



Rail Accident Investigation Branch

Rail Accident Report



Unsafe events at Heathrow Tunnel Junction 27 and 28 December 2014

Report 20/2015
December 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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Preface

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. 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.

The RAIB's findings are based on its own evaluation of the evidence that was available at the time of the investigation and are intended to explain what happened, and why, in a fair and unbiased manner.

Where the RAIB has described a factor as being linked to cause and the term is unqualified, this means that the RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident. However, where the RAIB is less confident about the existence of a factor, or its role in the causation of the accident, the RAIB will qualify its findings by use of the words 'probable' or 'possible', as appropriate. Where there is more than one potential explanation the RAIB may describe one factor as being 'more' or 'less' likely than the other.

In some cases factors are described as 'underlying'. Such factors are also relevant to the causation of the accident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, the words 'probable' or 'possible' can also be used to qualify 'underlying factor'.

Use of the word 'probable' means that, although it is considered highly likely that the factor applied, some small element of uncertainty remains. Use of the word 'possible' means that, although there is some evidence that supports this factor, there remains a more significant degree of uncertainty.

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the event being investigated, but does deserve scrutiny because of a perceived potential for safety learning.

The above terms are intended to assist readers' interpretation of the report, and to provide suitable explanations where uncertainty remains. The report should therefore be interpreted as the view of the RAIB, expressed with the sole purpose of improving railway safety.

The RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of any inquest or fatal accident inquiry, and all other investigations, including those carried out by the safety authority, police or railway industry.

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Summary

On 27 December 2014, and again on 28 December 2014, track workers were at serious risk of being struck by trains at the Stockley Flyover construction site, on the Heathrow Airport branch line. In the second incident, a train did collide with a small trolley which was being placed on the line by track workers.

During the first incident, 14 track workers walked along the open Down Airport line; an area where limited visibility meant that it was unsafe to do this when train services were operating. They mistakenly believed that train services had been stopped, and a Heathrow Airport to London service used the line shortly after the workgroup had been warned by other staff and had moved clear. The investigation has found that the engineering supervisor responsible for controlling track worker access was using an inappropriate control system, and permitted trains to start operating when his paperwork showed staff could reasonably believe services remained suspended. Further, the controller of site safety (COSS) who was responsible for the track workers' railway safety, directed the group to walk along the line when his paperwork showed it was open to traffic.

The following day, two track workers were placing a small trolley on the Up Airport line when the 09:48 hrs Heathrow Express service from Heathrow Airport to London Paddington, travelling on that line, emerged from a nearby tunnel at a speed of 45 mph (72 km/h). The track workers moved clear of the line seconds before the train struck the trolley and there were no injuries and only minor damage. The incident occurred because the track workers believed the line was closed, a consequence of the group, and their COSS, being accustomed to working in a way which diverged from the mandated site safety system.

The two incidents, and other safety shortcomings found during the investigation, showed that site supervision processes had not identified that deviation from the mandated site safety system had become normal practice. Also, formalised briefings had not been supplemented by any site signage to increase the likelihood of staff being aware of which lines were open.

The RAIB has made four recommendations, all addressed to Network Rail with some also seeking input from major contractors. The first seeks an improvement in monitoring of railway safety arrangements on major construction sites, particularly ensuring that there is sufficient direct observation of on-site activities. The second relates to effective monitoring of staff controlling access to worksites (areas where regular train services are suspended). The third seeks to provide workers on major construction sites with additional sources of information about the lines on which it is safe to work. The final recommendation seeks a review, and if necessary improvement, of the railway access control systems used on large construction sites.

Three learning points are included to remind engineering supervisors and COSSs that they should comply with safety requirements and query any safety related anomalies in their paperwork. There are two other learning points made which are not directly related to the incidents: a reminder to employers that they should ensure that their staff have received railway rule book updates; and a reminder to those preparing site safety paperwork to make it comprehensive, but concise.

Introduction

Key definitions

- 1 Metric units are used in this report, except when it is normal railway practice to give speeds and locations in imperial units. Where appropriate the equivalent metric value is also given.
- 2 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. Sources of evidence used in the investigation are listed in appendix C.

Overview

Summary

- 3 The RAIB has investigated two incidents which took place on a major civil engineering construction site at which a new viaduct and new railway line were being constructed over the Great Western main line near Heathrow Airport. This work formed part of Network Rail's Crossrail (west) project.
- 4 The first incident, referred to in this report as a track access irregularity, occurred at approximately 15:00 hrs on 27 December 2014 when 14 track workers walked along a section of railway where they were not permitted to be, because regular train services were operating.
- 5 The second incident occurred the following morning at about 10:05 hrs. Two track workers were forced to move clear of an approaching train seconds before it collided with a rail mounted *hand trolley* which they were placing on the line. No injuries resulted from either incident.

Context of both incidents

Location

- 6 Heathrow Tunnel Junction is situated about 1.75 miles (2.8 km) north of London Heathrow Airport, on the branch line serving the airport. It is between the connections to the Great Western main line and Heathrow Tunnel leading to the stations at Heathrow Airport (figure 1). It is about 12.3 miles (19.8 km) from London Paddington station and was being modified at the time of the incidents as part of Network Rail's Crossrail (west) project. The junction was within the Stockley Flyover construction site in which a new flyover was being constructed adjacent to the original flyover at this location (figures 2, 3 and 4).

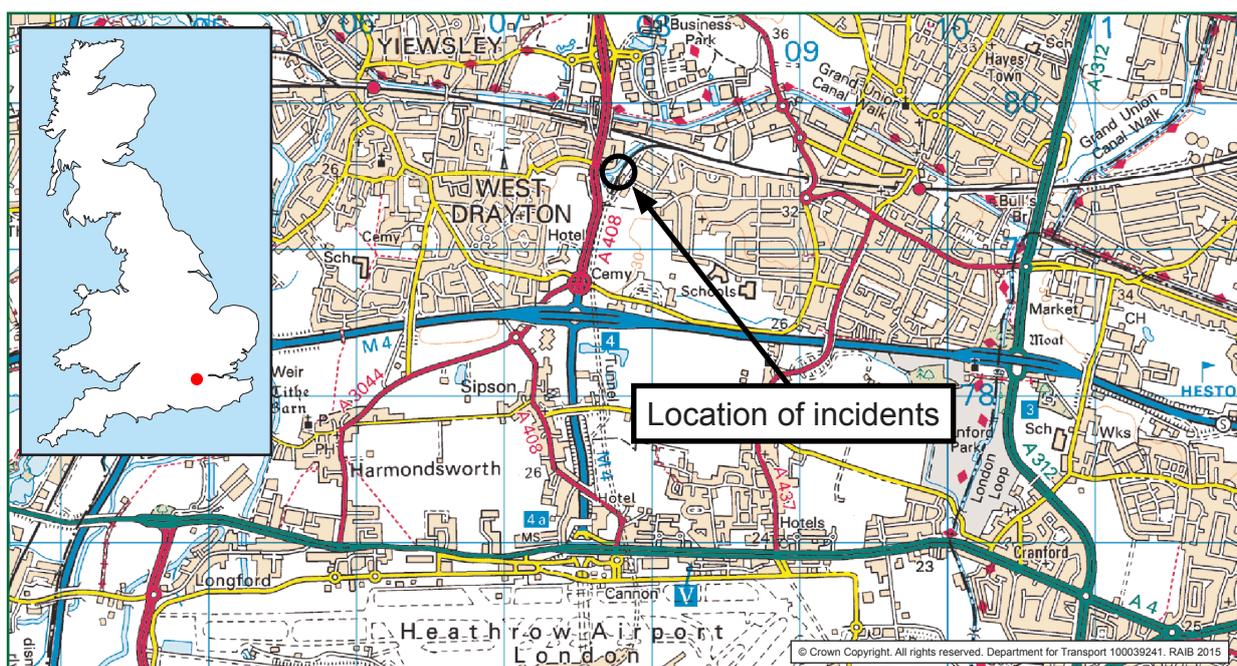


Figure 1: Location of both incidents

- 7 Heathrow Tunnel Junction is close to the portal of Heathrow Tunnel and provided crossover routes between the two tracks serving the airport, known as the *Up* Airport and *Down* Airport lines. The Great Western main line comprised up and down main lines (to which the corresponding airport lines were connected), up and down relief lines and a goods loop.
- 8 The new works being constructed when the incidents occurred had included laying a new line, not yet completed and known at the time of the incidents as the Up Airport Relief line, connected to the Up Airport line at Heathrow Tunnel Junction and running over the new Stockley Flyover to join the up relief line. This RAIB report does not refer to further changes to track names implemented after the incidents occurred. The maximum speed on both the Up Airport and Down Airport lines was 50 mph (80km/h).

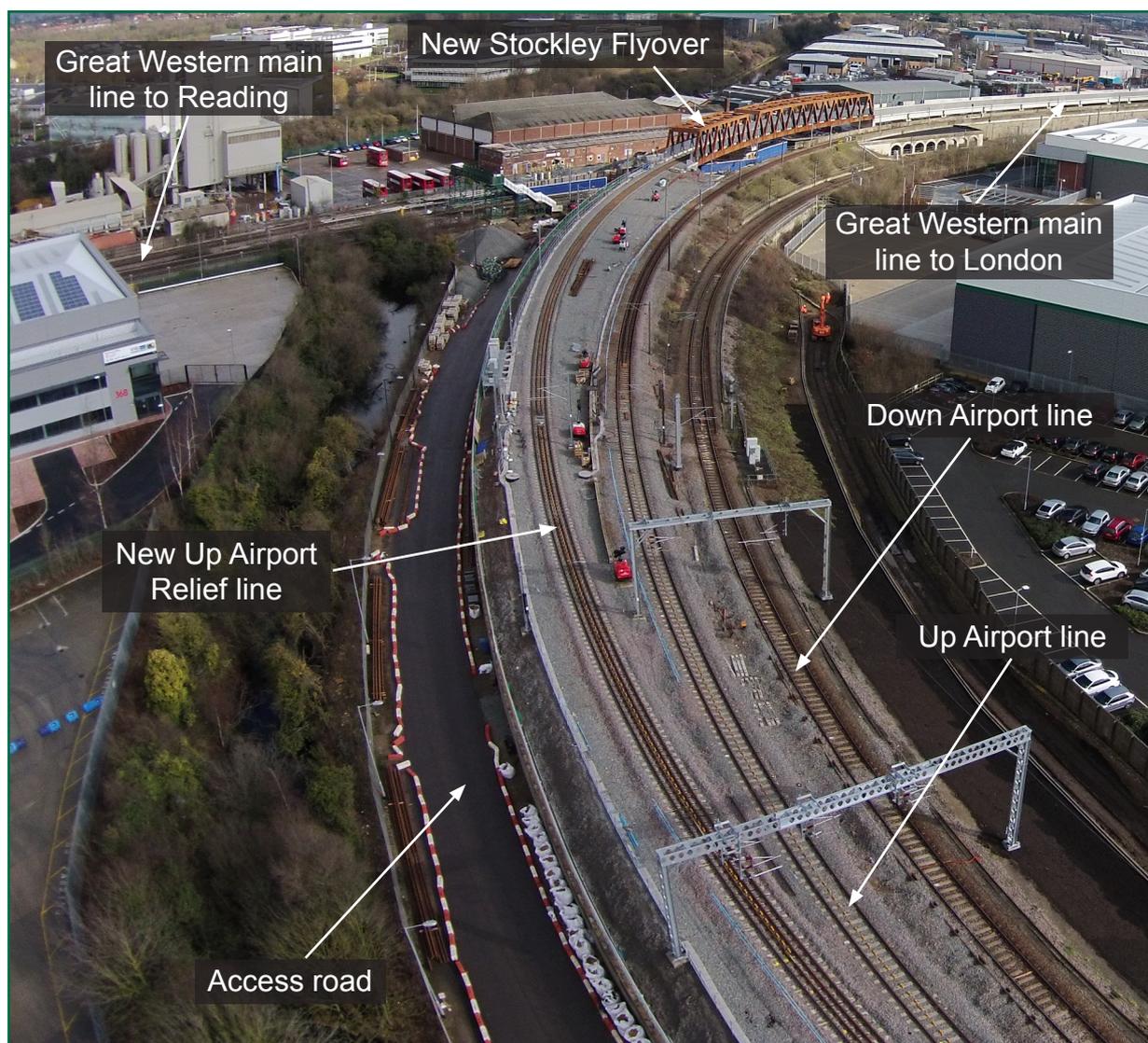


Figure 2: Stockley Flyover site looking north towards the Great Western main line (picture taken 25 February 2015)

