



Rail Accident Investigation Branch

Rail Accident Report



**Track worker struck by a train at Bulwell,
Nottingham
6 August 2012**

Report 20/2013
October 2013

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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Track worker struck by a train at Bulwell, Nottingham, 6 August 2012

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Summary

At 09:31 hrs on 6 August 2012, train 2W06, the 09:25 hrs service from Nottingham to Worksop, struck and seriously injured an off-track inspector on the up-down Mansfield line near to Bulwell station, in Nottingham. At the time of the accident, the off-track inspector was undertaking an inspection of lineside vegetation on foot.

The off-track inspector was struck by the train because he was standing too close to the track. His awareness of where he was standing had become reduced as he was focused on determining his location. It may also have become reduced because he needed to concentrate on some elements of the inspection.

Because the off-track inspector was working on a line open to railway traffic, he had implemented a pre-planned system of work to protect himself from train movements. However, this system of work was unsuitable for the location and task being undertaken. Had the most appropriate type of system of work been planned and implemented, then the accident would have been avoided. The off-track inspector did not realise that the system he was using was unsuitable during the inspection, probably due to the way in which it was implemented. He had also not realised it was unsuitable when the system was issued to him prior to the inspection; this was because the information provided to help him check that it was appropriate did not effectively highlight why it was unsuitable.

This system of work was issued to the off-track inspector because the planner who had prepared it was unfamiliar with the location. Information provided to support her decisions about which type of system to use either did not effectively highlight its unsuitability or was found by her to be impracticable to use given her workload.

In addition, it had become normal practice within the off-track section to plan and implement the least protective type of system of work for undertaking vegetation inspections. This was, in part, because the section only had a limited range of systems to choose from, but probably also because there was an informal agreement within the section to adopt this practice, which contravened the requirements of Network Rail's standards. Senior managers were unaware that this had occurred as they were provided with inaccurate safety monitoring data. The increased workload of planners within off-track sections was also identified as a factor in the accident.

The RAIB has identified two key learning points. These are: that the relevant Network Rail standard should be observed during the planning, approval and verification of systems of work; and that any incident where a train has struck something whilst passing persons working on or near the line should be initially treated as an accident.

The RAIB has also made five recommendations addressed to Network Rail. These relate to: the provision of information to staff about which systems of work have been found to be appropriate for given locations; the monitoring of which system of work types are being used; the resources available within off-track sections to plan and approve systems of work; how previous measures taken by Network Rail to improve the management of systems of work were implemented; and the provision of information to staff regarding the required warning times when working alone.

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 and speeds in this report are given in metric units except speed and locations which are given in imperial units, in accordance with normal railway practice. Where appropriate the equivalent metric value is also given. Location mileages given are measured from a zero datum at St. Pancras station, via Corby.
- 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.
- 6 Directions and locations are described in the report as they would appear for a train travelling from Nottingham in the direction of Worksop. Times given for events occurring on 6 August 2012 have been synchronised to match the time coding of the platform CCTV system at Bulwell tram stop.

The accident

Summary of the accident

- 7 At 09:31 hrs on Monday 6 August 2012, train reporting number 2W06, the 09:25 hrs service from Nottingham to Worksop, struck a track worker on the up-down Mansfield line near to Bulwell station in Nottingham (figure 1).

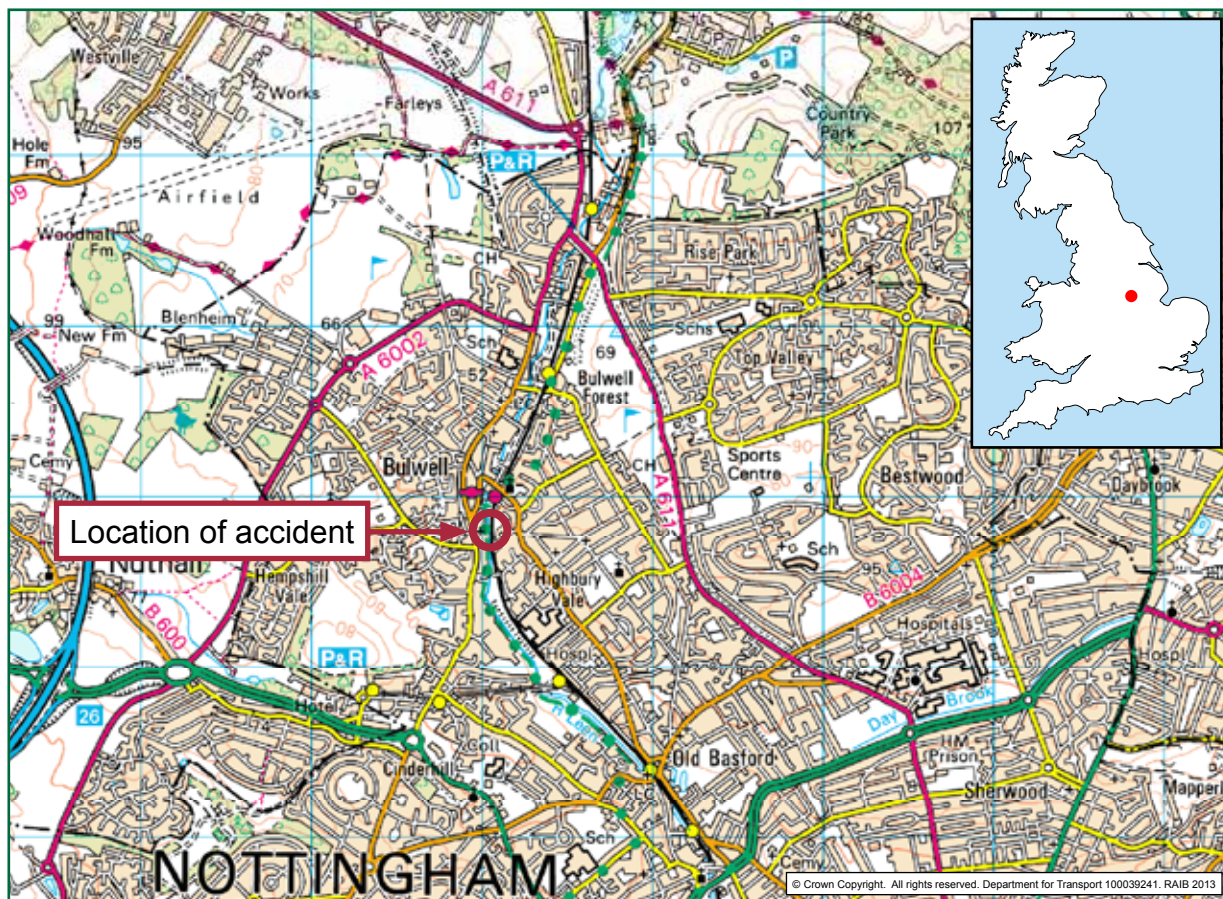


Figure 1: Extract from Ordnance Survey map showing location of accident

- 8 The track worker, who was an *off-track inspector*, suffered serious injuries as a result of the accident.
- 9 There was no damage to the train or to the infrastructure of the railway as a result of the accident. The line was re-opened to normal service at 14:30 hrs on the day of the accident.

Location

- 10 The accident took place on the up-down Mansfield Line (part of Network Rail's Robin Hood line) around 55 metres beyond Bulwell South Junction (128 miles 65 *chains*) and around 140 metres on the approach to the south (Nottingham) end of the platform at Bulwell station (128 miles 76 *chains*). The railway is single track (with trains travelling in both directions) beyond the junction (figure 2).

- 11 The maximum permitted speed for this type of train when travelling over Bulwell South Junction towards Bulwell station is 55 mph (89 km/h), rising to 70 mph (113 km/h) immediately beyond the junction and through Bulwell Forest CCTV level crossing (129 miles 35 chains).
- 12 Bulwell South Junction and Bulwell station are situated on a 771 metre radius right-hand curve. Beyond the station, the track becomes straight and remains so through Bulwell Forest CCTV level crossing.
- 13 The railway at Bulwell is on a north-south axis and is bordered to the west by a tramway. The tram platforms at Bulwell tram stop are situated directly opposite the single railway platform at Bulwell station (figure 2). The infrastructure of the tramway and railway are separated throughout by a high boundary fence.
- 14 A pedestrian footbridge passes over the tramway and the railway at the north (Worksop/Mansfield) end of Bulwell station. Around 45 metres north of the station, bridge 17B (129 miles 1 chain) carries a main road over the tramway and railway lines. At the time of the accident, a 37 metre length of the line between the north end of the platform and bridge 17B was designated as *Red Zone prohibited*.

