Report 08-112: safe working irregularity resulting in a collision and derailment at Cass crossing station on the Midland Line, 8 November 2008

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Final Report

Rail inquiry 08-112: safe working irregularity resulting in a collision and derailment at Cass crossing station on the Midland Line, 8 November 2008

Approved for publication: February 2011

Transport Accident Investigation Commission

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The Transport Accident Investigation Commission (the Commission) is an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

Commissioners

Chief Commissioner	John Marshall, QC
Deputy Chief Commissioner	Pauline Winter
Commissioner	Bryan Wyness

Key Commission personnel

Chief Executive	Lois Hutchinson
Chief Investigator of Accidents	Captain Tim Burfoot
Investigator in Charge	Peter G Miskell
General Counsel	Rama Rewi
Assessor	Alan McMaster

Email:	inquiries@taic.org.nz
Web:	www.taic.org.nz
Telephone:	+ 64 4 473 3112 (24 hrs) or 0800 188 926
Fax:	+ 64 4 499 1510
Address:	Level 16, AXA Centre, 80 The Terrace, PO Box 10 323, Wellington 6143, New Zealand

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Nature of the final report

This final report may not be used to pursue criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this final report inadmissible as evidence in any proceedings with the exception of a Coroner's inquest.

Ownership of report

Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1980 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in this final report are provided by, and owned by, the Commission.

Figure 1
Locomotive DXC5327

Figure 2
Location of occurrence

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Abbreviations

Commission	Transport Accident Investigation Commission
CTC	centralised traffic control
km	kilometre(s)
km/h	kilometre(s) per hour
m	metre(s)
SLAS	single-line automatic signalling
UTC	universal co-ordinated time

Data summary

Vehicle particulars

Train type and numbers:	express freight Train 848 and express freight Train 845
Operator:	KiwiRail

Details of accident

Date and time	8 November 2008 at 0404[1]
Location	Cass crossing station, 92 kilometres Midland Line
Persons involved	2 locomotive engineers
Injuries	nil
Damage	substantial damage to one locomotive and 4 wagons

[1] Times in this report are New Zealand Daylight Times (UTC + 13 hours) and are expressed in the 24-hour mode.

1. Executive summary

1.1. On Saturday 8 November 2008, eastbound express freight Train 848, conveying 30 loaded coal wagons, overran the fouling board[2] on the main line during a scheduled crossing movement at Cass Station on the Midland Line. Westbound express freight Train 845 entered the loop before the locomotive engineer on Train 848 radioed to confirm that he had stopped his train short of the fouling board.

1.2. The lead locomotive on Train 848 struck the second wagon on Train 845 and damaged the next 3 wagons before Train 845 was stopped by an automatic application of the train brakes after the train parted. The fourth and fifth wagons on Train 845 derailed.

1.3. Neither locomotive engineer was injured.

1.4. Following the collision, KiwiRail introduced revised operating procedures for the working of crossing stations in single-line automatic signalling (SLAS) territory on the Midland Line.

1.5. No new safety recommendations have been made in this report.

1.6. Safety recommendations made in a previous Transport Accident Investigation Commission (Commission) report were relevant to this inquiry and when implemented will remove the potential for this type of accident at crossing stations.

[2] The fouling board identified a location inside which trains crossing on the adjacent line were separated safely.

2. Conduct of the inquiry

2.1. On Saturday 8 November 2008, Train 848, while berthing on the main line, overran a fouling board and collided with Train 845 entering the crossing loop during a scheduled crossing movement at Cass on the Midland Line. The Commission opened inquiry 08-112 that same day to conduct a site examination, oversee the testing of the braking system of Train 848 and interview key personnel.

2.2. On 15 December 2010, the Commission approved draft final report 08-112 for circulation to interested persons for comment, which included operating staff, management of the operating company and the regulator.

2.3. Submissions were received from the regulator and the operator, whose comments have been considered and included in the final report where appropriate.

3. Factual information

3.1. Narrative

3.1.1. On Friday 7 November 2008, Train 848 was an eastbound express freight train travelling from Westport to Lyttelton. The train, crewed by a locomotive engineer, consisted of locomotives DXC5327 and DXH5448 in multiple[3], hauling 30 loaded coal wagons with a gross weight of 2035 tonnes, and a total train length of 467 metres (m).

3.1.2. On Friday 7 November 2008 at 2350, another locomotive engineer started his shift at KiwiRail's Middleton depot before driving to Otira by car, where he took up the running of Train 848 at 0232 the next day. At Arthur's Pass he received an operating instruction from train control by radio that included a crossing with Train 845 at Cass and a crossing with Train 847 at Darfield.

3.1.3. On Saturday 8 November 2008, Train 845 was a westbound express freight train travelling from Lyttelton to Ngakawau. The train consisted of locomotives DXC5379 and DXC5419 in multiple, hauling 26 empty coal wagons with a gross weight of 453 tonnes, and an overall train length of 415 m. Before departing Rolleston, the locomotive engineer received an operating instruction from train control that included a scheduled crossing with Train 848 at Cass.

3.1.4. At about 0400, Train 848 and Train 845 approached Cass Station from opposite directions to conduct the crossing in accordance with KiwiRail's operating rules and procedures (see Figure 3). The locomotive engineer on Train 845 made a radio call to the locomotive engineer of Train 848 to confirm the berthing sequence. It was agreed that because both sets of main-line points were set in the normal position, Train 848 would enter the station first and berth on the main line.

