



Rail Accident Investigation Branch

Rail Accident Report



**Runaway and subsequent collision near to
Loughborough Central station, Great Central
Railway
12 May 2014**

Report 04/2015
May 2015

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- the Railways (Accident Investigation and Reporting) Regulations 2005.

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This report is published by the Rail Accident Investigation Branch, Department for Transport.

Runaway and subsequent collision near to Loughborough Central station, Great Central Railway, 12 May 2014

Contents

Summary	5
Introduction	6
Preface	6
Key definitions	6
The accident	7
Summary of the accident	7
Context	7
The investigation	13
Sources of evidence	13
Key facts and analysis	14
Background information	14
Events preceding the accident	16
Events during the accident	19
Events following the accident	22
Identification of the immediate cause	24
Identification of causal factors	24
Identification of underlying factors	29
Observations	31
Summary of conclusions	36
Immediate cause	36
Causal factors	36
Underlying factors	36
Additional observations	36
Actions reported that address factors which otherwise would have resulted in a RAIB recommendation	38
Other reported actions	38
Learning points	39

Recommendations	40
Appendices	42
Appendix A - Glossary of abbreviations and acronyms	42
Appendix B - Glossary of terms	43
Appendix C - Key standards current at the time	48

Summary

At approximately 12:35 hrs on Monday, 12 May 2014, an unmanned train ran away for a distance of around 1.8 miles (2.9 km) before colliding with a set of unattended coaches. The collision occurred about 450 metres south of Loughborough Central station, located on the Great Central Railway. This is a heritage railway, and no train services for public use were being operated on the day of the accident. Nobody was injured as a result of the collision, although significant damage was sustained by some of the rail vehicles involved. The train which ran away had been previously left unattended within a possession on a main line opposite Quorn signal box. The railway at Quorn is on a gradient which descends towards Loughborough.

The train which ran away consisted of a locomotive, coupled to a single coach. The RAIB's investigation found that, before the train was left unattended, the air brakes on the locomotive had been applied by the driver and a single wheel scotch had been positioned against one of the locomotive's wheels by a member of staff. The handbrakes on the locomotive were not applied and the coach was not secured with either brakes or a wheel scotch.

The RAIB has concluded that the train ran away because the wheel scotch was positioned against the locomotive's wheel in a way which made it ineffective. The RAIB determined that the handbrakes on the locomotive, had they been used, would have provided sufficient braking force to have held the train. The driver did not apply the locomotive's handbrakes because he believed that they were not effective on this class of locomotive and that the wheel scotch would provide sufficient braking force, should the pressure in the air braking system leak away. The driver may also have been influenced by the prevailing practices on the railway which related to the use of handbrakes.

The train was not left in a location where it would have been protected from running away by the arrangement of the infrastructure. This was probably because the staff involved thought that these locations were either not available or needed disproportionate time to access. It may also have been because they had a reduced perception of the risks of leaving trains unattended outside of these locations.

The RAIB found that checks by the Great Central Railway's managers did not detect the full extent of the unsafe and non-compliant practices present within possessions. The investigation also found that some of the rules relating to the way in which rail vehicles were to be left unattended were inconsistent and potentially unclear.

The RAIB has identified two key learning points. These are: that the movement of trains not connected by a continuous automatic brake or which do not include a brake van under the control of a guard should be avoided; and that safety critical activities must be undertaken by an adequate number of staff holding the correct competencies.

The RAIB has also made four recommendations addressed to the Great Central Railway. These relate to: ensuring that activities which result in trains being left unattended are subject to effective risk controls; implementing the railway's safety management system to ensure that its requirements relating to the training and assessment of staff are effective; ensuring that non-compliances and unsafe practices are detected in the future; and ensuring that the Great Central Railway has effective oversight of the maintenance being undertaken on diesel locomotives operating on its infrastructure.

Introduction

Preface

- 1 The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability.
- 2 Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.
- 3 The RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of all other investigations, including those carried out by the safety authority or railway industry.

Key definitions

- 4 All dimensions in this report are given in metric units, except speed and locations which are given in imperial units, in accordance with normal railway practice. Where appropriate the equivalent metric value is also given. Any location mileages given are measured from the zero datum which was located at Manchester Piccadilly station (via Penistone).
- 5 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B.

The accident

Summary of the accident

- 6 At approximately 12:35 hrs on Monday 12 May 2014, an unmanned train consisting of a locomotive and a coach ran away for a distance of around 1.8 miles (2.9 km). The train subsequently collided with a set of five coaches which had previously been stabled and left unattended about 450 metres on the approach to Loughborough Central station (figure 1), located on the Great Central Railway (GCR). The GCR was not running train services for the public when the collision occurred.

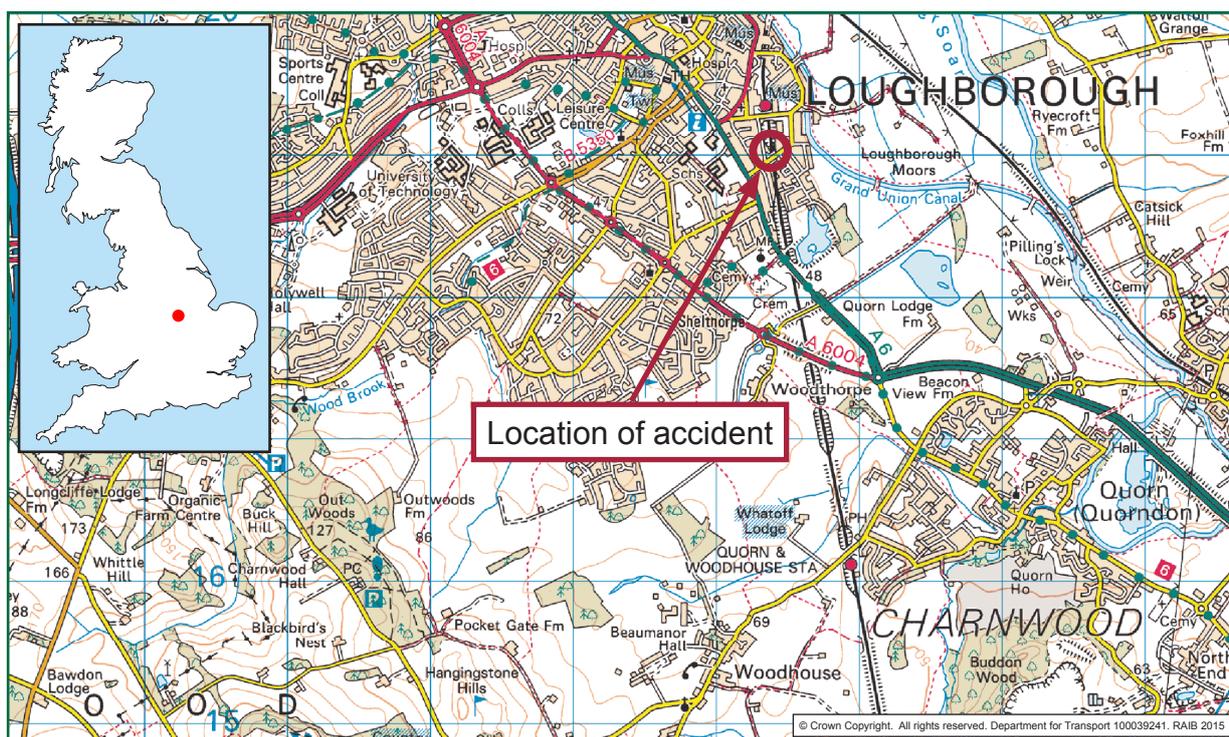


Figure 1: Extract from Ordnance Survey map showing location of accident

- 7 Nobody was injured as a result of the collision. Significant damage was sustained by some of the rail vehicles involved.

Context

Location

- 8 The GCR is a heritage railway and, as such, runs train services for passengers using preserved locomotives and rolling stock. It does not form part of Great Britain's national rail network.

- 9 The train which ran away (referred to as the 'incident train' throughout this report) had been left unattended on the *down* main line opposite Quorn signal box (95 miles 16 *chains*); this is situated just to the south of Quorn and Woodhouse station (95 miles 6 *chains*) (figure 2). The railway at this location is double-tracked and consists of the down main line (for trains travelling northwards towards Loughborough Central at 93 miles 2 *chains*) and an *up* main line (for trains travelling southwards to Swithland and Rothley). The lines within the *station limits* of Quorn signal box are not equipped with *track circuits*.
- 10 A single-track siding known as the 'down lie-by' is situated to the west of the down main line. This siding is around 300 metres long and can only be accessed from the down main line by trains making a shunting movement over *points* located to the north of the signal box, which controls it. The down main line is protected from unauthorised movements originating from the down lie-by by *trap points*. Quorn North and Quorn South sidings are situated to the east of the up main line and are also under the control of the signal box (figure 2). These sidings can be accessed from the up main line using points located to the north of Quorn and Woodhouse station and to the south of Quorn signal box respectively.

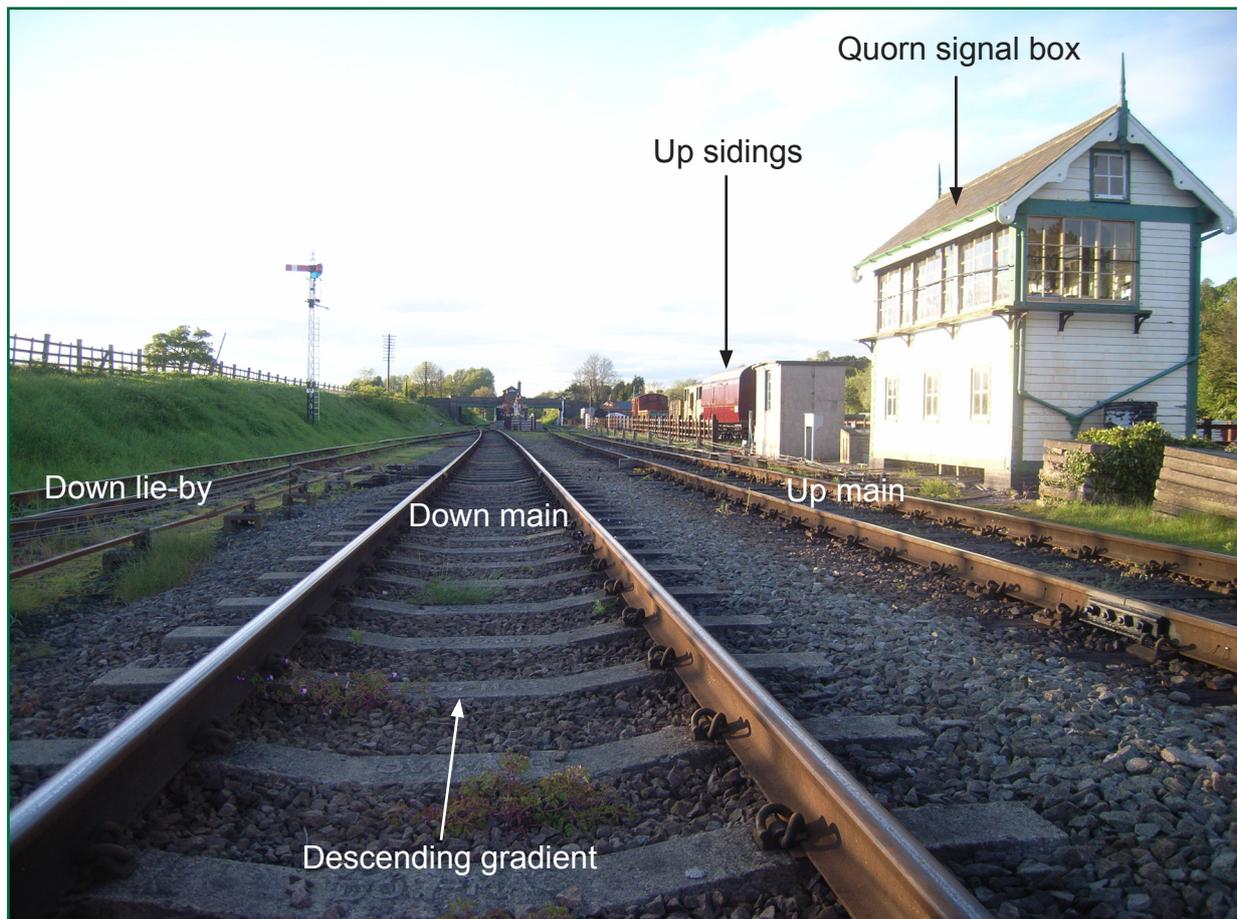


Figure 2: Layout of the track opposite Quorn signal box.