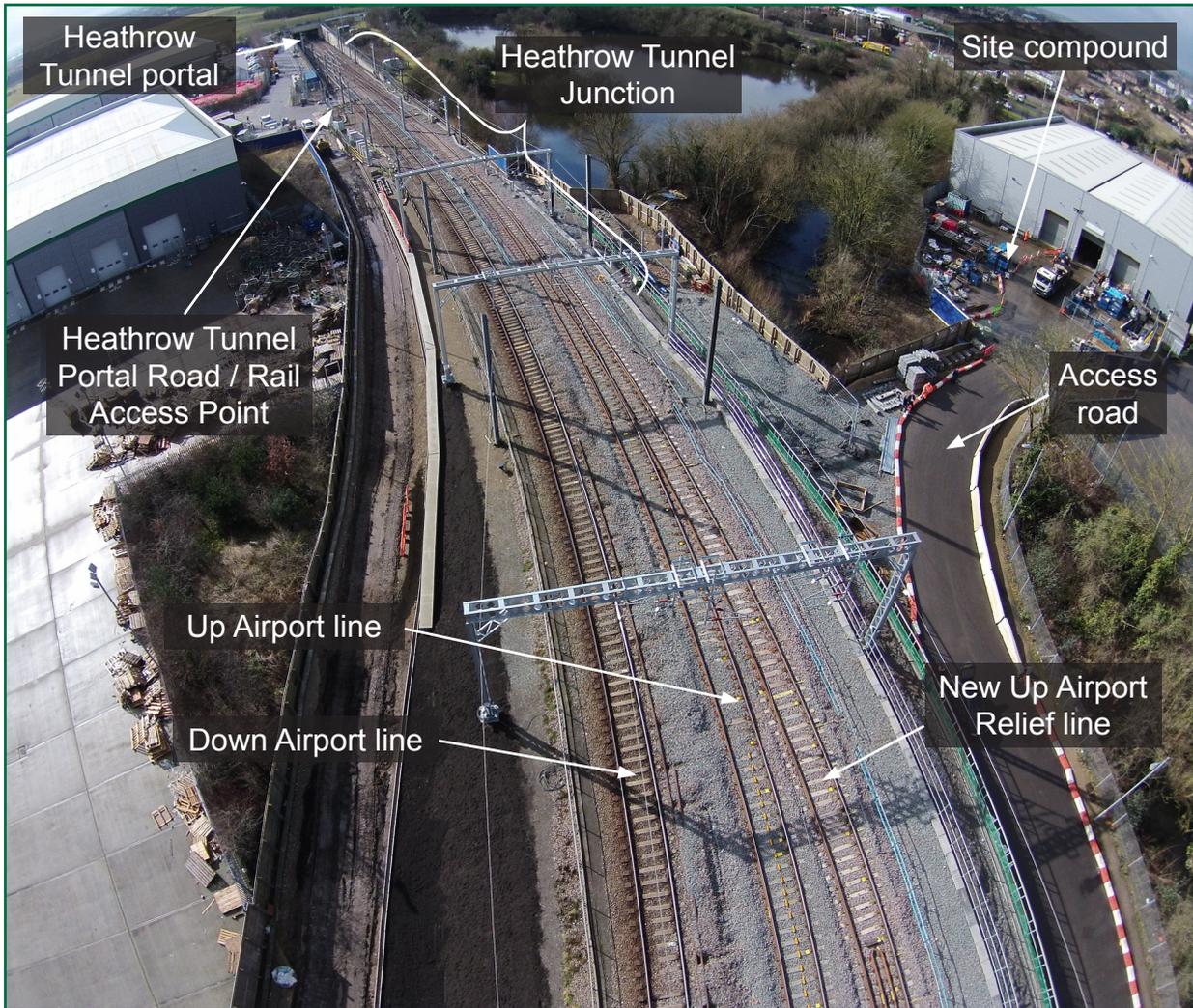


Figure 3: Stockley Flyover site looking south towards Heathrow Airport (picture taken 25 February 2015)

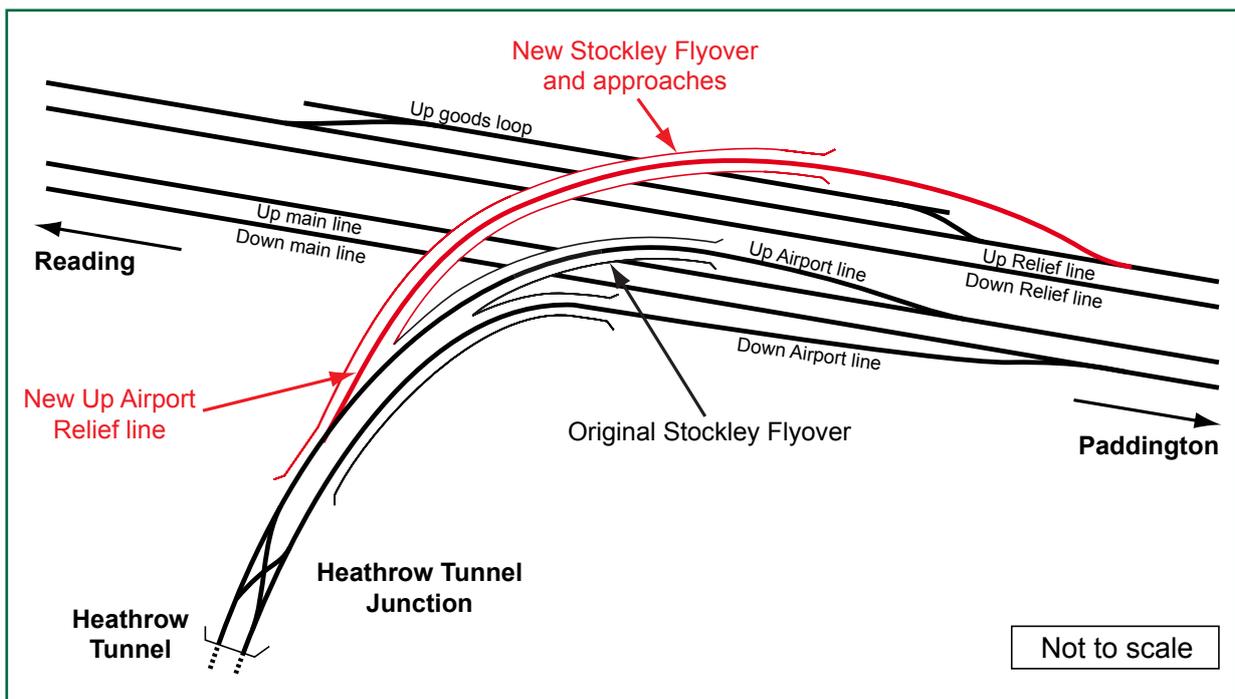


Figure 4: Track layout at Stockley Flyover (December 2014)

Organisations involved

- 9 Network Rail owns and maintains the railway infrastructure at the site and had employed Carillion plc (Carillion) to construct the new flyover and connections linking the Great Western main line to the lines serving Heathrow Airport. Network Rail remained responsible for the planning and delivery of the railway closures, known as *possessions*, required for the construction work. Its role included the supply of the team necessary to complete this activity.
- 10 Heathrow Express Ltd operates the passenger train services between London Paddington and Heathrow Airport, including the train which struck the rail mounted hand trolley on 28 December 2014.
- 11 Carillion undertook some parts of the flyover construction and associated work itself, and employed subcontractors to undertake other parts of the work. Carillion was responsible for the overall management of the site including co-ordinating all construction work, providing site access control and ensuring that all construction staff complied with relevant railway safety requirements. It carried out the latter role directly for some staff, and through subcontractors in other instances. Carillion employed the staff who placed the hand trolley on the line on 28 December 2014.
- 12 Signalling Solutions Ltd (Signalling Solutions) was the subcontractor for railway signalling work at the site and provided both the necessary technical staff and the staff required to comply with railway safety requirements. Signalling Solutions was responsible for the group involved in the track access irregularity on 27 December 2014.
- 13 Bridgeway Consulting Ltd (Bridgeway) supplied the possession delivery manager to Network Rail.
- 14 Vital Human Resources (Vitalrail) supplied *engineering supervisors* to Network Rail.
- 15 Coyle Personnel Ltd supplied the *controller of site safety* (COSS) involved in the track access irregularity to Signalling Solutions.
- 16 Resourcing Solutions Ltd supplied the COSS responsible for the group involved when the hand trolley was struck by the train.
- 17 Rail OP OHL Ltd supplied the site supervisor and trackworker A who were placing the hand trolley on the line moments before it was struck by the train.
- 18 These organisations freely co-operated with the investigation.

Management of site safety

- 19 The Stockley Flyover site safety system comprised Network Rail procedures, applicable to all staff working on and adjacent to its infrastructure¹, and additional site specific requirements set by Carillion. The application of this site safety system meant that staff could not work within 3 metres of a line *open* to traffic unless separated from the line by an approved fence (this is allowed in some circumstances elsewhere on Network Rail infrastructure). If no approved fence could be provided, a *site warden* was required to watch workers and give a warning if any worker moved to within 2 metres of the open line using a system described in paragraph 107.

¹ Including Network Rail standard NR/L2/OHS/019, Safety of People Working On or Near the Line.

- 20 As some construction work was required on or near lines normally open to traffic, construction was planned around a possession timetable identifying those periods of time when one or more of the lines within the site would be *blocked* to prevent their use by regular train services².
- 21 Site supervisors were appointed to each workgroup to be responsible for the safe and effective implementation of tasks in accordance with requirements applicable to all construction sites. When working in the vicinity of the railway, a COSS was appointed to be responsible for protecting themselves and their workgroup from the risk of being struck by trains.
- 22 The site supervisors were allocated tasks, given appropriate staff (including COSSs) and given their instructions by a site manager. Site managers were not intended to plan or instruct the safe systems of work needed to protect staff from the risk of being struck by trains.
- 23 Each possession was subdivided into one or more *worksites* with access to those worksites controlled by an engineering supervisor. The engineering supervisor's duties included authorising the start of activities within their worksite, and ensuring that the worksite was not returned to regular train services until it was safe to do so.
- 24 The railway rule book³ requires that, before a COSS and their workgroup can work within a worksite, the COSS must sign-in with, and receive a briefing from, the engineering supervisor. The engineering supervisor should not then consider the line is safe to return to normal traffic until all workgroups signed-in to his worksite are clear of the line (unless, but not relevant to the incidents in this report, they confirm they are using a safe system of work compatible with operation of normal train services).
- 25 Before undertaking tasks at the Stockley Flyover site, COSSs were issued with safe system of work (SSoW) packs detailing the planned method for protecting the workgroup from risks associated with rail traffic. The general layout and contents of the SSoW packs were given in Network Rail standard NR/L2/OHS/019. Each SSoW pack included an RT9909 'Record of Arrangements' form which, if not already fully completed when issued, was to be completed by the COSS to record the safe system of work they intended to apply. The COSS was required to brief these arrangements to the rest of their group. After the briefing, each member of the workgroup were required to sign the RT9909 form to acknowledge that they had received and understood the briefing.
- 26 On the Stockley Flyover site, after a workgroup had been briefed by their COSS, and the site supervisor had given the task specific brief, the COSS was required to log the team in with the site access control by telephone. The site safety system required that all of these actions must have been completed before work commenced.

² Engineering trains, used for construction and maintenance of railway infrastructure, are permitted to run on some blocked lines.

³ GE/RT8000 Handbook 9, IWA or COSS setting up a safe system of work, section 3.1.

Track access irregularity on 27 December 2014

Staff involved

- 27 The engineering supervisor on duty at the time of the incident had held this qualification for six years and had been managing worksites for the Network Rail Crossrail (west) project for about three months. A second person, designated the night shift engineering supervisor in this report, was working alternate shifts with the engineering supervisor. An overview of an engineering supervisor's duties is given in paragraphs 23 and 24.
- 28 COSS A had 38 years railway experience and had held a COSS qualification for over 10 years. Paragraphs 24 and 25 give an overview of a COSS's duties.
- 29 The possession delivery manager had 6 years railway experience including 4 years working within Network Rail's Crossrail possession planning and delivery team.