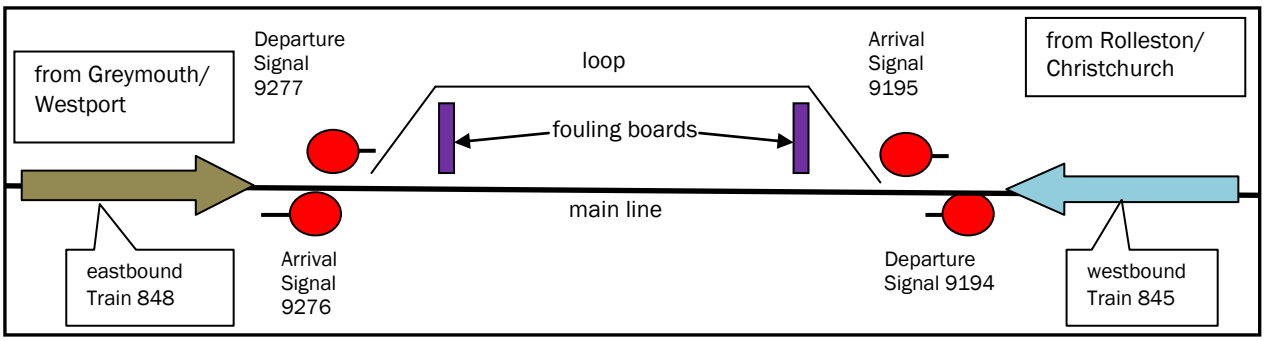

Figure 3
Train 848 and Train 845 approaching Cass crossing station (not to scale)

3.1.5. Train 848 stopped at "Stop and Proceed" Arrival Signal 9276 for 22 seconds then proceeded to the main line. In the meantime, the locomotive engineer on Train 845, stopped at Arrival Signal 9195, left his cab to set the points for the crossing loop. After returning to his cab he saw that the "L" light on Signal 9195 was illuminated and he saw in the distance the aspect on Departure Signal 9277 change from red to green. The change of aspect confirmed to him that the rear of Train 848 was clear inside Cass Station main line (see Figure 4).

[3] Multiple means that the locomotives are coupled and controlled from the lead locomotive.

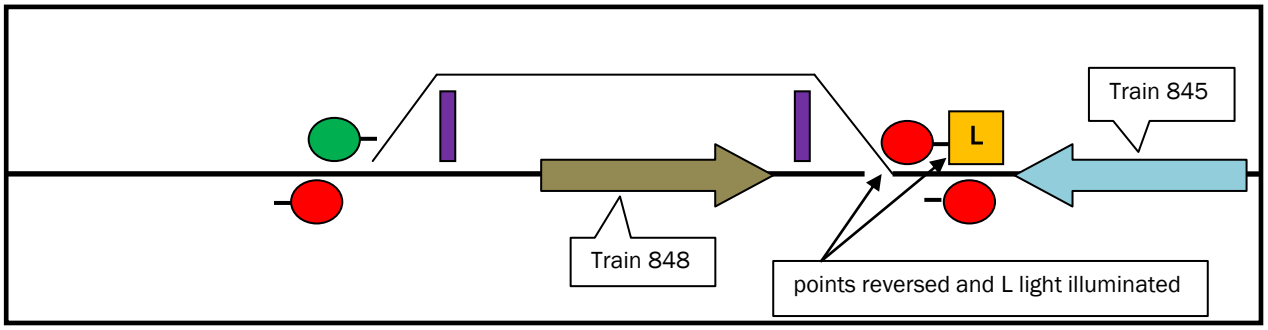

Figure 4
Signal aspects before Train 845 entered the crossing loop (not to scale)

3.1.6. Train 845 entered the crossing loop before it had been established that Train 848 was stationary. The locomotive engineer on Train 848 said he gave the other driver a wave when the locomotives crossed. Seated on the right of the cab, his peripheral vision caught the movement of wagons going past on his left side. He was looking at the bright red light from Departure Signal 9194 and didn't realise exactly where he was on the main line, but thought he had some distance before reaching the fouling board. When he saw the wagons getting closer he moved the throttle to idle and made an emergency brake application.

3.1.7. A few seconds later, the lead locomotive on Train 848 struck wagon CB10685, the second wagon on Train 845 and the following 3 wagons (see Figure 5).

Figure 5
Impact marks on wagon CB10685

3.1.8. The locomotive engineer on Train 845 felt his train lurch then noticed an air loss from the brake valve pressure indicator, so he radioed Train 848 and said that he may have burst a brake hose, but was told that there had been a collision (see Figure 6).

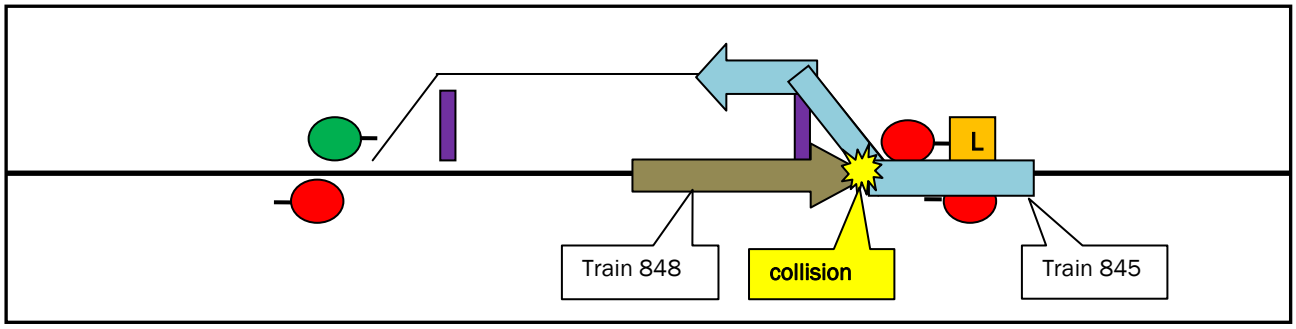

Figure 6
Train 845 crossing Train 848 at Cass (not to scale)

3.1.9. Train 848 stopped 15.6 m past the fouling board with DXC5327 wedged against Train 845 (see Figure 7). The collision resulted in the trailing bogies on wagons CB10224 and CB11177, the fourth and fifth wagons on Train 845, to derail.