- 11 Historical gradient tables record an average gradient of 1 in 330 for the railway at Quorn and Woodhouse, descending towards Loughborough (northwards). A survey undertaken by the RAIB showed that the location where the incident train was stabled (paragraph 57) was slightly steeper than this average, at around 1 in 212. The recorded average gradient increases in steepness to around 1 in 176 around 775 metres to the north of Quorn and Woodhouse. It then decreases before levelling out around 75 metres on the approach to the point where the collision occurred (figure 3); this was within the station limits of Loughborough North signal box. The down main line at the point of collision is equipped with track circuits which can be monitored from this signal box.

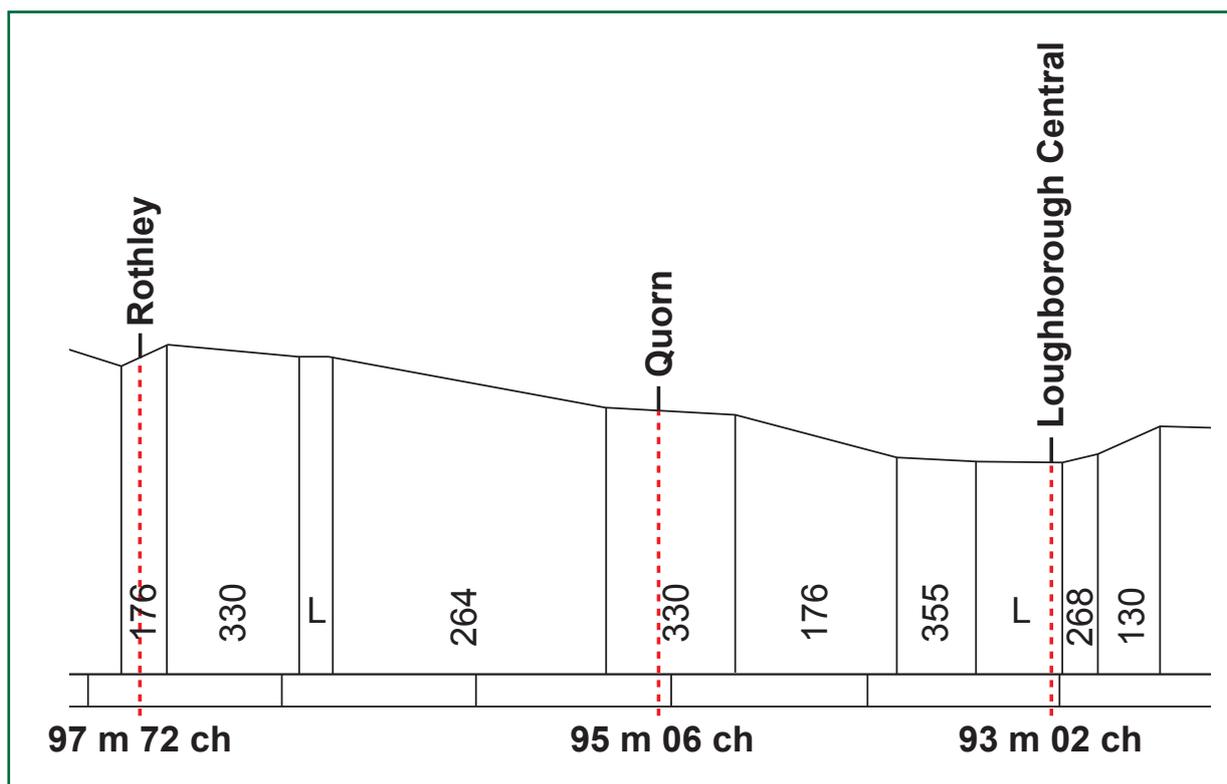


Figure 3: Diagram of line gradients between Rothley, Quorn and Woodhouse and Loughborough Central

- 12 The maximum permitted *line speed* for trains during normal passenger operations on the GCR is 25 mph (40 km/h), reducing to 10 mph (16 km/h) within station limits.

Trains involved

- 13 The incident train consisted of locomotive number 37198 (the trailing vehicle in the direction of the runaway) mechanically coupled to preserved Mk1 Post Office Sorter (POS) coach number 80301 (the leading vehicle). The train as a whole was approximately 39 metres in length and weighed 145 tonnes. The train did not include a *brake van* (paragraph 40).

- 14 Locomotive 37198 is a Class 37 diesel-electric locomotive and was built in 1964. It operated on the main line network in Great Britain until 1999 and was then placed in storage until it was sold into the heritage railway sector in 2004. In 2008, it was purchased by Network Rail as a spare *Class 97/3* locomotive for the *European Rail Traffic Management System* (ERTMS) testing programme. In 2009, Network Rail sent the locomotive to the GCR for some repair work; after this work had been completed, the locomotive was not immediately required by Network Rail. It was therefore left in storage on the GCR.
- 15 At some point during this period of storage, the Type One Locomotive Company asked Network Rail if it could carry out some restoration work to the locomotive in order that it could be operated on the GCR. Network Rail stated that it had no objection to this. The Type One Locomotive Company subsequently completed this restoration work and, in 2011, returned the locomotive into an operating condition. It was then assigned by the GCR on a full-time basis to its *permanent way* team, although it occasionally also hauled passenger trains during galas.
- 16 The locomotive was not fitted with an *on train data recorder* (OTDR). This was because the locomotive operated on the main line network before there was a requirement in *Railway Group Standards* for locomotives to have this equipment fitted. There is also no requirement for OTDR equipment to be fitted on locomotives operating on *minor railways*, such as the GCR.
- 17 A Class 37 locomotive has two bogies, each of which has three powered axles. It is equipped with air operated *tread brakes*, which are applied on all 12 wheels via either the *straight air* or *automatic air* braking systems¹. The locomotive can supply compressed air to, or draw a vacuum from, the braking systems of rail vehicles which are connected to it via the *brake pipe* or *automatic vacuum train pipe* respectively. The brakes on the train as a whole can then be controlled by the driver via the locomotive's automatic brake control valve.
- 18 The Class 37 locomotive is fitted with one handbrake per cab, which is applied using a hand wheel located by the *secondman's* seat. Turning this hand wheel will (via a chain drive) force the brake blocks to apply to the wheels on the middle axle on the bogie at that end of the locomotive (figure 4). An indicator within the cab will show an 'ON' flag once the handbrake is applied. The braking system of the Class 37 locomotive is explained in more detail between paragraphs 31 and 36.
- 19 POS coach 80301 is equipped with *vacuum brakes* but is not fitted with a handbrake. It had been coupled mechanically (via a *screw coupler*) to locomotive 37198. However, the automatic vacuum train pipe had not been connected to the coach and the vacuum brakes on the coach were not functional when the runaway occurred.

¹ Various different terms have been used to describe these braking systems during the service life of the Class 37. For clarity, standard modern railway terminology has been used throughout this report.

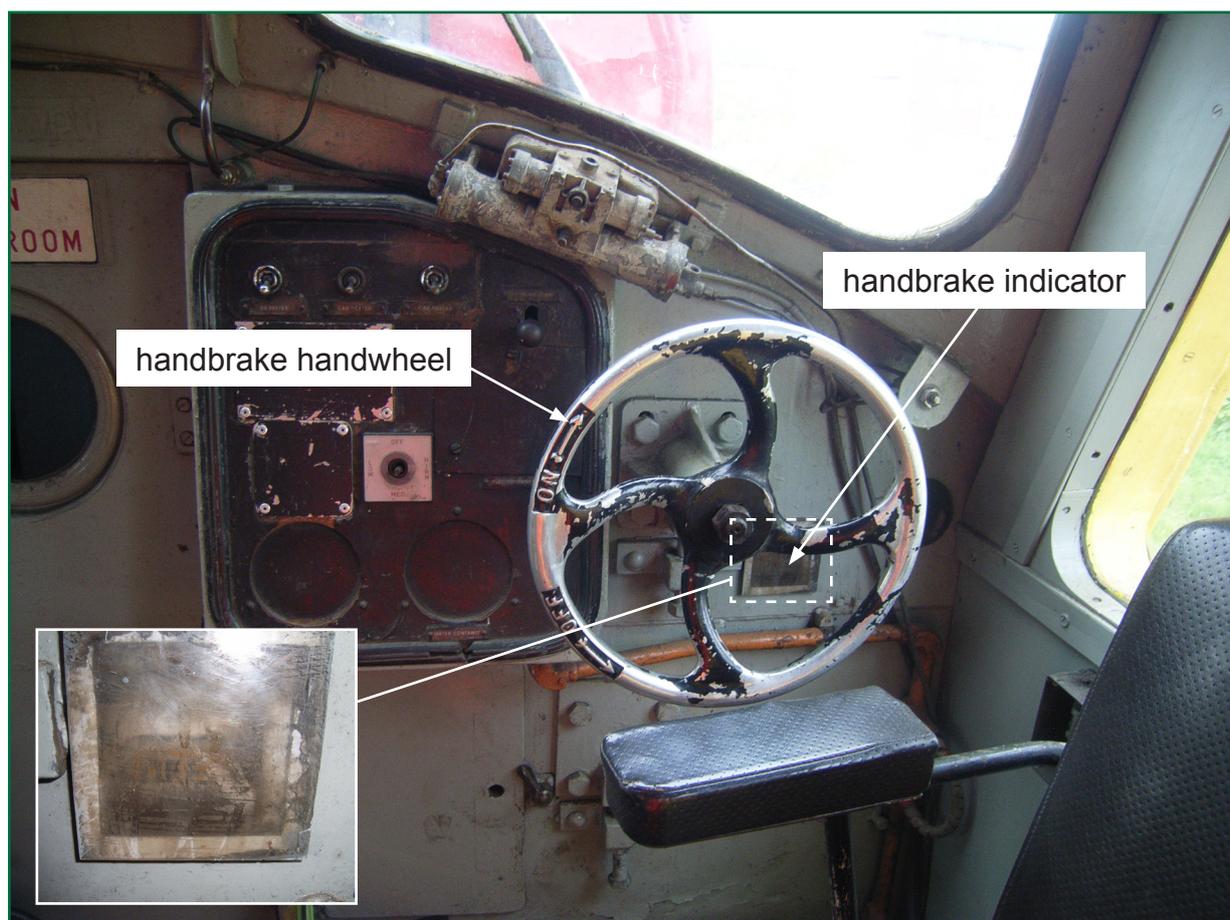


Figure 4: Class 37 handbrake hand wheel and indicator

- 20 The set of coaches which was struck by the incident train consisted of five Mk 1 type coaches, coupled together. The second vehicle in the set (from the end which was struck) was equipped with a handbrake; a site examination by the RAIB confirmed that this had been applied. The RAIB's examination also found a *scotch* lying around 12 m beyond the point of collision, which suggested that it had been used to secure the first vehicle in the set. Witness evidence was that staff had earlier been working in this set of coaches, but that they had been unoccupied for around 20 minutes before the collision occurred.

Organisations involved

- 21 The GCR manages and maintains the infrastructure where the accident took place and is responsible for all rail services which operate on it. The GCR employed² the operations manager, signallers, safety manager, *Person in charge of possession* (PICOP) and the permanent way team members. GCR staff undertook some of the restoration work on locomotive 37198 and examined it periodically for its *fitness to run* (paragraph 131).
- 22 The Type One Locomotive Company restores and maintains diesel locomotives which operate on the GCR. The Type One Locomotive Company undertook the most recent restoration work on locomotive 37198 and was responsible for its ongoing maintenance once it started running on the GCR in 2011.

² For the purposes of its safety management system, policy documents and rules the GCR considers volunteers to be employees.

- 23 Network Rail was the owner of locomotive 37198. It provided technical advice to the GCR and the Type One Locomotive Company regarding its restoration and maintenance and also purchased replacement components for the locomotive.
- 24 The GCR, the Type One Locomotive Company and Network Rail freely co-operated with the investigation.