External circumstances

- 30 The incident occurred in daylight on a cold afternoon after rain earlier in the day; these conditions played no part in the incident.

Events preceding the incident

- 31 To allow work, including connecting the new Up Airport Relief line to the existing railway, it was necessary for the Crossrail (west) project to arrange multiple possessions from Christmas 2014 until the 2014/15 New Year period. To manage the worksites within these possessions, Network Rail had appointed two engineering supervisors, each covering a 12 hour shift and changing over at 09:00 hrs and 21:00 hrs.
- 32 During the Christmas/New Year period, each of these engineering supervisors managed up to 14 individual worksites⁴ and up to 100 COSSs. To assist the engineering supervisors managing this task, the possession delivery manager (responsible for arranging the possessions) provided them with a support team and introduced a modified system for controlling access to the worksite(s).
- 33 The railway rule book⁵ requires an engineering supervisor to record the details of each worksite on an individual Worksite certificate (Network Rail form RT3199). This certificate consists of two parts, one part to record the worksite details and one to record details of each COSS requiring access to that worksite. All COSSs must sign the certificate relating to each of the worksites on which they intend to work. All COSSs must then sign-out of these same certificates when their workgroup have completed the work and are clear of the worksite.

⁴ Each of the seven lines around the Stockley Flyover site was a separate worksite and the engineering supervisor also controlled further worksites between Stockley Flyover and Hanwell.

⁵ GE/RT8000 Handbook 12 Duties of the engineering supervisor (ES) or safe work leader (SWL) in a possession, section 3.4.

34 The modified worksite access control system in use at the Stockley Flyover site was intended to reduce the workload of the COSS and engineering supervisor. This modified system retained the first part of the RT3199 worksite certificate for recording details of each worksite, such as its geographic extent and the time period when regular train movements were stopped. The second part of all the RT3199 worksite certificates was replaced by a single COSS sign-in matrix. The matrix consisted of one row for each COSS, one column for each worksite and additional columns to record the times when entries were made on the matrix. This system allowed a COSS to sign-in to multiple worksites by ticking the relevant columns and entering the date and time at which they did this. At the end of a shift and before any line was reopened, the COSS was required to provide only one signature indicating that their workgroup was clear of all worksites they had previously ticked (figure 5).

COSS sign-in details

Worksite details (one column per worksite)

Time COSS given authority to start work

COSS sign-out details

THIS FORM IS ONLY TO BE USED FOR THE NBS PERIOD ONLY, FROM 17:00 24th to 19:00 26th.
TICK THE BOXES IN EACH LINE YOU ARE WORKING ON, CLEARLY WRITE YOUR DETAILS

Print Name	Phone No	Working mileage	Worksite details												Authority to start work given to IWA/COSS		IWA/COSS confirms work completed or worksite protection no longer needed	Signature	
			Down Main	Up Main	Down Relief	Up Relief	Harrowell Down & Up Goods	Harrowell Bridge Sidings	Southall West Loop	Down & Up Brentford Sidings	Down & Up Brentford Single	Down & Up Goods	Hayes Tarmac	Up Airport	Down Airport	Dowry Goods			Time
Name 001	Telephone	From 8m 10ch To 12m 23ch	✓	✓	✓	✓									✓	✓	Time 09:10 Date 26/12/14	Time 20:25 Date 26/12/14	Sig. 001
Name 002	Telephone	From 8m 10ch To 12m 23ch	✓	✓	✓	✓									✓	✓	Time 09:10 Date 26/12/14	Time 19:55 Date 26/12/14	Sig. 002
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Name 022	Telephone	From 8m 10ch To 12m 23ch	✓	✓	✓	✓									✓	✓	Time 09:10 Date 26/12/14	Time 20:25 Date 26/12/14	Sig. 022

One row per COSS

Figure 5: Engineering supervisor's COSS sign-in sheet (COSS names and signatures replaced by reference numbers to preserve confidentiality)

35 Network Rail staff who planned the works had intended that the matrix sign-in system would be introduced at 17:00 hrs on 24 December, the start of the period when all lines through the site would be blocked. They also intended that signing-in using the matrix system would cease at 19:00 hrs on 26 December. This would ensure all COSSs signed-in under the matrix system had completed their tasks and signed-out before the booked train services resumed the following day. The planners intended that COSSs signing-in after 19:00 hrs on 26 December would do so in the usual way using the reverse side of the RT3199 forms.

36 The engineering supervisor involved in the incident on 27 December was on duty at 19:00 hrs on 26 December and continued to use the matrix system for COSSs signing-in after this intended cut-off time. The night shift engineering supervisor took over at 21:00 hrs and also used the matrix system to control sign-in, a practice continued by the engineering supervisor when he resumed duty at 09:00 hrs on 27 December.

Events during the incident

- 37 COSS A started his shift at around 08:00 hrs on 27 December, and received his task briefing for his work that morning from his installation supervisor. His task was to act as COSS to a group comprising a site engineer and two others needing to inspect the Up Airport line from Heathrow Tunnel Junction to the up main line in order to identify incomplete work.
- 38 COSS A then attended a briefing from the engineering supervisor and signed the matrix sign-in form at 09:25 hrs. It is uncertain whether COSS A signed the matrix form before or after receiving this briefing. COSSs sometimes completed the matrix forms before their briefing and the engineering supervisor has stated that he was content for this to happen.
- 39 After receiving authority to start work from the engineering supervisor, COSS A joined his workgroup at an *access point* known as the Heathrow Tunnel Portal *Road Rail Access Point* (RRAP), located near to the portal of Heathrow Tunnel (figure 3). The group crossed the Down Airport line adjacent to the access point and began walking along the Up Airport line. They reached the up main line and then walked back to the same access point, arriving at about 12:00 hrs. Both the Up and Down Airport lines were blocked to rail traffic throughout this period.
- 40 COSS A and the site engineer then left the Stockley Flyover site and returned to their depot, which was located off site, to report their findings. During the period that he was away from the railway, COSS A did not sign-out of any of the worksites he had signed into that morning, but the Down Airport line was reopened and COSS A was unaware of this.
- 41 That afternoon, the installation supervisor instructed COSS A and 13 others to undertake tasks along the Up Airport line. The installation supervisor had intended the 14 workers to work as three separate groups, and had included another two COSSs within the group to facilitate this. However, the 14 workers remained as a single group, with COSS A accepting responsibility for all the staff.
- 42 The workgroup left the depot and went to the Heathrow Tunnel Portal RRAP, arriving at approximately 14:45 hrs. COSS A's RT9909 includes signatures from the members of the workgroup acknowledging that they had received a briefing about the intended safe system of work from COSS A. However, COSS A has stated that he did not provide a briefing.
- 43 The workgroup walked from the access point towards the Great Western main line, pushing some equipment along the Down Airport line (figure 6) using a *rail skate* (a small trolley mounted on one rail, figure 7). They chose this line because it provided a *continuous rail* as they passed the *points* at Heathrow Tunnel Junction. COSS A intended the workgroup to cross to their working location on the Up Airport line after they had walked past Heathrow Tunnel Junction.

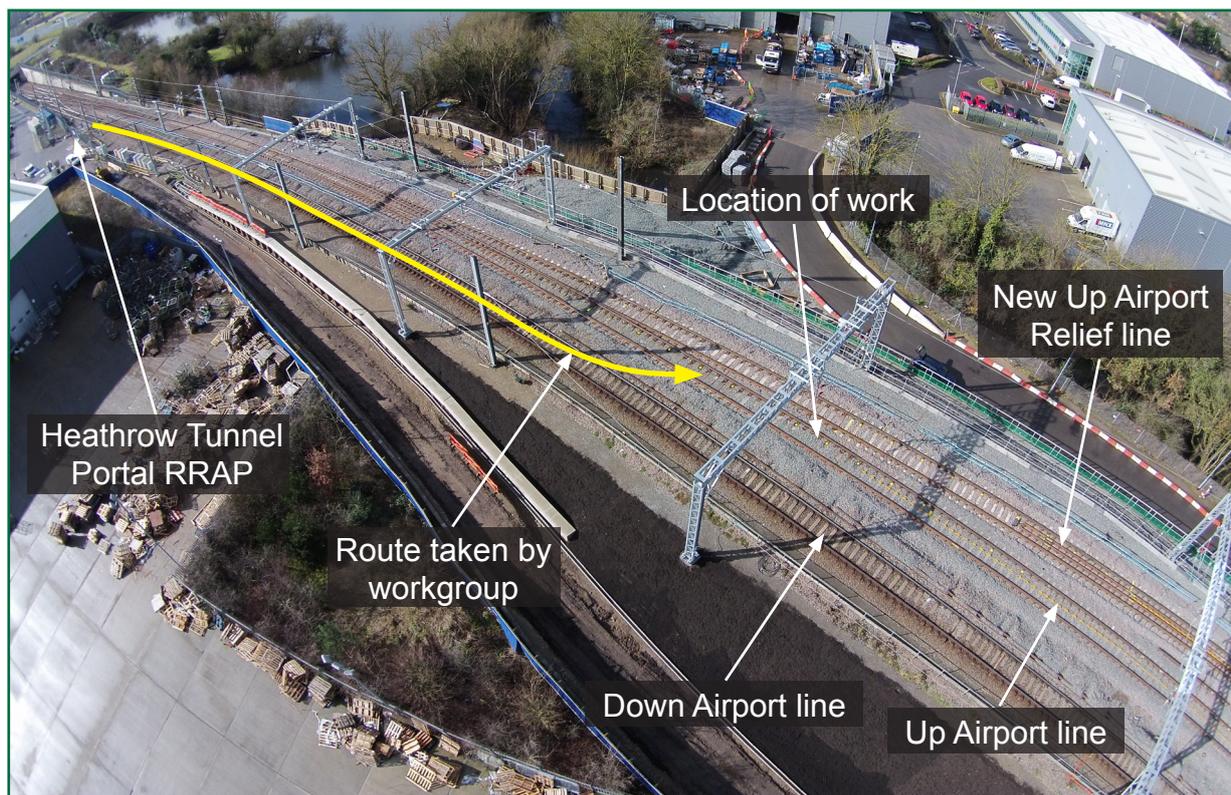


Figure 6: Route taken by workgroup on 27 December 2014



Figure 7: Typical rail skate (not identical to the rail skate used by the workgroup on 27 December 2014)

- 44 At about 15:00 hrs, as the group approached their working location, they were advised by staff working on the blocked Up Airport line that the Down Airport line was now open to traffic. COSS A still believed the Down Airport line to be blocked but, in response to the warning, moved his workgroup to the Up Airport line and they began their allocated tasks.

Events following the incident

- 45 At 15:17 hrs, while the workgroup were working on the blocked Up Airport line, a train from Heathrow Airport to London Paddington passed the construction site travelling along the section of the Down Airport line which had been used by COSS A and his workgroup as a walking route. A short time later, at around 15:30 hrs, the group were stood down from their work by a senior Carillion manager who had learned of the incident from other construction workers.
- 46 The engineering supervisor was informed of the irregularity at 16:20 hrs and continued in his role until his planned shift changeover at 21:00 hrs.

Key facts and analysis (for incident on 27 December 2014)

Identification of the immediate cause

- 47 **The engineering supervisor authorised the Down Airport line to be reopened to rail traffic while COSS A believed the line was still blocked to rail traffic.**

Identification of causal factors

- 48 The incident occurred due to a combination of the following causal factors:
- The engineering supervisor did not reach a clear understanding with COSSs about the status of the Down Airport worksite, as required by the railway rule book (paragraph 49);
 - The matrix system was being used to control track access after it became inappropriate (paragraph 59); and
 - COSS A did not query a mismatch between his SSoW paperwork and his understanding of lines open to traffic (paragraph 64).

Each of these factors is now considered in turn.