Figure 7
Lead locomotive of Train 848 wedged against Train 845

3.2. Site and operating information

3.2.1. The route between the Port of Lyttelton and Greymouth via Stillwater, and also Stillwater and Westport, was referred to as the coal route. The coal route included the Midland Line from Rolleston to Stillwater, a distance of 197 kilometres (km). There were 16 freight train movements and 2 passenger train movements scheduled between Rolleston and Stillwater during each 24-hour period.

3.2.2. Cass was a crossing station[4] between Craigieburn and Cora Lynn on the Midland Line. Eastbound trains approached Cass on a 2.8 km long, ascending grade averaging 1 in 80. The grade was maintained through the Cass crossing station. Westbound trains approached Cass on a 4 km long, descending grade averaging 1 in 70 until 700 m before the main-line facing points where the grade changed to level.

[4] A crossing station is an interlocked station or stations where the signals and points are protected by arrival signals.

3.2.3. Cass Station consisted of a main line, a crossing loop with 687 m between the fouling boards connected to the main line at each end by hand-operated points, and a double-ended service siding off the crossing loop.

3.2.4. Fouling points at each end of crossing stations within SLAS territory were delineated by concrete posts placed horizontally at ground level between the main lines and the crossing loops, with the top surfaces painted white. To improve sighting of these fouling boards, reflectorised vertical fouling point markers (plastic road-edge marker posts) were positioned outside the track loading gauge adjacent to the main lines and loops. On the day of the collision, the reflectorised vertical fouling point on the main line or driver's side at the east end of Cass crossing station was missing.

3.2.5. The first evidence of sand application[5] from Train 848 was 33.4 m before the fouling board. The initial point of impact occurred when Train 848 had overrun the fouling board by 8 m.

3.3. Signalling information

Single-line automatic signalling

3.3.1. Train movements on the Midland Line between Rolleston and Arthur's Pass and between Otira and Stillwater on the Midland Line were controlled from KiwiRail's national train control centre in Wellington and had operated under SLAS rules and procedures since 1923.

3.3.2. Trains running between Otira and Arthur's Pass, including the Otira Tunnel, were controlled by a centralised traffic control (CTC) system operated remotely from the national train control centre in Wellington and were signalled in accordance with CTC regulations.

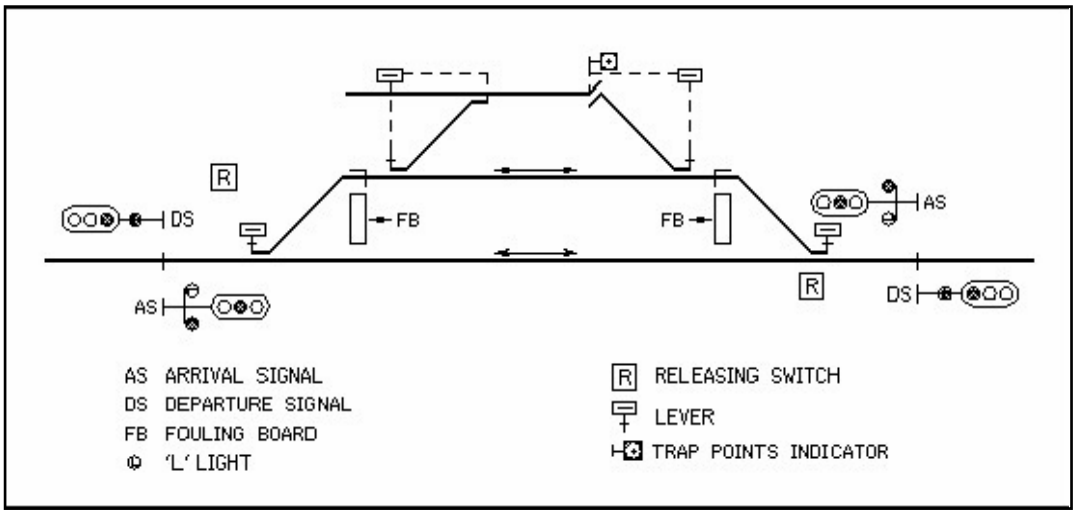

Figure 8
Typical layout of a crossing station in SLAS territory (not to scale)

3.3.3. In SLAS territory, an arrival signal was a "Stop and Proceed" signal and was sited at the entrance to a crossing station (see Figure 8). When such a signal was displaying a red aspect ("Stop" indication) and the train was not required to cross another at the station, the train had to be stopped and the next main line points restored to normal if needed. If after 10 seconds the signal was still at "Stop", the train could proceed cautiously past the signal with the locomotive engineer examining all other main-line points to ensure they were correctly set for the main line, so that the train could pass safely over them, being prepared to stop if the line ahead was occupied or obstructed.