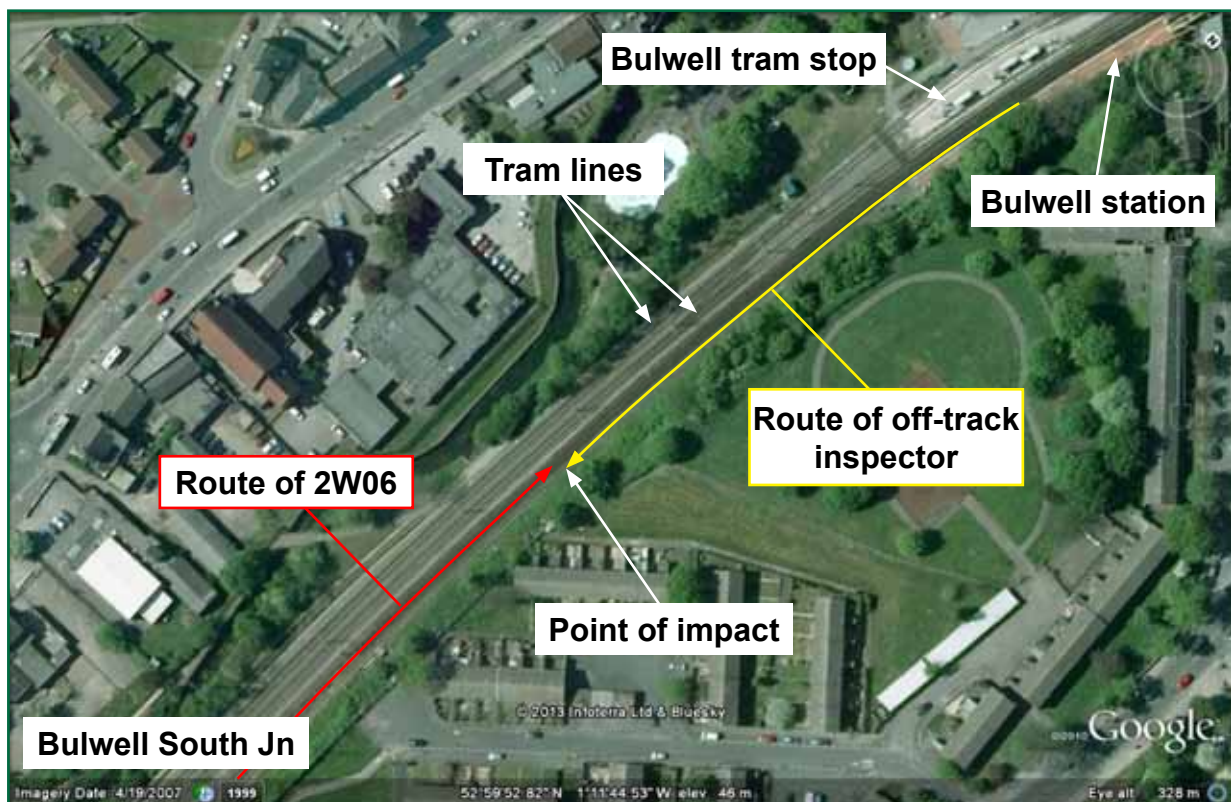


Figure 2: Layout of the railway at Bulwell and the routes taken by the train and off-track inspector

Organisations involved

- 15 Network Rail owns and maintains the mainline railway infrastructure at Bulwell and employed the off-track inspector, who was working for its Derby Maintenance Delivery Unit (MDU). This is part of Network Rail's East Midlands route.
- 16 East Midlands Trains operated train 2W06 and employed its train crew.
- 17 Nottingham Express Transit (NET) is the operator of the tramway located adjacent to the railway.

- 18 Network Rail, East Midlands Trains and NET all freely co-operated with the investigation.

Train involved

- 19 Train 2W06 was a two-car Class 156 *diesel multiple unit* (DMU). A senior conductor (who was undertaking the duties of the train's guard) and an assistant ticket examiner were in the rear cab. The train was fitted with a forward facing CCTV system (FFCCTV); this also captured images facing rearward from the rear cab.

Safe systems of work – roles and processes

- 20 In normal circumstances any work to be undertaken *on or near the line* will be subject to a plan known as the *safe system of work* (SSOW). The arrangements within these systems are intended to protect staff from the movement of trains, and will include details of how they are to be warned of a train's approach. The procedure for planning, accepting, verifying and implementing a SSOW is detailed within Network Rail standard NR/L2/OHS/019, Issue 8 'Safety of people working on or near the line', published in September 2010.
- 21 A SSOW is usually created, in advance of the task being undertaken, by a *planner*, who will work to the instructions of the manager requiring the work be undertaken (the *responsible manager*). Planners working within Network Rail infrastructure maintenance sections (such as a track engineering or *off-track section*) use the computer-based *safe systems of work planning system* (SSOWPS) to plan and create a SSOW. Planners are required to hold the *safe systems of work planner* competency.
- 22 Standard NR/L2/OHS/019 requires planners to consider a number of factors when creating a SSOW. These include:
- 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 inspections to take place in daylight;
 - the availability of opportunities to block the line to traffic;
 - the layout and *linespeeds* 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.
- 23 Standard 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 SSOW type practicable, given the factors listed above. A planner can only select a system from lower down the hierarchy after first considering the use of each of the higher types of SSOW. A summary of the hierarchy is shown in Table 1; this includes the equivalent terminology currently used in Network Rail's *personal track safety* (PTS) handbook¹.

¹ Network Rail, RT 3170, Issue 9 'A Guide to Personal Track Safety', June 2013.

	NR/L2/OHS/019 Safe System of Work	Equivalent term in the PTS handbook	Basic principle of operation
1	Safeguarded <i>Green Zone</i>	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 designated amount of space is provided between the site of work and the nearest open line. If a group are working, then a <i>site warden</i> may be appointed to warn 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 <i>Train Operated Warning System</i> (TOWS)	Equipment warning	The signalling system automatically detects an approaching train and gives a warning via sirens.
6	Red Zone with warning given by <i>Lookout Operated Warning System</i> (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 a COSS or 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 standard NR/L2/OHS/019 Issue 8 and the equivalent terminology for these systems used within RT 3170 Issue 9.

- 24 Standard 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.
- 25 To assist them in developing a SSOW, planners are required by standard NR/L2/OHS/019 and Network Rail guidance² to consult the *sectional appendix*, the *national hazard directory* and signalling diagrams in order to become familiar with the site of work. These documents should be supplemented, if appropriate, with photographs, track diagrams or a site visit.

² Network Rail 'Keypoints - SSOW Planner', October 2011, available from <http://www.safety.networkrail.co.uk/Information-Centre/Training-Materials>.

- 26 Network Rail guidance to planners states that, if a SSOW is selected which requires staff to work under Red Zone conditions, the planner should develop their understanding of the available *sighting distance* by referring to *five mile line diagrams*, the *geospatial information portal* (GI portal) or by checking with the responsible manager.
- 27 Once the SSOW has been created the planner will produce a *safe system of work pack* (SSOW 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. This pack is intended for use by a *controller of site safety* (COSS), who will be responsible for implementing the SSOW at the site of work and ensuring that the group for which they are responsible is protected from the movement of trains. A SSOW pack may also be issued to a member of staff holding the competency of an *individual working alone* (IWA), who will use it to protect only themselves.
- 28 Standard NR/L2/OHS/019 requires that SSOW for all *non-cyclic tasks* are reviewed and accepted by the responsible manager before being passed to the COSS or IWA; responsible managers are not required to sign SSOW packs which they have accepted.
- 29 Standard NR/L2/OHS/019 requires responsible managers to nominate a COSS and work group or IWA to undertake the work. They are expected to check that the nominated COSS/IWA is familiar with the location, type of work and arrangements for protection from the movement of trains. If they are not, then the responsible manager should ensure that familiarisation of the COSS/IWA takes place prior to work commencing. The standard states that familiarisation can be achieved using extracts from the sectional appendix and hazard directory, copies of signalling diagrams and photographs, or by the COSS/IWA conducting a site visit before the work takes place.
- 30 After the responsible manager has approved a SSOW pack for a non-cyclic task, it should be reviewed and verified by the nominated COSS/IWA at least a shift in advance of the work. The COSS/IWA is required by standard NR/L2/OHS/019 to use their familiarity with the site to judge if the contents of the pack are accurate, appropriate and can be implemented as proposed. If this is the case, then the COSS/IWA should approve the SSOW pack and sign it to say they have done so. If not, then the SSOW pack should be rejected and returned to the planner for amendment.
- 31 The only exception to these requirements is for SSOW relating to *cyclic tasks* (ie tasks performed repeatedly to a frequency schedule). These are instead verified by the responsible manager, in conjunction with a COSS/IWA who is familiar with the area. Once verified by the responsible manager, SSOW packs for cyclic tasks do not need to undergo further verification or acceptance by a COSS/IWA for a period of 12 months.
- 32 Guidance issued to COSS by Network Rail³ states that:

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

³ 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>.

- 33 Even after a SSOW pack has been verified and approved, the COSS/IWA remains ultimately responsible for safety on site. This means that, should site conditions be incompatible with the previously verified and approved SSOW, then the COSS/IWA must amend the system or suspend the work. Should a COSS/IWA wish to adopt a SSOW on site which is higher up the hierarchy of safe systems of work than that detailed in the SSOW pack (ie it is a more protective system) then they may do so at their own discretion. However if the SSOW proposed is from lower down the hierarchy (ie it is a less protective system) then they must obtain authority from the responsible manager before it is implemented. If the COSS/IWA is unable to safely implement a system from lower down the hierarchy (eg due to the unavailability of the necessary equipment or the correct number of competent staff) or the responsible manager's authority cannot be obtained, then they will be unable to complete the planned task.
- 34 After a work task or inspection has been completed, the person in charge (eg a track maintenance team leader or track inspector) will write down the number of hours which the task took on the relevant work order (such as a *maintenance scheduled task* (MST) or *work arising identification form* (WAIF)). They will also indicate the type of SSOW used by assigning a protection code to the task. Both the hours taken and the protection code are then entered into Network Rail's *ELLIPSE* work management system so that the data gathered can be used to monitor the percentage of hours being worked under Red and Green Zone SSOW (paragraph 127).