Controlling access to Down Airport line

- 49 **The engineering supervisor did not reach a clear understanding with COSSs about the status of the Down Airport worksite, as required by the railway rule book.**

- 50 Network Rail procedures require that, after all COSSs have signed out of a worksite, the engineering supervisor must remove their safety equipment from the track and inform the person in charge of the possession (PICOP) that the line is safe to be returned to normal traffic (a process known as *handing back* a worksite). The same process is required for all worksites within a possession; additional time is often needed to restore power to the overhead electric equipment, and then the PICOP must remove their safety equipment from the track before they can inform the signaller that normal train services can resume. These processes, plus the requirement for COSSs to brief their own workgroups, meant that little effective work could be done by a workgroup at the Stockley Flyover site unless their COSS could sign-in at least four hours before a line was due to be handed back. The site safety system therefore prohibited COSSs from signing-in to a worksite within four hours of the intended time for reopening the line.

- 51 When COSS A received his briefing from the engineering supervisor at 09:25 hrs the Down Airport worksite was already subject to this four hour rule because it was planned to reopen both the up main and the Down Airport lines at 11:00 hrs, although the Down Airport line did not actually reopen until 12:00 hrs. The engineering supervisor used large scale whiteboard diagrams showing the track layout, but not hand back times, to support his briefing. He has stated that his briefings took as long as he felt necessary to ensure all those attending understood the content and that, during this briefing, he said that COSSs should not sign-in to the Down Airport worksite. COSS A stated that he considered the briefing to be of a good standard, but he was not able to recall any specific details, possibly because he was asked several days after the event and this was one of many similar briefings he received during this Christmas period.
- 52 When he signed the matrix, COSS A placed tick marks in the up main, the Down Airport and three other worksite columns. The engineering supervisor did identify and advise COSS A that his up main worksite tick mark was invalid because the up main line would be reopened within four hours. In response to this, COSS A crossed out his tick mark and the engineering supervisor over-scribed this crossing out in red ink (figure 8).
- 53 It is uncertain whether the engineering supervisor recognised the Down Airport worksite column tick mark was also invalid at this time because this line was also due to be reopened within four hours. This is unlikely as COSS A's tick mark in the Down Airport column remained unaltered, and other COSSs subsequently put tick marks in the same column which were not corrected by the engineering supervisor.
- 54 After COSS A had signed-in, staff assisting the engineering supervisor became aware that COSSs were continuing to place tick marks in the Down Airport worksite column and advised the engineering supervisor of this. The engineering supervisor stated that he then drew a red line through the Down Airport worksite column, intending that this red line would prevent further tick marks being placed in that column. It is not possible to identify exactly when this occurred, but the engineering supervisor has stated he was aware this column already contained tick marks when he drew the line and did not believe any tick marks were made subsequently. If this is correct, the red line must have been drawn through the Down Airport worksite column after the last tick mark was made at 11:13 hrs (figure 9).
- 55 As COSS A had placed a tick mark in the Down Airport worksite column and signed the matrix, he left the briefing room with a clear understanding that he had authority to access the Down Airport worksite, contrary to the engineering supervisor's intention (paragraph 51). The railway rule book⁶ requires that an engineering supervisor must agree with each COSS the limits of their site of work before allowing work to commence. The mismatch between the tick marks and the engineering supervisor's understanding indicates that there was not a clear understanding between the engineering supervisor and some COSSs. The engineering supervisor took no action in respect of this mismatch and has stated that he believed his briefing took precedence over the ticks.

⁶ GE/RT8000 Handbook 12, section 4.1.

**THIS FORM IS ONLY TO BE USED FOR THE NBS PERIOD ONLY, FROM 17:00 24th to 19:00 26th.
TICK THE BOXES FOR EACH LINE YOU ARE WORKING ON, CLEARLY WRITE YOUR DETAILS**

Print Name	Phone No	Working mileage		Down Main	Up Main	Down Relief	Up Relief	Hanwell Down & Up Goods	Hanwell Bridge Slings	Southall West Loop	Down & Up Brentford Sidings	Down & Up Brentford Single	Down & Up Goods	Hayes Tarmac	Up Airport	Down Airport	Dawley Goods	Authority to start work given to IWA/COSS		IWA/COSS confirms work completed or work site protection no longer needed		Signature	
		From	To															Time	Date	Time	Date		Time
Name 001	Telephone			✓	✓	✓	✓															Sig. 001	
Name 002	Telephone																						Sig. 002
Name 003	Telephone																						Sig. 003
Name 004	Telephone																						Sig. 004
COSS A	Telephone																						Sig. 005
Name 006	Telephone																						Sig. 006
Name 007	Telephone																						Sig. 007
Name 008	Telephone																						Sig. 008
Name 009	Telephone																						Sig. 009
Name 0	Telephone																						Sig. 010
Name 0	Telephone																						Sig. 011
Name 0	Telephone																						Sig. 012
Name 013	Telephone																						Sig. 013
Name 014	Telephone																						Sig. 014
Name 015	Telephone																						Sig. 015
Name 016	Telephone																						Sig. 016
Name 017	Telephone																						Sig. 017
Name 018	Telephone																						Sig. 018
Name 019	Telephone																						Sig. 019
Name 020	Telephone																						Sig. 020
Name 021	Telephone																						Sig. 021
Name 022	Telephone																						Sig. 022

3 - Authority to work recorded as 09:25 hrs

2 - COSS advised up main is not available due to four hour rule and crosses out his tick mark. Engineering supervisor over-scribes this with a red cross (paragraph 52)

1 - COSS A ticks up main, Down Airport and three other worksites (paragraph 52)

Figure 8: COSS A entry on engineering supervisor sign-in sheet (personal details obscured and replaced by references including COSS A)

THIS FORM IS ONLY TO BE USED FOR THE NBS PERIOD ONLY, FROM 17:00 24th to 19:00 26th.
TICK THE BOXES FOR EACH LINE YOU ARE WORKING ON, CLEARLY WRITE YOUR DETAILS

353	Print Name	Phone No	Working mileage		Down Main	Up Main	Down Relief	Up Relief	Hanwell Down & Up Goods	Hanwell Bridge Sidings	Southall West Loop	Down & Up Brentford Single	Down & Up Brentford Sidings	Down & Up Goods	Hayes Tamac	Up Airport	Down Airport	Draughty Goods	Authority to start work given to IWA/COSS	IWA/COSS confirms work completed or worksite protection no longer needed	Signature		
			From	To																		Time	Date
354	Name 001	Telephone	From	To	✓	✓	✓	✓											Time	Date	Time	Date	Sig. 001
355	Name 002	Telephone	From	To															Time	Date	Time	Date	Sig. 002
356	Name 003	Telephone	From	To															Time	Date	Time	Date	Sig. 003
357	Name 004	Telephone	From	To															Time	Date	Time	Date	Sig. 004
358	COSSA	Telephone	From	To															Time	Date	Time	Date	Sig. 005
359	Name 006	Telephone	From	To															Time	Date	Time	Date	Sig. 006
360	Name 007	Telephone	From	To															Time	Date	Time	Date	Sig. 007
361	Name 008	Telephone	From	To															Time	Date	Time	Date	Sig. 008
362	Name 009	Telephone	From	To															Time	Date	Time	Date	Sig. 009
363	Name 010	Telephone	From	To															Time	Date	Time	Date	Sig. 010
364	Name 011	Telephone	From	To															Time	Date	Time	Date	Sig. 011
365	Name 012	Telephone	From	To															Time	Date	Time	Date	Sig. 012
366	Name 013	Telephone	From	To															Time	Date	Time	Date	Sig. 013
367	Name 014	Telephone	From	To															Time	Date	Time	Date	Sig. 014
368	Name 015	Telephone	From	To															Time	Date	Time	Date	Sig. 015
369	Name 016	Telephone	From	To															Time	Date	Time	Date	Sig. 016
370	Name 017	Telephone	From	To															Time	Date	Time	Date	Sig. 017
371	Name 018	Telephone	From	To															Time	Date	Time	Date	Sig. 018
372	Name 019	Telephone	From	To															Time	Date	Time	Date	Sig. 019
373	Name 020	Telephone	From	To															Time	Date	Time	Date	Sig. 020
374	Name 021	Telephone	From	To															Time	Date	Time	Date	Sig. 021
375	Name 022	Telephone	From	To															Time	Date	Time	Date	Sig. 022

4 - Tick mark for Down Airport made by another COSS before COSS A entry*

5 - Tick marks for Down Airport made by other COSSs after COSS A entry*

6 - Red line drawn by engineering supervisor after 11:13 hrs (paragraph 54)

* Four hour rule meant no COSSs should be signing-in to this line in this period (paragraph 51)

Figure 9: Engineering supervisor's red line drawn through Down Airport column after 11:13 hrs (personal details obscured and replaced by references including COSS A)

- 56 The engineering supervisor's belief that his briefing took precedence over the tick marks meant that he did not consider it necessary to contact the COSSs who had ticked this column before advising the PICOP that the line was safe to return to traffic.
- 57 The railway rule book⁷ requires that an engineering supervisor begins the process of removing the worksite protection only when the line is safe to return to traffic and all COSSs have signed-out on the RT3199 worksite certificate. In this instance the matrix sign-in sheet replaced the RT3199 worksite certificate, but contained no evidence that COSS A had signed-out of the Up Airport worksite when the engineering supervisor began the hand back procedure. Although not relevant to the incident, other COSSs had not signed-out of this worksite before it was returned to traffic.
- 58 The RAIB considers it unlikely that the engineering supervisor's workload influenced events on 27 December. The engineering supervisor was provided with a support team and has stated that he did not consider himself to be overloaded during this period.

System for control of track access

59 The matrix system was being used to control track access after it became inappropriate.

- 60 The matrix system used a single signature for a COSS to access multiple worksites, and a single signature for the COSS to sign-out of all of the same worksites simultaneously. A worksite could not be handed back during a shift unless all signed-in COSSs returned to the engineering supervisor, signed-out, and then signed-in again omitting any worksites to be handed back. This made the matrix system impractical if it allowed a COSS to sign-in to a worksite which was to be handed back during the same shift.
- 61 The matrix paperwork included worksites due to be returned to traffic from 07:00 hrs on 27 December and a note on the top of the matrix instructed that it should only be used until 19:00 hrs on 26 December. Although not stated on the form, this allowed staff to sign-in until this time and then both complete their work and sign-out before the worksite was handed back. The engineering supervisor has stated that he did not appreciate the reason for this restriction and so continued to operate the matrix system on the basis that he would be instructed by the possession delivery manager when to cease using it.

⁷ GE/RT8000 Handbook 12, section 10.3.

- 62 The night shift engineering supervisor was aware of the cut-off time, but did not challenge the continued use of the matrix system when he began his shift at 21:00 hrs on 26 December 2014. He has acknowledged that he should have challenged the continued use, but did not do so. During this shift, some COSSs signed-in to the down main worksite which was subsequently reopened to traffic. Cross marks through the COSS tick marks, and witness evidence, indicate that the night shift engineering supervisor probably telephoned each signed-in COSS before reopening the line. Use of the telephone for this purpose had not been permitted until the rule book was modified about three weeks before the incident. This change permitted telephone sign-out provided that, when given access to a worksite, a COSS is given a unique number which is intended to provide a reliable means of identifying the COSS during the hand back process. At the end of his shift, the night shift engineering supervisor did not question the continued use of the matrix during the handover meeting at 09:00 hrs the following morning.
- 63 The possession delivery manager, who was responsible for introducing the matrix system, was working on site within the team providing support to the engineering supervisor. The possession delivery manager was aware that the matrix system should only be used when all lines were blocked and was aware that some lines would be opened during the shift on 27 December. He has stated that he was not aware that the matrix system was still being used beyond the intended cut-off time.

Role of the COSS

64 COSS A did not query a mismatch between his SSoW paperwork and his understanding of lines open to traffic.

- 65 The SSoW pack which had been provided to COSS A for the work on the afternoon of 26 December did state that the Down Airport line would be open to traffic. This conflicted with COSS A's understanding that he had the engineering supervisor's authority to access the line as recorded by his tick mark in the Down Airport column of the matrix sign-in sheet (paragraph 53). COSS A also correctly understood that the railway rule book⁸ required the engineering supervisor to contact him before the line could be reopened to traffic.
- 66 The COSS has stated that he relied on his understanding that he had the engineering supervisor's authority because he did not have faith in the SSoW packs provided to him. This was because he believed the packs contained errors, although he was unable to provide examples. The RAIB has found an error in the SSoW pack, but it related to the task specific access point and not to which lines were open or blocked. This is discussed as an observation (paragraph 73).
- 67 No other member of the workgroup knew that the Down Airport line had been reopened, so none of the group had the information needed for them to challenge walking along this line. The COSS did not, and was not required, to show all parts of the SSoW pack to the workgroup. There were two other COSS qualified staff in the workgroup, but neither had attended a briefing from the engineering supervisor that day.

