RAIB

Rail Accident Investigation Branch

Rail Accident Report

Dangerous occurrence involving track workers, near Roydon station, Essex 16 July 2012

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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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Summary

At approximately 13:43 hrs on Monday 16 July 2012, train 2H33, the 13:04 hrs service from Cambridge to London Liverpool Street was approaching a bridge just north of Roydon station, Essex, at a speed of 62 mph (100 km/h). As it did so, two track workers had to run from the bridge in order to avoid being struck by the train. The last of these track workers got clear of the railway line around two seconds before the train passed them.

At the time of the incident, these track workers were working on a line which was open to railway traffic. They were being protected by a system of work which relied on a lookout to provide warning of approaching trains. If established correctly, such a system should allow track workers to reach a position of safety at least 10 seconds before a train arrives.

This incident occurred because the group's lookout was not able to give the track workers on the bridge sufficiently early warning of the approach of train 2H33. This was because the controller of site safety (COSS) responsible for protecting the group from train movements had implemented a system of work which was inappropriate, given the nature of the task and the location in which it was being undertaken.

The system of work implemented by the COSS had been issued by a planner, who had selected it as an appropriate system based on his knowledge of the location and his previous experience of working on the track. It is possible that this incident could have been avoided had the planner sought approval for the system from a more senior person before it was issued, as is required by Network Rail's standards.

The inexperience of the COSS and the group in implementing this type of system of work was an underlying factor in the accident. The short time-frame in which the work was planned and the experience of the planner were also possible underlying factors.

As a result of the investigation, the RAIB has identified two key learning points. These concern the need to keep the late planning of work to a minimum and for persons undertaking the duties of a COSS to follow the requirements of Network Rail's standards when issued with a system of work on the same shift that a task is to be undertaken.

The RAIB has made two recommendations, both addressed to Network Rail. These relate to improving the way in which available sighting distances are assessed by persons undertaking the duties of a COSS or a planner. The RAIB has also restated a previous recommendation addressed to Network Rail which relates to the manner in which training and assessment can deliver practical competences.

Introduction

Preface

1 The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability.

2 Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

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

Key definitions

4 All dimensions in this report are given in metric units, except train speeds and locations which are given in imperial units in accordance with normal railway practice. Location mileage is measured from a zero datum at London Liverpool Street station, via Clapton. The distance in yards is also given when referring to *sighting distance* (in line with common railway practice).

5 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B.

Description of the incident

6 At approximately 13:43 hrs on Monday 16 July 2012, train 2H33, the 13:04 hrs service from Cambridge to London Liverpool Street, was approaching Roydon station, Essex (20 miles 9 chains) at a speed of 62 mph (100 km/h). As the train approached a small bridge just north of the station (which carries the railway over the river Stort) two track workers had to run from it to avoid being struck by the train (figure 1).

Figure 1: Forward facing CCTV image from train 2H33. The two track workers can be seen on the track and moving towards the south end of the bridge.

Background

The bridge

7 The incident occurred on the up line[1] between two of the three main girders on the 20 metre long bridge (figure 1). These girders protrude above rail level, close to both sides of each track. The clearance between the track and girders is insufficient to permit staff working on the bridge to stand in a *position of safety* when a train approaches. To reach a position of safety, staff must first move to one end of the bridge and then stand in the *cess*.

The rules that applied to work on a line that is open to traffic

8 A system of work that involves a group working *on or near a railway line* that remains open to traffic is known as *Red Zone* working[2]. Under Red Zone conditions, if there is no equipment provided to automatically warn of approaching trains, it is a requirement of railway rules that lookouts be appointed whose sole role is to look for approaching trains and provide a warning to enable the group to move to a position of safety.

9 Railway rules[3] state that when staff are working in a group on or near the line one of them must act as the *Controller of Site Safety* (COSS). The COSS must be trained and qualified by the railway industry to undertake the role. The COSS is responsible for setting up, managing and briefing a system of work to the group. The COSS may also take part in the work, provided this does not prevent them fulfilling their duties as COSS.

Planning arrangements for working on or near the line

10 In normal circumstances any work to be undertaken on or near the line will be subject to a plan which is known as the *safe system of work* (SSOW). This should state the arrangements that have been planned to enable staff undertaking work to be protected from the movement of trains, including how they are to be warned of their approach. The procedure for the planning, acceptance, verification and implementation of the SSOW is mandated by Network Rail standard NR/L2/OHS/019, Issue 8 'Safety of people working on or near the line'.

11 The SSOW is usually created in advance by a member of staff known as a *planner*. Within Network Rail's infrastructure maintenance organisation, planners use the computer-based *safe systems of work planning system* (SSOWPS) to create a SSOW. This system is also used within other parts of Network Rail.

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[1] At this location the 'up line' is the line normally used by trains travelling in the direction of London.

[2] Although this term was withdrawn from the Railway Rule Book in December 2010, it continues to be used within Network Rail's standards.

[3] Railway Rule Book GE/RT8000 (in particular, Handbook 7 'General duties of a controller of site safety (COSS)' Issue 2, June 2012).

12 NR/L2/OHS/019 requires planners to consider a number of factors when creating a SSOW including;

- the number of people involved and the nature, location, duration and urgency of the work;
- the tools and equipment to be used and any specific requirements, such as the need for daylight inspection;
- the availability of opportunities to block the line to traffic;
- the layout of railway lines and the number, frequency and type of train movements; and
- if it is considered necessary for the work to take place under Red Zone conditions, the length of *warning time* and the number of lookouts required.

13 NR/L2/OHS/019 requires planners to select a SSOW from the hierarchy of safe systems of work. Types of SSOW are listed in the hierarchy with those seen as offering higher levels of protection from moving trains placed towards the top. Planners must select the highest (ie the most protective) SSOW type that they can, given the factors listed above. A planner can only select a system from lower down the hierarchy (ie one which is less protective) after first considering the use of each of the higher types of SSOW.

14 A summary of the hierarchy is shown in table 1; this includes the equivalent terminology currently used in the personal track safety (PTS) handbook[4].