Staff involved

- 35 The off-track inspector had 17 years of railway experience. He had been working within the off-track section at Derby MDU for 10 years, including around two years as an off-track inspector. He had undertaken railway industry approved training as a COSS and had been certified as competent in the role since 2001. He had last been recertified as a competent COSS in May 2011, via Network Rail's *assessment in the line* (AiTL) process. Although the off-track inspector was undertaking the role of the COSS on the day of the accident, he was using the SSOW to protect only himself⁴.
- 36 The planner had nine years of railway experience, all within the off-track section at Derby. She had worked for around five years as a data entry clerk and works scheduler and then as the section's planner for about four years. In this role, she was responsible for scheduling work for the section's inspection and production teams using the *ELLIPSE* work management system. She also planned the section's SSOW and created the associated SSOW packs. The planner had passed Network Rail's *core planner skills 1* and *core planner skills 2* training courses and had been trained in the use of SSOWPS. She was last recertified as competent in the role of a safe systems of work planner in May 2011, via the AiTL process. She had also undertaken railway industry approved training as a COSS and had been certified as competent in this role for around a year.

⁴ Staff holding a COSS competency are permitted to use a SSOW to protect only themselves in the same manner as the holder of an IWA competency.

- 37 The section manager of the off-track section had around nine years of railway experience in various positions, including a period as a *RIMINI planner* (paragraph 149). He had been appointed to the post of section manager around three weeks prior to the accident and was fulfilling the role of the responsible manager for the inspection at Bulwell. He was supported by an assistant section manager, who had been covering the role of section manager for seven months before this appointment.
- 38 The driver of train 2W06 had 32 years of experience as a member of train crew and had been a train driver for 20 years. He drove trains on the Robin Hood Line on average three days a week.

External circumstances

- 39 The weather on 6 August 2012 was warm, clear and sunny. Although there was some noise from the adjacent tramway, the location where the collision occurred was generally quiet.

Events preceding the accident

- 40 In the week leading up to 2 August 2012, the off-track section planner used SSOWPS to create a SSOW for a routine inspection of lineside vegetation on the up-down Mansfield Line. This inspection was planned for 6 August 2012 and would cover the portion of the line between milepost 127 and milepost 129 (figure 3). Completing the inspection would close-out a number of MST work orders within ELLIPSE.
- 41 The routine inspection of lineside vegetation by off-track sections became a requirement in Network Rail standards⁵ from 2009⁶. They are required to take place on foot at least once every three years, between the start of May and the end of October, supplemented by annual cab ride inspections. Lineside vegetation inspections are intended to detect hazardous trees, the presence of certain types of plants, obstructions to *positions of safety*, reduced clearances for passing trains and locations where vegetation growth could impede other inspections or restrict sighting. The inspection of 6 August 2012 was the first time that the line around Bulwell had been the subject of a lineside vegetation inspection on foot by the off-track section.
- 42 The inspection was planned to use a Red Zone COSS/IWA SSOW (paragraph 101) from 125 miles 38 chains to 129 miles 40 chains, a distance of just over four miles. This was longer than the length of the inspection itself, because the limits of the system corresponded with signals which could be used to provide protection if the COSS/IWA wanted to take a line blockage (ie if he decided to adopt a safeguarded Green Zone SSOW once on site).
- 43 A SSOW pack was created by the planner and issued to the off-track inspector. The pack included a partially completed form RT9909 'Record of Site Safety Arrangements and Briefing Form' which had on it a summary of the principal hazards in the national hazard directory covered by the SSOW.

⁵ NR/L2/TRK/5201 Issue 3 'Management of lineside vegetation', September 2009. This has now been superseded by Issue 4, which was issued in June 2012 with a compliance date of March 2013.

⁶ Before this date, the status of lineside vegetation was checked on foot as part of *basic visual track inspection*.

- 44 One of the hazards listed on the form RT9909 was described as 'Bulwell station - Red Zone working prohibited – 128 miles 1694 yards to 128 miles 1735 yards' (figure 3). Although the planner noted this Red Zone prohibited area, she assumed from the description that it referred to the track as it passed through the platform at Bulwell station, where there was no position of safety. The planner was not concerned by this as it would be normal practice in these circumstances for a COSS/IWA to walk through a station on the platform.
- 45 The SSOW pack also included an 11-page extract from the national hazard directory, which detailed all of the hazards recorded within the mileage covered by the SSOW. The hazards listed were mainly buried services, potentially injurious or invasive plants and details of access points. Hazards listed relevant to this accident included:
- a text box containing warnings of multiple site hazards around Bulwell Forest CCTV level crossing - these included restricted sighting distance; and
 - a text box describing the arrangements for using Bulwell Forest CCTV level crossing as an access point – this included the comment 'T12 required' ('T12' being an obsolete reference to a type of line blockage; if applied to this single track section of railway then it would equate to a safeguarded Green Zone in the current hierarchy of safe systems of work).

SSOW packs produced by the off-track section also included locally produced track diagrams marked with signals, the identity of lines and the track mileage of key features.

- 46 The off-track inspector verified and accepted the SSOW pack on 2 August 2012, and signed the verification form on the pack to confirm that he had accepted it. He also assumed, as the planner had done, that the Red Zone prohibited area listed on the RT 9909 form referred to the line through the platform at Bulwell station.
- 47 The off-track inspector arrived at work at around 06:30 hrs on 6 August 2012 and had a conversation with the section manager. The section manager asked him to work that day in conjunction with another off-track inspector, who would concurrently examine the lineside vegetation on the opposing railway boundary. The section manager stated that he did this because he wanted to mitigate some of the risks associated with *lone working*, such as an off-track inspector falling ill and being unable to summon help.
- 48 The off-track inspector then drove to Bulwell Forest CCTV level crossing with his colleague. As there was effectively lineside vegetation on only one side of the railway (as the opposite *cess* formed part of the tramway) it was decided that the off-track inspector would undertake the inspection alone, whilst his colleague drove ahead to wait for him. They agreed to meet each other at Basford Chemical Works user worked level crossing (situated around the half-way point of the inspection) in order to minimise the amount of lone working (figure 3).
- 49 Bulwell Forest CCTV level crossing was almost half-a-mile from the required start of the inspection, which was situated between Bulwell station platform and bridge 17B. The off-track inspector decided to start the inspection at the level crossing because he believed mistakenly (paragraph 69) that it was the access point closest to milepost 129. The start point of the inspection remained within the mileage covered by the SSOW.

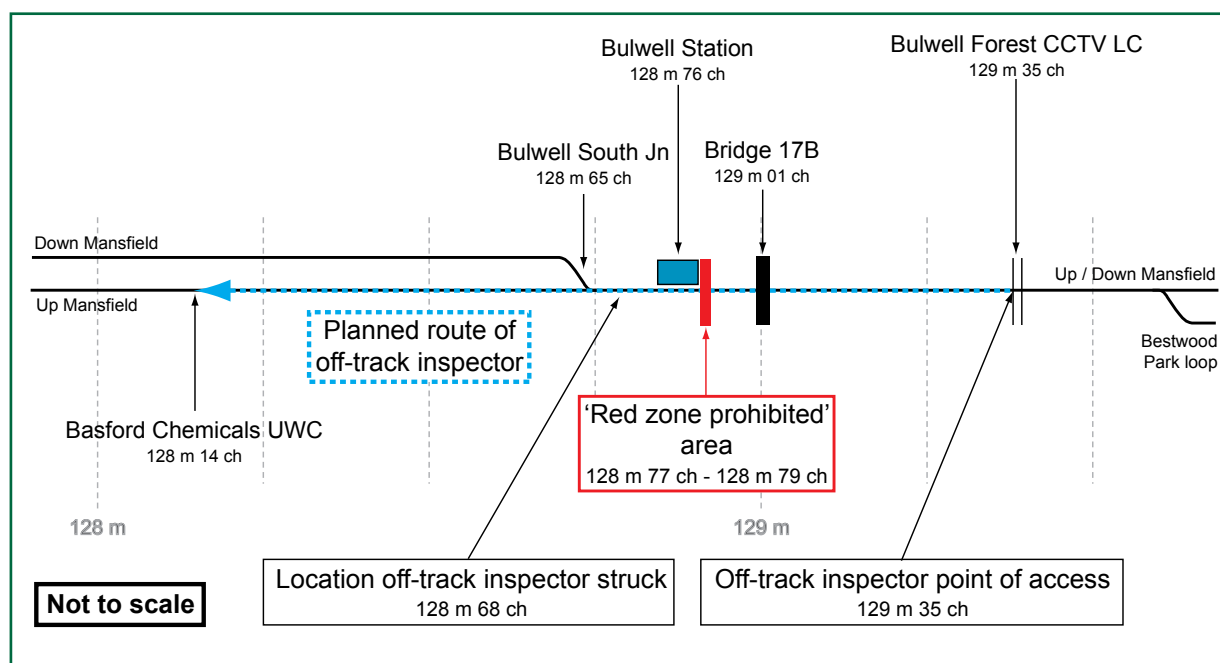


Figure 3: The planned route of the lineside vegetation inspection at Bulwell on 6 August 2012

- 50 The off-track inspector accessed the track at the level crossing just before 09:15 hrs. Although he had been issued with a pre-planned Red Zone COSS/IWA SSOW, he intended to adopt a separated Green Zone SSOW where the width of the cess and the state of lineside vegetation allowed⁷. This was common practice when undertaking lineside vegetation inspections. As the new SSOW was of a type from higher up the hierarchy, the off-track inspector could do this at his own discretion.
- 51 A separated Green Zone SSOW requires the COSS/IWA to maintain a distance of at least 2 metres from the nearest running rail. The presence of structures and vegetation blocking the cess during the inspection prevented this distance from being maintained throughout the inspection. This meant that the off-track inspector needed to revert for short periods to using the original Red Zone COSS/IWA SSOW detailed in his pack. This required him to keep a lookout for approaching trains and ensure that he had sufficient warning to be in a position of safety 10 seconds before they passed.
- 52 At 09:24 hrs, the off-track inspector was recorded by the platform CCTV system at Bulwell tram stop walking through bridge 17B in the four-foot of the up-down Mansfield line. CCTV images show him walking onto the north end of the platform at Bulwell station, where he remained during the arrival and subsequent departure of a Nottingham-bound train. As this train departed at 09:28 hrs, its FFCCTV system recorded the off-track inspector walking off the south end of the platform and into the cess.

