



Australian Government
Australian Transport Safety Bureau

Runaway of grain train 8960

Dombarton to Unanderra, NSW | 22 April 2017



Investigation

ATSB Transport Safety Report
Rail Occurrence Investigation
RO-2017-001
Final – 5 December 2018

Cover photo: Grain train 8960 at Port Kembla

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Addendum

Page	Change	Date
1	Time 'at 1210' removed, to eliminate a reported but inaccurate time	24 Dec 2018

Safety summary

What happened

On 22 April 2017, Qube Logistics (Qube) grain train 8960, travelling from Bogan Gate to Inner Harbour, Port Kembla, New South Wales, ran away as it descended the Illawarra Mountain between Dombarton and Unanderra. After passing Dombarton, the driver realised he had lost control of the train. At 1248, the driver contacted the ARTC network controller who, in conjunction with Sydney Trains' train controller, cleared a pathway for 8960. The maximum allowable speed for the Dombarton to Unanderra section was 30 km/h; however, the train reached a maximum speed of 107 km/h. At 1255, the train stopped, assisted by a shallower gradient near Unanderra station. There were no injuries or damage because of the incident.

What the ATSB found

The ATSB's investigation found that as train 8960 was operated down the Illawarra Mountain, the train management actions by the driver did not conform to train handling procedures. After passing Summit Tank, the driver made ten brake applications and in doing so did not allow the train's pneumatic brake system to fully recharge. This resulted in a loss of necessary braking capability to be able to control the train's speed on the steep continuous descent. The incident was further compounded when the driver's actions caused the locomotive's dynamic braking system to be rendered inoperative, further reducing control of the train.

The braking system was operating within specification and were loaded below the maximum allowable payload. However, the train was loaded by approximately 10% more than that recorded on the train's consist record. It is probable that the additional mass placed an extra load on the braking system and affected the handling characteristics of the train.

After the incident, the train controller in Sydney directed the driver of train 8690 to move the train from the rail network to Inner Harbour Terminal without any formal inspection following the runaway event. The Pacific National yard train controller in Inner Harbour did not alert ground personnel of the emergency event or of a runaway train being directed into their terminal.

What's been done as a result

Immediately following the incident, Qube withdrew the QBX locomotives and CGSY wagons from this route pending testing and inspections. They have since been cleared to return to operate on this route. Qube also changed the requirements for competency assessment on the Moss Vale to Unanderra section, from a single initial assessment to every six months. If a train driver has not been rostered over the corridor within six months he or she must be reassessed on this route. Qube also implemented other more stringent requirements for the training of drivers and weekly auditing of train operations between Moss Vale and Inner Harbour.

A review between the various rail infrastructure managers was conducted regarding the plans and procedures enacted in emergency events, and the decision-making process to move trains from the rail network to Inner Harbour.

Safety message

In order to minimise the risk of runaway events, freight operators should ensure that train drivers receive regular training and competency assessment for steep continuous gradient routes. The standards that apply to these routes should ensure that the locomotive and wagon braking ratios are suitable for the terrain the train will encounter on its route. Contingency plans and procedures to accommodate runaway trains in this area should be continually reviewed and tested by rail infrastructure managers.

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The occurrence

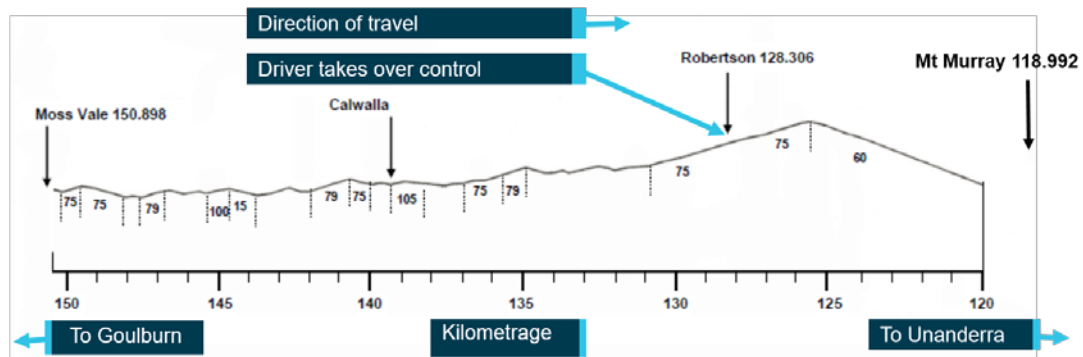
Events leading up to the occurrence

On 22 April 2017, a Qube Logistics (Qube)¹ train crew, comprising a driver and second person, signed on at Goulburn, New South Wales, depot at 0800². The crew were rostered to operate a loaded grain train, 8960, to Inner Harbour at Port Kembla where it was to be unloaded at the Quattro facility. The train had been loaded with wheat the previous day at Bogan Gate and was operated to Goulburn where it arrived at 2130 and was stabled overnight. The next day, a qualified train examiner inspected the train and no defects were reported.

Before departure, the train crew performed an inspection of the train. The driver instructed the second person to apply the brakes while the driver walked to the rear of the train to ensure that the brakes applied and there was brake pipe continuity on the train. He then radioed to the second person to release the brakes. The driver walked back to visually ensure that the brakes released and that all brake pipe and main reservoir pipe hoses were connected, and isolating cocks were in the open position.

At 0910, train 8960 departed Goulburn with the second person operating the train under the supervision of the driver. As the train departed Goulburn yard, a roll by inspection was performed to ensure that there were no visible or audible defects. The train then travelled on the Up Main line to Moss Vale where it branched off towards Unanderra and Inner Harbour. The train passed through Moss Vale at 1045. The second person continued to drive the train, under the supervision of the driver, from Goulburn to Robertson. At Robertson, the driver took over the controls from the second person in order to operate the train down the Illawarra Mountain (Figure 1).

Figure 1: Gradient diagram Moss Vale to Robertson



Source: Qube Logistics, annotated by ATSB

Between Goulburn and Mt Murray, the driver made a number of running brake applications using the train's air brake system to gauge the train's braking capability. There were no issues found with the train's braking capability. This is known as a running brake test and it is a standard driving practice that train crews conduct this test.

The train passed Mt Murray and then, at 1216, it was brought to a stand just past Summit Tank, as required by a Qube work instruction.³ Here, the driver conducted a performance test of the brakes. The driver was satisfied with the braking performance and resumed the journey.

The track gradient between Summit Tank and Unanderra is one of the steepest in the New South Wales rail network and runs for approximately 18 km with a ruling gradient of 1 in 30. There is only one short intermediate shallow grade of 1 in 120 as the track passes through the Number 2

¹ Qube Logistics is part of Qube Holdings Pty Ltd.