Staff involved

- 25 On 12 May 2014, the member of staff undertaking the duties of the PICOP was also the driver of the incident train. For clarity, he is referred to as the PICOP throughout this report. The PICOP was assisted in securing the incident train at Quorn by Trackworker A, who was a member of the GCR's permanent way team.
- 26 The PICOP was employed on a full-time basis by the GCR as the permanent way manager; as such he was responsible for the maintenance and inspection of the track. This included managing a permanent way team consisting of five full-time employees. The PICOP had joined the GCR as a volunteer in the early 1970's and had been a full-time employee from the mid-1980s. He had completed training as a train driver with the GCR and had been certified by the railway as competent in that role for around 20 years prior to the accident. In 2007, the PICOP undertook, and passed, a driver's conversion course for the Class 37 locomotive. In early 2013, the PICOP passed a bi-annual examination on the GCR's rules, a *route knowledge* test and a practical driving assessment in compliance with the GCR's training and certification policy for footplate crew. In June 2013, he had been briefed by the railway on the requirements of the new GCR Rule Book.
- 27 The PICOP was one of only two staff who were designated by the GCR as competent to act as a PICOP. This was based solely on his experience and status as the Permanent Way Manager (paragraph 122). The PICOP was also certified as competent in the role of guard; however no other member of staff within the team either held this competency or was appointed to undertake the guard's duties for the incident train.
- 28 Trackworker A was employed by the GCR on a full-time basis as a member of the permanent way team. He had joined the railway as a volunteer in around 2007 and had become a full-time member of staff in 2012. He undertook general track maintenance tasks and also performed shunting duties, as well as sometimes assisting the PICOP with tasks such as *stabling* vehicles. The GCR's records show that Trackworker A had received a copy of the new GCR Rule Book in June 2013.

External circumstances

- 29 The weather on the day of the accident was mild and clear, with a gentle to moderate breeze. Meteorological reports for the weather station closest to Quorn (which is located at Mountsorrel) recorded no rainfall during the morning of 12 May and witness evidence is that the *rail head* at Quorn and Woodhouse was dry when the runaway occurred³. No other train movements, shunting or other work were being undertaken within the possession or near to where the incident train was left unattended.

³ Although the RAIB inspected the condition of the rail head at Quorn following the collision, a period of rain post-incident meant that the results of this inspection were inconclusive.

The investigation

Sources of evidence

- 30 The RAIB used the following sources of evidence:
- an examination of the point of collision, the trains involved and the railway at Quorn and Woodhouse;
 - witness statements;
 - photographs of the vehicles and site;
 - a site survey;
 - the GCR Rule Book, General Appendix⁴, safety management system and relevant policies and procedures;
 - GCR staff training and competency records;
 - a reconstruction of how the incident train was stabled at Quorn and Woodhouse on 12 May 2014;
 - technical data and schematics relating to the Class 37 locomotive;
 - a detailed inspection of the damage sustained to locomotive 37198 and the status of its air braking systems;
 - testing and analysis to establish the condition and effectiveness of the handbrakes on locomotive 37198;
 - maintenance records for locomotive 37198; and
 - a review of previous incidents which took place between 2003 and 2014 on Network Rail managed infrastructure (and associated depots and sidings).

⁴ A document which serves as an appendix to the GCR Rule Book and working timetable.

Key facts and analysis

Background information

The braking system of the Class 37 locomotive

- 31 On a Class 37 locomotive, there is an automatic brake control valve situated in each cab. This valve is used by the driver to vary the air pressure in the locomotive's brake pipe within specified limits. The locomotive's *distributor* will detect these changes in pressure and react accordingly; a reduction in brake pipe pressure, for example, will cause the distributor to pass compressed air into relay valves located at each end of the vehicle. These relay valves will in turn admit compressed air from the automatic brake reservoir into the *brake cylinders*. The brake cylinders will become pressurised and, due to the action of the brake rigging, will force the brake blocks onto the surface of the locomotive's *wheel treads*. A brake application will also occur automatically should the pressure in the brake pipe be lost for some other reason, such as a train becoming divided. Increasing the pressure in the brake pipe will work in the opposite sense, and will cause the brakes to be released.
- 32 The relay valves which admit air into the brake cylinders from the automatic brake reservoir are of a *self-lapping* design. This means that any loss of air from the brake cylinders (eg due to leakage) will lead to further air being admitted; this will continue until the correct brake cylinder pressure (ie that which corresponds with the commanded brake pipe pressure) is restored.
- 33 As compressed air is drawn from the automatic brake reservoir to supply the brake cylinders, it is replenished from the locomotive's main air reservoirs; these are in turn replenished by the main air compressors, which will start automatically after a specified drop in main air reservoir pressure is detected. Should the main air compressors be shut down, the system as a whole will, over time, become progressively depressurised as air leaks away. This will eventually allow the brakes to release. The time taken for this to occur will depend on the air tightness of the systems and can be accelerated by factors such as the failure of a pipe or component.
- 34 Network Rail supplied the RAIB with a copy of its latest Vehicle Maintenance Instruction (VMI) for the Class 97/3 locomotive; this would have applied to locomotive 37198 once it had commenced ERTMS testing duties. This gave no criteria for the number of turns of the hand wheel which should result in a full handbrake application. However, the Network Rail engineer with responsibility for these locomotives stated that, as general guidance, a handbrake on these locomotives would normally be considered as being properly adjusted if around 25 turns of the hand wheel were needed to fully apply the brake blocks to the wheels. Any handbrake which required over 50 turns to become fully applied would normally be considered as being out of correct adjustment.

- 35 Damage to locomotive 37198 meant that only the No. 2 end handbrake (which would have been the trailing cab on the incident train) could be tested by the RAIB following the accident. During this test, the brake blocks were observed to have become fully applied to the middle wheel on the secondman's side after 60 turns of the hand wheel and on the driver's side after 80 turns. This indicated that the No.2 end handbrake was not correctly adjusted. The maintenance of the locomotive is discussed further in paragraphs 123 to 134.
- 36 A 'pull-away' test of the locomotive was undertaken with this single handbrake fully applied and the amount of force needed to move the locomotive was measured. Analysis based on the results of this test showed that, had this single handbrake been fully applied, then it would have produced enough braking force to prevent the incident train from moving on a descending gradient greater than the 1 in 212 present at the point where the train was stabled (paragraph 11).

The movement of trains within possessions

- 37 The arrangements for the movement of trains within possessions are detailed in the GCR Rule Book. This requires an *absolute possession* to be taken in accordance with Section T, Part III of the GCR Rule Book (commonly termed as a 'TIII possession') where the movement of engineering trains or other vehicles (such as cranes or *On Track Plant*) is required for work occurring within the possession.
- 38 The GCR Rule Book states the following with respect to possessions taken in accordance with Section T part III:

'The PICOP must arrange for the line to be protected as follows: -

A possession limit board must be placed on the line concerned ¼ mile ahead of the stop signal or points specified in [the possession control form]. Where, however, the distance of ¼ mile [400 metres] cannot be obtained, the [possession limit board] must be placed as far ahead of the signal or point specified as circumstances permit'.

- 39 The GCR Rule Book also gives the PICOP responsibility for authorising movements being made within possession limits, other than those taking place within *worksites*⁵.

The use of brake vans

- 40 The GCR Rule Book requires all trains to include a brake van as part of their formation. Where a train is running without an automatic brake, the GCR Rule Book requires the brake van to be the rearmost vehicle of the train.

⁵ No worksites were established within the TIII absolute possession taken between Rothley and Loughborough on 12 May 2014.

The stabling of trains

41 The arrangements for stabling trains are detailed within the GCR Rule Book. This states the following with respect to leaving locomotives unattended:

'When in charge of a locomotive, the Driver must not leave it without a competent member of staff being left in charge of it unless:-

(a) otherwise directed by the Rules or

(b) it is absolutely necessary to do so, or

(c) the locomotive is in a siding and has been secured by means of the handbrake or scotches and has carried out the other instructions appropriate to the type of locomotive concerned.'

42 The GCR General Appendix gives further requirements in relation to leaving both diesel locomotives and vacuum braked trains unattended:

'Diesel Locomotives must not be left without a competent member of staff in charge unless:-

- *The automatic train brake is fully applied*
- *The master controller is in the "Off" position with the master key removed*
- *The locomotive is secured by the handbrake or scotches.'*

The automatic vacuum brake must not be relied on to secure a vehicle or vehicles when a locomotive is not attached. Where provided, handbrakes must be used, supplemented by scotches if necessary.'

43 At a meeting with the RAIB, GCR managers stated that all staff involved in securing rail vehicles are trained to push scotches in firmly. They also stated that, prior to this accident, the number and location of scotches to be applied when leaving trains unattended was left to the discretion of the train crew or shunter involved. GCR managers additionally stated that they would consider the use of a single scotch to secure a train to be an unusual occurrence.

44 The GCR required that each locomotive and brake van operating on its railway carries a minimum of two scotches; GCR managers stated that those on locomotives are selected on the basis of being the best match to the relevant wheel profile. The post-incident reconstruction of the stabling of the incident train showed that the scotch used by Trackworker A was a good fit to the wheel profile of locomotive 37198.

Events preceding the accident

45 A steam gala was held at Swithland between Friday 9 May and Sunday 11 May 2014. On 9 May 2014, the GCR's operations manager signed possession control forms which gave permission for a TIII possession of the up and down main lines to be taken from Rothley to Loughborough, starting on Sunday 11 May. The operations manager endorsed the forms to indicate that the PICOP was allowed to undertake multiple roles within the possession.

- 46 The length of the possession between the limits given on the control forms was around 4.4 miles (7 km). Following the accident, the GCR stated that this length had been required as it planned to run a photographic charter train within the possession on Tuesday 13 May (paragraph 111). The *periodic operating notice*, which published the details of all planned possessions, stated that the intended duration of the possession was four days (from Monday 12 May to Thursday 15 May) and that it was required for the purposes of permanent way work.
- 47 At 18:20 hrs on Sunday 11 May, the signaller on duty in Quorn signal box blocked the up and down main lines between the limits given on the possession control forms and endorsed the forms to say that he had done this. The forms were then left in Quorn signal box.
- 48 At around 08:15 hrs on Monday 12 May 2014, the PICOP prepared locomotive 37198 for use in the southern end of Quorn sidings. This included checking the locomotive's fuel, lubricating oil, water and the turbocharger and air compressor oil. Having found no defects, the PICOP started the locomotive and then waited for the pressure in the main air and air braking systems to build up.
- 49 While waiting for the air pressure to build, the PICOP and the five staff making up the permanent way team discussed their plans for the day. These were to undertake shunting at Quorn sidings and then to re-arrange vehicles within the Swithland sidings and the Mountsorrel branch (figure 5). This latter activity was required following the previous weekend's gala and to accommodate the requirements of the upcoming photographic charter. The operations department had also requested that the permanent way team move the POS coach from Swithland to Loughborough.

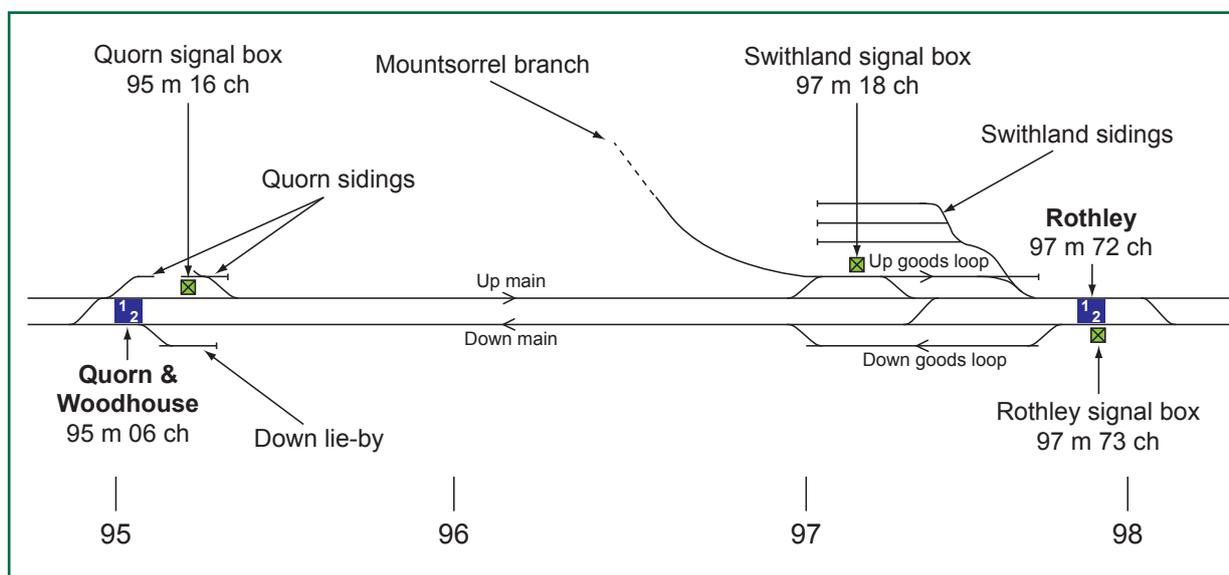


Figure 5: Line diagram of key locations within the possession of 12 May 2014

- 50 The movement of the POS coach met the criteria given within the GCR General Appendix for a *Class 3 empty coaching stock* movement. However, as the movement was taking place within a possession, it did not feature within the GCR's *working timetable* and had not been formally classified as such.