	NR/L2/OHS/019 Safe System of Work	**Equivalent term in the PTS handbook**	**Basic principle of operation**
1	Safeguarded *Green Zone*	Safeguarded	All lines within the site of work are blocked to train movements.
2	Fenced Green Zone	Fenced	A temporary fence separates the site of work and the nearest open line.
3	Separated Green Zone	Site warden warning	A space is provided between the site of work and the nearest open line. A site warden warns anyone moving too close to the open line.
4	Red Zone with warning given by Automatic Track Warning System (ATWS)	Equipment warning	The signalling system or lineside equipment automatically detects an approaching train and gives a warning via sirens, flashing lights and/ or personal warning devices.
5	Red Zone with warning given by Train Operated Warning System (TOWS)	Equipment warning	The signalling system automatically detects an approaching train and gives a warning via sirens.
6	Red Zone with warning given by Lookout Operated Warning System (LOWS)	Equipment warning	A lookout detects an approaching train and uses equipment to give a warning via sirens, flashing lights and/or personal warning devices.
7	Red Zone with warning given by one or more Lookouts or COSS/IWA working alone and looking out for him/herself.	Lookout warning	A lookout detects an approaching train and gives a warning by blowing a horn or whistle, by touch or by verbal message.

Table 1: The hierarchy of safe systems of work within NR/L2/OHS/019 Issue 8 and the equivalent terminology for these systems used within RT 3170 Issue 8.

[4] Network Rail, RT 3170, Issue 8 'A Guide to Personal Track Safety', December 2010.

15 NR/L2/OHS/019 states that the use of a higher type of SSOW would be disproportionate if its use would increase the resource-hours needed to undertake a task by more than 25%. This is because Network Rail considers that, after this point, the risks involved in staff spending more time on or near the line begin to outweigh the safety benefits of the higher level of protection.

16 To assist them in developing the SSOW, planners are required by NR/L2/OHS/019 to consult the *sectional appendix*, the *national hazard directory* and signalling diagrams. The standard states that, if the planner is unfamiliar with the location where the work is to take place, these documents can be supplemented by photographs, track diagrams or a site visit.

17 A guidance booklet issued to planners by Network Rail[5] states that if Red Zone working is to be undertaken then planners should develop their understanding of the sighting distance available by also referring to diagrams of the line, Network Rail's geospatial information (GI) Portal[6] or by checking with the manager who required the work to be undertaken (known as the *responsible manager*).

18 Once the SSOW has been created the planner will produce a set of documents for the COSS, known as the *safe system of work pack* (SSOW pack – also commonly known as a 'COSS pack'). This should include details of the work to be done, the planned SSOW and relevant extracts from the sectional appendix and the national hazard directory.

19 NR/L2/OHS/019 requires that all SSOW packs are then reviewed and accepted by the responsible manager before being passed to the relevant COSS. Responsible managers are not required to sign SSOW packs which they have accepted.

20 NR/L2/OHS/019 requires responsible managers to nominate a COSS and work group to undertake the work. They are expected to check that the nominated COSS is familiar with the location, type of work and arrangements for protection from the movement of trains. If they are not, then familiarisation should take place prior to commencing the work. NR/L2/OHS/019 states that the familiarisation of the COSS with the location can be achieved by consulting the relevant extracts from the national hazard directory and sectional appendix, by consulting documents such as photographs and signalling diagrams or by conducting a site visit.

21 The SSOW pack should be reviewed and verified by the nominated COSS at least a shift in advance of the work. They are required by NR/L2/OHS/019 to use their familiarity with the site to judge that the contents of the pack are accurate, appropriate and can be implemented as proposed. If this is not the case, then the SSOW pack should be rejected and returned to the planner for amendment.

22 A guidance booklet issued to COSS by Network Rail[7] to states that:

> *'You should never undertake the duties of…COSS unless you are site familiar with the location you are going to work at'.*

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[5] Network Rail 'Keypoints - SSOW Planner', October 2011, available from http://www.safety.networkrail.co.uk/Information-Centre/Training-Materials.

[6] The GI Portal was formerly known as MARLIN.

[7] Network Rail 'Keypoints – Controller of Site Safety, Individual Working Alone, Protection Controller', June 2012, available from http://www.safety.networkrail.co.uk/Information-Centre/Training-Materials.

23 The only exception to these requirements is for SSOW relating to *cyclic tasks* (ie tasks performed repeatedly to a frequency schedule specified in Network Rail standards). These are instead verified by the responsible manager, in conjunction with someone who is familiar with the area and who is either a COSS or and *individual working alone* (IWA). Once verified by the responsible manager, SSOW packs for cyclic tasks do not undergo further verification or acceptance for a period of 12 months.

24 In some circumstances the responsible manager may authorise the nominated COSS to review and verify a SSOW on the same shift as it is issued. Any SSOW packs authorised in this way should be signed by the responsible manager. NR/L2/OHS/019 requires that these 'same shift' authorisations be minimised and that occurrences be recorded for review by a more senior line manager.

25 Even after a COSS has verified a SSOW pack, they remain ultimately responsible for safety on site. This means that, should site conditions be judged incompatible with the previously verified SSOW, then the COSS can amend the system or suspend the work at their own discretion.

The staff involved

26 The work group and planner involved in the incident all worked for the same technical team, within Network Rail's Tottenham Maintenance Delivery Unit (MDU). This is part of Network Rail's Anglia route.

27 The group's COSS had undertaken railway industry approved training to act in the role of COSS and been assessed as competent to act in the role for about one year prior to the accident. The COSS was considered by local managers to be competent in the role, but had little experience of implementing Red Zone SSOW (paragraph 72). The COSS was in this case also responsible for the work being undertaken.

28 The lookout had been certified to act as lookout one month before the incident and had acted in the role on about eight occasions.

29 The third member of the group had one year of experience of working on the track on an occasional basis. He was not qualified to act as lookout or COSS.

30 The planner who prepared the SSOW pack for the work group did not undertake planning duties on a full-time basis. As the technical team had no planning resource of its own, any SSOW packs required were generally prepared by planners from track engineering sections. However, if they were not available for some reason, then the planner would prepare the packs instead.

31 The planner had undertaken training in the planning of safe systems of work a few months prior to the incident and still had probationary status as a planner. This meant that a sample of his plans was being reviewed by a more experienced planner, who was acting as a mentor. Although the planner was inexperienced in the planning of safe systems of work, he had around 10 years of railway experience and was an experienced COSS, who was familiar with the geographic area within which the technical team worked.

32 The planner occupied a more senior role within the technical team than the COSS. As part of this role, he would assist his line manager in identifying outstanding work tasks and in assigning resources to complete them. He would also undertake inspection tasks himself.