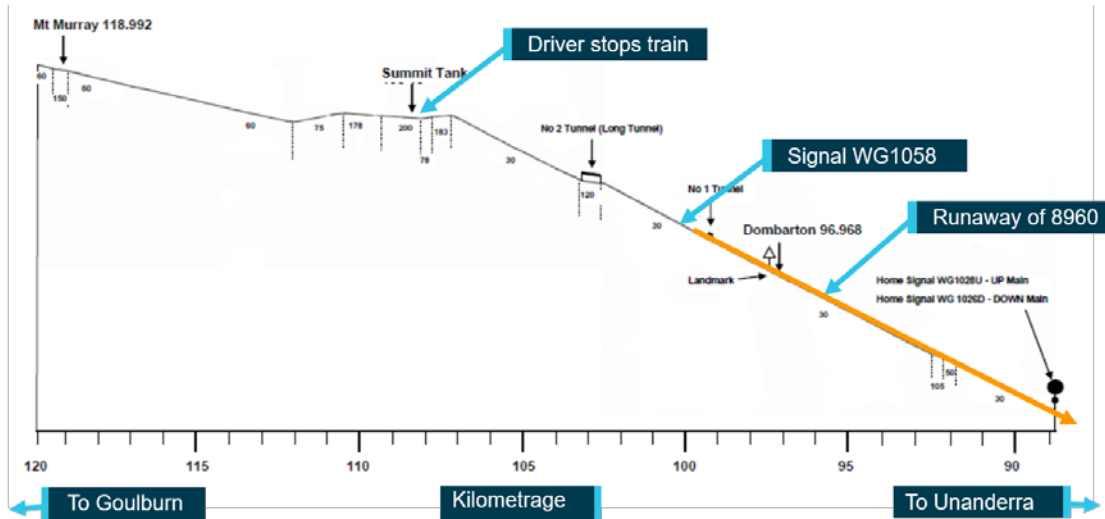
² The 24-hour clock is used in this report. Local time was Australian Eastern Standard Time (AEST).

³ Qube Logistics Work Instruction. Moss Vale to Inner Harbour Train Management. WI-540. Version 3.0 Issued 14 September 2016.

Tunnel (Figure 2). This means that once a train passes Summit Tank there are no rest points along the section where the train's brake system can be fully recharged.

On departing Summit Tank, at 1216, event recorders indicated that the train increased speed to 28 km/h before the driver made a brake application, which reduced the train's speed to 15 km/h. With dynamic brake engaged, the driver then made a further nine brake applications, and on each occasion, did not allow the air brake system to fully recharge prior to the next brake application.

Figure 2: Gradient diagram Mt Murray to Unanderra



Source: Qube Logistics, annotated by ATSB

The occurrence

The driver said the first indication that he had a problem was past signal WG 1058 (100.500 km), at Dombarton. The time was 1242. He said that the signal was at full clear with the train travelling at 20 km/h.

At 1242:07, the driver made a release of the train's air brake for approximately 30 seconds. He then reapplied the air brakes with a 50 kPa reduction in the brake pipe pressure. The dynamic brake was delivering 229 kN of braking force. The independent brake handle was in the release position and there was 0 kPa in the locomotive brake cylinders.

At 1242:28, the train's speed had increased to 30 km/h. At this point, the train brake air that had been venting to atmosphere was stopped by the movement of the automatic brake handle by the driver to the release position. The driver reduced the brake pipe pressure to 420 kPa. However, despite this, the train's speed continued to increase. The driver continued to reduce the brake pipe pressure in order to slow the train. The driver again reduced the brake pipe pressure to 344 kPa and the train's speed reached 46 km/h. The dynamic brake was still delivering 229 kN of force.

As the train approached a 20 km/h curve, at 1246:41, the driver applied the locomotive's independent brake, which activated the dynamic brake power knockout switch. This eliminates the dynamic braking effort and is a feature that is designed to prevent skidded wheels from excessive braking effort. The train was travelling at 44 km/h at the time.

At 1246:52, the driver moved the automatic brake handle to the full emergency position. When the automatic brake handle is placed into the emergency position, the brake pipe pressure is reduced to zero. The brake pipe pressure took 25 seconds to reduce to 0 kPa, the locomotive independent brake cylinder pressure increased to 482 kPa. The maximum amount of available braking effort was applied however, the train's speed increasing to 46 km/h.

The action of applying the automatic brake controller to the full emergency position by the driver did not increase the braking effort as the train brake was already fully applied. It also meant that

the dynamic braking system was deactivated. At this stage there was nothing further the train crew could do to reduce the speed of the train.

At 1248:37, the driver alerted ARTC train control at Network Control Centre South (NCCS) via the train radio that the train was running away.

NCCS: '8960 received. Over.'

Driver: 'Yeah mate, we are in emergency braking running away down the hill. Over.'

NCCS: 'You are running away there? Over.'

Driver: 'That is correct.'

The ARTC network controller⁴ at NCCS remained in constant communication with the driver throughout the runaway. This communication was effective in gaining information about the train's speed, location, and informing the driver about the route settings.

The ARTC network controller at 1249 notified Sydney Trains South Coast Control (STSCC) that Qube service 8960 was running away and that the train was in the ARTC controlled Dombarton to Unanderra section, but heading towards Sydney Trains' network. The train controller from STSCC also communicated with the driver and NCCS throughout the runaway.

At 1250, STSCC confirmed to NCCS and the driver that 8960 had the 'full road'—meaning that the route had been cleared for the train and that there was no rail traffic in its path. Around the same time, Sydney Trains Wollongong Complex contacted Pacific National's Inner Harbour train control to confirm that the route was clear of rail traffic. Number 1 Departure Road was confirmed as the final destination, in the event that the train ran that far.

At 1252:11, the train reached a maximum speed of 107 km/h as it rounded a curve approaching Unanderra station. The track speed at this location was 100 km/h. The train passed through Unanderra railway station where it was captured on CCTV camera (Figure 3). At 1252:21, the train started to reduce speed once it had reached the rising gradient at Unanderra north junction. The ARTC network controller expressed his concern to STSCC train controller that the driver had been unable to get the train under control. Just as he was saying this, the driver announced that the speed had reduced to 95 km/h.

⁴ Train controllers on the ARTC network are called 'network controllers' and on the Sydney Trains network 'area controllers'. In the Sydney Trains Rail Management Centre, the title 'train controller' is used and on the Pacific National controlled yards the title 'train controller' is also used.