- 51 At 08:30 hrs the PICOP signed the possession control forms which had been left in Quorn signal box to confirm he had taken the possession and placed the appropriate *protection* at the possession limits. The GCR Rule Book required possession limit boards to be placed when taking possessions (paragraph 37). However, on 12 May, no possession limit boards or other protection was placed; this is discussed further in paragraph 101. The PICOP stated that this was because there were no GCR road vehicles or suitable staff available to place them. The practices adopted by the permanent way team within the possession are discussed further at paragraph 103.
- 52 The permanent way team then started to shunt engineering wagons in and around Quorn sidings. The PICOP drove locomotive 37198 during this shunting and continued to drive it throughout the remainder of the morning's activities. After the shunting at Quorn was completed, locomotive 37198 left for Swithland, where it arrived at about 09:25 hrs. The permanent way team rode on board in the locomotive's cabs during this movement.
- 53 The team undertook shunting duties at Swithland for around two hours; this included retrieving the POS coach. After they had finished shunting, the permanent way team *loose-coupled* the POS coach to the locomotive, which they then boarded. The train departed Swithland on the down main and made a *wrong-direction* movement towards Rothley signal box, with the locomotive leading the coach.
- 54 This movement was still within the possession and it was required because the *block instrument* at Rothley signal box (which was unmanned) needed to be set to '*LINE CLEAR*', so that Swithland signal box could be closed. By this point, the team had already missed their scheduled 11:00 hrs break. However, they decided to continue with the movement to Rothley before taking their break so that the signaller at Swithland, who was a volunteer, could go home.
- 55 Once at Rothley, a member of the permanent way team⁶ set the block instrument to '*LINE CLEAR*'. The train then made a *right direction* movement towards Quorn and Woodhouse; this movement was made with the locomotive *propelling* the coach. Witnesses stated that, during this movement there were four team members in the leading cab (including the PICOP as driver) with the remaining two situated in the rear cab. The signaller at Swithland subsequently observed the incident train pass by on the down main line; he estimated its speed as being between 15 and 20 mph (24 and 32 km/h).
- 56 The train arrived at Quorn and Woodhouse between 11:50 and 12:00 hrs. After a discussion, the team decided to take a break in their mess room at Quorn, before going onwards to Loughborough with the POS coach. The PICOP decided to shut down the locomotive while the break was being taken, in order to observe the requirements of the GCR Rule Book relating to the need to limit potential noise nuisance. The PICOP then stopped the locomotive's engine and placed the *Master Switch* into '*OFF*'. This would have shut down the locomotive's two main air compressors.

⁶ One member of the permanent way team had been certified by the GCR as competent to operate Rothley and Quorn signal boxes. The team member was not qualified to operate Swithland signal box.

- 57 The accounts of witnesses and the position of the scotch as it was found post-incident (paragraph 64) indicate that the train was probably stabled with the leading cab doors of the locomotive roughly level with the northern edge of Quorn signal box.

Events during the accident

- 58 Using evidence from witnesses, an examination of the site and a post-incident reconstruction, the RAIB considers that the positions of the leading end cab controls of locomotive 37198 when it was left unattended were as follows.

- Master Switch – OFF;
- Automatic brake control valve – EMERGENCY;
- Straight air brake control valve – RELEASE;
- *Automatic Warning System (AWS) isolating switch – ISOLATED⁷;*
- Brake selector switch - AIR PASSENGER.

The evidence also indicated that the control key was left in place in the leading cab and that the handbrakes were left in the OFF (ie released) position in the leading and trailing cabs of the locomotive.

- 59 As the PICOP was shutting down the locomotive, the permanent way team started to disembark from both cabs. Trackworker A descended from the cab and was passed a scotch. He stated that he positioned this scotch against the leading (downhill) face of the right-hand (secondman's) side wheel of the rear axle of the locomotive's leading end bogie (figures 6 and 7) and drove it home against the wheel tread using his boot (figure 8). The POS coach (which was downhill of the locomotive) was not secured with a scotch.

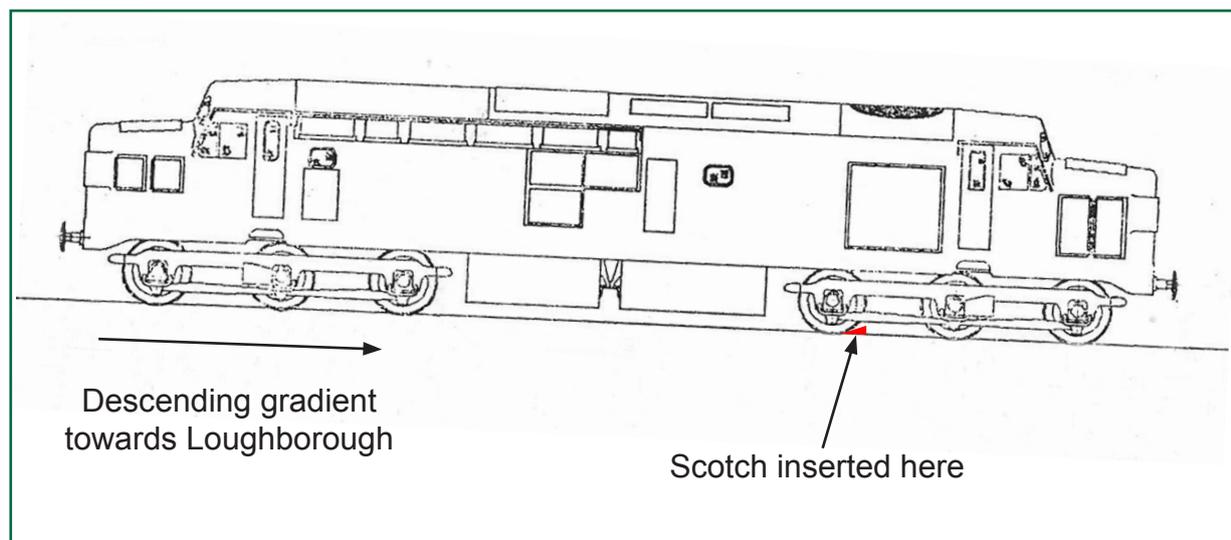


Figure 6: The position on the locomotive where Trackworker A placed the scotch

⁷ Although the GCR is not equipped with AWS, leaving this switch in the isolated position would have meant that the brake pipe remained vented even had the automatic brake control valve been moved to the RELEASE position.



Figure 7: The position of the scotch as it was placed during a post-incident reconstruction



Figure 8: A post-incident reconstruction of how the scotch was driven against the wheel tread

- 60 The available evidence suggests that the scotch was placed in this position by Trackworker A for a number of reasons, including:
- the team exited the cabs from this side of the locomotive (which was closest to the mess room);
 - scotches cannot be placed under the wheels on the leading axle due to the presence of sanding nozzles; and
 - the wheels on the middle axle were described by witnesses as being more difficult to access than the wheels on the trailing axle. In addition, anyone working around the middle wheels would tend to obstruct others who needed to enter or exit the cab.
- 61 Between around 12:20 and 12:30 hrs the permanent way team emerged from the mess room to find that the incident train was no longer where it had been stabled. The mess room was around 100 metres from where the incident train had been left and witness evidence indicates that the team members heard nothing which concerned them while they were inside on their break. Once the team had realised that the incident train had run away, the PICOP and a team member went onto the platform at the station. The team member later stated that from this position he could see the incident train in the distance and that it seemed to him that it was already at, or near to, the point where the collision occurred.
- 62 The PICOP telephoned the operations manager, who was at Loughborough, in order to warn him about the runaway. The operations manager asked a signaller to go to Loughborough North signal box in order to check the status of the track circuits. The signaller concluded from the indications within the signal box that the stabled set of coaches had moved and that a collision had occurred (figures 9 and 10).

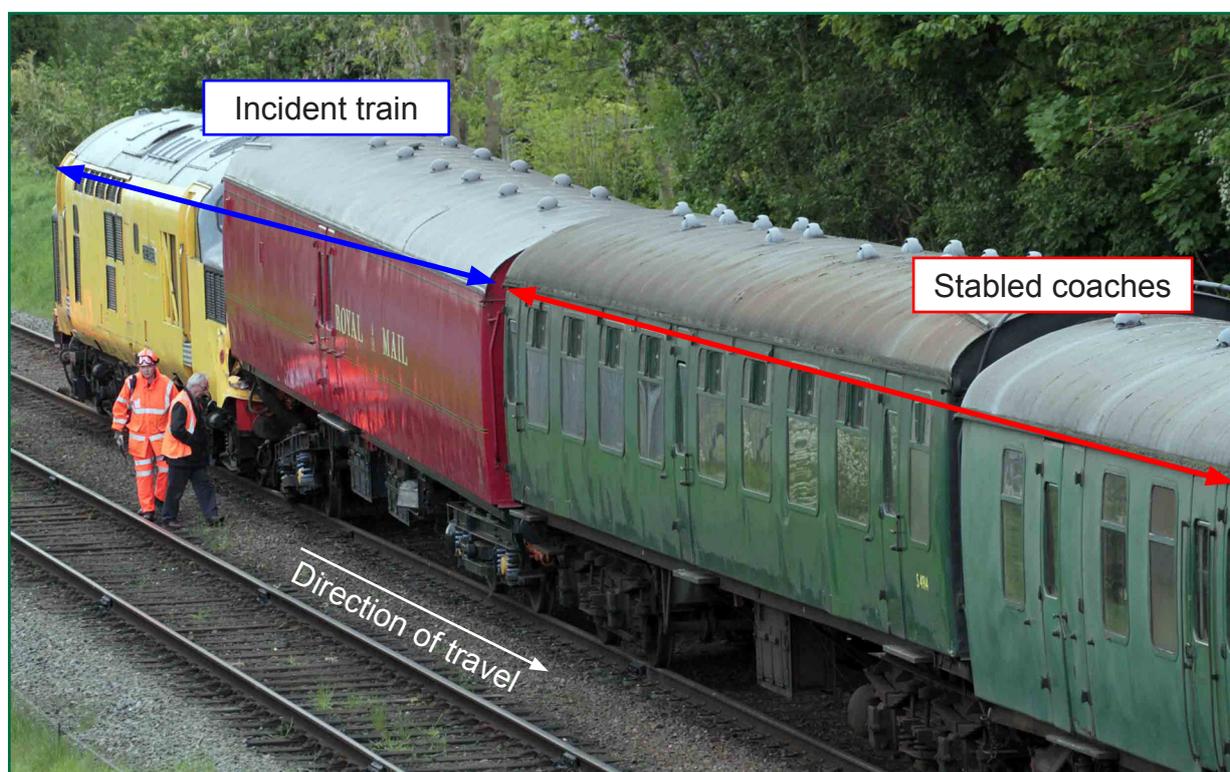


Figure 9: The positions of the incident train and stabled set of coaches following the collision (image courtesy of Chris Milner, *The Railway Magazine*)



Figure 10: Damage sustained by locomotive 37198 following the collision

Events following the accident

- 63 At 12:35 hrs, the booking office manager at Loughborough Central station was contacted by a nearby resident who had heard the sound of the collision and seen that an accident had occurred. The booking office manager immediately contacted the operations manager, who reported that he was already aware of the collision.
- 64 There is witness evidence that, following the runaway, members of the permanent way team found a scotch on the *field side* of the six foot rail of the down main, a short distance north of where the incident train had been stabled. The RAIB subsequently recovered this scotch during its post-incident examination of the railway at Quorn and Woodhouse (figures 11 and 12).
- 65 Some witnesses also stated that there were marks on the rail head which may have been the result of the scotch sliding along the top of the rail head. However, another witness present could not recall seeing any marks of this nature and they were not present when the rail head was later examined by the RAIB (paragraph 29).