The incident

The planning of the work

33 On 16 July 2012 the work group was due to undertake measurements to enable calculation of the clearance between trains and a platform at Bishop's Stortford (known as 'structure gauging'). The SSOW for this task used a safeguarded *Green Zone*, which had been planned in advance.

34 On the morning of 16 July 2012, the planner identified that the group would also have time to undertake three additional structure gauging tasks in the same area, which were in backlog. One of these additional tasks was the structure gauging of the bridge just north of Roydon station. This required two track workers to take measurements to enable calculation of the clearance between trains and the main girders.

35 The planner decided that he would plan the SSOW to cover these additional tasks himself; witness evidence indicates that this was either because planners from the other sections were not available, or because he wanted to get the pack issued quickly. The planner produced a single SSOW pack to cover the additional tasks, which were at three different sites within a five mile length of track. The pack stated that work was to be undertaken at all three sites under a Red Zone SSOW, with warning given by a single lookout.

36 The SSOW pack produced by the planner was neither approved nor authorised for 'same shift' verification by the responsible manager before it was issued to the COSS.

37 According to witness evidence, the COSS received the SSOW pack around 15 minutes before leaving to travel to the first site of work. The COSS stated that they queried the use of a single SSOW pack to cover three separate sites with the planner. However, having been told that it would be sufficient, the COSS accepted the pack without signing it or undertaking further verification. The COSS does not appear to have taken into account that the responsible manager's signature authorising 'same shift' verification was missing from the pack.

On site

38 The structure gauging at Roydon was the last of the three additional tasks being undertaken by the group on 16 July 2012. Of the other two, one structure was found on site not to need gauging and the other had been successfully gauged using the Red Zone SSOW.

39 Witness evidence confirms that, before commencing the work at Roydon, the COSS briefed the other two members of the group on the system of work that was described in the SSOW pack. The COSS explained that gauging work was to take place on the up line (ie the line used by southbound trains) within the length of the bridge. If a train approached on the up line, the members of the group on the bridge were to be warned by the lookout and then move into a position of safety in the cess at the nearest end of the bridge.

40 According to witness evidence, the COSS confirmed that the group had understood the briefing, but did not ask the group to sign the briefing form included in the SSOW pack, as they had already done this at a previous site. The COSS walked with the lookout to the north side of the bridge where the lookout was instructed to stand in the cess near to the bridge's north end and to give a verbal warning to the rest of the group if any southbound trains approached on the up line. The COSS and lookout agreed that enough sighting distance was available from this position to provide the required warning time. The COSS did not test the system of work to ensure it was adequate before starting work.

41 The COSS returned to the south side of the bridge and, together with the other track worker, walked back onto the bridge in the *four foot* of the up line. As they approached the middle of the bridge, train 2H33 approached from the north (figure 2) and the lookout gave a verbal warning. The COSS and the other track worker acknowledged the warning from the lookout (as is required by the railway rule book) and began to walk towards the south end of the bridge and their position of safety clear of the running line.

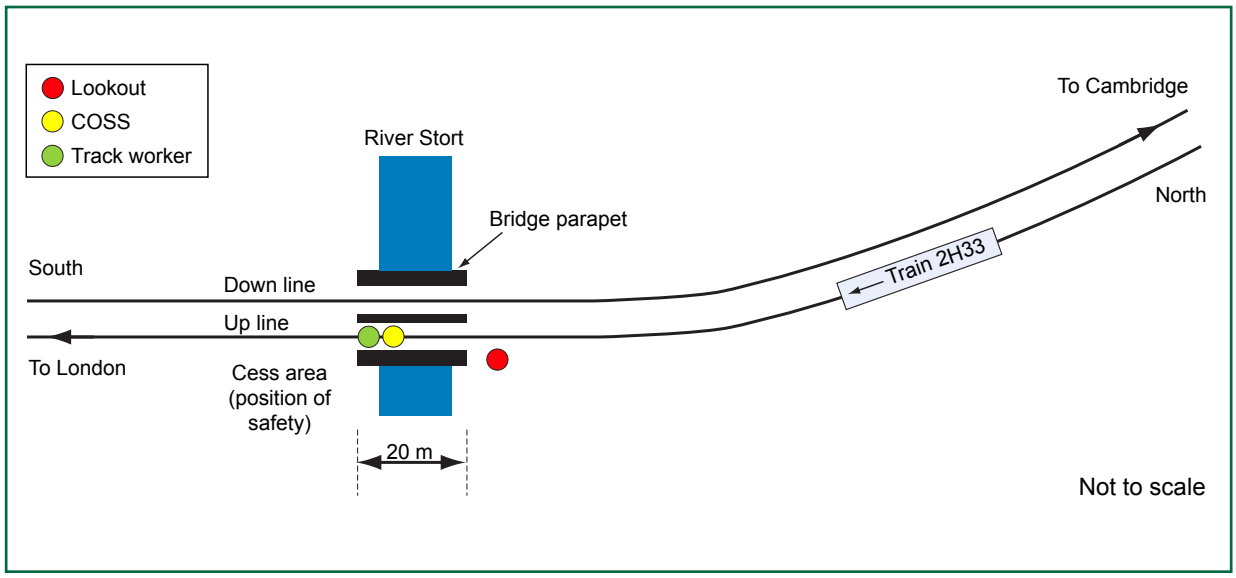

Figure 2: Plan of the bridge and the position of track workers as the train approached

42 At about the same time that the lookout warned the track workers on the bridge, the group came into the driver's view. At this moment the train was approximately 300 metres from them and travelling at 62 mph (100 km/h). Approximately 1 second later, the driver sounded a 5 second blast of the horn. At about the same time that the horn sound ceased, the driver applied the train's brake into step 2[8]. The train was then 155 metres from the north end of the bridge.

43 When the train was about 20 metres from the northern end of the bridge the driver made an emergency brake application. At about the same time, the COSS and the track worker started to run along the track for a few metres before reaching their position of safety. Around two seconds later, the front of the train passed by them.

44 Immediately following the incident the COSS recognised that an error had been made, withdrew the group and reported that a near-miss had occurred.

[8] The different positions on the driver's brake controller represent progressively greater brake demands from step 1 through to step 3, then emergency brake.