⁸ GE/RT8000 Handbook 12, Section 10.1.

- 68 Although not directly relevant to the incident on 27 December, the following information relating to this incident is relevant to the underlying factor relating to deviation from the site safety system (paragraph 115). COSS A has stated that:
- a. he did not always provide COSS briefings when working with a familiar workgroup and in familiar surroundings;
 - b. he did not provide a briefing to either workgroup on 27 December; and
 - c. his lack of a full COSS briefing was not challenged by either the morning or afternoon workgroup on 27 December.

Observations relating to the track access irregularity

Rule book update awareness

69 **The engineering supervisor and other staff were unaware that the railway rule book requirements regarding management of worksites had changed on 6 December 2014.**

- 70 During the course of the investigation, the RAIB observed that neither the engineering supervisor nor the night shift engineering supervisor were aware of changes to the railway rule book which took effect from 6 December. These changes did not affect the circumstances of the incident, but introduced a formalised system for COSSs to sign-out of worksites by telephoning the engineering supervisor. These updated requirements included safety processes absent from the informal system adopted by the night shift engineering supervisor on the night of 26/27 December (paragraph 62).
- 71 Both the engineering supervisor and night shift engineering supervisor were employed by Vitalrail and, although working for Network Rail, it remained the responsibility of Vitalrail, as their *primary sponsor*, to issue railway rule book updates to its staff⁹. Vitalrail did not issue the updates relating to the 6 December 2014 rule book changes until March 2015 and has been unable to explain why the distribution process was delayed.
- 72 The possession delivery manager was a qualified engineering supervisor and was also unaware of the 6 December 2014 railway rule book updates. His primary sponsor, Bridgeway, was responsible for providing these updates. Bridgeway stated that railway rule book, and other standards updates, are available on their intranet. Bridgeway has been unable to produce any evidence of a process for ensuring that its staff were being made aware of, and acknowledging, such updates.

⁹ In accordance with the Network Rail managed infrastructure accreditation scheme (*Sentinel* Scheme Rules, section 2.2d).

SSoW pack contents

- 73 **The Signalling Solutions SSoW pack did not identify a safe access point at which staff could enter railway infrastructure, and contained excessive amounts of unnecessary information.**
- 74 The SSoW pack issued to COSS A on 27 December 2014 instructed him to refer to an attached extract of Network Rail's *National Hazard Directory* for his access point. The National Hazard Directory is a document containing, amongst other information, a list of approved access points. The Heathrow Tunnel Portal RRAP used by COSS A was listed in the Hazard Directory, but use was only permitted when the Down Airport line was blocked to rail traffic. The SSoW pack stated that the Down Airport line was open, so use of this access would have been unsafe.
- 75 A temporary access point had been provided for use when both Airport lines were open and construction staff were required to work in locations such as that intended by COSS A. This access was a staircase adjacent to the new Up Airport Relief line (figure 10), but this had not been included in the Hazard Directory extract included in the SSoW pack.
- 76 The SSoW pack issued to COSS A for the task undertaken on 27 December comprised 51 pages of which only 12 were relevant to a COSS working on the Up Airport line at that time. The remainder related to an area which track workers could not reach directly from the Up Airport line at that time, possession details not needed by a COSS and task related information not relevant to railway safety. Inclusion of significant amounts of irrelevant information in SSoW pack contents makes it difficult for a COSS to find relevant information and is contrary to the safe system of work planning process described in Network Rail standard NR/L2/OHS/019.

Near miss with staff and hand trolley struck on 28 December 2014

Staff involved

- 77 The engineering supervisor was the same person who had been undertaking the engineering supervisor's role during the track access irregularity on the previous day (paragraph 27).
- 78 COSS B was responsible for railway safety of the workgroup. He was part of the Carillion site safety staff, supplied to Carillion by Resourcing Solutions Ltd. He had 14 months' railway experience and had held a COSS qualification for two months.
- 79 The site supervisor was part of the Carillion site staff, but directly employed by Rail OP OHL Ltd and had over 13 years' railway experience. He had previously held a COSS qualification, but this had expired (and was not required) at the time of the incident.
- 80 Trackworker A was also directly employed by Rail OP OHL Ltd, but was part of the Carillion site staff and had over 2 years' railway experience.

External circumstances

- 81 The incident occurred in daylight and the weather was cold and dry; these conditions played no part in the incident.

Events preceding the incident

- 82 The morning after the track access irregularity, Carillion's task planners had intended that COSS B and an eight-person workgroup would continue the installation of hand rails at the top of a new *retaining wall* adjacent to the Up Airport Relief line, a task they had undertaken during their shift on the previous day. Neither the task, nor the intended access route, required the workgroup to be on a line open to rail traffic, in part because construction of the Up Airport Relief line was still being completed.
- 83 COSS B was given a SSoW pack which, in accordance with the site safety system for tasks generated by Carillion planners, did not contain details of the lines open and blocked. COSSs were expected to add this information to the pack based on the briefings given to them by the engineering supervisors. COSS B attended the engineering supervisor's briefing and signed the RT3199 worksite certificate at 09:15 hrs. By this time, the matrix sign-in system in use the previous morning (paragraphs 33 to 36) had been replaced by standard RT3199 worksite certificates. COSS B understood correctly from the briefing that both the Up and Down Airport lines were open to traffic, but COSS B did not record this, or any other information about lines open and blocked, on his SSoW pack.

84 COSS B and the site supervisor then attended a task-specific briefing given at the construction site compound by the site manager. It is uncertain whether they received this task briefing at the same time, but they were both informed that, in addition to the planned handrail installation work, their workgroup was to transfer materials from the site compound to the trackside (figure 10). It was possible for the workgroup to undertake this additional task without updating their SSoW paperwork because similar material transfer was also necessary for the handrail installation. During the briefing, the site supervisor suggested to the site manager that the workgroup might use a rail mounted hand trolley (figure 11) to aid this task. The site manager raised no objection to its use, nor did he comment on the associated railway related safety provisions (paragraph 19). Ensuring compliance with these railway related procedures was not part of the site manager's role and there is no evidence that he was told anything suggesting the intended use of the trolley could be unsafe.

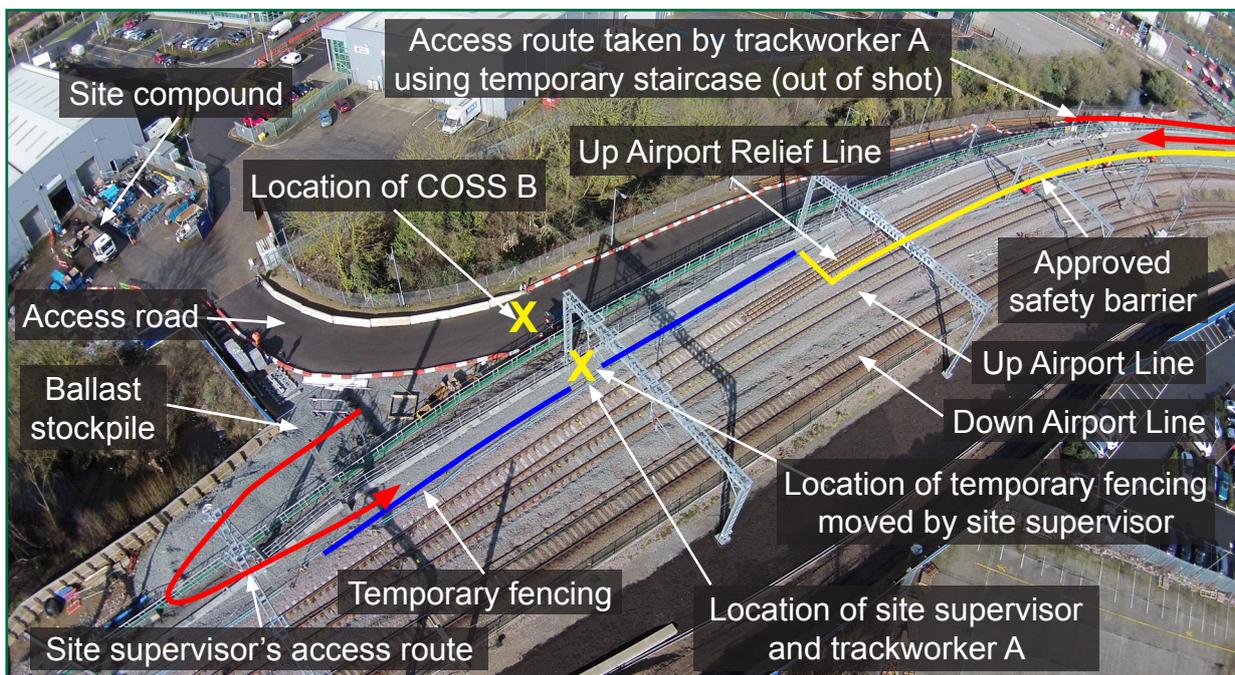


Figure 10: Location of access points and staff before incident

85 COSS B and the site supervisor left the site compound and met at a position on the access road near to the railway (figure 10) and were joined by the other members of the workgroup. COSS B then spoke to each member of the workgroup, although not all at the same time. COSS B stated that he did not consider he had given all members of the group a full briefing at that, or any other, time during the shift. Some members of the workgroup stated that, although they had received some information, they also did not consider this to be a full COSS briefing. However, all members of the workgroup did sign the RT9099 form (included in the SSoW pack) acknowledging that they had received a briefing from the COSS.

86 The site supervisor went ahead of COSS B to the intended location of work. This was near to COSS B but at the top of a retaining wall approximately 4 metres above the COSS's position. The site supervisor reached this location by walking up a large stockpile of *ballast*, a material needed for track installation and stored in a manner which created an unofficial access point (figure 10).

- 87 The last track worker to sign the acknowledgement form, trackworker A, left COSS B on the access road to join the site supervisor. Trackworker A stated that he accessed the location of work using the official access, a scaffold staircase (figure 10).
- 88 COSS B remained on the access road, near the foot of the ballast stockpile, to complete his SSoW paperwork and log his workgroup on with the site access control while the remaining members of the workgroup went to gather tools and equipment from the site compound (figure 10).



Figure 11: Example of a hand trolley, similar to the trolley involved in the incident on 28 December 2014

Events during the incident

- 89 The site supervisor located a hand trolley in the cess of the new Up Airport Relief line and called down to COSS B asking him to obtain the engineering supervisor's consent for this to be used. This consent is required by the railway rule book¹⁰ before a trolley can be placed on a line normally open to regular train services but blocked as part of a worksite. There is conflicting witness evidence as to whether this conversation included a statement about which line the site supervisor intended to place the trolley on.
- 90 COSS B contacted the engineering supervisor by telephone and requested permission to use a trolley on the new Up Airport Relief line. An engineering supervisor's consent was not needed for placing a hand trolley on this line because it was incomplete and so not subject to the possession and worksite regime applicable to lines normally open to regular train services. The engineering supervisor explained this to COSS B and, although not necessary or his responsibility, agreed to the use of the trolley and asked COSS B to contact him when it had been removed from the track.

¹⁰ GE/RT8000 Handbook 10, Duties of the COSS or SWL and person in charge when using a hand trolley, section 2.3.

- 91 After ending the telephone conversation with the engineering supervisor, COSS B called up to the site supervisor and gave permission to place the trolley on the track. The line name was not included in this communication; COSS B did not do so because he believed this had been established when the site supervisor requested consent to use the trolley (paragraph 89). The absence of a line name in this conversation meant that the site supervisor incorrectly believed he had permission to place the trolley on the Up Airport line which, unknown to him, was open to regular train services. The site supervisor and trackworker A then picked up the hand trolley from beside the Up Airport Relief line, carried it through a section of temporary fencing which had been moved aside by the site supervisor, and began to place it on the Up Airport line (figure 12).