⁷ A COSS/IWA working on their own or with one other person does not require a site warden to be present in order to establish a separated Green Zone SSOW.

Events during the accident

- 53 At 09:31 hrs train 2W06, which was not due to stop at Bulwell station, passed through Bulwell South Junction at a speed of 55 mph (89 km/h). As the train rounded the curve, the driver reported that he saw a track worker standing in the cess, around 20 to 30 metres away to the *non-driver's side* of the train; this was the off-track inspector (figure 4). The driver sounded a warning on the train's horn; his later recollection was that the off-track inspector looked up at the train, acknowledged the warning and possibly stepped away from the track⁸. The driver reported that he was able to see the off-track inspector only briefly before he lost sight of him a few metres before the train passed where he was standing. Moments later the driver heard two bangs come from the non-driver's side of the cab; he immediately initiated an *emergency brake application*.



Figure 4: FFCCTV image showing the off-track inspector's position as train 2W06 approached (image courtesy of East Midlands Trains)

- 54 The off-track inspector stated that his recollection of the accident was incomplete, although he remembered hearing the train's horn and acknowledging it before being struck by the train. Post-incident examination of the train showed marks to the non-driver's side cab front around head height (which probably resulted from contact with the off-track inspector's bump-cap) as well as further physical evidence indicating that he was also struck by the non-driver's side cab footstep.
- 55 As the train passed the off-track inspector, he became visible to the senior conductor in the rear cab, who thought he appeared to be getting up from a lying position in the cess. He was visible in FFCCTV images recorded from the rear cab for around 4 seconds.

⁸ FFCCTV images showed no movement away from the track by the off-track inspector as the train approached.

- 56 The train's *On Train Data Recording system* (OTDR) recorded that train 2W06 came to a stand 310 metres beyond the point of collision, 23 seconds after the emergency brake application had been initiated. Once stopped, the platform CCTV at Bulwell tram stop showed that its rear cab remained under bridge 17B. Due to the curvature of the track and the structures positioned around the railway (paragraph 14), only the platform ramp at the north end of Bulwell station was visible in the FFCCTV images recorded from the rear cab of the train. Taking into account the position of the FFCCTV camera, this would indicate that there was no visibility from any part of the train of the main part of the station platform.

Events following the accident

- 57 The impact of the collision knocked the off-track inspector backwards into the cess. He was aware that he had been seriously injured and unsuccessfully tried to find his mobile telephone (which had come out of his pocket during the accident) in order to call for assistance. As he could not find his telephone, and after he had shouted for help without response, he decided to try to get up and walk back to the station. He reached the platform at the station at 09:35 hrs, where he was able to attract the attention of people standing on the tram platforms. A NET staff member on duty at the tram stop realised that he was injured and called the tramway's control to request the attendance of the emergency services.
- 58 Once the train had stopped, the driver and senior conductor met at the front in order to discuss what had happened. The senior conductor reported that he had seen a track worker lying in the cess as the train passed but that he had seen him getting up and thought that he was OK. The driver got out and descended to the track in order to inspect the train for anything that might indicate a collision had taken place; as he could see nothing that concerned him, he re-boarded the train. The driver concluded that the track worker had not been hit by the train and had lain down to avoid a collision as the train passed.
- 59 The driver then contacted the signaller at the Mansfield workstation of the East Midlands Control Centre (EMCC) on his mobile telephone. He explained to the signaller what he thought had happened and, after confirming that no-one had apparently been injured, the signaller agreed that the train could continue onwards on its scheduled journey. Train 2W06 moved off towards Worksop just before 09:36 hrs.
- 60 The signaller reported the driver's call to the shift signalling manager, who called East Midlands Route Control at 09:41 hrs. After a short discussion, the route control manager asked for the line to be blocked to rail traffic and dispatched a mobile operations manager to Bulwell to investigate the incident. A few minutes later, NET Control contacted the signaller to report that there was an injured member of staff on the railway platform at Bulwell and that the emergency services had been called. The ambulance service arrived at Bulwell station at 09:47 hrs.

The investigation

Sources of evidence

- 61 The following sources of evidence were used:
- site photographs, measurements and observations;
 - interviews with witnesses;
 - images from on-train FFCCTV systems and the platform CCTV at Bulwell tram stop;
 - data from the OTDR fitted to train 2W06;
 - data recorded from signalling systems, replayed using the *Control Centre of the Future* system;
 - data from mobile telephone records;
 - a post-incident track walk and survey of sighting distances around Bulwell station;
 - a sample of completed safe system of work packs and vegetation inspection records;
 - Network Rail standards and briefing documents relating to the planning, accepting, verifying and implementing of safe systems of work;
 - Network Rail standards and briefing documents relating to lineside vegetation inspection and lone working;
 - the results of pre-incident audits and a post-incident compliance check of Derby MDU; and
 - a review of previous RAIB investigations that had relevance to this accident and Network Rail's responses to them.

Key facts and analysis

Identification of the immediate cause⁹

- 62 **The immediate cause of the accident was that the off-track inspector was in a position where he could be struck by train 2W06.**
- 63 The off-track inspector was not in a position of safety when train 2W06 struck him because his awareness of where he was standing with respect to the line had become reduced. This reduction in awareness probably occurred because he was focused on determining his location. His awareness may have also become reduced because he needed to concentrate on certain aspects of the inspection. The off-track inspector had been issued with, and had implemented, a planned SSOW which was unsuitable for the location and task; had the most appropriate SSOW been planned and implemented, then the accident would have been avoided.

Identification of causal factors¹⁰

- 64 When a train approaches staff working on or near the line, they are required to be in a position of safety 10 seconds before it passes them. For lines with a maximum permitted speed of 100 mph (160 km/h) or less, a position of safety is defined by the railway rule book¹¹ as being at least 1.25 m from the nearest line on which a train can approach. As train 2W06 was approaching him, the off-track inspector was not observing this rule; FFCCTV images and an examination of the scene of the accident by the RAIB showed that he was standing on the ballast shoulder, between 0.4 and 0.7 m from the nearest running rail. This resulted in him being struck by the train.
- 65 There is no evidence that the off-track inspector deliberately violated the rules concerning positions of safety. Although he had only recently started to undertake inspections of lineside vegetation (paragraphs 73 to 79), he was an experienced COSS with a reputation amongst his colleagues and managers for being very safety conscious. There was witness evidence that he had not been involved in any other safety-related incidents, and management spot checks of his work prior to the accident found that he had complied with, or exceeded, the requirements of all of the relevant rules.

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 Group Standard GE/RT 8000 Handbook 1, Issue 2 'General duties and track safety for track workers', December 2011 http://www.rgsonline.co.uk/Rule_Book/Forms/Live_Documents.aspx.

- 66 The off-track inspector had experience of implementing Red Zone COSS/IWA SSOW when acting in the role of COSS and there is witness evidence that he was both aware of the rule concerning positions of safety and had previously applied it in a variety of situations. There is no evidence that he either forgot the rule or misunderstood how to apply it on the day of the accident. There is also no evidence that the off-track inspector was affected by fatigue or that he was impaired by the effects of drugs or alcohol. As an analysis of telephone records showed that he had not used his mobile telephone to send or receive calls, text messages or data during the inspection, this has also been discounted as a possible source of distraction.
- 67 The off-track inspector was in a position where he could be struck by a train because;
- he was not in the position of safety required by the rule book; and
 - he was working under a SSOW which was unsuitable for the task and location.
- Each of these is now considered in turn.

The off-track inspector was not in the position of safety required by the rule book

- 68 The off-track inspector was not in the position of safety required by the rule book because he had a reduced level of awareness of where he was standing with respect to the line. This probably occurred because he was unfamiliar with the site at Bulwell and was focussed on determining his location. As he found some elements of the lineside vegetation inspection required concentration, this may also have diverted his attention and contributed to a general reduction in his awareness.**

The off-track inspector's unfamiliarity with the site

- 69 The off-track inspector had worked within the off-track section for 10 years. He stated that he felt he knew the area around Bulwell fairly well, although could not recall if he had previously undertaken other inspections there¹². Although local track diagrams were available in his SSOW pack, the off-track inspector was unfamiliar with the area at least to the extent of not knowing the exact location of milepost 129 before he started the inspection (paragraph 49).
- 70 By the time he reached Bulwell station, the off-track inspector stated that he had become aware of the correct location of milepost 129. However, once he left the station and continued his inspection towards Bulwell South Junction, he noticed a *sleeper* marked in paint with the number '1500' (figure 5). He recalled that he stopped at this point in order to check if this marking meant that he was standing at 128 miles 1500 yards and if so, if this agreed with where he now thought milepost 129 was located. The off-track inspector was conscious that he needed to know his location accurately in order for his inspection to be effective.
- 71 The off-track inspector was focused on the marking on this sleeper when he was struck by the train. Although his recollection is that he may have stepped towards the track in order to examine it more closely, he was also sure that he had been in a position of safety when the train approached. It is likely that the off-track inspector's focus on determining his location reduced his awareness of where he was positioned with respect to the line.