Identification of the immediate cause[9]

45 **The track workers were unable to reach a position of safety in sufficient time.**

46 The track workers were close to the middle of the bridge when train 2H33 approached the site of work at a speed of about 62 mph. It would have come into view of the lookout when about 350 metres from the site (paragraph 53). This meant that there was only 13 seconds available for the lookout to provide a warning and for the group on the bridge to walk about 11 to 12 metres to the position of safety. Consequently, the last member of the group on the bridge cleared the line only about two seconds before the arrival of the train.

Identification of causal factors[10]

Sighting distance

47 **The lookout was unable to give sufficiently early warning of an approaching train because the COSS had implemented a SSOW which was inappropriate for the nature of the work and the location. This was a causal factor.**

48 When there is only a single lookout appointed, then this person is required to remain with the group at a location where the view of approaching trains gives adequate warning time. The required warning time at this location should have been assessed by the COSS in accordance with the railway rule book[11]. Had this assessment been correctly carried out for a group with one lookout it would have indicated that 25 seconds warning time was needed. This would have been made up of:

a. 15 seconds to respond to the lookout and walk to the position of safety at the nearest end of the bridge:

Tests by the RAIB showed that between 11 and 12 seconds was required for these actions[12]. However, the chart in the railway rule book that is used for calculating sighting distance presents data in 5 second blocks and therefore an allowance of 15 seconds should have been used.

and

b. 10 seconds in the position of safety before the arrival of the train:

The railway rule book mandates that all persons should reach a position of safety at least 10 seconds before the arrival of the train.

[9] The condition, event or behaviour that directly resulted in the occurrence.

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

[11] Railway Rule Book GE/RT 8000 Handbook 7 'General duties of a controller of site safety (COSS)' Issue 2 dated June 2012.

[12] Handbook 7 requires that the warning time should include an allowance for stopping work and the time taken for everybody to reach a position of safety.

49 The maximum permitted speed for approaching trains at the site of work was 70 mph (although it changed from 80 mph about 200 metres before the north end of the bridge). According to the *sighting distance chart*, a speed of 70 mph and a required warning time of 25 seconds equates to a sighting distance of 800 metres (860 yards).

50 The COSS had been provided with an extract from the sectional appendix which showed the permitted speed of trains but had not noticed the change in permitted speed changed from 80 mph to 70 mph close to the site of work. For this reason the COSS made no allowance for the fact that the speed of trains when first sighted by the lookout could be higher than 70 mph.

51 The COSS estimated that the time required for the members of group on the bridge to move to the position of safety was 10 seconds. This meant that, in order for them to reach this position at least 10 seconds before the arrival of a train, they needed a total warning time of at least 20 seconds, equivalent to a sighting distance of 650 metres (700 yards) at 70 mph.

52 The COSS had been told in the past whilst working on track that *overhead line stanchions* were spaced at least 91 metres (100 yards) apart and so used these stanchions as a method of measuring the available sighting distance. Standing near the north end of the bridge, the lookout was able to see seven stanchions in the direction from which southbound trains would approach (figure 3). The COSS therefore assessed that the sighting distance was just sufficient for the site of work (ie 7 x 100 = 700 yards).

Figure 3: View from lookout's position (facing Up trains)

53 Normal stanchion spacing is in fact significantly less than 91 metres (100 yards) and is variable. The RAIB has confirmed that, although seven stanchions are indeed visible from the north end of the bridge, the lookout's actual sighting distance along the up line was only 350 metres (382 yards). Trains approaching this location at 70 mph would have covered the distance of 350 metres in about 11 seconds (ie 14 seconds less than the required warning time calculated by the RAIB).

54 Table 2 summarises the sighting distance required to enable a single lookout to provide sufficient warning for each of the cases presented above.

Warning time required (secs)	**Maximum train speed (mph)**	**Sighting distance needed for required warning time (metres)**	**Difference between sighting distance needed and that available (350 metres)**
20 (COSS assessment)	70	650	-300
25 (RAIB assessment)	70	800	-450
25 (RAIB assessment)	80	900	-550

Table 2: Summary of the required and actual sighting distances

55 Table 2 shows that the actual sighting distance at the site was inadequate for the conditions that applied.

56 Network Rail's training includes instruction for a COSS to estimate distance by various means eg mile posts, bridge locations etc. The training does not include the use of stanchion spacing as a means of assessing distance.

57 A site visit by the RAIB, and subsequent calculations, indicated that without the use of special equipment such as the *Lookout Operated Warning System* (LOWS), it would have been impossible to provide a sufficient warning time to a group working near the centre of the bridge using lookout protection. This is because, while using distant or intermediate lookouts would have extended the available sighting distance, it would also have required additional warning time to be provided to the group. The total warning time then required would exceed that provided by the extended sighting distance. This is not recorded in any of the supporting documents available to the planner or COSS (such as the national hazard directory).

58 The competency of the COSS and the other group members and their experience of implementing Red Zone SSOW is discussed further between paragraphs 71 and 75.

Verification of the SSOW

59 **The COSS did not verify and accept the planned SSOW and detect that it was inappropriate for the nature of the work and the location. This was a causal factor.**

60 The COSS was issued with the SSOW only shortly before leaving the office (paragraph 37). There is also witness evidence that the COSS was told to leave the office as soon as possible in order to avoid missing the pre-planned line blockage at Bishop's Stortford.

61 The RAIB considers that the time pressure that this created was probably why the COSS did not correctly verify and accept the SSOW pack. Had this been done the COSS may have seen that the responsible manager's signature authorising same shift verification was missing and/or recognised that the planned SSOW was inadequate. However, given that the COSS did not realise the inadequacy of the system when later implementing it on site (paragraph 72) it is probable that the COSS would not have rejected the SSOW pack, even had it been verified.

Planning of the SSOW

62 **The SSOW selected by the planner was inappropriate for the nature of the work and the location. This was a causal factor.**

63 The planner used only the sectional appendix and national hazard directory as source documentation when producing the SSOW pack. The planner did not check the curvature of the line and sighting distances by referring to track diagrams, the GI Portal, photographs or other appropriate references mentioned within NR/L2/OHS/019 and/or the relevant guidance.

64 This was because the planner reached the judgement, based on his understanding of the layout of the railway at Roydon and his previous experience of working on the track, that a Red Zone SSOW, with warning given by a single lookout would provide sufficient protection for the group. The selection of a Red Zone SSOW may also potentially have been influenced by the short notice with which the task was planned; this is discussed further between paragraphs 76 and 82.