Figure 3: Runaway train passing Unanderra station

Source: Sydney Trains

Post occurrence

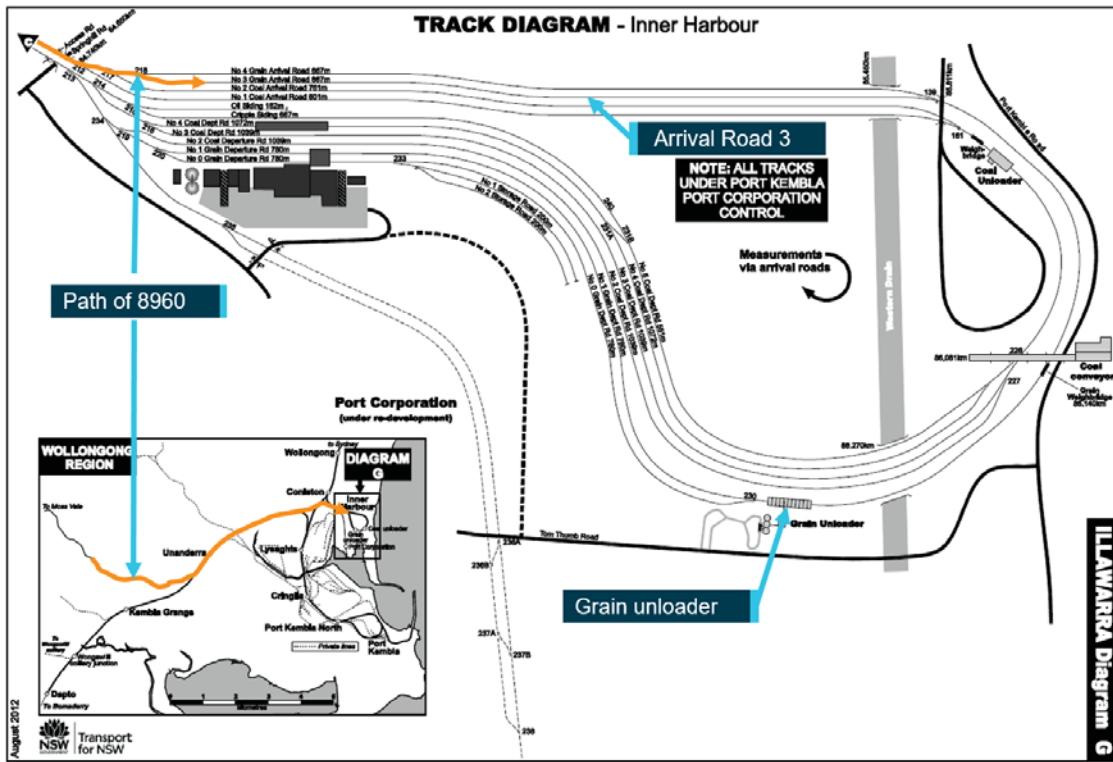
As the train was coming to a stand the ARTC network controller asked the driver about his condition, the driver responded that apart from a few nerves he was good. He said, "I am just coming to a stand there now, I don't know what my engine brakes are like but there is a lot of smoke behind me on the train, over." The train controller from STSCC, who was also connected into the conversation along with the area controller from the Sydney Trains Wollongong complex, informed the driver that Wollongong complex would take control of their route once the train had come to a stand.

At 1255:03, train 8960 came to a stand at 85.225 km, on the Up Inner Harbour South Fork line. The train had come to a stand on the Sydney Trains network. It was approximately 13 minutes from the time the runaway event commenced and during that time the train had travelled 14 km.

At 1259, under instructions from the area controller at Sydney Trains Wollongong Complex, the train driver moved 8960 from the main line into Inner Harbour. However, despite the runaway, no formal inspection was made on the train before it was moved.

At 1306, the area controller then requested that the train crew ensure that the end of train marker (EOTM) was still present. The driver then moved the train at reduced speed forward while the second person conducted a roll by inspection of the train. After inspecting the train and confirming that the EOTM was intact at its rear, the second person called the driver on the radio to confirm that everything was in order. The driver then stopped the train and walked back to meet the second person approximately halfway along the train. They discussed what problems they had identified and noted that one wagon had an extended brake piston travel and that several brake shoes were worn below limits. Under direction from the Pacific National Inner Harbour train controller, the driver moved 8960 into the Number 3 Arrival Road in Inner Harbour and waited for the train to be examined (Figure 4).

Figure 4: Inner Harbour track diagram



Source: Asset Standard Authority NSW, annotated by ATSB

At 1436, Sydney Trains inspected the track from the ARTC interface boundary at 91.080 km to Unanderra. No defects were found and the track was certified for use.

As well, ARTC organised a track inspection, from Mt Murray (118.800 km) to its boundary at 91.080 km. This was to observe if there was any:

- damage to the track or track infrastructure
- mechanical components that may have fallen from any train
- contamination (such as curve wear grease) on the rail head
- grease pots over greasing
- grain spills on or around the track.

At 1615, ARTC reported internally that there was no evidence of damage to the track or infrastructure. The track was certified for use.

At 1632, the train crew were drug and alcohol tested. They returned negative test results.

Six days later, on 28 April 2017, the train departed the Number 3 Arrival Road and discharged its load of wheat at the Quattro facility in Inner Harbour, Port Kembla and the mass of each wagon was measured.

Context

Incident Location

The runaway incident occurred between Dombarton and Unanderra on the Moss Vale – Unanderra line. Unanderra is in the Illawarra district, 88 rail km south of Sydney’s Central station (Figure 5).

Figure 5: Location of incident



This map shows the incident location and the path of 8960 (shown in red). Source: Geoscience Australia, annotated by ATSB

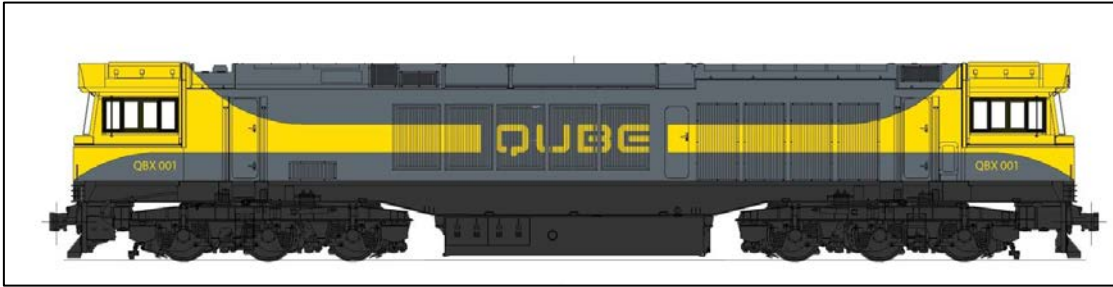
Train information

The train, designated as 8960, was a loaded wheat service operating from Bogan Gate to Port Kembla. It consisted of two QBX-type locomotives (Figure 6), QBX003 and QBX002 and 40 loaded CGSY wagons.

Qube Logistics (Qube) owned the diesel-electric locomotives and the wagons were leased from CFCL Australia (CFCLA). The train was 664 m long and had a gross trailing load of approximately 3360 tonnes (as recorded on the train consist).

The wagons were a CGSY grain hopper-type wagon (Figure 7). The wagons were designed and built in China in 2015.

Figure 6: QBX locomotive



This figure shows the side elevation of a QBX locomotive. Source: Qube Logistics

Figure 7: CGSY wagon



This figure shows CGSY wagon CGSY451F. Source: ATSB

Braking system

The automatic brake, the independent brake and the dynamic brake are sub-systems of the train's braking system.

Automatic brake

This brake is the normal service brake on the train and applies the brakes in balance when brake pipe pressure is reduced. When the train's brake pipe is charged to 500 kPa, the train brakes are released. Maximum braking effort is achieved when the brake pipe pressure is reduced to 350 kPa. There is no increase in braking effort between 340 kPa and 0 kPa.

