.

the train travelling at 25 km/h and despite the making an emergency brake application, a collision was unavoidable.

Figure 5: Stopping location of wagon RNDY 20927-S relative to the adjacent track

Image taken post collision of the re-railing of wagon RNDY 20927 illustrating the location of the wagon relative to the adjacent track and trailable point at the Western end of the Oonoomurra crossing location. Source: Queensland Rail annotated by ATSB

Findings

From the evidence available, the following findings are made with respect to the collision of train 9T66 with the rear wagon of train 9221 at the Oonoomurra directional travel station, Queensland, on 27 February 2018. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- The on-board information system in locomotive 8316 was operating in a degraded state, displaying erroneous speed and distance information to the driver.
- The Pacific National procedures to determine and communicate the serviceability of a locomotive to operate as a lead were inadequate.
- Train 9221 stopped with the rear fouling the track section between Cloncurry and Oonoomurra. The rail traffic crew relied solely on the displayed indication of distance travelled to determine the train was in clear and did not validate the distance travelled against the length of their rail traffic and the distance available in the loop before releasing the block to the Network Control Officer.
- Rail traffic crew of train 9T66, having received authority to proceed through Oonoomurra, did not identify the fouled track ahead with sufficient time to avoid a collision.

Safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Pacific National

As a result of this occurrence, Pacific National has advised the ATSB that they are taking the following safety actions:

Short term measures

- Verification of the Functionally Integrated Railroad Electronics (FIRE) systems on 83 class locomotives in the Pacific National fleet.
- Verify the message displayed to rail traffic crew when a ground radar fault occurs and determine arrangements to advise the rail traffic crew to use alternate methods to verify the accuracy of displayed information.
- Procedures for the maintainer to identify and qualify restrictions to locomotive operation to enable Pacific National to respond.
- Disseminate information to relevant staff reinforcing the procedures associated with the active identification of a stopping location.

Long-term measures

- Investigate the requirement to implement a procedural or locomotive-based system change for the identification to rail traffic crew of an inconsistent speed fault based on deviations greater than 7 per cent.
- Publish a Rollingstock Notice advising rail traffic crews of this faulty meter counter occurrence and follow-up action taken.
- Review the Townsville Bulk and the Coal Depot's risk registers to ensure the identification of hazards associated with faulty FIRE system indications and the implementation of control measures.

General details

Occurrence details

Date and time:	27 February 2018 – 2350 EST	
Occurrence category:	Incident	
Primary occurrence type:	Collision	
Location:	Oonoomurra, located 16.5 km by rail east of Cloncurry, Qld	
	Latitude: 20° 43.942’ S	Longitude: 140° 38.136 E

Train details – vehicle 1

Line operator:	Queensland Rail	
Train operator:	Pacific National	
Registration:	9221	
Type of operation:	Freight	
Persons on board:	Crew – 4	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Damage:	Minor	
Departure point:	Mt Isa, Qld	
Destination:	Townsville, Qld	

Train details – vehicle 2

Line operator:	Queensland Rail	
Train operator:	Aurizon	
Registration:	9T66	
Type of operation:	Freight	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Damage:	Minor	
Departure point:	Townsville, Qld	
Destination:	Phosphate Hill, Qld	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- Aurizon
- Pacific National
- Queensland Rail
- Rail Traffic Crew.

References

Pacific National, *Active Identification of a Stopping Location*, PN-SPL-SAF, Single Point Lesson, version 1.

Queensland Rail Standard, MD-10-113, *Direct Traffic Control Manual*, Module DT-1 General, s 1.6 Computer Operations, version 2.5, 26 October 2016, pp. 7-8

Queensland Rail Standard, MD-10-194, *Interface standard*, s 2.3.4, version 4.1, 4 September 2018.

Queensland Rail, MD-10-107, *Rail Traffic Movements*, Module GS 2, s 2.9 - Rail Traffic in Clear and Complete, version 2.4, 10 March 2014, pp. 24-25

Submissions

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

A draft of this report was provided to Aurizon, Office of the National Rail Safety Regulator, Pacific National, Queensland Rail and the Rail Traffic Crew.

Submissions were received from Aurizon, Office of the National Rail Safety Regulator, Queensland Rail and the Rail Traffic Crew. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly.

Australian Transport Safety Bureau

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

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

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

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

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

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation

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