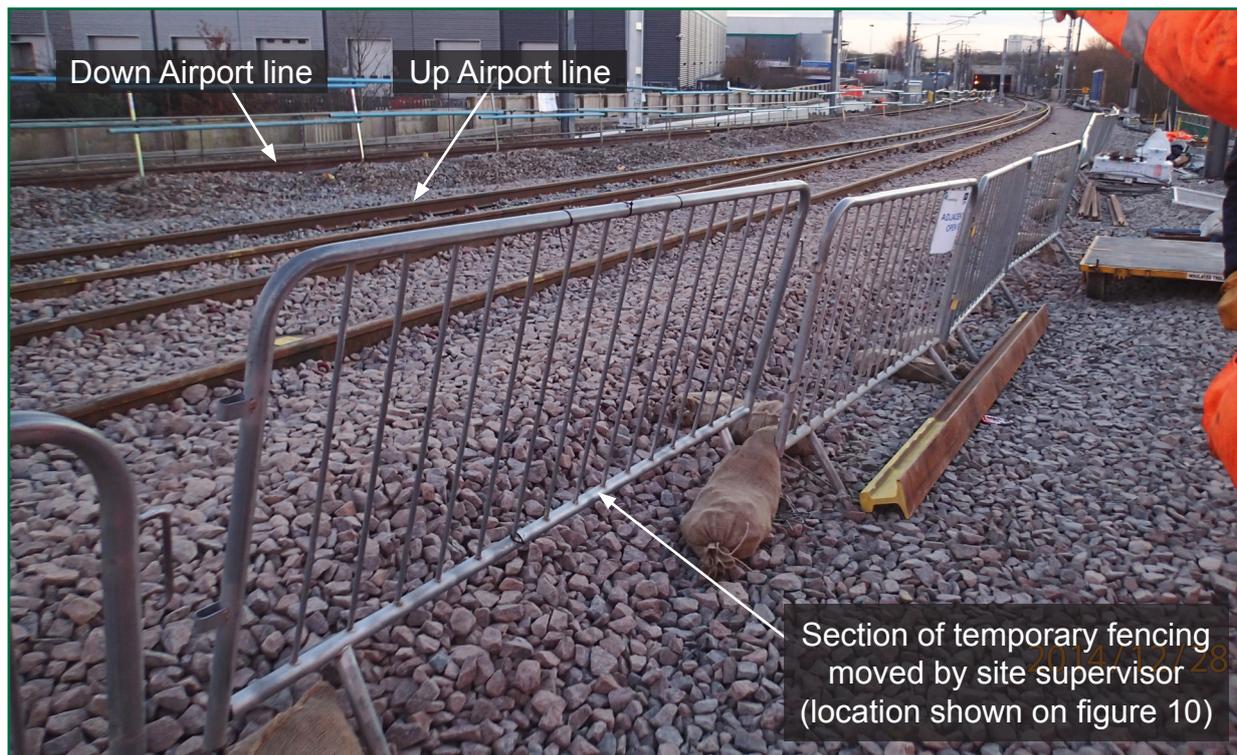


Figure 12: Section of temporary fencing moved to gain access to railway

- 92 At around 10:05 hrs, train 1Y40, the 09:48 hrs Heathrow Express passenger service from Heathrow Airport to London Paddington, emerged from Heathrow Tunnel travelling at approximately 45 mph (72 km/h) on the Up Airport line. As the train left the tunnel portal, approximately 300 metres from the site supervisor and trackworker A (figure 13), the driver realised there were people on the track on which he was travelling. He applied the *emergency brake* and started to repeatedly sound a warning using the train horn.
- 93 This warning was heard by the site supervisor and trackworker A while they were lining up the hand trolley with the rails. They both dropped the trolley with trackworker A moving aside and the site supervisor rolling clear of the train moments before it struck the trolley. At this point the train had slowed to approximately 36 mph (58 km/h). The train continued, with the trolley underneath the first *bogie*, until it stopped approximately 85 metres from the point of impact.

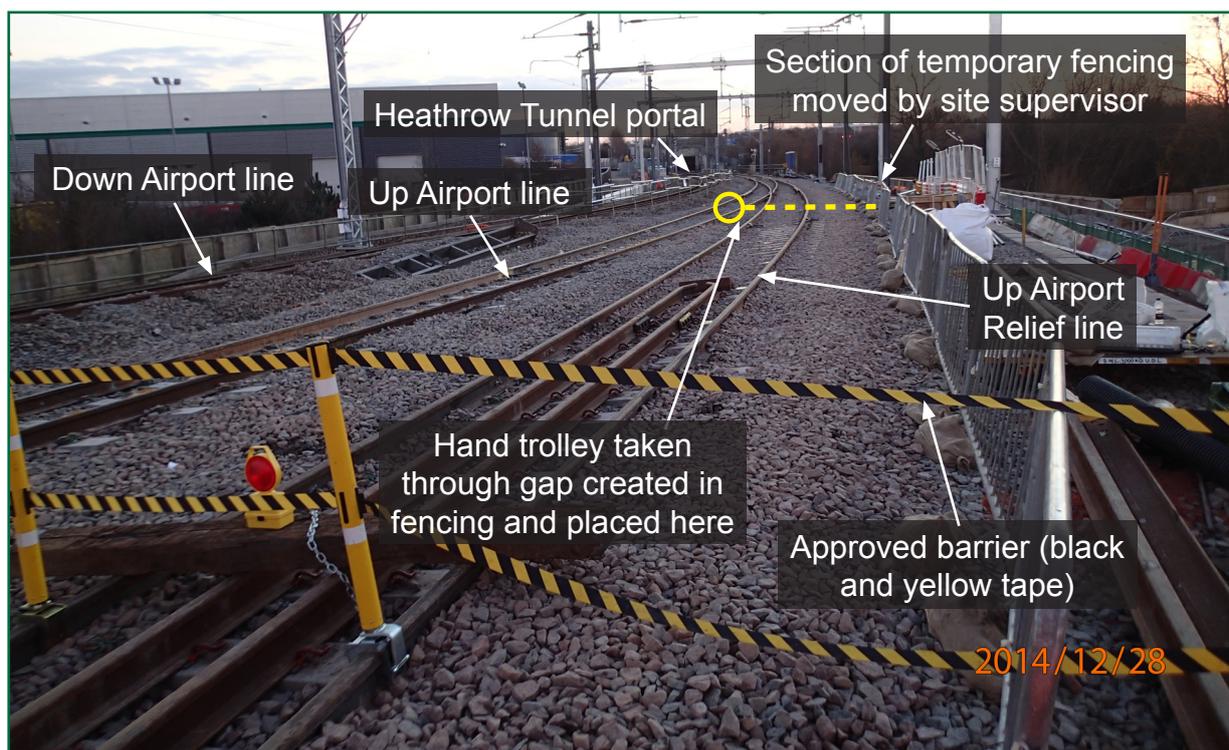


Figure 13: position of hand trolley relative to Heathrow Tunnel portal

- 94 Several staff on site, alerted by the warnings given by the train horn, called out to the site supervisor and trackworker A moments before the impact. The commotion and the sound of the train hitting the trolley caught the attention of COSS B who ran up the ballast stockpile to the location of the incident.

Events following the incident

- 95 When the train had come to a stand, the driver made an emergency call to the signaller. The signaller blocked the Up and Down Airport lines while the driver left his cab to investigate. The driver reported his findings to the signaller who then reopened the Down Airport line at 10:18 hrs. After being examined and declared serviceable by a specialist inspector, train 1Y40 continued its journey to London Paddington station at 12:17 hrs and the Up Airport line was reopened to other trains following minor track repairs at 13:03 hrs.

Key facts and analysis (for incident on 28 December 2014)

Identification of the immediate cause

- 96 **The site supervisor and trackworker A placed a trolley on the Up Airport line when unaware that it was open to rail traffic.**

Identification of causal factors

- 97 The incident occurred due to a combination of the following causal factors:
- the information provided to the site supervisor did not prevent him from deciding it was safe to move the temporary fencing separating him from a line open to traffic and place a hand trolley on the open line (paragraph 98); and
 - members of the workgroup and COSS B were routinely using railway safety and access arrangements which they knew were not compliant with the site safety system (paragraph 101).

Each of these factors is now considered in turn.

Identifying safe working limits

- 98 **The information provided to the site supervisor did not prevent him from deciding it was safe to move the temporary fencing separating him from a line open to traffic and place a hand trolley on the open line.**

- 99 The site supervisor would not have moved the temporary fencing if he had been aware that the Up Airport line beyond the fence was open (figure 13). The site supervisor believed the line was closed, as it had been the previous day. The absence of a full briefing by the COSS (paragraph 85) and the absence of a clear understanding regarding which line the hand trolley was to be used on (paragraph 91) meant that he had not been given any indication that the status of the Up Airport line had changed. This is discussed further at paragraph 106.
- 100 It is possible that safety signage would have led the site supervisor to query his incorrect belief that the line was blocked. There were signs posted on the temporary fencing which stated 'adjacent line open site'. These were intended to give COSSs information they needed when implementing the safe system of work (paragraph 107). The site supervisor has stated that he did not notice these signs before he moved the temporary fencing. It is uncertain whether this was because they were not easily visible from his walking route, they lacked conspicuity (figure 12), or they did not contain wording giving an explicit warning of danger (eg 'Line beyond fence open to traffic'). If the site supervisor had noticed these or other appropriate site safety signage, he would have been alerted to the fact that, contrary to his previous understanding, the Up Airport line was now open to rail traffic (paragraph 128).

Behaviour of COSS B and the workgroup

101 **Members of the workgroup and COSS B were routinely using railway safety and access arrangements which they knew were not compliant with the site safety system.**

102 Several aspects of this incident illustrate that safety arrangements did not prevent members of the workgroup and COSS B becoming accustomed to working in an unsafe way. This is demonstrated by the following:

- COSS B did not always provide a safety briefing, and did not complete his SSoW pack, according to the site safety system (paragraph 103);
- COSS B did not lead the conversation with the site supervisor in a way which ensured that they both understood the intended use of the hand trolley (paragraph 106);
- COSS B was not with his workgroup and some members of this group continued to work in this situation (paragraph 107);
- workers were using an unapproved route to access the flyover (paragraph 110); and
- neither the site safety system, nor non-technical skills training given to COSS B, prevented the workgroup becoming accustomed to unsafe working practices (paragraph 111).

COSS safety briefing and completion of SSoW paperwork

103 COSS B did not provide an effective briefing to his workgroup before allowing work to commence (paragraph 85). COSS B has stated that he had not always provided a full briefing on other occasions. The railway rule book¹¹ requires a COSS to provide a briefing to the workgroup, and obtain a signed acknowledgement from each member of the workgroup as confirmation they understand its content. This briefing includes details of how the track workers will be protected from rail traffic and must state which lines are open to traffic. COSS B has stated that, at the time of the incident, he did not appreciate the importance of effective briefings.

104 COSS B has stated that no member of the workgroup challenged the lack of a COSS briefing, but all members signed the RT9099 briefing acknowledgement form confirming that they had received a briefing.

105 COSS B did not add details of lines open to his SSoW pack when briefed by the engineering supervisor (paragraph 83). This is not considered a cause of the incident as COSS B has stated he was aware that the Up Airport line was open. However, both this and the absence of an effective briefing by the COSS are indicative of COSS B and the workgroup prioritising the commencement of work over compliance with the site safety system. Despite this, COSS B was aware that all aspects of paperwork should be completed and would normally ensure he had done so before returning the paperwork at the end of his shift.

¹¹ GE/RT8000 Handbook 7, General duties of a controller of site safety (COSS), section 5.

Safety critical communication

106 The railway rule book¹² requires effective communication between staff on matters that are critical to safety, and identifies who is responsible for leading such communication. Conversations between a COSS and track workers (including the site supervisor) must be led by the COSS in a way which ensures that there is a clear understanding between the people involved. On this occasion, COSS B and the site supervisor did not reach a clear understanding about the line on which the hand trolley was to be used and, as a result, it was placed on a line open to traffic.