The brakes on the train do not apply simultaneously. The brake on the leading wagon will apply first and the other wagons sequentially. It may take 30 seconds for all the wagons brakes to fully apply. When the train's air brakes are applied and released it may take 40 seconds for the air pressure to be fully restored to 500 kPa or to a level where the brakes can be effectively reapplied.

The train automatic brake controller has five positions:

1. Release – provides 500 kPa of air pressure in the brake pipe and releases the automatic brake and independent brake on the locomotive (if the independent brake controller is in release as well).
2. Minimum (or lap) – reduces the brake pipe pressure from 500 kPa to 430 kPa, this also initiates a minimum application of the train brakes and the locomotives brakes.
3. Service zone – allows the brake pipe pressure to be progressively reduced from 430 kPa to 350 kPa.
4. Full service – reduces the brake pipe pressure to 350 kPa and fully applies the locomotive brakes and train brakes.
5. Emergency – reduces the brake pipe pressure faster than other brake applications so that the train brakes and the locomotive independent brakes are quickly applied. This turns off the dynamic braking system.

Independent brake

This brake applies air brakes to the locomotive and works independently of the train brake system. The locomotive's brakes are applied when the locomotive independent brake controller is operated separately from the train brake system. This turns off the dynamic braking system.

Dynamic brake

Dynamic braking is a function on locomotives designed to reduce wear and heat in the friction type braking equipment on the train. Being a supplementary system, it provides an additional means of train-speed control but is not a substitute for the train air brakes. Dynamic braking operates through the electrical traction motors that drive the locomotive wheels by reversing the function, from a motor using electrical current, to a generator producing electrical current. When using dynamic braking, the current generated by the traction motors dissipates out through an electrical resistor bank on the locomotive's roof as heat. Increasing or decreasing the amount of electrical resistance varies the retardation or braking effect on the rotating locomotive wheels and thereby train.

Control of the braking system

The QBX-type locomotive is fitted with a Wabtec braking system. 'The Wabtec system is an electro-pneumatic interface between the operation of the driver's automatic and independent brake controller stands and the brake computer. This interface provides the various braking functions on the locomotive and the train as is required.'⁵

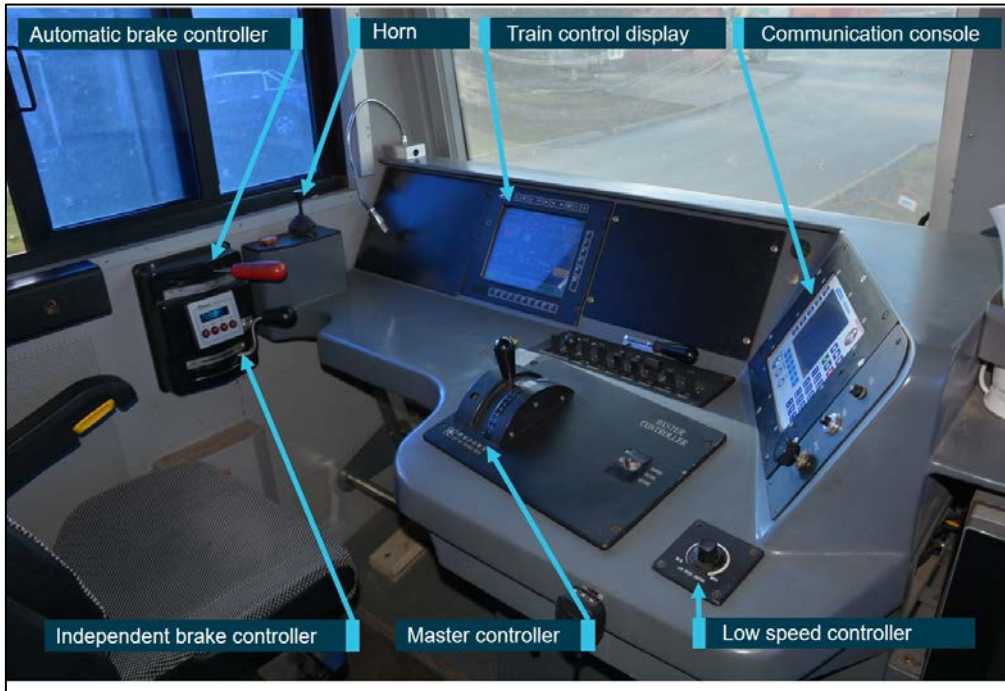
The position of the brake controller is to the driver's left when seated (Figure 8). The movement of either brake controller transmits electronic signals to the brake computer, which in turn, responds to give the required brake application. The train control display shows pressure representations in numeric values on the driver's screen.

The train control display shows the following air brake settings:

- brake pipe pressure
- equalising reservoir pressure
- main reservoir pressure
- brake cylinder pressure
- brake pipe flow meter
- end of train brake pipe setting (where fitted).

⁵ Qube Logistics – QBX Class Locomotive Briefing Package, March 2016.

Figure 8: QBX locomotive driver’s control area



This figure shows the various controls and display areas for the driver’s position on a QBX-type locomotive. Source: ATSB

Train crew

The train was crewed by a driver and a second person based at Qube’s Goulburn Depot. The driver was qualified for the rollingstock and the Goulburn to Port Kembla route. The driver had 17 years’ experience as a freight train driver and had previously worked in the rail industry as a shunter.

The second person was in training and qualified to drive a train under the supervision of the driver. Both the driver and second person held current competencies and medical certification.

Track information

The line on the Illawarra Mountain between Moss Vale and Unanderra is mostly a single track with crossing loops at Mt Murray. The section between Summit Tank and Unanderra, where the train ran away, has a posted track speed of 30 km/h. At Dombarton, the line reverts to a double line. The track between Summit Tank and Unanderra has a ruling gradient of 1 in 30.

The posted track speed varies from 115 km/h from Goulburn to Moss Vale to 30 km/h from Summit Tank to Unanderra.

This standard gauge railway line was built in 1932. It provides a direct route linking Wollongong and Port Kembla to the Main South line. It carries mostly freight services (intermodal, coal and grain) and occasionally heritage passenger services.

No evidence exists to support that track conditions contributed to the incident.

Train control information

As 8960 progressed from Goulburn to its ultimate destination to the grain terminal at Port Kembla Inner Harbour, it came under three separate train control entities: ARTC, Sydney Trains and Pacific National.

Train movements on the Main South line from Goulburn to Moss Vale, and then between Moss Vale and Unanderra (at 91.080 km) are controlled from the ARTC Network Control Centre South at Junee under network rule ANSY 500 *Rail Vehicle Detection System*.

For trains travelling in the 'Up'⁶ direction, once a train passes the network interface boundary at 91.080 km the train enters the Sydney Trains network. Sydney Trains direct train movements in their network from the Rail Management Centre in Sydney. These movements are controlled in conjunction with Wollongong Signalling Complex.