¹² As well as lineside vegetation, off-track inspectors may also carry out inspections of drainage, fencing and level crossings.

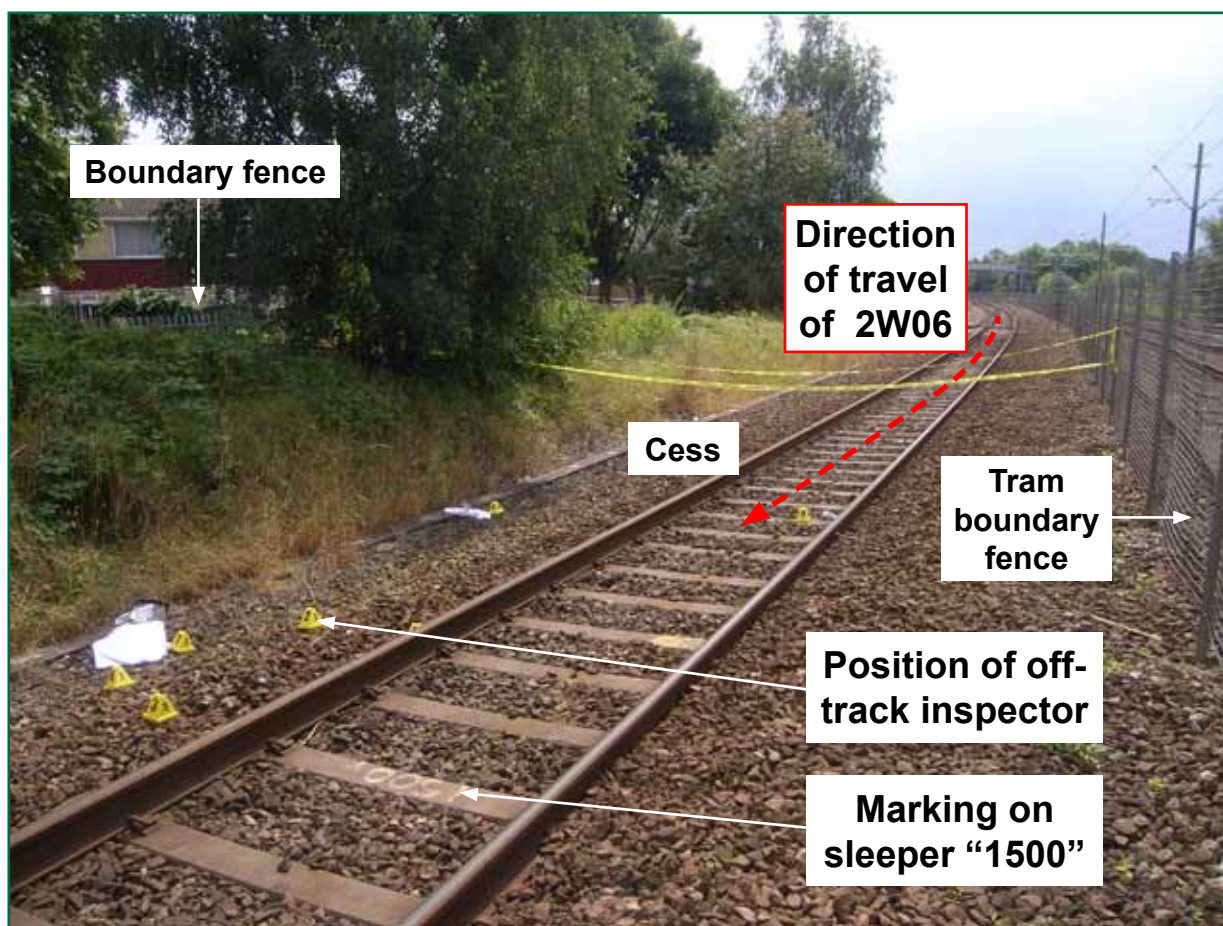


Figure 5: The site of the accident

- 72 Had the off-track inspector been more familiar with the railway at Bulwell, he would have needed to direct less of his attention towards determining his location and would have therefore retained a greater awareness of where he was positioned. This probably would have prevented him from being struck by train 2W06.

The demands of the inspection

- 73 Routine lineside vegetation inspections were first undertaken within the East Midlands Route in 2011, although they were not planned to take place within Derby MDU until 2012. Whilst off-track section managers are responsible at MDU level for ensuring these inspections are completed, at route level the management of lineside vegetation is the responsibility of the Route Asset Manager (Track). They are assisted in this by a technical specialist known as the Senior Asset Engineer (Support) [Lineside], more commonly referred to as the lineside engineer. There was a single lineside engineer covering both the East Midlands and London North Eastern routes; part of his role was to provide briefings and technical support on vegetation issues to the off-track sections.
- 74 It was decided by the lineside engineers at network level that the routine lineside vegetation inspections planned for 2011/2012 should prioritise the identification of hazardous trees and the examination of vegetation in the *ballasted area* of the track, the *cess* and *cess strip*. It was intended that the inspection data collected would provide a basis for assessing the cost of asset maintenance and assist in the development of vegetation management plans.

- 75 The lineside engineer with responsibility for the East Midlands route delivered a briefing to the Derby MDU off-track section on routine lineside vegetation inspections in May 2011. The briefing lasted about an hour and was delivered as part of a training day, which also covered other subjects. The briefing discussed key definitions, how to identify hazardous trees and the different varieties of invasive or injurious plants. It also discussed how to complete Network Rail form TEF 3079, which off-track inspectors were to use to record their findings. The lineside engineer focused the briefing on the priority areas for inspection.
- 76 A further briefing was held in April 2012, at the request of the off-track section, in order to clarify the use of form TEF 3079, which some staff had found confusing. The lineside engineer who delivered both briefings stated that there were no questions during delivery and that the contents appeared to be understood by those attending. Once the inspections started, there was little feedback from off-track sections about any problems arising, although some inspectors had reported problems with accurately determining their position on the track.
- 77 Although in some cases (eg where there are access difficulties) off-track sections may apply to use cab ride inspections in lieu of lineside vegetation inspections on foot, it was the opinion of the lineside engineer who gave the briefings that only inspections on foot would fulfil all of the objectives of these inspections, such as the identification of hazardous trees. No application to use cab ride inspections in lieu of inspections was made for the line at Bulwell, although an application was made for another location within Derby MDU where positions of safety were limited.
- 78 The off-track inspector attended both of the lineside engineer's briefings and a post-incident compliance check (paragraph 115) showed that he had completed at least four previous lineside vegetation inspections on foot prior to 6 August 2012. However, he stated that the briefings had not provided him with adequate preparation and that certain elements of these inspections (such as identifying different plant types) were challenging and needed concentration.
- 79 The RAIB considers that the diversion of some of the off-track inspector's attention towards the inspection task had the potential to reduce his awareness, although probably to a lesser degree than that caused by his focus on determining his location (paragraph 71).

The off-track inspector was working under an unsuitable SSOW

80 The off-track inspector was working under a planned SSOW which was unsuitable for the inspection. Had the most appropriate SSOW for the inspection been used, then the accident would have been avoided.

- 81 The off-track section had only a limited range of SSOW types which could be implemented for inspections, including safeguarded and separated Green Zones and Red Zone lookout (including COSS/IWA) SSOW (paragraph 118).

- 82 The railway rule book¹³ allows a COSS/IWA to undertake inspections alone and without the line being blocked under the following circumstances:
- 'You can patrol, examine or inspect an open line when you are alone if you are sure you will be able to look up often enough (at least every 5 seconds) to see any train approaching and:*
- *you will be able to reach a position of safety at least 10 seconds before any approaching train arrives, and*
 - *you can reach that position of safety without crossing any open line other than the one you are on.'*
- 83 The relevant sections of the railway rule book do not discuss how a COSS/IWA working alone should determine the warning time needed to reach a position of safety at least 10 seconds before an approaching train arrives. However the rule book for COSS contains an 'Aid to working out warning times' which requires a COSS to account for the following factors when calculating the total warning time required;
- the time needed to stop work and down tools;
 - the time needed for everyone to reach a position of safety;
 - an additional 5 seconds warning time if a lookout is looking out in two directions;
 - an additional 5 seconds warning time for each distant or intermediate lookout; and
 - the 10 seconds needed to be in a position of safety before a train passed.
- 84 A similar aid is not provided within the rule book for IWA, although Network Rail guidance for COSS/IWA¹⁴ states that:
- 'You will need to:*
- *work out the required warning time.*
 - *make sure there is sufficient sighting distance'*
- 85 The version of Network Rail form RT9909 'Record of Site Safety Arrangements and Briefing Form' printed out by SSOWPS and placed into SSOW packs contains a table which allows COSS/IWA to calculate the required warning time using the same factors as those contained in the COSS rule book. This table requires an additional 5 seconds warning time be added if a COSS/IWA is working alone; this additional warning time is not discussed within the relevant sections of the railway rule book or within Network Rail guidance (paragraph 154).
- 86 On the RT9909 form issued as part of his SSOW pack, the off-track inspector calculated that 15 seconds of warning time was required and that this would equate to a sighting distance of 500 metres (or 520 yards). This calculation was based on the 10 seconds needed to be in a position of safety before a train passed and a further 5 seconds as he was working alone. The off-track inspector did not make any allowance for the time needed to stop work and to reach a position of safety.