[5] When an emergency brake application is made, sand is automatically applied to the head of the rail from the locomotive's sanding system positioned near the lead axle.

3.3.4. An arrival signal displayed a "Stop" indication when:

- an opposing train was approaching the station at the same time, or
- the trailing points at the opposite end of the station were set in the reverse position, or
- the facing points immediately past the arrival signal were set in the reverse position (in which case the "L" light would be illuminated).

When both sets of points at a crossing station were set in the normal position, the arrival signal would normally display a "Caution Proceed" or "Clear Proceed" indication, provided there was no train in the section ahead.

3.3.5. An arrival signal was fitted with a short-range, low-intensity light, which showed an illuminated white letter "L" when the facing points were set in the reverse position (for the crossing loop). With the facing points set for the loop, the arrival signal controlling the entrance of a train into the crossing station would display a "Stop" indication. The illuminated "L" light confirmed that the route was set for the loop, but not that the loop was unobstructed. A locomotive engineer on a train signalled to enter the loop was not required to stop at the arrival signal but was required to be satisfied that the route was clear before proceeding.

3.3.6. The points were connected to the signals electrically so that when the points at either end of a crossing station were in the reverse position, both arrival signals went to "Stop" and the "L" light was illuminated at the end at which the points were reversed.

3.3.7. A departure signal controlled the exit from a crossing station and the entrance to the next single-line block section[6]. In SLAS territory, there was only one departure signal at each end of a crossing station and this signal controlled the departure of a train from either the main line or the crossing loop (see Figure 8).

3.3.8. When 2 trains approached a crossing station from opposite directions at the same time, the departure signal at both ends of the station would be at "Stop" and as each train occupied the clearing track circuit (from 400 m to 1200 m from the loop facing points) it would cause the opposing arrival signal (which was normally at "Caution") to change to "Stop".

3.3.9. Under SLAS operating procedures there was no requirement for locomotive engineers on opposing trains to make radio contact when approaching a crossing station. However, most locomotive engineers operating on the Midland Line did so as a courtesy to their colleagues, as was the case on this occasion. Radio contact was mandated for trains crossing in Track Warrant Control[7] areas and locomotive engineers had over time transferred the process to SLAS territory on the Midland Line.

Working a crossing station

3.3.10. Single Line Automatic Signalling Regulation 9, amendment 16, dated 15 December 2003, set out the requirements for crossing a train and stated in part:

> *(a) The main line points at each end of a crossing station are operated by a hand lever fixed near the points, the lever being secured by an AS padlock. The crews of all trains on lines operated under this system must carry a key for AS padlocks. The points are electrically connected with the signals so that when the points at either end of a station are reversed, both Arrival signals go to "Stop" and the "L" light is illuminated at the end at which the points are reversed.*
>
> ...
>
> *(e) If, upon arrival the locomotive engineer of the train which is required to enter the loop observes the opposing train stopped at the arrival signal at the other end of the crossing station, or if the train required to enter the loop arrives first, the train must not pass the arrival signal, unless the "L" light is illuminated. If the "L" light is not*

[6] A block section is the section of single line between the departure signals of any 2 adjoining sections equipped for crossing trains.

[7] Track Warrant Control is an operating system used on lines with low to medium train density where occupation of the main line is controlled by instructions issued by train control.

illuminated then a member of the train crew must go forward and set the points for the train to enter the loop. After ascertaining that the points are secure, that the line is clear into the loop, and that a train is not entering or leaving the opposite end of the station, the locomotive engineer, on ensuring that the "L" light is illuminated must take the train into the loop.

(f) When both trains arrive at a crossing station at the same time both arrival signals will be at "stop". The crossing of the trains will then take place in accordance with the relevant instructions for trains at crossing stations.

3.3.11. Ontrack's Rail Operating Procedures, Section L6, approved on 30 June 2008, required the westbound train, in this case Train 845, to berth on the crossing loop. Train control could change the berthing arrangements by issuing a Mis 50/51 Operating Instruction but no such instruction was issued on the day of the accident.

3.4. Signal overlap distances

3.4.1. A train berthing on the main line or loop could proceed up to the fouling board, which indicated the position where crossing trains were separated safely. At Cass, there were 61 m of overlap between the east-end fouling board and Arrival Signal 9195.

3.4.2. Sections of track operating under an alternative track-circuited signalling system called CTC were arranged and equipped so that interlocked stations could operate unattended. The signals and motor-driven points at such stations were operated remotely from the national control centre in Wellington or from a remote signal box. For recently commissioned crossing loops within CTC territory, the nominal distance between a home signal (the equivalent of the arrival signal) and an opposing departure signal was 150 m. One of the purposes of the 150 m overlap was to provide an additional buffer zone should an overrun occur. In SLAS areas, there was no overlap distance between arrival and departure signals, with the signals positioned adjacent to each other on opposite sides of the main line, a few metres before the main-line points.

3.5. Personnel

The locomotive engineer on Train 848

3.5.1. The locomotive engineer had been driving trains for 33 years and had been based in Christchurch for all of that time. His certification was current.

3.5.2. He was rostered off duty on 2 and 3 November and worked a 10-hour, 5-minute day shift on 4 November and an 8-hour day shift on 5 November before starting an 8-hour shift at 2350 on 6 November. He said that he finished the shift early and was in bed by 0630 and slept through until 1230. He had an evening meal at 1830 before taking a 125-microgram Triazolam tablet at 1900 before having another sleep. He woke at 2300 to prepare himself for starting the shift on 7 November at 2350, when he drove a car to Otira to take up the running of Train 848. He said that he was well rested before starting the shift.