The Quattro grain unloading facility is located in the Port Kembla Inner Harbour terminal. Once trains are routed into the terminal controlled by Pacific National Inner Harbour Train Control. Movements in and out of this terminal are controlled in conjunction with the Wollongong Signalling Complex.

Environmental conditions

Weather conditions at the time of the incident were dry and fine. The Bureau of Meteorology recorded a maximum temperature of 23.3°C, at Bellambi, approximately 15 km from Unanderra.

It was determined that environmental conditions did not contribute to the incident.

Related occurrences

On 7 February 2011, a loaded El Zorro Transport grain service travelling to Port Kembla ran away down the Illawarra Mountain. The driver was unable to control the speed of the train towards the end of the descent. The 2988 tonne train was 691 metres in length.

After passing Summit Tank, the driver made a number of progressively larger brake applications on the descent into Unanderra. As the train approached the bottom of the Illawarra Mountain, braking effort was at its maximum. The train then proceeded uncontrolled through Unanderra Station and signal WG 1014 at Stop, before coming to a stand on the slight uphill gradient 527 metres beyond the signal.

When the crew realised they were in difficulty, the driver told the co-driver to contact the signaller to have signal WG 1014 cleared for them. The co-driver stated that he tried to do so on nine occasions using a mobile telephone but was unsuccessful. The signaller at Wollongong explained that he was busy on other calls at the time.

The Office of Transport Safety Investigations (OTSI) conducted an investigation⁷ into this incident and found that the grain service became uncontrolled during its descent of the Illawarra Mountain because the train was not managed in accordance with current train management procedures.

The investigation also found that the company had no documented policies or procedures for the control of trains descending the Illawarra Mountain. Instead, drivers were instructed to use the rail infrastructure managers' Train Operating Condition (TOC) manuals. It also found, despite being issued with TOC waivers that classified the wagons as single pipe wagons⁸, the company operated the grain train services under differing dual pipe conditions from the time of introduction of the wagons into service. This anomaly was not identified by the rail infrastructure managers.

⁶ Up lines typically carry train movements towards Sydney, Down lines away from Sydney.

⁷ OTSI Investigation Report 04505 (2011) *Uncontrolled movement of El Zorro grain service 3996 Unanderra 7 February 2011*. OTSI investigation reports can be accessed online at otsi.nsw.gov.au.

⁸ A single pipe train is a train that only has one airline pipe running through the consist for braking and recharging air reservoirs. The disadvantage of a single pipe train is that it takes much longer to recharge the air brake system.

Safety analysis

The investigation determined that the runaway event between Dombarton and Unanderra was the result of the train management actions made by the driver of train 8960. Despite concerns raised by train crew and another driver about the effectiveness of the train's braking system, it was found to be within the specified standards.

It also analysed train management, braking performance, train loading, and risk management by the train operator and rail infrastructure managers.

Train management

Train management is a critical aspect of driving a train, especially loaded trains on a route that includes a long steep descent. Besides an understanding of the train performance itself, drivers need to have route knowledge over each rail section they travel over. Some aspects of route knowledge include gradients, train behaviour, location of signals, location of speed boards, brake release points and any changes to train operating conditions.

Drivers are trained and assessed in the operation of each locomotive type. This training consists of classroom instruction, in-field instruction and operation of the light engine working. The driver was assessed as competent in the operation of QBX locomotives on 3 September 2016.

The driver of 8960 had driven this route 31 times previously since the start of the year. The driver had also operated a further 20 different grain train configurations on this same route. The second person had also previously accompanied this driver and other drivers on this route. He said that he had done the trip between 15 to 20 times since 1 January 2017.

Neither crew member had previously experienced a runaway train incident. During interview, the driver said 'you have to give that mountain a lot of respect'. Both crew members stated they understood the risks and were not complacent about the task of operating a loaded train down the Illawarra Mountain.

Qube restricted the speed of its freight services down the Illawarra Mountain to a maximum of 30 km/h. It stated in a work instruction⁹ that 'the 65 km/h and 45 km/h speed boards between Mount Murray and Dombarton must be disregarded. The Sydney Trains speed board approaching Unanderra must also be disregarded. Train speed must not exceed 30 km/h'. Specific instructions and driving techniques were also detailed in this work instruction. This instruction states that 'if the brake pipe pressure reduction needs to exceed 100 kPa in order to control the speed then you must:

- stop the train and apply the locomotives' independent brakes
- apply sufficient handbrakes if required, before recharging the train brake
- fully recharge the train's air brake system before releasing the independent brake.

In this case, the driver did not get the chance to follow this instruction as he only became aware there was a problem after the train had started running away. By this time, the train was travelling at 46 km/h and its speed was increasing. The window of opportunity to take action by completely stopping the train and applying the handbrakes on the wagons had passed.

The critical sequence of train management actions occurred after Summit Tank. The driver made ten air brake applications, which did not allow a full recharge of the train's air brake system. This resulted in a loss of necessary braking capability to control the train's speed on the steep descent.

When the driver applied the independent brake, at 12:46:41, it also deactivated the dynamic brake via a power knockout switch. When, ten seconds later, the driver applied the automatic brake

⁹ Qube Logistics Work Instruction. Moss Vale to Inner Harbour Train Management. WI-540. Version 3.0 Issued 14 September 2016.

controller to the full emergency this did not increase the braking effort as, by this time, the train air braking system was already fully applied. At this stage there was nothing further the train crew could do to reduce the speed of the train.

The driver understood that when he applied the independent brake the locomotive's dynamic braking system would become inoperative. He stated that 'it is the golden rule that you never put it into emergency on this mountain.' When questioned at interview why he did so, he said that he panicked.

A few weeks after the incident, on 9 June 2017, an operational test was performed of the braking capabilities of a similar train between Moss Vale and Inner Harbour. This test was done with a similarly configured train—40 loaded CGSY wagons hauled by two QBX locomotives. However, this train was 3179 t, compared to 3680 t on the runaway train. There was no information provided in the test report regarding the condition of the brake slack adjustors and other braking components on the test train on 9 June 2017.

This test assessed the effectiveness of the current work instruction for the operation of freight services on this route. A representative of The Instruction Company, a training organisation responsible for the production of the Qube work instructions, was present and supervised the actions of the train crew. The train was operated according to the Qube work instruction. The train completed the journey without issue over the test route.

Brake performance

The locomotives, wagons and wagon brake system components were examined and tested a number of times both before and following the incident. While a number of minor faults were identified, overall, the train braking system complied with standards. Some of these checks and examinations are discussed below.

The train had undergone a number of inspections on its braking system before the incident.

- A qualified train examiner inspected the train at Bogan Gate the day before the incident.
- The train crew at Bogan Gate inspected the train after it was loaded and operated the train to Goobang Junction.
- Another train crew operated this train between Goobang Junction and Goulburn without problem.
- A qualified train examiner inspected the train at the Goulburn depot on the morning of departure without problem.
- The driver tested the brake pipe continuity in the Goulburn depot.
- The train crew conducted a roll by inspection as the train departed Goulburn.
- The train crew conducted a running brake test between Goulburn and Mt Murray.
- The train crew conducted a performance test of the train's air brakes just past Summit Tank.