65 Witness evidence shows that, although the planner felt that he had some idea of the track layout near to Roydon station, he was unclear about the nature of the structure that was to be measured by the group. Whilst he thought that it could possibly be a bridge, he was not aware either of its length or its configuration. This suggests that he was not sufficiently familiar with the nature of the work or the location to have effectively planned the SSOW.

66 Had the planner used documents other than the sectional appendix and national hazard directory to improve his familiarity with the site when planning the SSOW then he might have recognised that a single lookout could not provide the necessary warning for the group at this location.

The role of the responsible manager

67 **The SSOW pack was not sent for approval by a more senior person as required by Network Rail standards. This was possibly a causal factor.**

68 Network Rail standard NR/L2/OHS/019 requires that the SSOW pack for this inspection be approved by the responsible manager (see paragraph 19). The standard only allows a COSS to verify a SSOW pack on the same shift that the work is to take place if the responsible manager authorises it (see paragraph 23).

69 Neither the approval nor the authorisation took place. There is witness evidence that, although the planner was aware of the requirement for there to be a same shift authorisation, on this occasion he forgot to obtain it before issuing the pack to the COSS.

70 Had either the required approval or authorisation been undertaken by the responsible manager then it is possible that he would have raised concerns about the planned method of work. However, since this would have depended upon the manager's local knowledge, it is not certain that the inadequacy of the proposed system of work would have been recognised.

Identification of underlying factors[13]

Competency of the COSS and the other group members

71 **The COSS and the other group members did not have the necessary experience of implementing Red Zone SSOW to recognise that the planned system of work could not be undertaken safely. This was an underlying factor.**

72 The COSS had qualified to undertake the role a year before the near-miss and had acted as COSS on a regular basis during that period. However, on most of these occasions the COSS had been working on lines that were blocked to traffic (usually at night) and there had been no requirement to appoint a lookout or to estimate the required sighting distance. The COSS therefore had little experience of implementing Red Zone SSOW. It is possible that this was a factor in the over-estimation of the sighting distance and the non-recognition of the inadequacy of the system of work that had been planned for the group. This general inexperience was exacerbated by the fact that the COSS was not familiar with the location (the COSS could only recall working in this area on one previous occasion).

73 Had the SSOW been recognised as inadequate, the COSS should then have arranged to implement a more appropriate SSOW or abandoned the structure gauging. Although opportunities for line blockages were limited at Roydon at the time of the incident[14], it may have been possible for the COSS to have arranged one or two short blockages directly with the signaller that would have allowed the structure gauging to have taken place within a Green Zone SSOW.

[13] Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

[14] The up line is used by up to eight passenger and one freight train per hour during weekday off-peak hours. Network Rail's '*Green Zone Guide*' indicates that there is only a limited opportunity for short term work activities between trains.

74 The COSS did not test the SSOW before starting work (paragraph 40) as is required by the railway rule book[15]. Witness evidence suggests that this was probably because the COSS was satisfied that it was adequate and had received confirmation from other members of the group during the briefing that they were happy to use the system proposed. It may also have been because the same SSOW had already been used successfully earlier in the day for a similar task.

75 Although Network Rail encourages staff to challenge potentially unsafe arrangements, the briefing given by the COSS was accepted by the other members of the work group without being challenged. This was probably because they were themselves inexperienced at judging distances and had also been told in the past that overhead line stanchions were spaced at least 91 metres (100 yards) apart. It may also have been because they had insufficient familiarity with the location to recognise that the sighting distance was inadequate.

The decision to undertake the additional tasks at short notice

76 **The decision to undertake the additional tasks was made at short notice and so placed the COSS and planner under time pressure; it may also have influenced the type of SSOW selected for the additional tasks. This was possibly an underlying factor.**

77 The planner decided to undertake the additional tasks on the morning of 16 July 2012, in order to help clear a backlog of structure gauging (paragraph 34). However, before the COSS could leave the office, it was necessary for the planner to prepare a SSOW pack(s) for these tasks. There was also a need for the COSS to depart in sufficient time to avoid missing a pre-planned line blockage (paragraph 60). This time pressure probably affected the behaviour of the COSS with respect to the verification and acceptance of the SSOW pack (paragraph 61).

78 Although the planner has stated that he did not feel subject to time pressure when planning the SSOW, the RAIB considers that he would have been well aware of the need for the SSOW pack to be issued quickly and that this is probably why he issued the COSS with a single Red Zone SSOW pack to cover multiple sites (paragraphs 35 and 97).

79 It is probably the case that the planner would have found most of the higher types of SSOW to have been disproportionate, given the nature of the structure gauging task (paragraph 15); the group, in any case, did not hold the correct competences to use warning equipment such as TOWS or LOWS. However, it is possible that a safeguarded Green Zone SSOW would have been a proportionate alternative SSOW and its use would have prevented the incident from occurring.

80 The use of a safeguarded Green Zone under normal circumstances requires planners to make a request for a line blockage via the electronic *Green Zone Access Management* (GZAM) system; this is available to planners via SSOWPS. Within Network Rail's Anglia route, requests for line blockages via SSOWPS must be made no later than 11:45 hrs on the day before the work is due to take place.

[15] Railway Rule Book GE/RT 8000 Handbook 7 'General duties of a controller of site safety (COSS)' Issue 2 dated June 2012.

81 Although requests by planners for line blockages can be made directly with the signaller or with Network Rail control later than this deadline, NR/L2/OHS/019 states that this can only be done in *exceptional circumstances*. As the additional tasks did not fall within this definition, the planner would have been too late to request the line blockage necessary to establish safeguarded Green Zone SSOW for the additional tasks[16].

82 There is no evidence that the planner considered using a higher type of SSOW from the hierarchy of safe systems of work for the additional tasks (paragraph 64). However, the RAIB considers that the selection of a Red Zone SSOW by the planner was potentially influenced by there not being an alternative higher SSOW type available. This would have left him with the choice of either using a Red Zone SSOW or not undertaking the additional tasks, which were in backlog.

The planner's competence to plan SSOW

83 **The planner held only probationary status in the role and lacked experience in the planning of SSOW. This may have affected the way in which the SSOW pack for the additional tasks was planned and issued. This was possibly an underlying factor.**

84 The way in which the SSOW pack for the additional tasks was planned and issued did not comply with relevant Network Rail standards and guidance. The planner was not sufficiently familiar with the site to effectively plan the SSOW (paragraph 65) and forgot to send the SSOW pack to the responsible manager before issuing it to the COSS (paragraph 69). There is also no evidence that he considered the hierarchy of safe systems of work when selecting the type of SSOW to be used (paragraph 64).