Safe work boundary and control of workgroup

107 When work is to be undertaken within 3 metres of a line open to traffic, the railway rule book requires that the limit of safe working is protected either by an approved *safety barrier* or by a nominated member of staff, called a site warden. The purpose of the safety barrier or site warden, who does not take part in the work, is to ensure that members of the workgroup do not stray too close to the open line. It had not been possible to erect approved safety barrier fencing in all parts of the construction site so in these areas Carillion staff used temporary fencing. Temporary fencing had been erected in the location where the incident occurred and laminated signs had been attached to the fence stating that it was an 'adjacent line open site'. This was effectively an instruction to COSSs working in that area to appoint a site warden, using the fence only as a guide to the safe limit of work.

108 The railway rule book permits a person qualified both as a COSS and a site warden to undertake these duties at the same time provided that they do not take part in the work. Although the site safety system at Stockley Flyover did not permit this arrangement, and this was stated in his SSoW pack, COSS B did intend to act as site warden when he joined the group after completing his paperwork.

109 The railway rule book and the site safety system required that both a COSS¹³ and a site warden¹⁴ must be with their workgroup when the group is near a line open to traffic, a situation which applied to the Up Airport Relief line, on the 'safe' side of the temporary fencing. COSS B knew that the site supervisor and trackworker A were working in this area when the site supervisor asked him for permission to use the hand trolley. At this time the distance and vertical separation between COSS B and these staff was too great for him to act as COSS or site warden.

¹² GE/RT8000 Handbook 1, General duties and track safety for track workers, section 9.

¹³ GE/RT8000 Handbook 7, section 4.1 requires all COSSs to stay with their group and personally observe and advise everyone until either, the work is completed and the group is clear of the line, or they are replaced by another COSS.

¹⁴ GE/RT8000 Handbook 7, section 4.6 requires that a site warden is positioned so that the limits of the safe area and everyone in the group can clearly be seen and any warning given by the site warden will be heard by everyone in the group.

Site access

110 The site safety system required track workers to access the Stockley Flyover site using a temporary scaffold staircase provided to the south of the new flyover (figure 10). When using this access track workers reached an area where they were protected from the operational railway by an approved safety barrier. Witness evidence indicates that, while trains were running on the open Up Airport line, site staff were routinely gaining unofficial access to areas of work by walking up the ballast stockpile used by the site supervisor (paragraph 86). Track workers using this unapproved access would first reach a location next to the Up Airport line, an area where track workers were not permitted while this line was open.

Processes did not prevent deviations from the site safety system

- 111 The deviations from the site safety system described in paragraphs 103 to 110 were not detected by site safety management processes. Shortcomings in these processes are an underlying factor to the incidents on both 27 and 28 December, and are discussed further at paragraph 115.
- 112 Network Rail expects COSSs to fully comply with the requirements of the site safety system, even in circumstances where other staff are not fully compliant. Network Rail expects Non-Technical Skills (NTS) development training¹⁵ to provide COSSs with the attributes needed to achieve compliance. COSS B had attended some NTS development courses although he had not, and was not required to have, participated in Network Rail's most recent NTS development programme.
- 113 The organisation providing COSS B to Carillion (Resourcing Solutions Ltd) and COSS B's previous employer had assessed his NTS and considered them to be acceptable. Given the extent of non-compliant behaviour by other staff on the Stockley Flyover site (paragraphs 68 and 103 to 110), it is possible that COSS B deviated from the site safety system due to the human tendency for matching peer behaviour. Although Network Rail expects NTS training to prevent this happening, the RAIB does not consider this is something which can be reliably overcome by training alone. Site management processes are therefore needed to identify and correct such behaviour.

¹⁵ Network Rail describes non-technical skills as the cognitive (mental) and interpersonal skills needed for competent job performance and has introduced a programme to develop these skills and abilities necessary for individuals to improve safety and to help them effectively and proactively manage their work activities.

Underlying factors common to both incidents

- 114 Two underlying factors have been identified which are common to both incidents. These are:
- site safety supervision processes did not identify that deviation from the site safety system had become normal practice (paragraph 115); and
 - site management had not used available opportunities to mitigate risks associated with changes to railway protection arrangements (paragraph 128).

Site safety supervision

115 Site safety supervision processes did not identify that deviation from the site safety system had become normal practice.

- 116 Evidence that there were significant deviations from the site safety system is provided by:
- shortcomings in the engineering supervisor's control of access to his worksites (paragraphs 49 to 57);
 - continued use of the matrix sign-in sheet after it became inappropriate (paragraphs 60 to 63);
 - COSS A's actions (paragraphs 65, 66 and 68);
 - COSS B's actions (paragraphs 103 and 105 to 109);
 - the workgroups not challenging the absence of adequate COSS briefings (paragraphs 68 and 104); and
 - use of an unapproved access point to enter the railway (paragraph 110).

Network Rail's site safety audit process

- 117 The engineering supervisor was not acting in accordance with the established railway rule book worksite access control requirements (paragraphs 49 to 57 and paragraphs 60 to 63). He has also stated that, when controlling access to worksites before a telephone based sign-out procedure was introduced by the 6 December 2014 railway rule book change, he permitted COSSs to 'sign-out' by telephone instead of requiring they meet with him and sign the RT3199 worksite certificate in person. The night shift engineering supervisor and the possession delivery manager have also stated that they permitted COSSs to sign-out of worksites by telephone before the 6 December 2014 railway rule book change.
- 118 The RAIB has not been provided with evidence of any Network Rail process which would identify where a possession delivery team has deviated as a group, from the rule book requirements.
- 119 Network Rail standard NR/L2/OHS/019 requires that contractors should audit the safety systems applicable to their own staff and staff working for subcontractors. This includes implementing on-site assessment of COSSs and auditing of their paperwork and, where necessary, corrective action.

120 Carillion and Signalling Solutions were routinely undertaking on-site inspections throughout the Stockley Flyover site and paperwork audits relating to on-site activities which were not subcontracted to major suppliers. On-site paperwork relating to work by major suppliers, such as Signalling Solutions, was audited by the relevant supplier. The Network Rail standard required the paperwork audit to be undertaken on at least 20% of all issued SSoW packs. These paperwork audits would not identify any COSS who completed his paperwork late, but did so before returning it at the end of their shift.

Signalling Solutions site safety audits

- 121 Each SSoW pack produced by Signalling Solutions was normally given a unique identity number. This identity is recorded on a register together with the COSS it was issued to and whether it was returned for audit after the shift. Signalling Solutions audited a minimum 20% of SSoW packs returned by its COSSs, but stated that this audit process did not account for packs which were not returned. Signalling Solutions has stated that it was not always practical for COSSs to return their SSoW packs for audit at the end of their shift. Signalling Solutions stated that, although its register contained the information necessary to identify those COSSs who habitually failed to return SSoW packs, it did not have a process which used this information to then prompt corrective action.
- 122 COSS A had worked for Signalling Solutions on other sites before working at Stockley Flyover in December 2014, but the audit records were insufficient to determine whether any of his previous SSoW packs had been audited. The likelihood of these having been audited was reduced because COSS A has stated that he did not always return his packs for audit and this had not been challenged. Signalling Solutions' records are sufficient to show that, if audited, no significant shortcomings were found in COSS A's SSoW packs.
- 123 If Signalling Solutions' audit process had included 20% of all issued SSoW packs (as opposed to all returned packs), it is possible that shortcomings in COSS A's paperwork would have been identified and resolved before the incident on 27 December 2014.
- 124 Signalling Solutions did not comply with its normal procedure for numbering SSoW packs at the Stockley Flyover site during the Christmas period, considering this to be impractical. Instead, the SSoW packs were pre-printed without a unique identity and provided to COSSs as necessary. Signalling Solutions' managers issued a register on which installation supervisors were intended to record the names of staff issued with SSoW packs. Signalling Solutions has been unable to provide a copy of this register so it is uncertain whether it could have identified staff, including COSS A, who had returned packs, identified staff who had failed to return packs or established the number of packs requiring audit during this period.

Carillion site safety audits

125 Carillion did not track all of the SSoW packs issued, considering this to be impractical, but knowing the number of COSSs on site during each shift, was able to estimate that more than 70% of issued SSoW packs were returned by COSSs for audit. Carillion audited 100% of returned SSoW packs, thus meeting the minimum 20% requirement.

- 126 Carillion provided evidence that auditing returned SSoW packs had resulted in follow-up site inspections and corrective action. Examples of non-compliances found by these audits include incomplete RT3199 Record of Arrangements forms and incorrect entries by COSSs in respect of lines open and blocked to traffic. Carillion also provided audit records relating to documents returned by COSS B. These audits did not identify any issues requiring corrective action or a follow-up site inspection.
- 127 Carillion also undertook ad-hoc site inspections in addition to those identified as necessary by the paperwork audit. The number and the details of such ad-hoc site inspections were not recorded, so details of issues found, and corrective actions taken in response to these ad-hoc inspections, was not available. Carillion was unable to identify whether COSS B had been subject to this process or whether, prior to the incident on 28 December 2014, it had identified any occasions where COSS B had completed his paperwork late, but before the end of his shift.

Provision of site safety information

128 Carillion site management had not used available opportunities to mitigate risks associated with changes to railway protection arrangements.

- 129 Both incidents would almost certainly have been prevented if members of the workgroup who were not undertaking COSS duties had been aware of which lines were open. The communication of safe work limits, particularly which lines were open, was solely reliant on the correct transfer of information from the engineering supervisor to the COSS, and then from the COSS to the workgroup. In both incidents, this communication line was compromised.
- 130 It is common practice on large construction sites to disseminate important safety information using worksite signage to inform a large number of workers. At the Stockley Flyover site, scrolling signage was being used for this purpose. Carillion management had considered including information about which lines were open on the scrolling signs, but had discounted this on the basis that it would be impractical to ensure that the scrolling messages were always up-to-date. They were therefore concerned about the risk that the messages would conflict with correct information being briefed by the engineering supervisors. The RAIB has not carried out a full evaluation of this decision, but notes that similar information provision can provide valuable safety benefit on many large sites.

Summary of conclusions

Immediate cause of the track access irregularity on 27 December 2014

131 The engineering supervisor authorised the Down Airport line to be reopened while COSS A believed the line was still blocked to rail traffic (**paragraph 47**).

Causal factors relating to the track access irregularity

132 The causal factors were:

- a. The engineering supervisor did not, as required by the railway rule book, reach a clear understanding with COSSs about the status of the Down Airport worksite (**paragraph 49, Learning point 1, Recommendation 2**).
- b. The matrix system was being used to control track access after it became inappropriate (**paragraph 59, Recommendation 4**).
- c. COSS A did not query a mismatch between his SSoW paperwork and his understanding of lines open to traffic (**paragraph 64, Learning point 3**).

Immediate cause of the near miss and hand trolley struck by train on 28 December 2014

133 The site supervisor and trackworker A placed a trolley on the Up Airport line when unaware that it was open to traffic (**paragraph 96**).

Causal factors relating to the near miss and hand trolley struck by train

134 The causal factors were:

- a. The information provided to the site supervisor did not prevent him from deciding it was safe to move the temporary fencing separating him from a line open to traffic and place the hand trolley on the open line (**paragraph 98, Recommendation 3**).
- b. The workgroup and COSS B were routinely using railway safety and access arrangements which they knew were not compliant with the site safety system (**paragraph 101, Learning point 2, Recommendation 1**). This factor is demonstrated by:
 - COSS B did not always provide a safety briefing, and did not complete his SSoW pack, according to the site safety system (paragraph 103);
 - COSS B did not lead the conversation with the site supervisor in a way which ensured that they both understood the intended use of the hand trolley (paragraph 106);
 - COSS B was not with his workgroup and some members of this group continued to work in this situation (paragraph 107);

- workers were using an unapproved route to access the flyover (paragraph 110); and
- neither the site safety system, nor non-technical skills training given to COSS B, prevented the workgroup becoming accustomed to unsafe working practices (paragraph 111).

Underlying factors relating to both incidents

135 The underlying factors were:

- a. Site safety supervision processes did not identify that deviation from the site safety system had become normal practice (**paragraph 115, Recommendations 1 and 2**).
- b. Carillion site management had not used available opportunities to mitigate risks associated with changes to railway protection arrangements (**paragraph 128, Recommendation 3**).