No issues or concerns were raised about the braking performance of 8960 on the day of the incident or the day before the incident when it was operated from Bogan Gate to Goulburn. The train examiners certificates, issued at Bogan Gate and Goulburn, indicated that the examined wagons were within specification.

Following the incident, the train was inspected a number of times. The summary of these tests are described below.

- The second person conducted a visual inspection immediately after the incident. A wagon with an extended brake piston travel, and worn brake shoes were noted (these were within the allowable metrics). The end of train marker was also confirmed as being in place.
- The Office of Transport Safety Investigations (OTSI) inspected the train approximately four hours after the incident. The brakes were still hot. No problems were identified with the

exception of two wagons, which had worn brake blocks and excessive piston travel. There was no evidence of overheated brakes or wear.

- On the day after the incident, 23 April 2017, an independent brake engineer tested the brake retention time, brake pipe leakage rate and brake pipe continuity. All were within specification.¹⁰
- As well as testing the train's brakes, the brake cylinder piston travel lengths were measured on all 40 CGSY wagons. It found that seven piston lengths exceeded the Asset Standard Authority (ASA) criteria relating to piston travel. Qube stated in their report that as the train had been manually regulated the piston travel was not considered a contributing issue.
- On 1 May 2017, a single car air test (SCAT) was carried out on three randomly chosen wagons: CGSY 4502, CGSY 4507 and CGSY 4510. This test was conducted by an independent contractor. The tests found that the slack adjusters were ineffective. This can cause irregular braking forces if the piston lengths increase outside tolerances and they fail to take up or let out the slack. The issue with the slack adjusters was known to the operator and 'due to their design have never been effective.'¹¹ The slack adjusters have since been re-engineered but at the time they were manually inspected and regulated prior to every train journey between Goulburn and Unanderra.
- On 4 May 2017, the train was inspected by an independent railway bogie and braking engineer. The inspection found that apart from the known problem with the slack adjusters there were no other braking issues that may have affected the performance of the train. It found that the slack adjuster operation would not have contributed to the incident as adequate mitigation strategies had been put in place by CFCL Australia (CFCLA) and Qube.¹²
- On 18 May 2017, an independent contractor measured the actual mass of a CGSY wagon. The total tare mass of a wagon (CGSY 4502V) was found to be 23.096 t. At this time, the Net Brake Ratio was calculated.¹³ The ASA standard stated that for composite brake blocks a fully loaded wagon should have a net brake ratio of 13 per cent minimum. The net brake ratio calculated for this wagon complied with ASA standards.¹⁴
- On 23 May 2017, a brake control valve from CGSY 4502 was tested by an independent contractor to determine its operational suitability. The test found that the valve was able to make repeatable minimum and normal brake applications and hold applied pressure for 15 minutes. It was considered satisfactory for normal use.¹⁵
- On 9 June 2017, a simulated braking performance test was conducted at Goulburn Workshops. This test was conducted by an independent brake engineer, an independent driver trainer, and an independent wagon maintenance expert. Other staff from Qube and CFCLA assisted. The test involved two QBX locomotives (QBX 4 and QBX 5) with 42 loaded CGSY wagons. Pressure gauges were fitted to the brake cylinder and auxiliary reservoir on three test wagons. A test gauge was also fitted to the brake pipe of the 42nd wagon. The purpose of the test was to simulate the brake applications and release made before the runaway to assess the train braking performance. The result was that the train braking system performed satisfactorily. It also showed that the brake applications made by the driver on the day of the incident may have been 'less than optimal to ensure full recharge of the brake system'.

¹⁰ AR Ball Rolling Stock Maintenance Pty Ltd. *CGSY Braking System Incident Moss Vale to Unanderra line*. 22 April 2017.

¹¹ QUBE Logistics. Initial Investigation Report FM-512. Version 1. Issued 1 June 2017.

¹² SNC-Lavalin Rail & Transit Pty Ltd. Report of Bruce Sismey. 10 May 2017 amended on 1 November 2017.

¹³ The net brake ratio is the ratio of the sum of the measured actual brake block forces in kilograms divided by the total vehicle mass, in kilograms.

¹⁴ Asset Standards Authority NSW. T HR RS 00400 ST RSU 400 Series – Minimum Operating Standards for Rolling Stock – Freight Vehicle Specific Interface Requirements. Version 2.0. Issued 24 August 2017.

¹⁵ Wayne Clift Consulting Pty Ltd. Test report for control valve from CGSY 4502. Issued 25 May 2017.

The investigation noted that there were anecdotal reports from drivers that train 8960 did not handle consistently. The braking performance of the train was criticised by the train crew during the interview. The driver said 'normally it is not a very good braking train. Most of the other trains you take down the hill when you use balanced braking they go down nice and sweet. This one, it doesn't do anything the same on each particular day it is always different. It is a lot different actually.'

The second person was also critical of the braking performance of the train. He said 'I have been down there (Illawarra Mountain), with that train, same wagons, a different driver, I've had to wind ten handbrakes on it, we've pulled it up, it hadn't stopped, we wound five (handbrakes) on and it didn't make much difference. So when we did pull up eventually the second time, I went and put another five on.'

Another driver from Qube came forward and was interviewed. This experienced driver said that this train did not brake consistently. 'One time I can't fault it; next time I'm flat out stopping it.'

Despite the criticism of the train braking performance by the train crew and another driver, the testing found that the train's braking system was operating and adjusted to within the specified standards current at the time of the incident.

Since the runaway incident, the ASA has modified the braking ratios for bulk type commodity wagons across the rail network. This change was not made as a result of this incident but, rather, due to the introduction of new coal hopper wagons, and testing that identified brake performance deficiencies.

At the time of the incident, the net brake ratio was specified as a minimum of 13 per cent for high friction composite brakes on freight vehicles. From 1 January 2018 this specification was raised to 16 per cent for bulk commodities. The minimum level of 13per cent is still permitted, provided the brake performance can be confirmed by a stopping distance test.

The standard states: 'From 1 January 2018 for all new bulk commodity type wagons, such as grain hopper, coal hopper, ore hopper, and wagons that are commonly marshalled in unit train consist at their fully loaded condition (for example, container wagons used to haul grain), the higher figure of 16% net brake ratio should be used as the minimum. Figures of less than 16%, down to 13% net brake ratio as a minimum, may be accepted; however, the wagons will require a dynamic brake test in the loaded condition in a comparable consist to confirm that the train consisting of these wagons is able to stop within the brake performance curves applicable for the operating corridor. Generally these will be the GW16, GW30, and GW40 brake performance curves; refer to T HR RS 00830 ST.'¹⁶

The ATSB has been informed, that since the incident Qube has not experienced any significant braking incidents with grain trains operating from Moss Vale to Port Kembla. This provides some evidence that the changes made since April 2017 have, to a large extent been positive. The changes have included both procedural changes to the operation of the train, as well as a design change refinement to the braking system on the CGSY wagons. It has been noted by the ATSB that whilst the component level checks have been made and procedure specific train loading and setup as per the April 2017 incident has not been recreated exactly, commercial logistics have precluded this to date.