85 The RAIB considers that the planner's probationary status and inexperience in the planning of SSOW were possibly why these non-compliances occurred.

Observations[17]

Use of a single SSOW pack to cover three sites of work

86 Although the SSOW pack applied to three sites, it contained only one form for the COSS to calculate and record sighting distance and warning times (RT9909, 'Record of site safety and site arrangements and briefing form'). This information differed at the three sites and the COSS could not record information relating to Roydon because the relevant section of the form had already been filled in at one of the previous sites.

[16] Whilst line blockages should be pre-planned whenever possible, none of these requirements would prevent a COSS from requesting a line blockage from the signaller once at site, although there is no guarantee that the signaller will grant such a request.

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

87 There is no evidence that this affected the manner in which the COSS implemented the SSOW at Roydon. However, during the RAIB's investigation into an accident which took place in March 2010 at Cheshunt Junction (RAIB report 06/2011[18]), Network Rail stated that Tottenham depot (now Tottenham MDU) had issued an instruction that a separate form was to be issued for each location at which a group is to work. This instruction does not appear to have been observed by the planner.

The extent of engineering work on lines open to traffic

88 Over the last 10 years Network Rail has been working to reduce the extent of Red Zone working. Its business processes are designed to encourage staff to actively consider other ways of protecting track workers (such as temporary blockages of the line) and to limit the selection of Red Zone working to those cases where there is no practical alternative.

89 In 2002 a report commissioned by the railway industry estimated that 65% of all track work was carried out under Red Zone conditions. More recent data collected by Network Rail indicates that this proportion had dropped to about 25% by the end of 2012 (see figure 4).

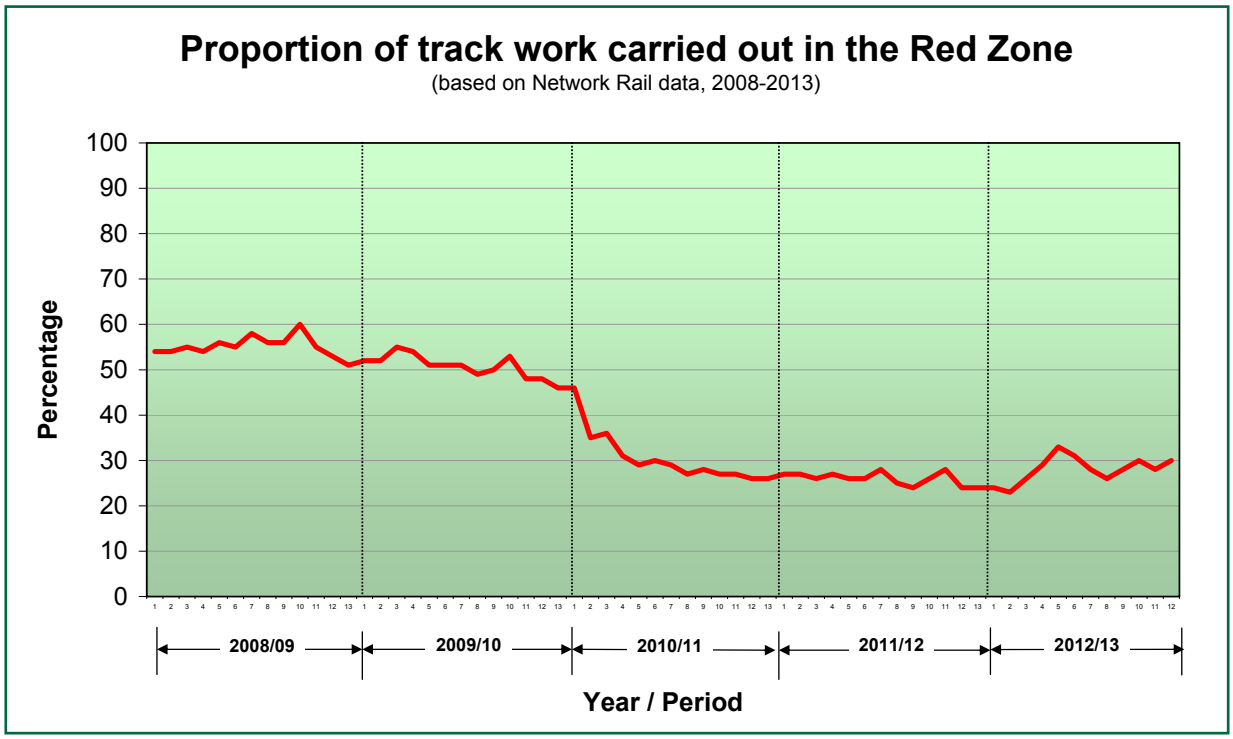

Figure 4: Network Rail data on the extent of Red Zone working (April 2008 to March 2013)

[18] RAIB reports are available at www.raib.gov.uk.

90 The Office of Rail Regulation (ORR) is still pressing for a continued reduction in the extent of 'Red Zone Working'. In its requirements for Network Rail's Strategic Business Plan for 2014-19, ORR stated:

> *"The use of red zone working – where track workers either inspect or undertake work on the line whilst train operations continue - is one of the greatest safety risks to track workers. This is in line with the workforce's increased exposure to the railway environment and the hazardous nature of the work carried out in the railway industry. We believe that more could be done to reduce the associated risks further without importing additional cost to the railways through deployment of alternative ways of working, and/or adoption of available or new technology. Reducing red zone working should also increase efficiency, requiring fewer staff for lookout duties for example".*

91 Network Rail has since published its Strategic Business Plan for 2014-19. This includes a commitment to deliver investments which will improve safety at engineering worksites using both Green Zone and Red Zone SSOW.

Summary of conclusions

Immediate cause

92 The track workers were unable to reach a position of safety in sufficient time (**paragraph 45**).

Causal factors

93 The following causal factors were identified:

a. The lookout was unable to give sufficiently early warning of an approaching train because the COSS had implemented a SSOW which was inappropriate for the nature of the work and the location (**paragraph 47, Recommendation 1**);

b. The COSS did not detect that the planned SSOW was inappropriate for the nature of the work and the location (**paragraph 59, Learning point 2**); and

c. The SSOW selected by the planner was inappropriate for the nature of the work and the location (**paragraph 62, Recommendation 2**).