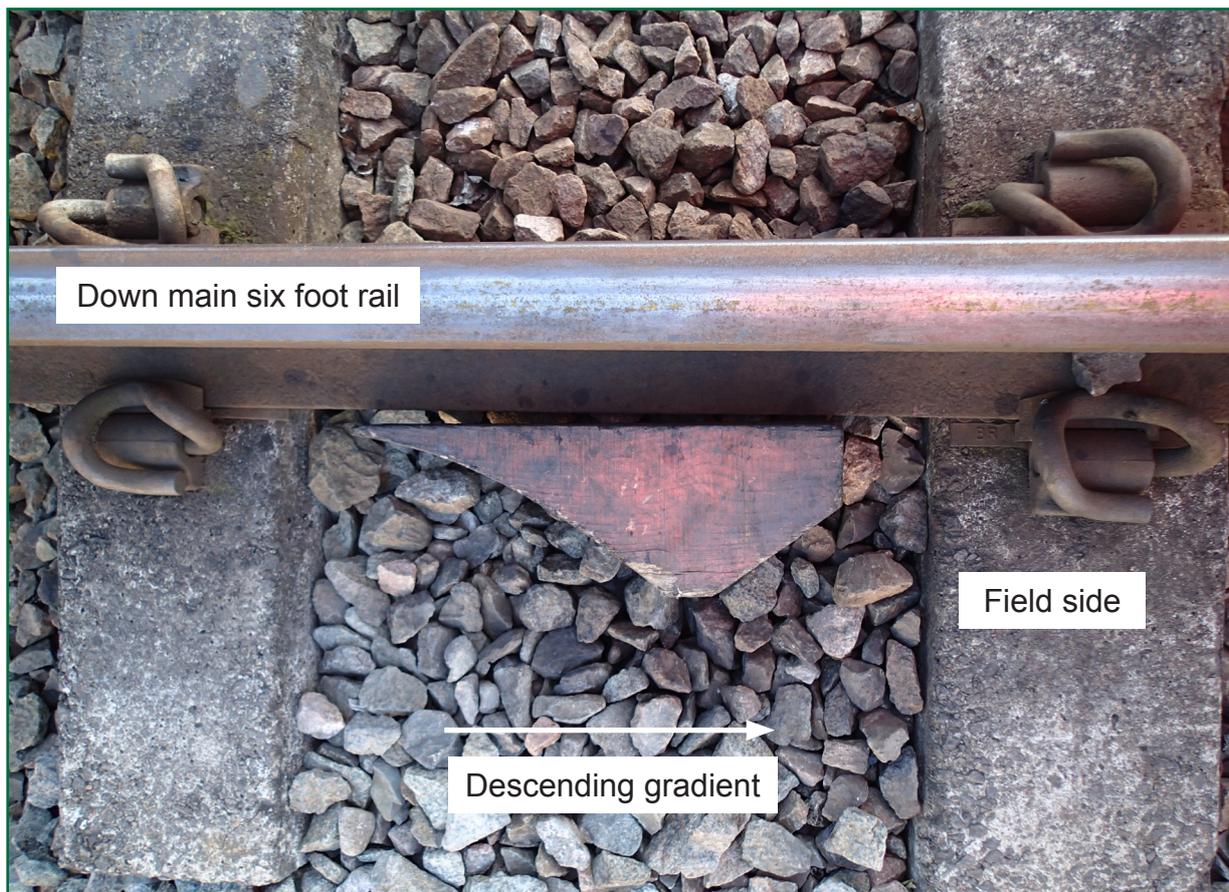


Figure 11: Position of the scotch as found post-incident by the RAIB at Quorn and Woodhouse

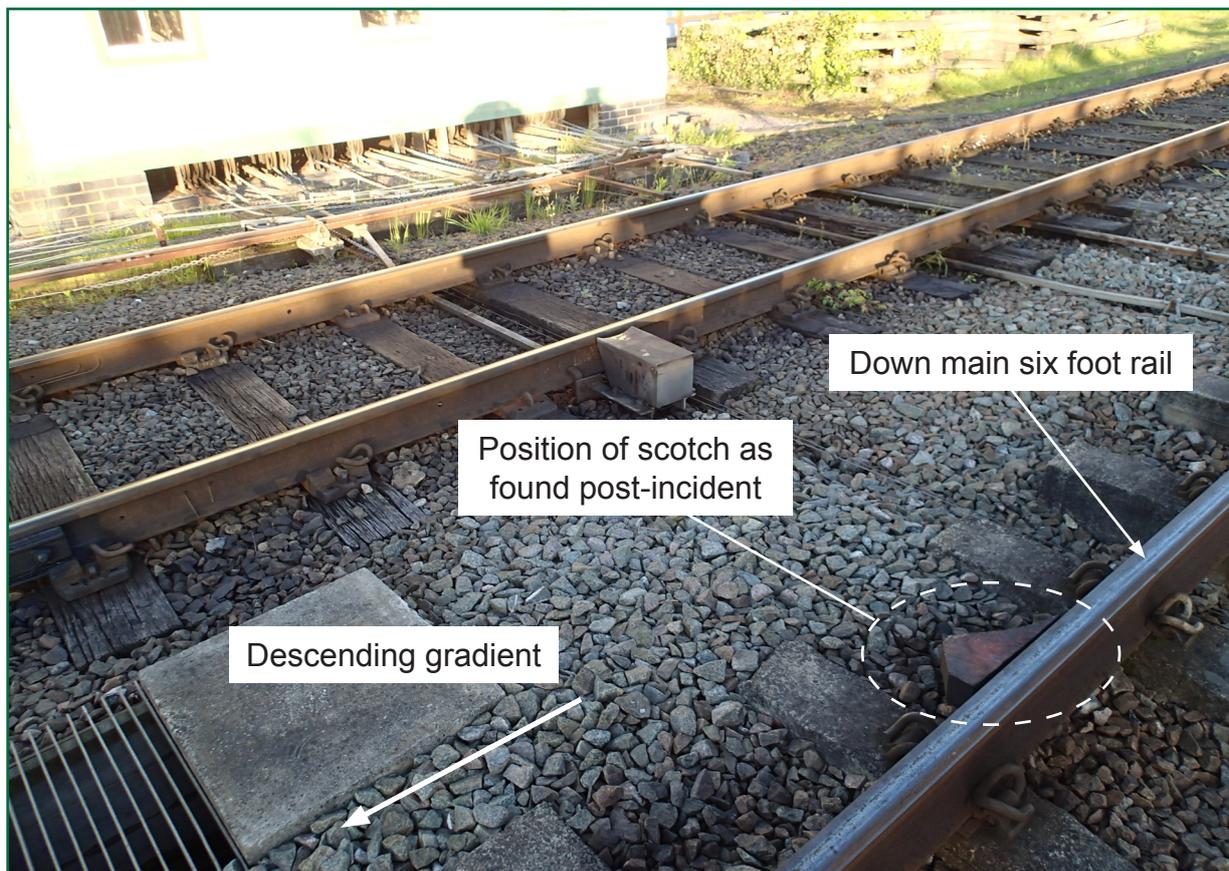


Figure 12: Position of the scotch as found post-incident by the RAIB at Quorn and Woodhouse

Identification of the immediate cause⁸

66 The incident train was left unattended and stabled in a way that allowed it to run away and subsequently collide with a set of coaches.

67 Evidence regarding the position of the controls in the leading cab of the locomotive (paragraph 58) and accounts from witnesses (paragraphs 59 and 61) indicate that the collision occurred after the incident train had been left unattended at Quorn and Woodhouse and while the locomotive was shut down.

68 Evidence from the RAIB's site examination (paragraph 20) showed that the set of coaches struck by the incident train had been stabled on the approach to Loughborough Central station entirely in accordance with the requirements of the GCR Rule Book and General Appendix.

Identification of causal factors⁹

69 The accident occurred due to a combination of the following causal factors:

- the scotch and the incident train's brakes did not hold the incident train on the gradient at Quorn and Woodhouse (paragraphs 70 to 94); and
- the incident train was left unattended on the down main line in a location where there was no runaway protection (paragraphs 95 to 100).

Each of these factors is now considered in turn.

The scotch and the incident train's brakes

70 The scotch and the incident train's brakes did not hold the train on the gradient at Quorn and Woodhouse.

71 The RAIB undertook testing and analysis to establish the probable resistance to movement of the incident train when it was in an un-braked condition (ie when the brakes were released and no scotch was applied). Further analysis indicated that a train with this predicted resistance to movement would have run away on a 1 in 212 descending gradient when un-braked.

72 It is likely that two factors combined to allow the incident train to run away. These are listed below (and discussed in further detail between paragraphs 75 and 94):

- Trackworker A probably positioned the scotch in a way that made it ineffective; and
- The PICOP did not apply the train's handbrakes and believed that using scotches would be an appropriate alternative.

⁸ The condition, event or behaviour that directly resulted in the occurrence.

⁹ Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

- 73 The automatic brake control valve was left by the PICOP in the EMERGENCY position (paragraph 58). This would have completely vented the locomotive's brake pipe, caused the brake cylinders to be at their maximum pressure and applied the brake blocks to all wheels. The holding force created by this brake application would have been sufficient to have held the train on the gradient at Quorn and Woodhouse. This means that, in order for the train to have run away, this braking application must have become ineffective at some point after the incident train was left unattended.
- 74 Although the lack of braking force from the *automatic air brake* application is causal to the accident, it is a general principle of railway operations that air/vacuum brake applications must not be relied upon to secure unattended vehicles against undesired movements. This principle was reflected in the GCR Rule Book and General Appendix. There is also witness evidence that the PICOP was not relying on the automatic air brake to secure the train. For these reasons the status of the locomotive's automatic air brake is discussed as an observation between paragraphs 123 and 134.

The positioning of the scotch by Trackworker A

- 75 To be effective, a scotch has to be positioned squarely on the rail head and snugly against the face of the wheel tread. Failure to do this may allow the scotch to fall out or reduce its available holding force. Trackworker A stated that, when he placed the scotch, he was certain that it was 'well in place' and that he was 'very conscious' of the need not to leave a gap between the wheel and the scotch.
- 76 However, the RAIB has concluded that, when Trackworker A positioned and drove home the scotch against the face of the wheel tread (paragraph 59) he probably did so in a way that resulted in the scotch being ineffective. The RAIB has drawn this conclusion because the arrangement of the bogies on the Class 37 locomotive may have increased the likelihood of Trackworker A making this kind of error (paragraph 77) and also because other potential reasons for a scotch becoming ineffective can be discounted (paragraphs 78 to 84).
- 77 Although the wheels on the trailing axle were thought by witnesses to be easier to scotch compared with those on other axles (paragraph 60) the RAIB observed during the post-incident reconstruction that access to the wheels on the trailing axle was nevertheless significantly obstructed by the arrangement of the bogie's suspension (figure 7). This restricted access would have increased the likelihood of Trackworker A having made an error when he positioned the scotch.
- 78 Based on witness evidence, the RAIB has found no suggestion that fatigue or impairment due to drugs or alcohol were factors which might have increased the probability of an error being made by Trackworker A.
- 79 Competency records (paragraph 28) and witness evidence indicated that Trackworker A's training in securing vehicles had been informal and undertaken 'in-house' by other permanent way team members. However, Trackworker A was able to correctly demonstrate the placement of a scotch during a post-incident reconstruction and there was also witness evidence that he understood correctly how a scotch should be placed (paragraph 75). There is no evidence therefore that Trackworker A's training and competency in the use of scotches were causal to the accident. The way in which the permanent way team was trained is discussed as an observation between paragraphs 115 and 121.