Train loading

There were discrepancies between the recorded train load and the actual mass of the train. The train consist recorded gross tonnage for the 40 wagons as 3360 t (84 t per wagon). It appeared that the mass for each wagon was originally recorded as 92 t with a gross tonnage of 3680 t

¹⁶ Asset Standards Authority NSW. T HR RS 00400 ST RSU 400 Series – Minimum Operating Standards for Rolling Stock – Freight Vehicle Specific Interface Requirements. Version 2.0. Issued 24 August 2017.

however this had been hand written over. The changes to the consist should have been signed or initialled by the train crew, but this was not done.

The mass recorded on the train consist was 10 per cent lighter than the actual mass of the load. While the total mass was within the allowable limits of the track infrastructure, the heavier load impacted on the braking performance of the train. The train crew, that took over at Goulburn, said that they noticed the consist had been altered, they also noticed the extra load as the train was coming out of Goulburn. This indicated that the train crew was aware of the extra load and its potential to affect train performance.

The tare (unloaded) mass of each wagon was designated as 22.2 t with a loading capacity of 68.8 t. The actual tare mass of a wagon (CGSY 4502V) was measured after the incident. It was 23.1 t, 900 kg over the tare mass of 22.2 t stencilled on the side of the wagon and that designated by the manufacturer. Typically, the greater the payload (up to the allowable limit) loaded into the wagon the better the economic return on the trip.

When the train was discharged at the Quattro facility at Inner Harbour, the wheat load was weighed at the facilities as 2784 t in total. The heaviest wagon contained 73.91 t and the lightest 45.49 t. The average was 69.6 t per wagon (see Figure 9). This meant that the wagon mass was 3708 t, an average of 92.7 t per wagon. When the extra wagon mass and the extra grain mass was added together there was an extra 349 t or 10 per cent more than what the consist recorded.

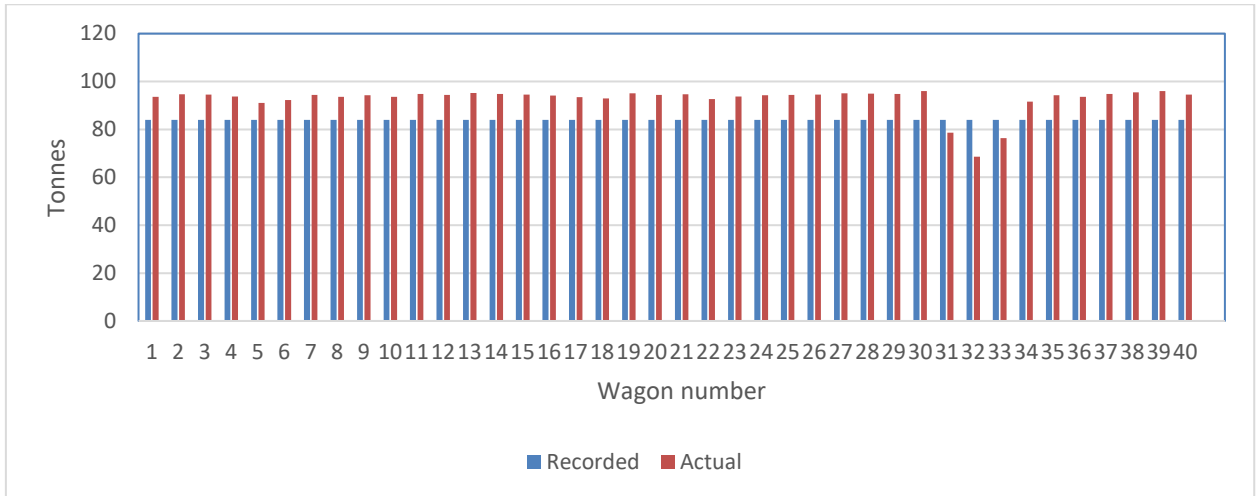
As specified in the Qube work instruction, a calculation that should be performed by train crew before departing is the Tonnes per Operative Brake (TOB).¹⁷ This will determine the braking effort required to control the train on the downward sections of the route. It is calculated by adding the mass of the locomotives to the total mass of the wagons, then dividing this by the number of wagons. In the case of 8960, it was the addition of locomotive 1 (134 t) with locomotive 2 (134 t) and the mass of consist (3360 t). This gives 8960 a TOB of 90.7. The work instruction states: 'grain trains with a TOB that exceeds 80 generally require higher brake cylinder pressures to bring the train to a stop or to control the train speed. Train drivers need to be mindful of this requirement when operating down steep grades'.¹⁸

The train crew were aware of the extra load of the train, the driver said 'we ran the train at 80 km/h that day, you can tell as soon as you get out of Goulburn, an extra 300 t is a heavy weight. It felt heavy pulling along the flat.' The extra mass placed an additional load on the braking system and affected the handling characteristics of the train.

¹⁷ Qube Logistics Work Instruction. Moss Vale to Inner Harbour Train Management. WI-540. Version 3.0 Issued 14 September 2016.

¹⁸ Ibid.

Figure 9: Wagon mass



This figure shows the recorded and actual loading of the 40 wagons in the train consist. Source: Qube Logistics and Quattro grain facility. Calculations by ATSB

Risk management

The track section where the runaway occurred had a ruling gradient of 1 in 30. Unlike the Blue Mountains, west of Sydney, there are no relief sections of shallow gradients to allow for the recharging of the air brake system.

Until the mid-1990s, a dead-end siding was available near Dombarton to divert an uncontrolled train in the event of a runaway. This siding was a part of the former Dombarton crossing loop. Though not originally placed as a risk mitigation measure, it could act as such if required. The siding was subsequently removed on the basis that the brakes on modern rollingstock were more effective.

Other issues

The train was moved on soon after coming to a stand despite not being formally inspected for any faults by a suitably qualified person. This was after a request from Sydney Trains Wollongong Signalling Complex to move the train from the Sydney Trains network to Arrival Road 3 in Inner Harbour. The request was made to keep the passenger line open.

The driver said that he should probably have refused to move the train but ‘wanted to do the right thing’. It was probable the driver was still affected by the incident. While the train was operated safely at a low speed into Inner Harbour, after such a runaway event it would have been prudent to ensure the train was safe to be moved and have an alternative crew to operate the train.

In addition, the Pacific National Train Controller at Inner Harbour did not inform any ground personnel, in particular the Pacific National Illawarra shift leader, of the emergency event of a runaway train being directed into the terminal. The original joint decision by Sydney Trains and Pacific National was to route the train into the Number 1 Departure Road. This road is adjacent to fuel storage and office buildings and other options were not discussed or considered. The option of routing the train into Number 1 Departure Road was not used as the train came to a stand outside the terminal.