Additional observations

136 Although not linked to the incidents on 27 and 28 December 2014, the RAIB observes that:

- a. The engineering supervisor and other possession delivery staff were unaware that the railway rule book requirements regarding management of worksites had changed on 6 December 2014 (**paragraph 69 Learning point 4**).
- b. The Signalling Solutions SSoW pack did not identify a safe access point at which staff could enter railway infrastructure, and contained excessive amounts of unnecessary information (**paragraph 73, Learning point 5**).

Previous RAIB recommendation relevant to this investigation

137 The following recommendation, which was made by the RAIB as a result of a previous investigation into an accident at Newark North Gate on 22 January 2014, ([RAIB report 01/2015](#)), is related to routine non-compliances with site safety systems, an issue identified in this investigation (paragraphs 64 and 101). The RAIB is making further recommendations relating to this issue for the reasons explained below:

Recommendation 1

Network Rail should:

- a) systematically brief and where appropriate rebrief its COSS/Safe Work Leaders that they must be on site at all times, even when working with experienced staff, and that they must provide a full site based safety briefing once the safe system of work has been verified by them as being appropriate for the conditions at the time of the work;*
- b) this sub-section is not relevant to the incidents at Heathrow Tunnel Junction;*
- c) actively monitor the degree to which work site discipline is being maintained, and take appropriate corrective action if any issues are found; and*
- d) investigate how best to maintain vigilance and safety discipline for cyclical and repetitive tasks and implement any practicable measures into its working procedures.*

138 Although the construction tasks undertaken by the track workers at Heathrow Tunnel Junction varied from day to day, and some of the track workers had limited railway related experience, the railway related safety precautions and (if given) the associated briefings would be similar on most days. While there is considerable overlap between the issues addressed in the above recommendation and the circumstances of the Heathrow Tunnel Junction incidents, the previous recommendation relates to the environment in which Network Rail staff normally work. Therefore the RAIB has made an additional recommendation (Recommendation 1) dealing with similar issues in the context of major construction sites.

139 The previous recommendation addresses issues associated with safe work leaders responsible for the safety of a workgroup (a role which incorporates the duties of a COSS). The Heathrow Tunnel Junction investigation has identified similar issues amongst staff controlling access to worksites and addresses these in Recommendation 2. The competency required for controlling worksite access was designated engineering supervisor, but is now part of the competence of some safe work leaders. This change is reflected in the wording of Recommendation 2.

140 The recommendation made following the accident at Newark North Gate was published on 16 February 2015 and the RAIB is awaiting the first response to it from the ORR.

Actions reported as already taken or in progress relevant to this report

- 141 Carillion has introduced a tier system for its COSSs, rating each COSS as Gold, Silver or Bronze based on competence and experience and rewarding COSSs as they progress with more challenging and preferred duties. This system encourages positive attitudes towards site safety culture as this is one of the criteria used to assess when a COSS can progress up the tiers.
- 142 Carillion has also launched a behavioural culture initiative intended to promote safe behaviours and to empower staff to challenge unsafe practices.

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

- 143 Signalling Solutions has revised its audit methodology so this includes action in respect of COSSs who do not return packs, and promotes effective follow up of shortcomings found by the audit process.
- 144 Signalling Solutions has also modified the method of issuing SSoW packs so that safe system of work planners are directly responsible for issuing, and recording the issue, of all SSoW packs. It expects this to provide a more reliable record of packs issued.

Learning points

145 The RAIB has identified the following key learning points¹⁶:

- 1 The safety incident on 27 December 2014 highlights the need for engineering supervisors to follow the requirements of the railway rule book Handbook 12 (GE/RT8000/HB12). In particular:
 - authority to start work should only be given after confirming that the COSS sign-in entries match the content of the engineering supervisor's briefing in accordance with Handbook 12, section 4.1 (paragraph 132a);
 - worksites should not be handed back in accordance with Handbook 12, section 10 until:
 - the engineering supervisor has received positive confirmation that all COSSs, IWAs and SWLs under their protection are clear of the line or are no longer relying on the worksite for protection (paragraph 132a); and
 - all safety related anomalies in the worksite paperwork have been satisfactorily resolved (paragraph 132a).
- 2 It is important that COSSs and SWLs complete their SSoW paperwork and provide a full safety briefing to their workgroup in accordance with railway rule book Handbook 7 section 5, and remain close to, and be able to observe, all work undertaken by the workgroup in accordance with section 6. This is essential to maintain the integrity of the SSoW needed to allow the group to work safely (paragraphs 68a and 134a).
- 3 COSSs, IWAs and SWLs should query and resolve any mismatch between their SSoW pack and their understanding of the status of the railway, for example whether lines are open or blocked, to reduce the possibility for misunderstandings or errors resulting in unsafe working (paragraph 132c).
- 4 Primary sponsors should ensure they have an effective means of:
 - verifying that railway rule book updates have been acknowledged; and
 - identifying and remedying those instances where acknowledgement by their staff is outstanding (paragraph 136a).

This is necessary to allow staff who are required to comply with the rule book to be up-to-date with its content.

continued

¹⁶ '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.

- 5 Organisations preparing SSoW packs should avoid excessive amounts of unnecessary information, reflect changes due to ongoing construction work and, where relevant, include temporary construction access points to provide COSSs, IWAs and SWLs with comprehensive, but concise SSoW pack information (paragraph 136b).

Recommendations

146 The following recommendations are made¹⁷:

- 1 *The intent of this recommendation is to achieve a more effective balance between audits of safety related paperwork and direct observation of on-site safety behaviour which would not be detected by a paperwork audit.*

Network Rail, liaising with Principal Contractors, should review management systems for monitoring railway safety arrangements on major construction sites not separated from the railway by a permanent barrier. The review should identify any improvements needed to ensure that, in addition to appropriate auditing of paperwork after completion of shifts, the management systems promote sufficient direct observation of on-site activities and workgroup questioning to give adequate confidence that mandated safe systems of work are being correctly implemented throughout each shift. Network Rail should then implement any improvements identified by the review (paragraphs 134a and 135a).

continued

¹⁷ 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 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 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 RAIB's website www.gov.uk/raib.

- 2 *The intent of this recommendation is to prevent non-conformance developing into normal practice within a possession management team. The wording acknowledges that Network Rail is currently implementing a process which will result in the engineering supervisor role being undertaken by a 'safe work leader'.*

Network Rail should review the monitoring arrangements applying to engineering supervisors/safe work leaders managing engineering worksites. The review should establish:

- any improvements needed to give adequate confidence that the monitoring arrangements can identify where the actions of an engineering supervisor/safe work leader are not in compliance with the railway rulebook (for example when ensuring staff and equipment are clear of the line and concluding that the railway is safe to return to traffic); and
- how those actions can be corrected before they become habitual.

Network Rail should then implement any improvements identified by the review (paragraphs 132a, 135a and 136a).

- 3 *The intent of this recommendation is to reduce risks associated with a COSS being the only route by which railway safety information is provided to their workgroup. It applies only on relatively large construction sites on which it is practicable to provide such information.*

Network Rail, liaising with Principal Contractors, should identify and provide a process for implementing, where practicable, improved arrangements for communicating safe working limits to all workers on large construction sites not separated from the railway by a permanent barrier. This communication, such as signage highlighting lines which have recently reopened, should increase the likelihood of staff recognising and then challenging the proposed safe system of work (paragraphs 134a and 135b).

- 4 *The intent of this recommendation is to consider possible solutions to the practical problems experienced by engineering supervisors when controlling access for numerous COSSs using multiple RT3199 forms. If practicable, an alternative method of control (possibly a matrix sign-in sheet operated within a robust process) should be introduced. The wording acknowledges that the engineering supervisor role will, in future, be undertaken by a safe work leader.*

Network Rail should review whether the use of multiple RT3199 forms should be replaced by an alternative, risk assessed, process for engineering supervisors/safe work leaders controlling worksites which comprise both multiple lines and activities undertaken by several workgroups. If justified by this review, Network Rail should introduce an appropriate alternative process (paragraph 132b).

Appendices

Appendix A - Glossary of abbreviations and acronyms

COSS	Controller of Site Safety
IWA	Individual Working Alone
NTS	Non-Technical Skills
PICOP	Person in Charge of Possession
RRAP	Road / Rail Access Point
RT3199	Engineering supervisor's standard form used to record worksite details
RT9099	COSS's standard form used to record safe system of work and workgroup acknowledgements
SSoW	Safe System of Work
SWL	Safe Work Leader

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.

Access point	A designated point along a railway at which entry to railway property may be made safely. Most are pedestrian only, often with steps to track level. The remainder are vehicular and range between those that are just simple gates to large levelled areas with level crossing surfaces permitting easy access for road rail machines (see Road Rail Access Point (RRAP)). The presence of an access point does not guarantee that access to the track itself is necessarily safe at that location.*
Ballast (track)	Crushed stone used to support the track.
Blocked (line)	A portion of a railway removed from the use of revenue traffic and given to the engineer to permit work to be carried out on or near the line.*
Bogie	An assembly of two wheelsets in a frame which is pivoted at the end of a long vehicle to enable the vehicle to go round curves.
Cess	The space alongside the line or lines.*
Continuous rail	A length of rail not broken or interrupted by the moving parts necessary to allow points to function.
Controller of Site Safety (COSS)	A person certified as competent and appointed to provide a safe system of work (SSoW) to enable activities to be carried out by a group of persons on Network Rail infrastructure in accordance with the requirements of the railway rule book.*
Down (line) (at this location)	A line on which the normal direction of travel is away from London.
Engineering supervisor	The person nominated to manage the safe execution of works within an engineering worksite. This includes arranging the marker boards, authorising movements of on-track plant, road-rail vehicles and trains into and out of the worksite and managing access to the site by Controllers of Site Safety (COSS).*
Emergency brake	The (abnormal) full application of all available braking effort, sometimes using a more direct and separate part of the control system to signal the requirement for a brake application than that used for the full service application.*
Handback	The process followed by an engineering supervisor for the removal of a worksite and declaration that the line is now safe to return to regular train services.
Hand trolley	A small platform with a rail wheel at each corner used to transport tools, equipment and materials along the railway for maintenance work.*

National Hazard Directory	A database maintained by Network Rail which contains details of the health, safety and environmental hazards known to exist on Network Rail controlled infrastructure.*
Open (line)	A line on which regular train services are operating.
Points	A section of track with moveable rails that can direct a train from one track to another.
Possession	A formal temporary closure of a line to trains for safety reasons or to allow engineering work to take place.*
Primary sponsor	An organisation responsible for managing the railway safety competences of staff.
Rail skate	A small trolley, with two double flanged wheels, which is designed to run along the rail head of one rail, used to assist in the transportation of heavy items of equipment along the track.
Retaining wall	A brick, concrete or masonry wall whose function is to hold back the side of an excavation or filled area.*
Road Rail Access Point (RRAP)	A level crossing style installation provided for the sole purpose of allowing road rail plant to access the track easily. Such facilities are normally closed off with a barrier when the line is open to trains.*
Safety barrier (approved)	Semi-permanent fencing constructed of materials approved by the infrastructure manager and positioned at least 1.25 metres (4 feet) from the nearest line open to rail traffic.
Safe Work Leader	Replacing the current Controller of Site Safety (COSS) competency, a Safe Work Leader will be accountable not only for planning and risk assessing tasks but also for the safe delivery of those tasks on site.*
Sentinel Scheme	The scheme for recording an individual's railway safety competencies and their primary sponsor. The scheme issues individuals with a Sentinel smart card to enable them to access and work on the Network Rail managed infrastructure.
Site warden	A person appointed by a Controller of Site Safety (COSS) to warn all staff to stay in a safe area, ie more than 2 metres for the nearest line open to movements.
Up (line) (at this location)	A line on which the normal direction of travel is towards London.
Worksite (engineering)	The area within a possession that is managed by an engineering supervisor. A worksite is delimited by marker boards when engineering trains are present. It may contain many workgroups, each controlled by a Controller of Site Safety (COSS).*

Appendix C - Investigation details

The RAIB used the following sources of evidence in this investigation:

- information provided by witnesses;
- Line closure documentation;
- Site safety system documentation;
- Network Rail standards;
- information taken from the train's on-train data recorder (OTDR);
- site photographs and measurements;
- weather reports and observations at the site; and
- a review of previous RAIB investigations that had relevance to this incident.

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