94 It is possible that the following factor was also causal:

a. The SSOW pack was not sent for approval by a more senior person as required by Network Rail standards (**paragraph 67, Learning point 2**).

Underlying factors

95 The following underlying factors were identified:

a. The COSS and the other group members did not have sufficient experience of implementing Red Zone SSOW to recognise that the planned system of work could not be undertaken safely (**paragraph 71, Recommendation 4 of RAIB report 03/2012 (paragraph 111)**).

96 It is possible that the following factors were also underlying:

a. The decision to undertake the additional tasks was made at short notice and so placed the COSS and planner under time pressure; it may also have influenced the type of SSOW selected (**paragraph 76, Learning point 1**).

b. The planner held only probationary status in the role and lacked experience in the planning of SSOW. This may have affected the way in which the SSOW pack for the additional tasks was planned and issued (**paragraph 83, no recommendation**).

Observations

97 Although the SSOW pack issued to the staff applied to three sites, it contained only one form (Network Rail RT9909, 'Record of site safety and site arrangements and briefing form') for the COSS to calculate and record sighting distance and warning times (**paragraph 86, no recommendation (paragraph 114)**).

Previous RAIB recommendations relevant to this investigation

98 The RAIB has previously made recommendations that are directly relevant to a number of the issues identified in this investigation:

- COSS familiarity with the location ('Collision between a passenger train and two rail-mounted grinding machines at Acton West'; RAIB report 15/2009);
- the selection of staff to undertake safety leadership roles ('Passenger train struck by object at Washwood Heath; RAIB report 01/2011); and
- the competency of track maintenance staff ('Two incidents involving track workers between Clapham Junction and Earlsfield'; RAIB report 03/2012).

Details of the recommendations, and the actions taken in response, are given below.

Acton West (RAIB report 15/2009)

99 Recommendation 1 of this report is:

Network Rail should:

a. re-brief the requirements (now in standard NR/L2/OHS/019) for the COSS pack to be prepared and checked by individuals who have geographical knowledge of the relevant area and for COSSs to have geographical knowledge of the area in which they are to work;

b. take steps to achieve compliance with the requirements defined in 1a; and

c. conduct a compliance audit after a suitable period of time to confirm that these requirements defined in 1a are being implemented satisfactorily.

100 The ORR reported to the RAIB that, in response to this recommendation, Network Rail had re-briefed the requirement for the COSS to have sufficient geographical knowledge to verify the adequacy of the SSOW pack, and then to implement it in a safe manner. This was recorded in a national briefing document and distributed to all parts of the industry including contractors and training organisations. Compliance to standard NR/L2/OHS/019 had also been included within audits of Infrastructure Maintenance Delivery Units and Infrastructure Projects Programmes.

101 Based on these responses, the ORR considered in June 2010 that this recommendation had been implemented.

102 The national briefing document referred by the ORR's is Infrastructure Group Safety Bulletin IGS 217 'Local Knowledge and Safe Systems of Work'[19]. This states that

'1. If you plan or check safe systems of work for people working on or near the line you must have access to and use relevant sources of local knowledge required to plan or check the safe system of work.

2. If you are a COSS/IWA you must satisfy yourself that you have access to and use relevant sources of local knowledge required to implement your safe system of work and ultimately keep you and your group safe'.

[19] Network Rail Infrastructure Group Safety Bulletin IGS 217 '*Local Knowledge and Safe Systems of Work', 2009.*

Washwood Heath (RAIB report 01/2011)

103 Recommendation 3 of this report reads as follows:

Network Rail should extend the work it is undertaking to improve the methods and criteria used when selecting staff to undertake safety leadership roles to include consideration of the training and assessment of those staff who are already qualified in those roles.

104 The ORR reported to the RAIB that, in response to this recommendation, Network Rail introduced in December 2010 an element of pre-selection against a range of behavioural markers into its training course for new COSS. This assessment against behavioural markers had been extended from June 2011 to cover the recertification of existing COSS.

105 For existing holders of COSS competence undertaking external recertification the behavioural assessment takes place at the end of the recertification course. Existing COSS who are members of Network Rail staff are recertified using the internal Assessment in The Line (AiTL) process within which the knowledge test has been changed to include range of behavioural based questions. The responses to these questions form part of a line manager's assessment of competence of staff, in addition to evidence from observations in the workplace.

106 Network Rail also designed a training course entitled 'Managing Site Safety', aimed at front line supervisors and team leaders who have a role to play in leading safety behaviours. The course is intended to help individuals understand the role they have in developing and leading a safety culture within Network Rail and is now mandatory for all staff involved in leading site safety. The first course took place in May 2011.

107 Based on these responses, the ORR considered in November 2012 that this recommendation had been implemented.

108 Network Rail reported that by the end of November 2012, 2,647 staff had attended and passed the 'Managing Site Safety' course, with around one thousand staff still needing to attend.

109 Network Rail has additionally reported during the Bulwell investigation that all existing holders of a COSS competence working for either Network Rail or their principal contractors will be required to undertake a 'Non-technical Skills' (NTS) development day by June 2015. This is intended to develop the thinking and interpersonal skills needed to undertake the COSS role.

110 The day includes an assessment, the results of which will be used to create a development plan for each COSS attending. The development day may identify that a particular individual is not currently suitable to hold the COSS competence; in this case the COSS competence will be removed from them pending further development and training.

Clapham & Earlsfield (RAIB report 03/2012)

111 Recommendation 4 of this report reads as follows:

Network Rail should review the adequacy of training and assessment of track maintenance staff to deliver practical competence, particularly in skills or situations which are encountered infrequently. Where necessary, improvements should be made to enhance current processes. Consideration should be given to:

a. the extent to which it is appropriate to have detailed and complex rules for responding to infrequently-encountered situations;

b. methods of providing experience in situations which an individual may encounter infrequently;

c. identifying methods of assessment for situations which it is unlikely a line manager would normally be able to observe;

d. reassessing safety-critical competences when there are significant changes in an individual's work pattern, eg changing from day patrolling to planned maintenance work on permanent night shifts; and

e. reinforcing the need for regular face-to-face reviews of staff performance and competence by line managers.

112 The ORR has still to report to the RAIB the actions taken, or proposed, in response to this recommendation. However, it is understood that Network Rail is undertaking a review of its competence management system. The RAIB awaits the outcome of this review.