Remedial actions

Qube have undertaken a number of changes since the incident. These include the following changes:

- The QBX locomotives and CGSY wagons were initially suspended from service on the Goulburn to Inner Harbour route. After testing the QBX locomotives and the CGSY wagons were returned to service on the Goulburn to Inner Harbour route.
- QUBE train drivers are now competency assessed on the Moss Vale to Unanderra section of track every 6 months. If a train driver has not been rostered over the corridor within 6 months he or she must be reassessed on the corridor.
- All driver trainers are now competency assessed by an external Registered Training Organisation (RTO) on the Moss Vale to Unanderra section of track.
- Trainee train drivers are now briefed to the same level as a train driver before being rostered on the Moss Vale to Unanderra section of track.
- A training audit for assessing train handling strategies on the corridor has been conducted. This has resulted in the instruction being amended.
- The recommencement of diesel and air brake refresher training for train crew was undertaken.
- An RTO was engaged to develop an improved training package. The first train crew to be trained were the train crew on the Goulburn to Unanderra line.
- An RTO was engaged to review QUBE Work Instruction WI-540 Train Management Moss Vale to Inner Harbour.
- A QUBE investigation officer, since the incident, has conducted weekly audits of trains operating between Moss Vale and Inner Harbour.
- Regular scheduled datalogger downloads have commenced for trains between Moss Vale and Unanderra.

As a result of this incident, Pacific National have undertaken a number of changes since the planned movement of 8960 into its facilities. These include the following changes:

- Review with Sydney Trains the plans and procedures enacted in emergency events, and the decision making process to move Qube Trains from Sydney Trains network to Inner Harbour.
- Review training for Train Controllers to ensure the protocols for an emergency event are followed, and risks are managed, for example: depot evacuation, and escalation process is followed.

Findings

From the evidence available, the following findings are made with respect to the runaway incident involving train 8960, between Dombarton and Unanderra, New South Wales on 22 April 2017. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Safety issues, or system problems, are highlighted in bold to emphasise their importance.

A safety issue is an event or condition that increases safety risk and (a) can reasonably be regarded as having the potential to adversely affect the safety of future operations, and (b) is a characteristic of an organisation or a system, rather than a characteristic of a specific individual, or characteristic of an operating environment at a specific point in time.

Contributing factors

- **The train was loaded by approximately 10 per cent more than that recorded on the train's consist, it is probable that the additional mass placed an extra load on the braking system and affected the handling characteristics of the train.**
- Train 8960 was not operated down Illawarra Mountain in accordance with the operator's work instructions. After passing Summit Tank the driver made ten brake applications and the brake system was never permitted to fully recharge again before the brakes were reapplied. This resulted in a loss of control of a train on a steep descent. The incident was further compounded when the driver's actions caused the locomotive's dynamic braking effort to be deactivated, further reducing control of the train.

Other factors that increased risk

- The Sydney Trains' train controller directed the driver of train 8690 to move the train from the Sydney Trains network to Inner Harbour without any formal inspection of the train following the runaway event.
- The Pacific National Train Controller did not inform Inner Harbour ground personnel of the emergency event of a runaway train being directed into the terminal.

Other findings

- The train crew of 8960 was experienced and fully qualified. The crew had travelled this route down the Illawarra Mountain on numerous occasions.
- The train braking system was operating within the required specifications.

Safety issues and actions

Loading of train

Number:	RO-2017-001-SI-01
Issue owner:	Qube Logistics
Operation affected:	Rail Freight
Who it affects:	All owners and operators of freight wagons

Safety issue description:

The train was loaded by approximately 10 per cent more than that recorded on the consist, it is probable that the additional mass placed an extra load on the braking system and affected the handling characteristics of the train.

Proactive safety action taken by Qube Logistics

Action number: RO-2017-001-SI-01

A Qube investigation officer conducted weekly audits of trains operating between Moss Vale and Inner Harbour following this incident. This included a check that the train consist was recorded correctly.

ATSB comment/action in response

The Australian Transport Safety Bureau notes the response provided and is satisfied that the action initiated by Qube Logistics will address the safety issue.

General details

Occurrence details

Date and time:	22 April 2017 – 1248 EST	
Occurrence category:	Incident	
Primary occurrence type:	Runaway	
Location:	Dombarton to Unanderra	
	Latitude: 34° 27.689' S	Longitude: 150° 44.763' E

Train details

Train operator:	Qube Logistics	
Registration:	8960	
Type of operation:	Freight	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 0	Passengers – 0
Damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Australian Rail Track Corporation
- CFCL Australia
- Pacific National
- Office of National Rail Safety Regulation
- Qube Logistics
- Sydney Trains
- Transport for NSW

References

AR Ball Rolling Stock Maintenance Pty Ltd. *CGSY Braking System Incident Moss Vale to Unanderra line*. 22 April 2017.

Asset Standards Authority NSW. *T HR RS 00400 ST RSU 400 Series – Minimum Operating Standards for Rolling Stock – Freight Vehicle Specific Interface Requirements*. Version 2.0. Issued 24 August 2017.

Australian Wheat Board (AWB) *Wagon loading instructions*. Issued by El Zorro No. 002 31 October 2010.

CFCL Australia. *CGSY Wagon data sheet*. Issue No. 1.

Downer Rail. *Engineering Report CER02691CSGY Wagon Specifications*. Issued 14 June 2017.

Lacterus Verus Pty Ltd. *Report into the braking system performance of QBX 003 locomotive on 22 April 2017*. 23 May 2017.

Office of National Rail Safety Regulator. *Guideline for the top event classification of notifiable occurrences – OC-G1*. 2008.

OTSI Investigation Report 04505 (2011) *Uncontrolled movement of El Zorro grain service 3996 Unanderra 7 February 2011*.

Pacific National *Incident Report – Dombarton to Unanderra, to Inner Harbour*. 31 August 2017.

QUBE Logistics. *Initial Investigation Report FM-512*. Version 1. 1 June 2017.

Qube Logistics. *Work Instruction WI-540 Moss Vale to Inner Harbour Train Management*. Version 3.0. 14 September 2016.

SNC-Lavalin Rail & Transit Pty Ltd. *Principal author Bruce Sismey*. 10 May 2017 amended on 1 Nov 2017.

Sydney Trains. *Incident Information System Management - Incident Report 43*. 24 April 2017.

The Instruction Company. *QLRS Train Braking Procedures Moss Vale to Inner Harbour – Participants Workbook*. Version 1.0. 10 June 2017.

The Instruction Company. *Report on 9 June 2017 test run Goulburn to Inner Harbour*. 15 June 2017.

Wayne Clift Consulting Pty Ltd. *Test report for train braking simulation on 9 June 2017*. 26 May 2017.

Wayne Clift Consulting Pty Ltd. *Test report for auxiliary reservoir fill times on CGSY 4502*. 26 May 2017.

Wayne Clift Consulting Pty Ltd. *Test report for control valve from CGSY 4502*. Issued 25 May 2017.

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 the Australian Rail Track Corporation, CFCL Australia, Pacific National, the Office of National Rail Safety Regulation, Qube Logistics, Sydney Trains, and Transport for NSW.

Submissions were received from the Office of National Rail Safety Regulator and CFCL Australia.

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.