¹³ Railway Group Standard GE/RT 8000, Handbook 6, Issue 2 'General duties of an individual working alone (IWA)', June 2012 and Railway Group Standard GE/RT 8000 Handbook 7, Issue 2 'General duties of a controller of site safety (COSS)', June 2012. http://www.rgsonline.co.uk/Rule_Book/Forms/Live_Documents.aspx.

¹⁴ 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>.

- 87 The off-track inspector confirmed on this form that 500 metres of sighting distance was available. However, the RAIB has found that it was not available in both directions at any point between the level crossing and the point where the accident occurred. The best combined sighting distance available was at the crossing itself, where there was 220 metres sighting distance towards Worksop (the equivalent of 7 seconds of warning time) and 611 metres towards Nottingham (19.5 seconds). This lack of available sighting distance meant that Red Zone COSS/IWA was an unsuitable SSOW to have used for the inspection.
- 88 There was no need for the off-track inspector to have been working under Red Zone conditions at the point where he was struck by train 2W06. There were no structures nearby and the cess was free of obstructions and wide enough for the off-track inspector to have been working within a separated Green Zone SSOW (figure 5). However, because the required distance from the running line could not be maintained throughout the inspection (paragraph 51) a separated Green Zone alone would not have been a suitable SSOW to have used for this task.
- 89 A post-incident track walk of the inspection route showed that it was possible to arrange pre-approved line blockages of around 20 minutes between trains (paragraph 119) in similar rail traffic conditions to those found on 6 August. This track walk also showed that at least two separate line blockages would have been needed to establish a safeguarded Green Zone SSOW from the start of the inspection to the point where the accident occurred. Had the off-track inspector used line blockages to create a safeguarded Green Zone SSOW for the inspection in this way, then the accident would have been avoided.
- 90 A combination of safeguarded and separated Green Zone SSOW could also have been used during the inspection. However, this approach would have required the off-track inspector to arrange several line blockages of very short duration directly with the signaller (ie where the required distance from the running line could not be maintained due to the cess being blocked by vegetation) as well as also using pre-approved line blockages to pass known structures (such as bridge 17B). Given the time required to arrange each line blockage, this approach would almost certainly have required more time to implement than the use of a safeguarded Green Zone SSOW alone. For this reason, a safeguarded Green Zone would have been the most appropriate SSOW to have used for the inspection.
- 91 The off-track inspector was able to work under an unsuitable SSOW due to a combination of factors. These were that:
- the off-track inspector did not realise that a Red Zone COSS/IWA SSOW was unsafe to implement for the inspection once on site;
 - the off-track inspector had earlier verified and accepted a Red Zone COSS/IWA SSOW pack; and
 - the planner had issued the off-track inspector with a Red Zone COSS/IWA SSOW pack.

The off-track inspector did not realise that a Red Zone SSOW was unsafe to implement once on site

- 92 The off-track inspector's memory of the inspection was incomplete (paragraph 54); however he stated that, when calculating the available sighting distance at a site of work, he would normally use his experience of working on track and look for mileposts and other track features. This was in accordance with Network Rail's training for COSS, which requires distances to be estimated either in this way or by using a range finder¹⁵. Improvements to the way in which COSS assess the required and available sighting distances at sites of work were the subject of Recommendation 1 of the RAIB's investigation report into a dangerous occurrence at Roydon in July 2012 (paragraph 185).
- 93 When he implemented the Red Zone SSOW on 6 August 2012, it appears that the off-track inspector made an error in judging the amount of sighting distance available. This may have been because he was distracted by the demands of the inspection (see paragraph 68) or because of the way in which he applied his training and experience in judging sighting distances.
- 94 The RAIB considers, however, that this error is more likely to have been caused by the way in which the off-track inspector was switching between different types of SSOW (as he was permitted to do under NR/L2/OHS/019). He was working for only very short periods under Red Zone conditions (paragraph 51) and this probably adversely affected his assessment of the available sighting distance. This is probably why he was unaware that it was unsafe to implement a Red Zone SSOW for the inspection.

The off-track inspector verified and accepted the Red Zone COSS/IWA SSOW pack

- 95 Standard NR/L2/OHS/019 requires the nominated COSS/IWA either to be familiar with the site or to use supporting documents to familiarise themselves. It also requires nominated COSS/IWA to use this site familiarity to verify that the contents of SSOW packs are accurate, appropriate and can be implemented on site (paragraph 29).
- 96 The off-track inspector verified and accepted the SSOW for the inspection on 2 August 2012, well before the day of the inspection. He stated that he used the contents of the SSOW pack as part of his verification and acceptance; this included local track diagrams and extracts of the sectional appendix and hazard directory.
- 97 Neither the sectional appendix, nor the local track diagrams, included any information that would have highlighted the poor sighting distance at Bulwell. The extract of the hazard directory provided in the SSOW pack did include references to poor sighting distance and the need to take a line blockage when using the level crossing as an access point (paragraph 45). However, both references were included within text boxes containing other information and were part of an 11 page long list of hazards. This meant that the relevant information was not particularly prominent.

¹⁵ Witness evidence is that there was a single range finder available to the off-track section but that it was not normally used by COSS/IWA to check sighting distances.

- 98 The off-track inspector did not have access to the GI portal (paragraph 26) or have any other photographs of the site available. Even if access to the GI portal had been provided, it would probably not have been practicable for him to have used it as a supporting document for verification and acceptance, as the single computer shared between the six off-track inspectors was in constant use. Witness evidence indicated that the number of inspections being undertaken by the off-track inspectors meant it was probably not practicable for them to conduct site visits as part of verification and acceptance, although this would almost certainly have highlighted the poor sighting distance at Bulwell.
- 99 In summary, although the off-track inspector undertook verification and acceptance of his SSOW pack, the information which was intended to make him site familiar did not effectively highlight the poor available sighting distance at Bulwell. This meant that he was unable to detect, at this point, that the planned SSOW would be unsafe to implement once on site.

The issuing of a Red Zone COSS/IWA SSOW by the off-track section planner

- 100 Standard NR/L2/OHS/019 requires planners to select the highest SSOW type consistent with the nature, location and duration of the work. It also requires planners to consider the length of warning time and sighting distance available at the proposed site of work when planning Red Zone SSOW (paragraph 23).
- 101 However, the off-track section planner issued a Red Zone COSS/IWA SSOW pack for the routine lineside vegetation inspection at Bulwell despite it being unsuitable (paragraph 87). This was because;
- the planner was unfamiliar with the site of work; and
 - the majority of routine lineside vegetation inspections within the off-track section were planned to use a Red Zone COSS/IWA SSOW.

The planner's familiarity with the site of work

- 102 Planners are required to consult the sectional appendix, the national hazard directory and signalling diagrams when planning SSOW. Planners are also advised to familiarise themselves with a site in a similar manner to a COSS/IWA and to develop an understanding of the available sighting distance by referring to five mile line diagrams, the GI portal or by checking with the responsible manager (paragraphs 25 and 26).
- 103 The off-track section was responsible for undertaking work within the whole of the Derby MDU area of approximately 450 route miles (and around double that of railway boundary). This meant that the planner had to cover the same area as five local track engineering sections, each of which had their own planner. Because of the large area being covered, it was inherently difficult for the off-track section planner to develop the required familiarity with the sites of work that she was dealing with.
- 104 The planner had produced SSOW packs for a number of lineside vegetation inspections prior to planning that for the lineside vegetation inspection of 6 August 2012. Evidence from a post-incident compliance check undertaken by Network Rail showed that the planner had produced at least seven SSOW packs for such inspections within the small sample of work which was examined (paragraph 115).

- 105 When planning SSOW, the planner used local track diagrams, the sectional appendix and the hazard directory to aid her. However, as with the verification and acceptance of the SSOW by the off-track inspector (paragraph 99) these documents did not effectively highlight the lack of available sighting distance at Bulwell.
- 106 The planner had become a COSS in order to improve her knowledge of SSOW and to allow her to conduct site visits. She undertook these with some difficulty due to her high workload; even with more time available to undertake them, she could have become familiar with only a relatively small percentage of the MDU's area. The planner had not, in any case, made a site visit to Bulwell prior to producing the SSOW pack for the lineside vegetation inspection of 6 August 2012. The planner's workload is discussed in more detail between paragraphs 131 and 137.
- 107 The planner had access to five mile line diagrams and had been trained to use them. However, she did not consult them when planning SSOW as the locally produced track diagrams contained a greater level of relevant detail. Although the five mile line diagrams for Bulwell contain details of curve radii, the RAIB considers that, even if they had been used by the planner, they probably would not have effectively highlighted the poor available sighting distance.
- 108 The planner also had access (via SSOWPS) to the GI portal and could have used data from this to help her understand the available sighting distance. However, because of her high workload, the planner considered that consulting the GI portal when planning SSOW for sites with which she was not familiar would require too much time to be practicable; she therefore did not use it.
- 109 The RAIB has examined the data relating to Bulwell contained within the GI portal (figures 6, 7 and 8). This consists of geographic map tiles and photographs. In the case of Bulwell, the photographs provided by the portal were 11 years old and showed neither the effect of summer vegetation on available sighting, nor the presence of the tramway and its boundary fence. However, the RAIB considers that the geographic map tiles provided by the portal could have potentially alerted the planner to the poor sighting distance available at Bulwell.
- 110 The planner consulted with the section manager, assistant section manager and experienced section staff if she was unsure about the type of SSOW to use for a particular site. However, the planner did not do this for the inspection at Bulwell, as it had become accepted practice in the off-track section to plan a Red Zone COSS/IWA SSOW for almost all routine lineside vegetation inspections; this is discussed in more detail between paragraphs 115 and 125.
- 111 The planner did occasionally use other sources of information when planning SSOW. If considering a complex junction or station, she would search SSOWPS for plans created by other planners who had greater familiarity with the site. There is no requirement to do this, or to consult with other staff local to a site, when planning a SSOW. The planner did not check for similar plans in SSOWPS when planning the inspection at Bulwell, again probably because it had become accepted practice to plan a Red Zone COSS/IWA SSOW for almost all routine lineside vegetation inspections. Had she done so, she might have seen that the track engineering section with responsibility for Bulwell (and who were familiar with the available sighting distances) planned and implemented only safeguarded Green Zone SSOW when undertaking basic visual track inspection at this location.