80 A search undertaken by RSSB¹⁰ of incidents on Network Rail managed infrastructure (and associated depots and sidings) between 2003 and 2014 reported that there had been seven incidents involving scotches in which trains or rail vehicles had run away. All of these incidents had occurred either within depots or sidings. The immediate causes for the incidents were recorded and can be broken down as follows:

- three incidents where scotches had not been used where they should have been;
- one incident where a scotch, which was already in a poor condition, was crushed;
- one incident where the scotch was ineffective due to poor rail head adhesion caused by grease contamination;
- one incident where an insufficient number of scotches were used; and
- one incident where an uncertain cause was recorded, although an insufficient number of scotches being used was given as the probable cause.

Each of these mechanisms was then considered for their applicability to the runaway of 12 May.

- 81 Accounts of witnesses either support Trackworker A positioning the scotch before the train was left unattended and/or support the scotch being found following the runaway near to where the incident train had been stabled.
- 82 The RAIB examined the scotch which was recovered post-incident (paragraph 64). This showed that the scotch was in a reasonable state of repair and that it had not been crushed or over-ridden by rail wheels. It was also evident that the base of the scotch was not heavily contaminated with either oil or grease.
- 83 Analysis by the RAIB also showed that a single scotch would have had sufficient holding force (by some margin) to prevent the incident train from moving on a 1 in 212 descending gradient.
- 84 Although the GCR was not running trains for the public on 12 May 2014, Quorn and Woodhouse station and the station car park remained open to the public. The RAIB therefore also considered whether the scotch had been removed by an unauthorised person. However, witnesses stated that there were few people around and that nobody was seen in the vicinity of the incident train either during or immediately after its stabling.

The incident train's handbrakes

- 85 Neither of the handbrakes on locomotive 37198 were applied when the incident train was stabled (paragraph 58). Witness evidence was that this was because the PICOP had intentionally decided not to apply them. As the POS coach was not equipped with handbrakes (paragraph 19) and a brake van did not form part of the incident train (paragraphs 13 and 93) the locomotive's handbrakes were the only ones which could potentially have been used to secure the train. Testing and analysis undertaken by the RAIB indicated that the application of a single handbrake on the locomotive would have prevented the incident train from running away (paragraph 36).

¹⁰ A not-for-profit company owned and funded by major stakeholders in the railway industry, and which provides support and facilitation for a wide range of cross-industry activities. The company is registered as 'Rail Safety and Standards Board', but trades as 'RSSB'.

- 86 There are a number of factors which may have informed the PICOP's decision not to apply the locomotive's handbrakes. Firstly, there is witness evidence that the PICOP had been told during his Class 37 conversion course that they were unreliable and that scotches should be used instead to secure this type of locomotive. In addition, the PICOP stated that his previous experience of working with a different Class 37 locomotive had also led him to believe that the handbrakes on this class of locomotive could not be relied upon. Witness accounts suggest that the rest of the permanent way team had also developed a similar understanding regarding the unreliability of the handbrakes on this class of locomotive.
- 87 The PICOP additionally stated that he had been briefed that the handbrakes on this particular locomotive were not in an operational state when it was assigned to the permanent way team (paragraph 15).
- 88 The PICOP's decision not to use the handbrakes and to use scotches to secure the locomotive may have also been influenced by practice which had been adopted more generally on the GCR. There was witness evidence that drivers on the GCR may have been using scotches instead of handbrakes when stabling any type of diesel locomotive, in order to allow for common practice between those types which were perceived as having effective handbrakes and those that were not.
- 89 There was also evidence that a practice had developed on the GCR of using only scotches to secure diesel locomotives within yards and sidings. The GCR stated that this had arisen because each of the operating groups which owned diesel locomotives which were operating on the railway kept their cabs locked when they were not in use, in order to avoid unauthorised access. As each group had their own lock and key combination, the cabs could not always be easily accessed in order to release handbrakes by GCR staff undertaking shunting.
- 90 The PICOP may also have had a reduced perception of the risk of using only scotches to secure the locomotive when it was being stabled at Quorn and Woodhouse because of the way in which he had previously stabled engineering trains there during possessions (paragraph 97). Witness evidence was that engineering trains normally included wagons fitted with handbrakes which were considered to be effective and which were always applied firmly (known as 'pinning down') when these trains were stabled at this location. As this would have provided additional protection against trains running away, it may have led to the use of scotches alone to secure the locomotive becoming accepted as a safe practice at this location.
- 91 The PICOP stated that he believed that the incident train had been stabled in accordance with the requirements of the GCR Rule Book and General Appendix when it was left unattended on 12 May. It is possible therefore that the PICOP's perception of risk relating to the use of scotches alone to secure the locomotive may have been affected by a lack of consistency in the GCR's rules regarding stabling (paragraphs 41 to 42). This is discussed as a potential underlying factor between paragraphs 107 and 109.

- 92 The PICOP stated he had not tried to use the handbrakes on locomotive 37198 at any point because of his understanding that they were unreliable on this class of locomotive and non-operational on this specific vehicle (paragraphs 86 and 87). However, the RAIB considers that the state of adjustment and repair of the handbrakes on this locomotive was unlikely to have significantly affected the PICOP's decision not to apply the handbrakes, given his experience and training relating to the Class 37 and the prevailing practices on the GCR regarding the use of handbrakes on unattended diesel locomotives (paragraphs 86, 88 and 89). The maintenance of the locomotive's braking system is discussed further as an observation between paragraphs 123 and 134.
- 93 Although the GCR Rule Book required that trains such as the incident train have a brake van attached as the rearmost vehicle (paragraph 40), one was not attached on 12 May (paragraph 13). Had this rule been complied with, then there would have been an additional handbrake available to secure the incident train which might have prevented the runaway from occurring.
- 94 Witness evidence was that engineering trains operating in TIII possessions generally did not have a functioning automatic brake but that brake vans were nevertheless not always attached to these trains. Witnesses also stated that empty coaching stock movements would generally only include a brake van if one of the vehicles being moved was capable of fulfilling that role eg if it included a brake compartment.

The absence of runaway protection

95 The incident train was left unattended on the down main line at Quorn in a location where there was no runaway protection.

- 96 Had the incident train been left at Quorn in a location where there was suitable runaway protection (eg such as the down lie-by or sidings, paragraph 10) then the accident would have been avoided. The incident train was not stabled where there was runaway protection because of the following factors (which are discussed in further detail between paragraphs 97 and 100):
- when working within possessions, the permanent way team probably had a reduced perception of the risks of stabling trains outside of runaway protection when at Quorn; and
 - locations where the incident train could be stabled at Quorn within runaway protection were seen as either not available or not practicable to access.

The perception of the risks of stabling outside of runaway protection

- 97 Witness evidence was that engineering trains being used within possessions by the permanent way team would normally be stabled on the main line at Quorn and put into sidings only at the end of the week (ie when the possession was due to be given up). Witnesses stated that this only occurred within possessions and that engineering trains would always be stabled within sidings when other trains were running on the railway. Witness evidence suggested that stabling engineering trains in this way had become accepted by the permanent way team as being a safe practice, even though it offered a reduced level of protection against a train running away when compared to the use of sidings.

- 98 This practice was probably adopted because it saved time at the beginning and end of the permanent way team's working day. It may also have developed because the team had no way to operate the points leading into the sidings before a member of the team became certified as competent to operate some signal boxes (including Quorn) in 2012.
- 99 The permanent way team's acceptance of this practice may have also been influenced by the availability of effective handbrakes on the wagons forming the engineering train (paragraph 90). Witnesses stated that the permanent way team's perception of risk regarding the stabling of the incident train on 12 May 2014 was probably also reduced as they were leaving the train for only a short period.

The availability of locations offering runaway protection

- 100 The down lie-by was occupied by wagons on the day of the accident and so was not available to stable the incident train. Although it is probably the case that the up sidings could have been used to stable the train, witness evidence suggests that moving the incident train from the down main line and into the up sidings would have been regarded by the permanent way team as requiring a disproportionate amount of time to complete when compared with their planned break of 30 minutes.

Identification of underlying factors¹¹

Effectiveness of inspection and process audits

101 Checks by senior managers did not detect the full extent of the non-compliances and unsafe practices present within TIII possessions.

- 102 There is a requirement within the GCR's safety management system that the railway's general manager and senior managers regularly check to ensure that internal processes are operating correctly. Witness evidence indicates that the principal way in which this requirement was observed was by line managers (such as signalling inspectors) observing staff who were working while the GCR was running train services for the public. The GCR reported that these inspections were supplemented by a programme of audits undertaken by the safety manager, although the permanent way team had not been audited prior to the accident.
- 103 The RAIB's investigation has found that a number of the practices adopted by the permanent way team when working within the TIII possession of 12 May did not comply with the requirements of the GCR Rule Book and General Appendix. These included:
- possession limit boards were not used to protect the limits of the possession (paragraph 51);
 - a brake van was not included as part of the incident train (paragraphs 13 and 93);
 - the movement of the incident train was undertaken without the automatic vacuum train pipe being connected (paragraph 19);

¹¹ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

- a guard was not appointed to control the incident train (paragraph 27 and paragraph 118);
- there were more than two people in the leading cab of the locomotive during the movement of the incident train from Rothley to Quorn (paragraph 55); and
- the movement of the incident train from Rothley to Quorn was made as a propelling movement (paragraph 55).

Some of these non-compliances also did not meet with the relevant guidance laid down by the Office of Rail and Road¹² for minor railways.

- 104 Witness evidence indicates most of these non-compliances would have also been present during train movements made by the team within previous possessions. Although many of the non-compliances found were not causal to the accident, the lack of a brake van was found by the RAIB to be a potential factor (paragraph 93).
- 105 Discussions with the GCR revealed that, while some of the non-compliances found by the RAIB's investigation were known to the railway's managers, others were not. The lack of detection of some non-compliances and the absence of action by managers to correct others were likely to have reinforced the permanent way team's belief that the practices they had adopted were acceptable.
- 106 The RAIB further notes that the way in which the POS coach was stabled on 12 May was potentially unsafe and did not comply with good practice. This was because the coach was left downhill of the locomotive, unsecured by scotches (paragraph 59) and without functioning brakes (paragraph 19). This meant that the coach could have run away, had the screw coupler holding it to the locomotive failed.

Clarity and consistency in the rules relating to the stabling of trains

107 Some of the rules relating to the stabling of locomotives and other vehicles were inconsistent with each other and may have been unclear to the PICOP.

- 108 The GCR Rule Book allowed diesel locomotives to be secured by means of handbrakes or scotches but only within sidings or where directed by the rules or when 'it is absolutely necessary to do so' (paragraph 41); this latter criteria was not clearly defined prior to the accident. The General Appendix broadly duplicated these requirements when stabling diesel locomotives, although it does not specifically mention the requirement for the locomotive to be secured within sidings (paragraph 42). The General Appendix also required handbrakes be used (where provided) to secure vehicles not connected to a locomotive (paragraph 42).
- 109 The PICOP believed that the way in which the incident train was stabled complied with the relevant rules and this may have influenced his perception of the risk of using scotches to secure the train (paragraph 89). The RAIB considers that this belief may have developed due to the presence of inconsistencies in the requirements concerning stabling.

¹² The Office of Rail Regulation, Railway Safety Publication 5, 2nd Edition, 'Guidance on minor railways', 2007 available from http://orr.gov.uk/__data/assets/pdf_file/0015/2634/rsp005-minorrail.pdf.

Observations¹³

The use of TIII possessions to facilitate empty coaching stock movements

110 TIII possessions were being periodically used by the GCR to facilitate empty coaching stock and other movements. This did not comply with the requirements of the GCR Rule Book.

111 Witness evidence was that the permanent way team were at least periodically using TIII possessions to make movements of empty coaching stock and also to undertake shunting of non-engineering rolling stock. It was also the case that the GCR planned to run a photographic charter within a TIII possession on 13 May (paragraph 46). None of these activities met the requirements of the GCR Rule Book, which permits only engineering train and vehicle movements within TIII possessions where those movements are required for the work being undertaken (paragraph 37).

112 From the available evidence, it appears that using TIII possessions to make non-engineering train movements was found by the GCR to be necessary because, when the railway was not operating trains for public use, there was an insufficient number of signallers available to open the signal boxes which would be required to make them using normal signalled movements. GCR managers stated that, although this may have been the case previously, in their view TIII possessions would have been used to facilitate movements in this way on only one or two occasions per year in the years immediately preceding the accident.