3.5.3. The locomotive engineer said that he had been prescribed Triazolam by his doctor and had been taking the medication sporadically for about 3 years depending on his shift patterns and the time of the year.

3.5.4. On 4 November 2008, 4 days before the collision, the locomotive engineer had an 8-monthly safety observation while he was driving Train 849 from Darfield to Arthur's Pass on the Midland Line. All tasks observed were carried out competently and the assessor endorsed the Key Tasks Form with comments that included: *the locomotive engineer completed a good run, the signal indications were called and there was good communication with the locomotive engineer of opposing Train 842 when the trains crossed en-route.* The assessor did not identify any areas of concern.

3.5.5. The locomotive engineer said that although the train departed Otira about 2 hours late, there was sufficient slack in his shift for Train 848 to arrive at Christchurch before his scheduled book-off time. Had the train run to schedule, he would have been assigned yard-driving duties before completing the shift.

The locomotive engineer on Train 845

3.5.6. The locomotive engineer had been operating rostered shifts from the Christchurch Locomotive Depot for more than 30 years. His operating certification was current. He said that he had no problems operating under SLAS rules and regulations on the Midland Line.

3.5.7. He had worked identical 7-hour, 10-minute day shifts on 5 and 6 November and was off duty the next day. On 8 November he started a 9-hour, 5-minute shift at 0120 and was rostered on outward Train 845 to change over with inbound Train 850 at Otira. Train 845 arrived at Cass at the scheduled time.

3.5.8. He said that he took Train 845 into the crossing loop after he thought Train 848 had stopped a couple of engine lengths short of the fouling board.

3.6. Event recorder

3.6.1. The event recorder data from each train was downloaded. The times of critical events are summarised in the table below:

Time	Train 848 event	Train 845 event
0400:25		Stopped at Signal 9195
0400:32	Train stopped at Signal 9276 and independent brake applied	
0400:54	Throttle moved from idle to 3	
0401:09	Independent brake fully released	
0401:16	Movement started to the main line at Cass crossing station	
0403:42		Movement started to crossing loop at Cass crossing station
0404:18	A full service brake application made while travelling in notch 1. Train speed was 15 km/h	
0404:24	An emergency brake application was made while train travelling at 12 km/h	
0404:33	Train travelling at 5 km/h when it struck Train 845	Train travelling at 11 km/h when struck by Train 848
0404:35	Train stopped	Automatic brake application
0404:41		Train travelling at 8 km/h
0404:47		Full service brake application
0404:50		Train stopped

3.7. Wagon braking performance

3.7.1. A stationary brake test was carried out by United Group Rail[8] on Train 848 following the collision. Twenty-five of the 30 wagons were found to be functioning correctly. The 5 faulty wagons were taken to the wagon depot at Christchurch for further examination and testing.

3.7.2. The tests confirmed that when the emergency brake application was made on Train 848, the 5 faulty wagons had the equivalent braking performance of 2.7 wagons; one wagon had 40% of the expected pressure; the other wagons had 43%, 45%, 70% and 75% of the expected pressure.

3.7.3. KiwiRail's Rail Operating Code relating to the running of unbraked wagons on a train stated in part:

> **6.5.10 Running of Unbraked Vehicles**
>
> **(a)** Except as permitted in 6.5.10 there must be either, two bogie braked vehicles or the equivalent at the rear of a train.
>
> **(b)** Vehicles which are unbraked must be distributed throughout the train.
>
> **(c)** Unbraked vehicles must not be placed together on a train.
>
> **(d)** Except as permitted in Rule 805 the number of unbraked vehicles on an express freight train conveying 26 to 35 vehicles must not exceed 3.

3.8. Other operating incidents within SLAS territory investigated by the Commission

Investigation Report 05-105

3.8.1. On Thursday 3 February 2005, westbound express freight Train 829 entered the limits of an authorised track occupation in which track staff were carrying out maintenance activities. The safeguarding of track occupations was one of the safety issues identified.

3.8.2. On 19 December 2005, the Commission recommended to the Chief Operating Officer of Ontrack that he:

> develop a safety defence system for track occupations in SLAS areas in line with systems that provide a similar level of safeguards in other signalling areas. (102/05)

3.8.3. On 31 January 2008 Ontrack advised that a proposal had been agreed in principle to upgrade the signalling system to CTC, which would enable the implementation of blocking procedures as used elsewhere on the network. Agreement had been reached between Toll Rail and Ontrack to install CTC on the Midland Line.

3.8.4. On 18 August 2010, KiwiRail Network confirmed that the viable technical options for re-signalling the Midland Line had been determined and cost estimates for the required work were being developed.

Investigation Report 05-124

3.8.5. On Thursday 20 October 2005, eastbound express freight Train 834 was scheduled to cross westbound express freight Train 841 at Cora Lynn on the Midland Line. Train 841 was berthed on the crossing loop when struck head-on by Train 834.

3.8.6. The safety issues identified included:

(a) the appropriateness of the signalling and interlocking arrangements and operating procedures on the Midland Line

(b) the use of non-compliant operating work practices on the Midland Line.

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[8] United Group Rail was contracted by KiwiRail to carry out the inspection and maintenance of rolling stock to standards set by KiwiRail.