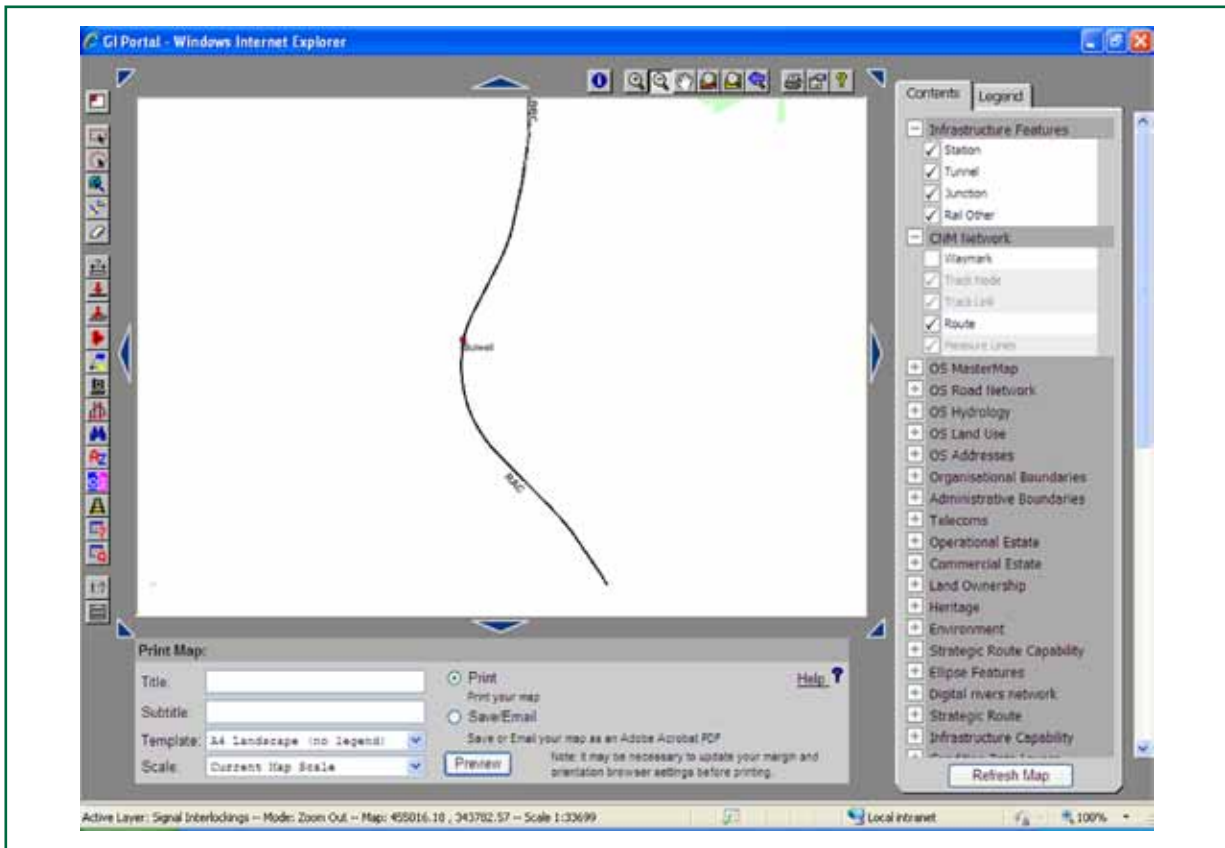


Figure 6: Geographic map tile of Bulwell provided by Network Rail's G.I portal (image courtesy of Network Rail)

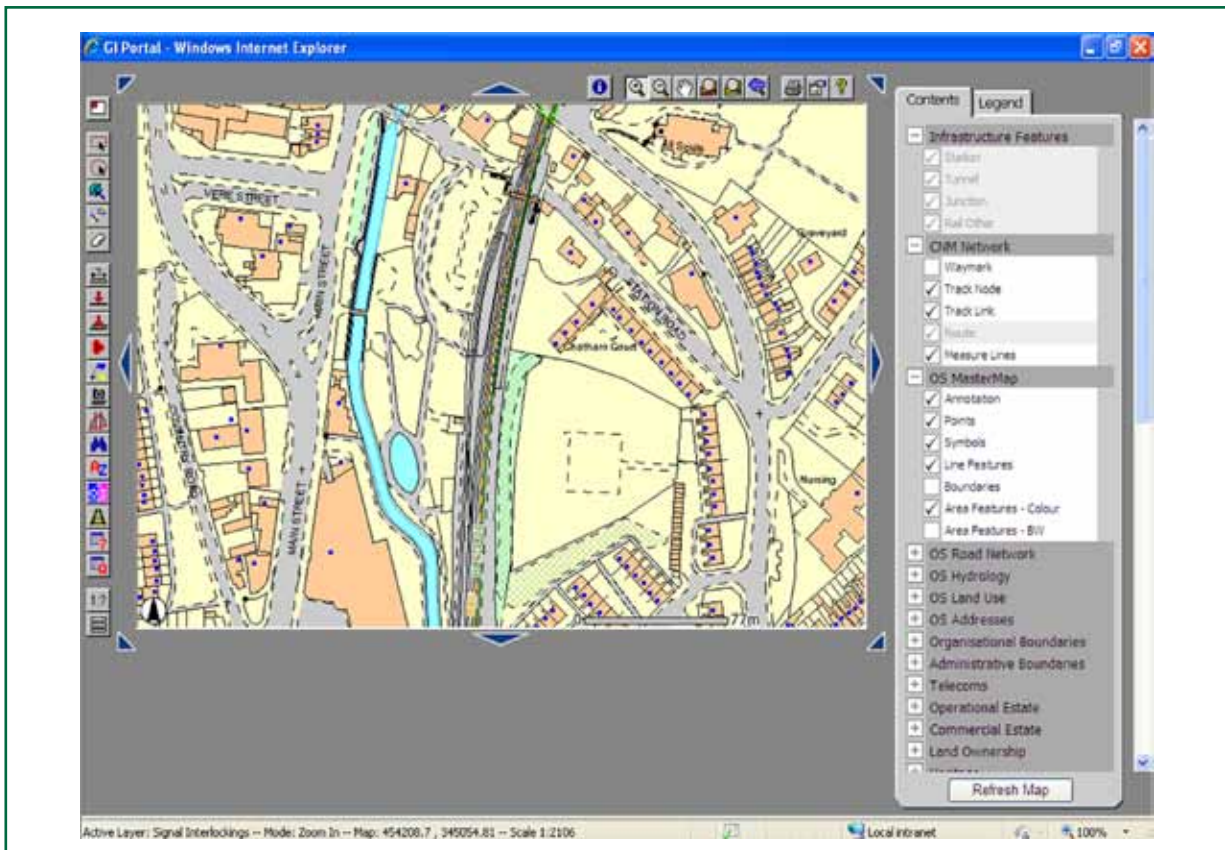


Figure 7: Geographic map tile of Bulwell provided by Network Rail's G.I portal (image courtesy of Network Rail)



Figure 8: Photograph of the track on the approach to Bulwell South Junction obtained from Network Rail's GI portal in 2012. The image dated from 2001 (image courtesy of Network Rail)

- 112 In summary, although the planner used supporting information when planning the SSOW for the routine lineside vegetation inspection at Bulwell, the sources of information she consulted did not effectively highlight the poor available sighting distance at Bulwell. Other sources of information about the site which were available, and which might have alerted her to this issue, were not used, because she found them impracticable to use given her high workload and lack of familiarity with the sites she was dealing with. She did not consult others when preparing the plan because it had become accepted practice to plan Red Zone COSS/IWA SSOW for almost all routine lineside vegetation inspections.
- 113 As this was the first time that a routine lineside vegetation inspection had taken place at Bulwell, it was classified within the section as a non-cyclic task. This meant that the SSOW pack should have been approved by the responsible manager (in this case the section manager) before being issued to the off-track inspector (paragraph 28). This did not take place because neither the planner nor the section manager were aware that it was required.
- 114 The section manager was new to the role (paragraph 37) and there is witness evidence that he did not know the Bulwell area. This means that it is unlikely that he would have made changes to the SSOW pack, or have rejected it, even had he considered it for approval. This omission was, therefore, not a factor in the accident. The actions of the section manager in the role of responsible manager are discussed between paragraphs 147 and 152.