113 GCR managers stated that this situation had arisen because all but two of the railway's signallers were volunteer members of staff who would normally be rostered to work when the railway was operating trains for the public. GCR managers said that the issue was exacerbated around gala weekends because these events were resource intensive and often exhausted the supply of available volunteers. There was also witness evidence that many volunteer signallers preferred to work when the railway was running train services for the public.

114 GCR managers were aware that TIII possessions were being used to facilitate shunting, empty coaching stock movements and photographic charters. These were predictable operational requirements and alternative solutions should have been found to facilitate them which either complied with existing rules or which led to the development and validation of appropriate additional rules and procedures.

Staff competence within the permanent way team

115 The requirements of the GCR's safety management system with respect to staff competence were not effectively implemented within the permanent way team.

116 The GCR's safety management system states the following with respect to staff competence;

'There are ... positions on the Railway which require variable levels of competency. Staff occupying these positions are competent by virtue of their background and basic training.... Departmental Managers are responsible for ensuring that their staff are fully competent for the positions they fulfil.'

¹³ An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the accident but does deserve scrutiny.

- 117 The safety management system also designates certain staff roles as being safety critical. This includes designated train crew competencies (such as driver, secondman, *fireman* and shunter¹⁴) and also the role of guard. The train crew and guard competencies each have an associated policy document which lays down the requirements for their training and assessment.
- 118 The activities being undertaken by the permanent way team on 12 May 2014 required the staff undertaking them to hold some of these safety critical competencies. For example, the empty coaching stock movement required both a competent driver and guard to be present on the train (paragraphs 27 and 103) while the shunting at Quorn and Woodhouse and Swithland should have been under the direct control of a competent guard or shunter, working with a driver. However, as only the PICOP was qualified to act as driver and guard (paragraph 27) this meant that tasks being undertaken by the team were not, and could not have been, undertaken by an adequate number of staff holding the required competencies. The GCR reported that managers were aware that permanent way team members did not hold the correct competencies for some of the tasks which they were undertaking.
- 119 Witness evidence was that the permanent way team used in-house training delivered by experienced team members to train staff in areas such as the stabling of vehicles (paragraph 79) and shunting activities. There was also evidence from both the GCR and witnesses that, following the release of the updated GCR Rule Book in 2013, permanent way team members had requested the training and assessment required to become certified as shunters in line with the requirements of the train crew training policy document. However, these requests had been not actioned by the management of the GCR prior to the accident.
- 120 It appears that these requests were not actioned because GCR managers saw it as being difficult for the permanent way team members (who normally work when and where the railway is not operating a service for public use) to gain certain safety critical competencies (such as train crew and guard).
- 121 Based on the evidence available to the RAIB, it appears that the issues identified relating to staff competence probably applied only to the permanent way team and a few full time employees undertaking similar work patterns. There was also no evidence that the permanent way team's training was causal to the accident (paragraph 79). However, the management of the GCR should have taken action to correct this situation, given the potential risks which could have arisen.
- 122 The RAIB has also observed that the GCR had not made any requirements within its safety management system for the training and assessment of staff undertaking the PICOP role (paragraph 27).

¹⁴ The role of shunter was designated by the GCR as being a train crew competence in 2013.

The maintenance and inspection of diesel locomotives

123 The maintenance and inspection activities undertaken on locomotive 37198 did not act as an effective control against the risks relating to a failure of its automatic air braking system and also did not ensure that the handbrakes on the locomotive were being maintained. In addition, the GCR did not have sufficient visibility of the maintenance and inspection being undertaken.

Maintenance and inspection arrangements for locomotive 37198

- 124 Records provided by the Type One Locomotive Company showed that its maintenance of the locomotive started in 2011, while it was being restored into running condition, and that it remained responsible for maintenance throughout its use on the GCR (paragraph 22). During the 2011 restoration various air braking system components were overhauled and/or replaced and the braking systems were subject to examination and functional testing. Records also show that a 'full brake test' was undertaken in 2012 after the locomotive's distributor was replaced, although the maintenance records available do not state exactly what testing activities were undertaken.
- 125 In March 2013 and March 2014, the Type One Locomotive Company undertook examinations of the locomotive. These examinations comprised periodic maintenance tasks which had been selected by the company as being appropriate from the full list contained within the VMI for the Class 37 locomotive issued in 1984¹⁵. Records of these examinations showed that the locomotive's brake blocks and brake rigging were checked in both 2013 and 2014. A post-incident inspection of the locomotive showed that all of the brake blocks and brake cylinder piston strokes complied with the requirements of the latest Class 97/3 VMI.
- 126 Maintenance records also showed that brake tests had been undertaken in both years and that an *air leakage test* had been undertaken during the March 2014 examination. The Type One Locomotive Company has been unable to confirm exactly what criteria were used for this test and the results which were obtained. Damage sustained in the collision meant that it was not possible to undertake this test following the accident. Maintenance records also indicated that there had been some previous air leaks on the locomotive, although it was not clear exactly which components were affected. However, an inspection undertaken post-incident found welded patches on the main air pipe, indicating that this at least had been the site of previous repairs.
- 127 Witness evidence was that, while the air braking systems on the locomotive had continued to function correctly up to the point where the train arrived at Quorn, both of the main air compressors needed to cut in frequently in order to maintain the required system pressures¹⁶ (paragraph 33). Witnesses also stated that the air brakes 'leaked off' the locomotive 'fairly quickly', but that they nevertheless would have expected the brakes to stay applied for the duration of the break which was taken and probably for up to an hour.

¹⁵ Network Rail stated that it had expected the Type One Locomotive Company to maintain the locomotive to the 2011 VMI. However, there was no documentary evidence that this had been agreed with the Type One Locomotive Company or that a copy of the relevant VMI had been given to it.

¹⁶ If the locomotive was hauling vacuum braked rolling stock, then the brake selector switch would be turned to a vacuum setting. This would lead to a single main air compressor running in conjunction with an *exhauster*.

- 128 This history of air leaks and repairs and the need to maintain both compressors running indicate that the air systems on the locomotive, although functional, were probably in a degraded state on 12 May. The shorter than usual period of time which it took the brakes to leak off during the break at Quorn may also point to an additional failure occurring within these systems after the locomotive had been stabled.
- 129 The annual examination records also showed that the handbrakes were not being maintained. The Type One Locomotive Company stated that this was a low priority because it was accepted practice on the GCR not to use handbrakes when stabling diesel locomotives in yards and sidings (paragraph 91).

Visibility of diesel locomotive maintenance arrangements

- 130 The GCR's safety management system and locomotive maintenance policy detail the railway's requirements regarding periodic maintenance intervals, defect reporting and arrangements for visiting locomotives. Steam and diesel locomotives in normal passenger operations are required to undergo a fitness to run examination every two days. Steam locomotives are also required to undergo specific periodic maintenance examinations at longer intervals (eg after a given number of steams and annually) although a similar requirement is not made for diesel locomotives.
- 131 The requirements for a fitness to run examination of a diesel locomotive include a check on the function of the locomotive's engine, lighting, air system and brakes and other safety systems. There is also a requirement for a check on the condition of the brake rigging and brake blocks. Prior to the accident, a check on correct handbrake operation did not form part of a fitness to run examination of diesel locomotives, although it was included in the comparable examination for steam locomotives. The GCR stated that a check of the handbrake had been left off the list of items to be checked on diesel locomotives in error.
- 132 The GCR also stated that, in practice, fitness to run examinations of diesel locomotives running in passenger operation were undertaken weekly because they operated in a different operating environment when compared with steam locomotives. In addition, diesel locomotives which ran when the railway was not running services for the public (such as 37198 on 12 May) were not given fitness to run examinations, but instead relied on the checks undertaken by the driver as part of their daily preparation. These would be similar in scope to the fitness to run examination, although less detailed.
- 133 The GCR stated that all periodic maintenance of diesel locomotives is undertaken by the responsible operating group, such as the Type One Locomotive Company¹⁷. The GCR has no visibility of what has been done by each group, but relies solely on the fitness to run examination undertaken by its examiner to confirm that a locomotive is in an appropriate condition to run on the railway. Although there was evidence that fitness to run examinations could in some cases highlight issues such as air leakages, it is unlikely that these examinations, even undertaken rigorously, would detect all of the potential failure modes which could occur on rail vehicles.

¹⁷ This contrasted with the railway's practice regarding steam locomotives, where all maintenance is undertaken directly by GCR staff.

134 The RAIB considers that relying solely on the fitness to run examinations to provide oversight meant that the GCR did not have sufficient visibility of how the maintenance and inspection of diesel locomotives running on its infrastructure were being undertaken. This meant that it could not be sure that the risks relating to these components and systems failing were being adequately controlled.

Summary of conclusions

Immediate cause

135 The incident train was left unattended and stabled in a way that allowed it to run away and collide with a set of coaches which had been correctly stabled (**paragraph 66**).

Causal factors

136 The scotch and the incident train's brakes did not hold the incident train on the gradient at Quorn and Woodhouse. This was due to the following factors:

- a. Trackworker A probably positioned the wheel scotch in a way that made it ineffective (**paragraph 75, Recommendation 1**); and
- b. the PICOP did not apply the train's handbrakes and believed that using scotches would be an appropriate alternative (**paragraph 85, Recommendation 1**).

137 The incident train was left unattended on the down main line at Quorn in a location where there was no runaway protection. This was due to the following factors:

- a. the permanent way team probably had a reduced perception of the risks of stabling outside of runaway protection at Quorn, when working within possessions (**paragraph 97, Recommendation 1**); and
- b. locations at Quorn where the incident train could be stabled within runaway protection were seen as being not available or as needing disproportionate time to access (**paragraph 101, Recommendation 1**).

Underlying factors

138 Checks by senior managers did not detect the full extent of the non-compliances and unsafe practices present within TIII possessions (**paragraph 101, Learning point 1, Recommendation 2**).

139 Some of the rules relating to the stabling of locomotives and other vehicles were inconsistent with each other and may have been unclear to the PICOP (**paragraph 107, Recommendation 1**).

Additional observations

140 TIII possessions were being periodically used by the GCR to facilitate empty coaching stock and other movements. This did not comply with the requirements of the GCR Rule Book (**paragraphs 110 and 144, no recommendation**).

- 141 The requirements of GCR's safety management system with respect to staff competence were not effectively implemented within the permanent way team. This meant that the tasks being undertaken by the team were not undertaken by an adequate number of staff holding the required competencies (**paragraphs 115 and 145, Learning point 2, Recommendation 3**).
- 142 The maintenance and inspection activities undertaken on locomotive 37198 did not act as an effective control against the risks relating to a failure of its automatic air braking system. They also did not ensure that the handbrakes on the locomotive were being maintained. In addition, the GCR did not have sufficient visibility of the maintenance and inspection being undertaken on diesel locomotives (**paragraph 123, Recommendation 4**).

Actions reported that address factors which otherwise would have resulted in a RAIB recommendation

143 On 17 May 2014 GCR issued a bulletin entitled 'Vehicles left on running lines'. This stated the following;

'All crews are reminded that trains must not be left on running lines unless absolutely necessary. In other words when there is no alternative e.g. an emergency situation.

If it is necessary for a train or vehicles to be left unattended on a running line, ALL handbrakes must be fully applied AND the wheels securely chocked in both direction to prevent movement...

The permission of the DTM [Duty Traffic Manager] must be obtained before any locomotive, vehicle or train may be left in these circumstances.'

144 The GCR has reported to the RAIB that the requirements of the GCR Rule Book regarding the use of TIII possessions for train movements (paragraph 37) are now being enforced and that only engineering train movements required in connection with the work being undertaken are being permitted. In addition, a process has been introduced so that any request for a possession must be submitted (along with a justification) to the operations manager for approval at least 72 hours prior to its planned implementation, excepting emergencies.

145 The GCR has also introduced a new process which requires any additional train movements (ie those not included within the working timetable) to be approved by the operations manager, who will also ensure that an adequate number of staff holding the correct competencies are appointed to crew them.

146 The GCR also reported that signaller rosters have been re-arranged to increase the number of signallers available in the mid-week period (paragraph 113). In addition, three full-time members of staff are undergoing training as signallers, in order to provide further resilience.