3.8.7. On 9 January 2006, the Commission recommended to the Chief Executive of Ontrack that he:

> Review existing signalling and interlocking arrangements and operating procedures at Single Line Automatic Signalling crossing stations on the Midland Line with a view to introducing enhanced operating practices or engineering modifications to reduce the risk of a collision resulting from the overrunning of a signal at stop. (109/05)

3.8.8. On 31 July 2007, the Engineering Manager of Ontrack replied in part:

> Ontrack has undertaken a review of signalling and interlocking arrangements and operating procedures on the Midland Line and has identified a number of potential alternatives.
>
> Ontrack is preparing a submission to Toll seeking their concurrence to a long term permanent solution to replace the Single Line Automatic Signalling on the Midland Line.

4. Analysis

4.1 The collision at Cass between eastbound, loaded Train 848 and westbound, empty coal Train 845 Cass occurred when Train 845 entered the crossing loop while Train 848 was still moving on the main line and overran the fouling board.

4.2 The Rail Operating Procedures for the berthing of trains on the Midland Line required westbound freight trains to berth on the crossing loop and eastbound freight trains to berth on the main line. However, on the date of the collision KiwiRail had no instruction that determined which train was to enter the crossing station first when 2 trains approached from opposite directions at the same time.

4.3 The indications displayed by "Stop and Proceed" arrival signals in SLAS were controlled by the setting of the facing main-line points, immediately past the arrival signal, or the setting of the trailing main-line points at the opposite end of the crossing station or by an opposing train that had entered the clearing track circuit. When Trains 848 and 845 approached their respective arrival signals at Cass crossing station at the same time, both arrival signals correctly displayed a red aspect ("Stop" indication) as the locomotive engineers had anticipated.

4.4 Because the facing points at the west end had been left in the normal position, the locomotive engineers agreed that Train 848 would enter the crossing station first after stopping at Arrival Signal 9276.

4.5 The event recorder showed that the locomotive engineer on Train 848 complied with the indication displayed on "Stop and Proceed" Arrival Signal 9276. Train movement was registered on the locomotive event recorder at 0401:16, 42 seconds after the train had stopped.

4.6 The locomotive event recorder showed that Train 848 reached a maximum speed of 20 km/h momentarily before the locomotive engineer moved the throttle from notch 3 to notch 1 in preparation for stopping the train before the fouling board. Train 848 had to stop before the fouling board so that Train 845 could pass safely into the loop.

4.7 After setting the east-end points to the reverse position and observing the illuminated "L" light on the arrival signal and a "Proceed" on Departure Signal 9277, the locomotive engineer on Train 845 advanced the throttle position from idle to notch 1 at 0403:34.

4.8 SLAS regulation 9 (e) required the locomotive engineer of Train 845 to ascertain before taking the train into the loop that: the points were correctly set, the "L" light was illuminated, the route was not obstructed and a train was not entering or leaving the opposite end of the station. The locomotive engineer complied with 3 of the 4 conditions, but did not wait until Train 848 had completed the berthing movement on the main line before entering the crossing loop. Although the locomotive engineer of Train 845 thought Train 848 had stopped about 2 engine lengths before the fouling board before he started to move towards the crossing loop, the approaching train was travelling at 15 km/h and was still 221 m from the fouling board.

4.9 The event recorder showed that Train 848 was travelling at 12 km/h when the locomotive engineer made an emergency brake application 33 m before the fouling board. The train was 8 m past the fouling board and travelling at 5 km/h when it struck the second wagon on Train 845. Therefore, Train 848 would have overrun the fouling board by a greater distance had the locomotive engineer not made an emergency brake application.

4.10 Because Train 848 was still moving past the fouling board while Train 845 was entering the crossing loop, there was insufficient clearance between the main line and the curved road of the crossing loop for the trains to pass safely.

4.11 Had Train 845 waited on the main line clear of Arrival Signal 9195 until Train 848 had been reported stopped, it was likely that the accident would have been avoided. A safety recommendation to review the berthing and communication procedure when crossing trains in SLAS territory would have been made had the operator not already introduced revised procedures, see Section 6.

4.12 There was no time pressure on the locomotive engineers when the scheduled crossing of Trains 845 and 848 at Cass was undertaken. Both locomotive engineers would have finished their allocated work before their scheduled book-off times. The locomotive engineer on Train 845 should have been able to determine the difference between opposing Train 848 stopped 2 engine lengths (about 30 m) from the fouling board and the train moving and still 221 m from the fouling board.

4.13 The locomotive engineer on Train 848 was familiar with the layout of Cass crossing station, having carried out hundreds of crossings at that location. He was unable to explain exactly why he overran the fouling board on this occasion, but said that had a reflectorised vertical fouling point marker been in place outside the main line, on the driver's side of the locomotive cab, the overrun might not have happened. The locomotive engineer's view-line of the reflectorised vertical fouling point marker outside the crossing loop became obscured as Train 845 entered the crossing loop. The locomotive engineer on Train 848 might have been distracted by Train 845 entering the crossing loop in an unexpected simultaneous berthing scenario, not realised exactly where he was and thought that his train had yet to reach the fouling board.

4.14 It could not be determined when the reflectorised vertical fouling point marker outside the main line at the east end of Cass had been removed because it had not been reported missing by the track inspector or by locomotive engineers before the collision.

4.15 Transport staff working irregular hours and night shifts may from time to time experience sleep difficulties, especially after entering middle age when sleep is more easily disturbed. If transport workers are to avoid coming on shift after disturbed sleep impaired by fatigue, the periodic use of hypnotics (sleeping pills) such as Triazolam may be acceptable. If transport workers are occasionally using hypnotics, this should only occur with appropriate management supervision and medical oversight.