Learning points[20]

113 The RAIB has identified the following key learning points.

1. NR/L2/OHS/019 requires that authorisations for the 'same shift' issue of SSOW packs are kept to a minimum. Planning SSOW in advance of the shift allows the pre-planning of line blockages and provides more opportunity to allocate the work to staff that are familiar with the location, task and form of protection. Advance planning also gives more time for those involved in the planning, approval and verification of the pack to ensure that it is accurate, appropriate and can be implemented with the available resources.

2. When a SSOW pack is issued on the same shift that work is due to start, it is important that the COSS receiving the pack checks that it has been authorised for a 'same shift' verification by the responsible manager, and then undertakes verification and acceptance of the pack, as required by NR/L2/OHS/019.

[20] '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.

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

114 Network Rail introduced a new version of SSOWPS into service, known as SSOWPS 2, in October 2012. This includes new features that are directly relevant to a number of the issues identified in this investigation, including:

- SSOW packs can now cover multiple SSOW. This allows separate and, if necessary different, SSOW types to be planned and documented for separate activities (such as walking to a site of work and working). It will also accommodate 'parallel' SSOW for the same activity, if alternative systems could potentially be adopted by the COSS/IWA depending on the conditions at site.
- a modified RT9909 form is produced as part of the SSOW pack. This allows COSS/IWA to calculate multiple warning times and sight distances within a single form.
- there is an automatic interface with the sectional appendix and hazard directory, which will insert targeted extracts of both into the SSOW pack.

Recommendations

115 The following recommendations are made[21]:

1 *The intent of this recommendation is to improve the means by which controllers of site safety assess both the required and available sighting distance at sites of work.*

Network Rail should review, and then improve as appropriate, the methods by which controllers of site safety assess both the required and the available sighting distance when at sites of work. The review should include:

- the accuracy, availability and presentation of information concerning the available sighting distances at sites of work (particularly in those areas where sighting is limited, or too short to permit a sufficient warning from one or more lookouts);
- identification of recommended methods of assessing sighting distance when on site (including the use of special equipment); and
- the adequacy of existing training and assessments of competence related to the assessment of sighting.

(paragraph 93a)

continued

[21] 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 Regulation 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.raib.gov.uk.

2 *The intent of this recommendation is to improve the planning of work on lines that are still open to traffic ('Red Zone working') such that the controller of site safety is provided with an adequate safe system of work pack.*

Network Rail should review, and then improve as appropriate, the methods by which planners assess the suitability of 'Red Zone working' when selecting an appropriate safe system of work. The review should include:

- the availability and presentation of information on sighting distances and warning times;
- an assessment of when and how the available information is generally used by planners and any barriers to its use;
- the means by which planners establish locations at which multiple lookouts or special equipment are needed in order to provide sufficient warning; and
- the means by which planners are informed of locations at which it is impossible for lookout(s) to provide sufficient warning without the use of special equipment.

(paragraph 93c)

Appendices

Appendix A - Glossary of abbreviations and acronyms

COSS	Controller Of Site Safety
GZAM	Green Zone Access Management
IWA	Individual Working Alone
LOWS	Lookout Operated Warning System
ORR	Office of Rail Regulation
RAIB	Rail Accident Investigation Branch
SSOW	Safe System Of Work
SSOWPS	Safe Systems Of Work Planning System
TOWS	Train Operated Warning System

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.

Cess	The area alongside the railway.
Controller of site safety (COSS)	A person certified as competent to provide a safe system of work for activities being carried out by a group of persons on Network Rail railway infrastructure.
Cyclic task	An inspection or maintenance task performed repeatedly to a frequency schedule which is specified in Network Rail's standards.
Exceptional circumstances	For the purposes of planning and implementing a safe system of work, this is defined as any circumstance when there is a need to undertake work to avoid or reduce risks to people, or significant disruption to train services, which could not foreseeably have been planned in advance by the designated planner.
Four foot	The area between the two running rails.*
Green zone	A site of work on or near the line within which there are no train movements or where a safe distance from the line can be maintained.
Green zone access management (GZAM)	A Network Rail system which is used to book line blockages.
Green zone guide	A Network Rail publication made available to all who need to plan or undertake work on their infrastructure. The guide details • when it is likely to be possible to block one or more lines without disrupting train services; • arrangements for 'booking' blockages of line(s); and • the circumstances when requests to block lines will not be granted.
Individual Working Alone (IWA)	A person certified as competent to implement a safe system of work for their own protection on Network Rail controlled infrastructure.
Lookout operated warning system (LOWS)	Approaching trains are detected by a lookout who triggers a warning system of flashing lights and sirens and/or personal warning devices.
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.

On or near a railway line	Someone is on or near the line if they are on the railway line itself or if they are within 3 metres of a railway line and not separated from it by a permanent fence or structure.
Overhead line	An assembly of metal conductor wires, insulating devices and support structures used to bring a traction supply current to suitably equipped traction units.* Also known as overhead line equipment (OLE).
Planner	A competent person planning safe systems of work with suitable and sufficient knowledge and experience to discharge this responsibility in a competent manner.
Position of safety	If the maximum permitted linespeed is 100 mph or less, a position of safety is defined within GE/RT 8000 Module G1, Issue 4 as being at least 1.25 metres from the nearest line on which a train can approach.
Red zone	A site of work on or near the line, which is not protected from train movements.
Responsible manager	The person responsible for the management of staff who working on or near the line. This would typically be their line manager or an on call manager
Safe system of work (SSOW)	Arrangements to make sure a workgroup, including lookouts, that is to walk or work on or near the line is not put in danger by passing trains or movements.
Safe system of work pack (SSOW Pack)	A pack of information used by a COSS that provides details of the site of work, the work to be done and the planned safe system of work. May also be known as a COSS pack.
Safe system of work planning system (SSOWPS)	A standardised Network Rail computer system used for planning safe systems of work and which generates the documents used to create the Safe System of Work Pack.
Sectional appendix	The publications produced by Network Rail containing layout and location details for running lines, stations, tunnels, level crossings and other technical information. Location information is given in miles and chains.
Sighting distance	The distance at which trains must be seen in order to give adequate warning time.
Sighting distance chart	A chart contained within certain handbooks of the railway rule book which allows the calculation of the required sighting distance for a safe system of work, based on the maximum permitted speed of trains and the required warning time.
Stanchion	The vertical part of an overhead line structure.*

Warning time	The amount of time needed to ensure everyone is in a position of safety at least 10 seconds before the arrival of an approaching train.

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