147 The GCR stated that it has also reviewed the requirements for fitness to run examinations of diesel locomotives (paragraph 132) and has now implemented changes to ensure that these examinations include any locomotives used on non-passenger services and a check on the functionality of the handbrake.

Other reported actions

148 The GCR has informed the RAIB that it has now appointed a Diesel Maintenance Co-ordinator, who will report to the GCR's Chief Mechanical Engineer. This co-ordinator will be responsible for managing the maintenance of diesel locomotives operating on GCR infrastructure and for ensuring that any maintenance activities undertaken on them are appropriately recorded.

Learning points

149 The RAIB has identified the following key learning points¹⁸:

- 1 The movement of trains not fitted with a continuous automatic brake or which do not include a brake van under the control of a guard as the rearmost vehicle should be avoided due to the possibility of a vehicle without operational brakes running away following a coupler failure. The risks of vehicles running away in such circumstances have been previously highlighted in the RAIB's report into the runaway of an engineering vehicle from Highgate on the London Underground on 13 August 2010 (RAIB report 09/11)¹⁹ (**paragraph 138**).
- 2 Safety critical activities (such as the movement, shunting and stabling of trains) must be undertaken by an adequate number of staff holding the correct competencies (**paragraph 141**).

¹⁸ 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when the RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where the RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

¹⁹ RAIB reports are available at www.gov.uk/raib.

Recommendations

150 The following recommendations are made²⁰:

- 1 *The intent of this recommendation is for the Great Central Railway to ensure that activities which result in trains or vehicles being left unattended are subject to consistent and effective risk controls.*

The Great Central Railway should review those parts of the Great Central Railway Rule Book, General Appendix and any other instructions which relate to leaving trains or vehicles unattended.

This review should consider whether the rules and instructions contained within these documents are clear and consistent and if they adequately address all of the risks involved in trains and vehicles being left unattended. The review should specifically examine the use of handbrakes and wheel scotches and the stabling of vehicles within locations which offer runaway protection.

The Great Central Railway should implement any changes identified as being necessary as a result of this review. The Great Central Railway should ensure that suitable briefing and training accompanies any changes which are implemented (paragraphs 136a, 136b, 137a, 137b and 139).

continued

²⁰ Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail and Road (ORR) to enable it to carry out its duties under regulation 12(2) to:

- (a) ensure that recommendations are duly considered and where appropriate acted upon; and
- (b) report back to the RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 200 to 203) can be found on the RAIB's website www.gov.uk/raib.

- 2 *The intent of this recommendation is for the Great Central Railway to ensure that the requirement within its safety management system for regular checks to be undertaken on the correct operation of internal processes is implemented so that non-compliances to rules and instructions are detected in the future.*

The Great Central Railway should review the arrangements currently in place which are intended to ensure that the safety management system, rules and procedures are functioning as intended.

This review should ensure that these arrangements are suitable and able to identify any future non-compliances to policy, rules and instructions similar to those identified by this investigation. The review should specifically ensure that arrangements remain effective during periods when train services are not being run for the public and that the results of all inspections and audits are recorded.

The Great Central Railway should implement any changes identified as being necessary as a result of this review (paragraph 138).

- 3 *The intent of this recommendation is for the Great Central Railway to ensure that the requirements within its safety management system and policy documents which relate to the training and assessment of staff are effectively implemented.*

The Great Central Railway should review the arrangements currently in place which relate to the training and assessment of staff in order to ensure that they are effective at ensuring employees (including volunteers) are fully competent to undertake their duties. This should specifically include roles relating to the shunting of trains and the management of possessions.

The Great Central Railway should implement any changes identified as being necessary as a result of this review (paragraph 141).

- 4 *The intent of this recommendation is for the Great Central Railway to ensure that it has effective control and oversight of the maintenance undertaken on diesel locomotives operating on its infrastructure.*

The Great Central Railway should review the arrangements currently in place by which it ensures that diesel locomotives operating on its infrastructure are being maintained in a way which adequately addresses the risks posed by the potential failure or reduced reliability of components and systems. This review should specifically consider the maintenance of braking systems.

The Great Central Railway should implement any changes identified as being necessary as a result of this review (paragraph 142).

Appendices

Appendix A - Glossary of abbreviations and acronyms

AWS	Automatic Warning System
ERTMS	European Rail Traffic Management System
GCR	Great Central Railway PLC
PICOP	Person in charge of possession
POS	Post Office Sorter
VMI	Vehicle Maintenance Instruction

Appendix B - Glossary of terms

All definitions marked with an asterisk, thus (*), have been taken from Ellis's British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com.

Absolute possession	A period during which the operation of normal service trains is suspended on a designated section of line for the purposes of maintenance and/or engineering works.
Air leakage test	A test which measures the pressure drop in the main air reservoir of a rail vehicle over a period of time. This is then compared against a pass/fail criteria. Vehicles failing the test are required to undergo remedial work (eg finding and fixing the source of any leakage) before being retested.
Automatic air brake	A continuous brake which applies throughout a train and which will cause a brake application on all of its vehicles when air pressure in the brake pipe is reduced, either by the driver operating the brake controls or in the event of other circumstances such as a train division.
Automatic vacuum train pipe	A pipe running the length of a train that controls (and creates a vacuum in) the vacuum brakes on the rail vehicles forming the train. An increase in pressure in the vacuum train pipe will apply the brakes.
Automatic Warning System (AWS)	A track inductor based system linked to the aspects of fixed lineside signals that provides audible and visual warnings to the driver on the approach to signals, certain level crossings and emergency, temporary and certain permanent speed restrictions.
Block instrument	A case containing block indicator, switches and the bell key for an absolute block section.*
Brake cylinder	A cylinder into which pressurised air is admitted or vented by the action of the distributor. The pressure of the air varies with the position of the distributor and the associated variable load valve. The admission of air extends a spring loaded piston connected to the brake rigging, producing a mechanical force proportional to the air pressure applied. When air pressure is reduced, this spring retracts the piston.
Brake pipe	A pipe running the length of a train that controls (and in the single brake pipe configuration also supplies) the air brakes on the rail vehicles forming the train. A reduction in brake pipe air pressure will apply the brakes.
Brake van	A type of railway vehicle equipped with a handbrake which can be applied by the guard. Other railway vehicles (such as postal or passenger coaches) may be fitted with brake compartments which allow them to be designated as a brake van for the purposes of the rule book.

Chain	A unit of length, being 66 feet or 22 yards (approx 20.117 metres). There are 80 chains in one standard mile.*
Class 3	A train running on infrastructure managed by the Great Central Railway which is either a parcels train composed of coaching stock, a travelling post office not running as a Class 1 movement or an empty coaching stock movement.
Class 97/3 locomotive	A Class 37 locomotive which has been refurbished for use by Network Rail for the purposes of ERTMS testing. These locomotives are fitted with ERTMS equipment but remain otherwise unchanged.
Distributor	The pneumatic component of an air brake system which responds to changes in brake pipe pressure and initiates charging and venting of the brake cylinders.*
Down	In a direction away from London, the capital, the original railway company's headquarters or towards the highest mileage.*
Emergency brake application	A commanded application of the automatic air brake which vents the brake pipe completely and at a quicker rate than for other braking applications. May use a more direct and separate part of the control system in order to signal this requirement.
Empty coaching stock	A train consisting of empty passenger coaches being moved from one place to another for operational reasons.*
European Rail Traffic Management System	A standardised system of rail traffic control which supplements or replaces the existing conventional fixed signalling system.*
Exhauster	A component on a diesel locomotive braking system which creates a vacuum.
Field side	The side of a rail nearest the cess or six foot.*
Fireman	The person responsible for keeping a steam locomotive supplied with coal during a journey, and assisting in the observation of signals when required to do so.*
Fitness to run	An inspection undertaken every two days of locomotives operating on infrastructure managed by the Great Central Railway which checks the function and condition of key systems.
Line clear	In areas signalled under the absolute block signalling system, this is a message is sent via a block instrument in order to accept a train into section.*
Line speed	The maximum speed at which trains may run when not subject to any other restriction.*

Loose coupled	Rail vehicles which have been coupled together mechanically but without a connected automatic brake.
Master switch	A switch operated by the driver to activate the relevant cab, and to select the direction of travel.*
Minor railways	A definition used by the Office of Rail Regulation to refer to light/preserved railways, which are normally limited to operating trains at 25 mph or less. Often operated and maintained by volunteer bodies.
On track plant	A rail-mounted engineering vehicle which can only be used in possessions.
On train data recorder (OTDR)	Equipment fitted on-board a traction unit which records train speed and the status of various controls and systems relating to the unit's operation. This data is recorded to a crash-proof memory and is used to analyse driver performance and train behaviour during normal operations or following an incident or accident.
Periodic operating notice	An operating notice issued by the Great Central Railway which describes the scheduled train services, engineering works and other operational information for a specified time period.
Permanent way	The track, complete with ancillary installations such as rails, sleepers, ballast, formation and track drains, as well as lineside fencing and lineside signs.*
Person in charge of possession (PICOP)	A person certified as competent to manage a possession on infrastructure managed by the Great Central Railway.
Points	An assembly of two movable rails, the switch rails, and two fixed rails, the stock rails. Also known as a set of points or a set of switches. Used to divert rail vehicles from one track to another.
Possession limit board	A miniature version of the stop sign used on the roads, denoting the end of a possession.*
Propelling	The act of pushing a train from the rear using a locomotive.*
Protection	The measures taken to mark the limits of a possession.*
Rail head	The bulbous upper part of a rail section.*
Railway Group Standard	A document which applies to companies operating on the national rail network in Great Britain and which mandates the technical or operating standards required of a particular system, process or procedure.*
Right direction	A train movement made in the normal direction for the line concerned.*

Route knowledge	The knowledge that a driver must have before they can drive along a particular route. This will include the location of junctions, stations, signals and the maximum permitted line speeds along the route.
Scotch	A shaped piece of timber that is positioned against the wheel of a rail vehicle in order to ensure that the vehicle does not roll away.*
Screw coupler	A variety of coupler which consists of a pair of loops connected by a threaded bar with left and right-hand threads on opposite ends, allowing the coupling to be lengthened and shortened as required when connected between the coupling hooks of rail vehicles.*
Secondman	A member of train crew who assists the driver of a diesel locomotive with his duties.
Self-lapping valve	An air valve which maintains a constant setting by automatically compensating for loss or gain of air due to leakage or blow by of the valve seating.
Stabling	The act of shutting down and securing a train or rail vehicle before leaving it unattended.
Station limits	The section of a railway line controlled by a signal box which lies between the home signal and the section signal.*
Straight air brake	The air braking system that applies the brakes on the locomotive's wheels only. It does not apply the brakes of any rail vehicles connected to the locomotive via the automatic air brake system.
Track circuit	An electrical train detection system, based on the principle of proving the absence of a train. In its basic form, a source of electrical current is connected between the running rails at one end of the section to be detected. At the other end a relay coil (or equivalent) is connected between the rails. When there is no rail vehicle present, the current source energises the relay coil and the section is proved clear. When a rail vehicle enters the section, the action of wheels and axles is to short the relay out, creating an open circuit.*
Trap points	Facing points provided to derail unauthorised movements and thereby protect other trains.
Tread brakes	A friction braking system where the brake force is applied directly to the wheel tread.
Up	In a direction towards London, the capital, the original railway company's headquarters or the lowest mileage.
Vacuum brakes	An automatic brake, normally maintained in the released position by a vacuum.*

Wheel tread	The part of a rail wheel that runs on the rail.*
Working timetable	The version of the timetable for use by drivers and signallers which gives full details of all trains, including empty coaching stock movements.*
Worksite	The area within a possession which is managed by an engineering supervisor.
Wrong direction	In a direction opposite to that which trains normally run on the line concerned. The opposite of right direction.*

Appendix C - Key standards current at the time

Great Central Railway PLC, GCR PD100, Rule Book
GCR Rule Book, December 2012

Great Central Railway PLC, GCR PD101, General Appendix
GCR General Appendix to the Working
Timetables and books of Rules and
Regulations, December 2012

The Office of Rail Regulation, Railway Safety Publication 5, 2nd Edition, 2007
Guidance on minor railways

This report is published by the Rail Accident Investigation Branch,
Department for Transport.

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