4.16 Triazolam has some pharmacological characteristics that make it a suitable hypnotic for the transport sector in some cases, in that it has no sedating metabolites (breakdown products) and is eliminated from the body within one and a half to 5 and a half hours, so that any sleep-inducing effect is short-lived; and as long as pill-induced sleep is followed by normal sleep, the user does not feel sleepy the following morning. On the other hand, in some users side effects occur, including anxiety and other psychiatric disturbances. For this reason, the use of hypnotics by transport workers should always be carefully monitored by medical practitioners and transport operators.

4.17 KiwiRail had a policy in place that required staff to declare the use of prescribed medication to their manager. This was not done in this case and KiwiRail is now aware that the use of similar hypnotic medication amongst operating staff is more widespread than envisaged. KiwiRail had not condoned the use of this hypnotic medication.

4.18 In this case, the locomotive engineer had slept for 4 hours after taking the Triazolam medication. A further 5 hours had elapsed at the time of the collision. Given his likely high state of alertness, having just spoken on the radio to the locomotive engineer on Train 845, and the crossing manoeuvre that they were undertaking, it was unlikely that taking the Triazolam tablet 9 hours earlier contributed to Train 848 passing the fouling board and the subsequent collision with Train 845.

4.19 Post-incident static testing of the wagons confirmed that when Train 848 went into emergency braking the 30 wagons had the equivalent braking performance of 27.7 wagons. This loss of 7.66% of braking potential was within KiwiRail's guidelines that permitted a 30-wagon train to operate with brakes cut out on 3 wagons, providing the wagons with brakes cut out were distributed throughout the train. The 5 wagons on Train 848 found to have reduced braking capacity were distributed throughout the train and it was therefore unlikely that the train braking performance contributed to the train overrunning the fouling board.

4.20 The entry to a crossing station in SLAS territory was controlled by an arrival signal and hand-operated points only. The safe working of the crossing station was reliant on the arrival signal displaying the intended aspect and operating staff complying with the rules and operating procedures. There were no additional defences built into the crossing station layout.

4.21 Most of the train crossings within SLAS territory occurred with the first train having already berthed on the appropriate road before the second train arrived. Because of the low number of trains on the Midland Line at any one time, there was a low probability of opposing trains arriving at crossing stations controlled by SLAS at precisely the same time. The Cass crossing station, consistent with all other crossing stations within SLAS territory on the Midland Line, was not equipped with safety points and was not designed for "simultaneous berthing". The practice was therefore never envisaged and not provided for in the operating rules and procedures for the safe working of crossing stations in SLAS territory.

5. Findings

The following findings are not listed in any order of priority:

5.1 The locomotive engineer of Train 845 created a simultaneous berthing situation by moving his train into the crossing loop before the locomotive engineer on Train 848 had reported that he had stopped on the main line. The movement of Train 845 was contrary to what the locomotive engineers had agreed previously and was implicitly prohibited in SLAS Regulation 9, amendment 6.

5.2 The locomotive engineer of Train 848 misjudged his braking application, most likely because he had inadequate visual cues for the location of the fouling board.

5.3 The reduced braking performance of 5 wagons on Train 848 was not a contributory cause of the collision because, even with an emergency brake application, the train overran the fouling board position.

5.4 The collision occurred because of the combination of Train 845 entering the crossing loop before Train 848 had stopped, and Train 848 overrunning the fouling board.

6. Safety actions

6.1. General

6.1.1. The Commission classifies safety actions by 2 types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission that would otherwise have resulted in the Commission issuing a recommendation

(b) safety actions taken by the regulator or an operator to address other safety issues that would not normally have resulted in the Commission issuing a safety recommendation.

6.1.2. The following safety actions are not listed in any order of priority.

6.2. Safety actions addressing proposed recommendations

6.2.1. KiwiRail erected additional marker posts with reflector strips on the drivers' side of the track at all crossing stations within SLAS territory to identify the fouling boards.

6.2.2. On 19 December 2008, KiwiRail Network Services issued Semi-Permanent Bulletin No. 1054, which included a new instruction within Rail Operating Rules and Procedures, Local Instructions – Section L6, All lines west of Rolleston, Local Network Instructions that stated in part:

> **5.3 Berthing of trains**
>
> **5.3.1 Working of Midland Line, Single Line Automatic Crossing Stations, except Springfield (new instruction)**
>
> When crossings are required the Locomotive Engineers on trains must before entering the station:
>
> - **Establish the whereabouts of each other by calling on radio channel 1.**
>
> **If radio contact cannot be established:**
>
> - **Entry into the station may occur after visual observation indicates it is safe to do so,**
>
> or
>
> - **Request Train Control to establish and advise the whereabouts of the opposing train.**
>
> In all situations a clear understanding must be achieved as to the berthing arrangements to prevent both movements entering the station at the same time.
>
> - **If both trains arrive simultaneously** the train to berth on the loop must enter the station first.
> - **If a "yellow" or "green" indication is displayed on the Arrival signal** for a train which is to berth on the loop any automatic alarms at level crossings will operate normally. The train Must Stop at the facing main line points and after being reversed the "L" light should illuminate and the train proceed into the loop.
> - **If the "L" light is illuminated on the Arrival signal** the train which is to berth on the loop may then proceed past the Arrival signal and into the loop.
> - **If a "Stop" indication is displayed on the Arrival signal and the "L" light is not illuminated** the train MUST STOP at the signal then proceed cautiously past the signal and stop clear of the main line points; *any* automatic alarms at level crossing will not operate until the train passes the Arrival signal. In these circumstances, if any road vehicles are observed to be closely approaching the crossing, the train must not cross the road until either the road vehicles have stopped or the alarms have operated for 20 seconds. The points must then be set for

the train to enter the loop and on ensuring that the "L" light is illuminated the Locomotive Engineer must take the train into the loop.

- In special circumstances Train Control may require the points to be set for the main line and the points lever padlocked once a train has passed into the loop and is clear of the fouling point. In this case, the Arrival signal for the train approaching from the opposite direction will then go to "Proceed" and this train may enter the station on the main line.

Single Line Automatic Signalling Regulation 9(e) and 9(f) are modified accordingly. (19/12/08)

6.2.3. On 28 June 2010, KiwiRail Network Services issued Semi-Permanent Bulletin No. 423 relating to Rail Operating Rules and Procedures, Section 5, Single Line Automatic Signalling that included new Regulation 10, which stated in part:

10. **Communication during train crossings** (new Regulation)

Approaching a crossing station

- When approaching a crossing station call on radio channel 1 to establish the whereabouts of the opposing train:
- If radio contact cannot be established, either:
  1. Attempt to make contact using the **"Midland portable"** using channel 1, or
  2. Confirm **visually** that the opposing train is not standing at the opposite end Arrival signal. If it is not the train can be berthed, or
  3. Confirm berthing arrangements **via train control** if:
     - The train cannot be reached by **"Midland portable",** or
     - It is not possible to view the train stopped at the opposite end Arrival signal.

Berthing

- The first train to berth must be confirmed stationary before the second train commences berthing.
  Confirmation should be by channel 1
- In the event of a radio contact not being established, the first train is to confirm that it is stationary by either:
  1. Attempting to contact the second train using the **"Midland portable"** using channel 1, or
  2. **Hand signal** the opposing train if the locomotive is visible, or
  3. **Via train control** if unable to contact the second train using the **"Midland potable",** or the opposing train's locomotive is not visible.

7. Recommendations

7.1. General

7.1.1. The Commission may issue, or give notice of recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector.

7.1.2. In the interests of transport safety it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

7.2. Previous recommendations

7.2.1. On 19 December 2005, the Commission recommended to the Chief Operating Officer of Ontrack that he:

> develop a safety defence system for track occupations in SLAS areas in line with systems that provide a similar level of safeguards in other signalling areas. (102/05)

On 31 January 2008, Ontrack advised that a proposal had been agreed in principle to upgrade the signalling system to CTC, which would enable the implementation of blocking procedures as used elsewhere on the network. Agreement had been reached between Toll Rail and Ontrack to install CTC on the Midland Line.

On 18 August 2010, KiwiRail Network confirmed that the viable technical options for re-signalling the Midland Line had been determined and cost estimates for the required work were being developed.

7.2.2. On 9 January 2006, the Commission recommended to the Chief Executive of Ontrack that he:

> Review existing signalling and interlocking arrangements and operating procedures at Single Line Automatic Signalling crossing stations on the Midland Line with a view to introducing enhanced operating practices or engineering modifications to reduce the risk of a collision resulting from the overrunning of a signal at stop. (109/05)

On 31 July 2007, the Engineering Manager of Ontrack replied in part:

> Ontrack has undertaken a review of signalling and interlocking arrangements and operating procedures on the Midland Line and has identified a number of potential alternatives.
>
> Ontrack is preparing a submission to Toll seeking their concurrence to a long term permanent solution to replace the Single Line Automatic Signalling on the Midland Line.

7.3. New recommendations

7.3.1. No new recommendations have been made.

Recent railway occurrence reports published by the Transport Accident Investigation Commission (most recent at top of list)

09-102	Passenger fatality after falling between platform and passenger Train 8125, Newmarket West station, 1 July 2009
08-109	Passenger express Train 9113, platform overrun resulting in signal passed at danger, Fruitvale Road Station, North Auckland Line, 4 September 2008
07-114	Derailment caused by a wheel-bearing failure, Huntly, 19 October 2007, and 11 subsequent wheel-bearing failures at various locations during the following 12 month period
09-103	Passenger Train 1608, collision with slip and derailment, Tunnel 1, Wairarapa Line, Maymorn, 23 July 2009 (incorporating investigation 08-106, collision with slip and derailment on the Johnsonville Line)
09-101	(Incorporating 08-105): express freight train derailments owing to the failure of bogie side frames, various locations on the North Island Main Trunk, between 21 June 2008 and 7 May 2009
07-105	Push/pull passenger train sets overrunning platforms, various stations within the Auckland suburban rail network, between 9 June 2006 and 10 April 2007
08-110	Train control operating irregularity, leading to potential low-speed, head-on collision, Amokura, 23 September 2008
08-101	Express freight train 923, level crossing collision and resultant derailment, Orari, 14 March 2008
06-111	Express freight Train 237, derailment, Utiku, 20 October 2006
08-113	empty push/pull passenger Train 5250, collision with platform-end stop block, Britomart station, Auckland, 19 December 2008
08-103	Passenger Train 6294, electrical fire and collapse of overhead traction line, Mana station, Wellington, 18 April 2008
08-108	Express freight Train 845, track warrant overrun, Reefton - Cronadun, 13 August 2008
07-103	Passenger express Train 200, collision with stationary passenger express Train 201, National Park, 21 March 2007

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