The majority of routine lineside vegetation inspections were planned to use a Red Zone COSS/IWA SSOW

115 A post-incident compliance check undertaken by Network Rail considered a sample of work orders completed by Derby MDU's off-track section during a two week period within June 2012. This found that 65% (41 out of 63) of the tasks completed had used a Red Zone lookout SSOW (a category which includes Red Zone COSS/IWA SSOW). It also found that 85% (6 out of 7) of the routine lineside vegetation inspections completed had used a Red Zone lookout SSOW.

116 This is a small sample size on which to draw conclusions. However it is supported by witness evidence that virtually all fencing and routine lineside vegetation inspections within the off-track section were planned with Red Zone COSS/IWA SSOW by default, regardless of the location or other factors. The only exceptions to this were for sites where Red Zone prohibited areas existed that could not be avoided. Using Red Zone COSS/IWA SSOW in this way directly contravened the requirements of standard NR/L2/OHS/019 and there are a number of probable reasons as to why it occurred. These are that:

- the off-track section could use only a limited range of SSOW for lineside inspections;
- some off-track inspectors had developed a preference for conducting inspections under Red Zone SSOW; and
- the high level of Red Zone SSOW usage within the off-track section was not detected by more senior managers.

The range of SSOW types available to the off-track section

117 The off-track section did not have the equipment or competent staff available to implement Red Zone SSOW requiring warning equipment (eg LOWS or TOWS) and the mobile nature of the inspections would have made the use of fenced Green Zone SSOW disproportionate (paragraph 24).

118 This meant that the section was effectively limited to using safeguarded Green Zone, separated Green Zone or Red Zone lookout (including COSS/IWA) SSOW when undertaking inspections.

Preference of some off-track inspectors to conduct inspections under Red Zone COSS/IWA SSOW

119 Establishing a safeguarded Green Zone SSOW requires all lines within a site of work to be blocked to traffic. Line blockages may also be used as part of other types of SSOW (eg in order to close a single track as part of a separated Green Zone at a location where there are multiple railway lines). Planners make requests for these line blockages to the Green Zone Access Controller (GZAC) via the electronic Green Zone Access Management (GZAM) system. Witness evidence was that, whilst there were periodically problems in getting such requests granted (particularly at sites such as Bulwell which was reported by the *Green Zone Guide* as having low availability of Green Zones due to the frequency of train services in the daylight hours which the inspections required), the off-track section generally did not have a problem in pre-booking the line blockages that it required.

- 120 However, there was witness evidence that off-track inspectors would sometimes arrive at site and find that the signaller was either unable to grant a line blockage which had been previously been approved by the GZAC, or could only grant it for a shorter time period than had been requested. This was normally for operational reasons (such as late running or unscheduled trains) although witnesses also occasionally found that other line blockages had already been taken that either conflicted with those requested or meant that the signaller was already managing the maximum number of line blockages permitted.
- 121 There was also witness evidence that the time required to implement a line blockage in practice could, in some cases, increase the resource-hours needed to a disproportionate level when compared to other appropriate SSOW (paragraph 24). The availability and duration of line blockages, and the time needed to set each line blockage up, were the principal reasons given by witnesses as to why the resource hours required could increase.
- 122 If the necessary line blockage(s) could not be obtained for some reason, the COSS/IWA would have to implement a SSOW from lower down the hierarchy (which would require the authority of the responsible manager) or abandon the planned task and return another day.
- 123 Witness evidence indicates that the use of pre-planned line blockages came to be regarded as undesirable by at least some of the off-track inspectors in the section. This was in part because of the factors described above but principally because the need to attend locations at fixed times in order to use them removed much of the flexibility from their working day.
- 124 Witness evidence also supports there being an understanding in the section as a whole that COSS/IWA working within it were familiar enough with the area to be able to reject any unsuitable SSOW issued to them and that the COSS/IWA would be better placed than the planner to judge conditions once at site, where they could also feedback any safety related issues arising (such as poor sighting).
- 125 Although witness evidence is not entirely consistent on the matter, it is probably the case that some informal agreement was reached between the off-track inspectors and the management of the off-track section during 2011 that only Red Zone COSS/IWA SSOW packs would be issued for fencing and lineside vegetation inspections, with the intent that off-track inspectors arrange higher SSOW at their own discretion once they were at site and aware of the conditions. The devolving of decisions to the COSS/IWA in this way would have suited the wish of the off-track inspectors to work flexibly and also alleviated the planner's workload to some degree; however it also removed one of the defences intended to prevent unsuitable SSOW from being planned and issued.

The high level of Red Zone SSOW usage was not detected by more senior managers

- 126 The implementation of issue 8 of standard NR/L2/OHS/019 in December 2010 created the role of the senior responsible manager. Their responsibilities include monitoring the percentage of tasks carried out under Red and Green Zone SSOW to ensure that the use of Red Zone SSOW does not exceed targets. They are required to do this by monitoring SSOW packs, ELLIPSE data, completed RT9909 forms and signalling records.

- 127 The senior responsible manager at Derby MDU was the infrastructure maintenance engineer (IME). He was provided each period with data drawn from ELLIPSE which detailed the percentage of work hours that each group within the MDU (including the off-track section) spent using Red and Green Zone SSOW. This would be compared with the route's targets; these were that at least 70% of each group's work was to be undertaken within Green Zone SSOW, with action being required if the percentage of working within Red Zone SSOW was above 50%.
- 128 ELLIPSE data for June 2012 presented to the senior responsible manager reported that 79% of the total working hours and 71% of the hours spent undertaking lineside vegetation inspections had used a Green Zone SSOW. This would give the impression to the senior responsible manager that the use by the off-track section of Red Zone SSOW was within the target levels set by the route; this is why no further action was taken (paragraph 138).
- 129 The post-incident compliance check undertaken by Network Rail found that 65% of all tasks (and 85% of the lineside vegetation inspections) completed by the off-track section during the same period used a Red Zone lookout SSOW (paragraph 115). There was also witness evidence that virtually all fencing and routine lineside vegetation inspections within the off-track section were planned with Red Zone COSS/IWA SSOW by default (paragraph 116).
- 130 There was, therefore, a significant difference between the usage of Red Zone SSOW indicated within the data provided by ELLIPSE and that being undertaken by the off-track section in reality. The suitability of ELLIPSE data for use as a safety monitoring tool is discussed in more detail between paragraphs 138 and 142.

Identification of underlying factors¹⁶

Off-track section planning workload

- 131 The planning workload within the off-track section had increased to a point where the planner could no longer effectively plan safe systems of work.**
- 132 Off-track sections were originally responsible only for the maintenance of fencing, access points, vegetation and level crossings. Further tasks were assigned to these sections from around 2005; these included the maintenance and inspection of drainage and the inspection of fencing, access points and level crossings. Witness evidence is that the planner's workload rose significantly because of the additional work scheduling and SSOW planning required by these new tasks and that eventually she was working at, or over, her full capacity.
- 133 Evidence available to the RAIB indicates that, although some additional resources were provided to the off-track section to undertake the new tasks assigned to it, no provision was made to increase the amount of planning resource available to the section at the same time. In fact, because the planner role had previously been split between two posts prior to 2007 (the RIMINI planner, who planned SSOW, and the Works Scheduler, who planned work) the planning resource available to the section actually decreased during the period in which the additional tasks were assigned.

¹⁶ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

- 134 When drainage inspections were assigned to the off-track section, the previous section manager (who left the section in December 2011) raised concerns about workload with senior managers within the MDU. In response, it was proposed that off-track inspections be combined, where possible, with other work being undertaken by local track engineering sections. As the inspectors would be able to work within the track engineering section's SSOW, it was expected that this would reduce the planning and management workload on the off-track section.
- 135 Although this proposal was adopted, there is witness evidence that it was not completely successful in practice at reducing the planning workload. There was difficulty in coordinating the inspections, which were scheduled at different frequencies, and synchronising these activities was itself seen within the off-track section as requiring a significant amount of additional planning work. In addition, some off-track inspections required more time to complete than the comparable track engineering inspections had available.
- 136 Evidence was provided by Network Rail that other steps to reduce the planning workload within the off-track section were suggested by senior managers within the MDU. This included advice to make greater use of cyclic SSOW planning (paragraph 32), although the RAIB has been unable to find any evidence that this suggestion was adopted. It was also suggested that a suitably experienced member of staff from within the section be used as a planning resource. Although there is witness evidence that this person was able to provide temporary help to the planner, this does not appear to have resulted in a sustained reduction in the planner's workload.
- 137 The increase in the planner's workload undermined her ability to safely and effectively plan SSOW. It meant that she could not undertake tasks such as site visits (paragraph 106) or use the sources of information available to assist her in understanding sighting distances (paragraph 108). It probably also contributed to the decision by the section to issue only Red Zone COSS/IWA SSOW for fencing and lineside vegetation inspections (paragraph 125).

The suitability of ELLIPSE data for use in monitoring safety

138 The ELLIPSE data provided to the senior responsible manager did not accurately reflect the proportion of Red Zone working being undertaken by the off-track section. It was therefore not suitable for use as a safety monitoring tool.

- 139 There was a significant under-reporting of the percentage of Red Zone SSOW being used by the off-track section within the ELLIPSE data presented to the senior responsible manager (paragraph 130).
- 140 It was suggested by witnesses that this may be introduced when a single SSOW pack covers a number of MSTs (as for a lineside inspection). In these circumstances, each MST could potentially be given a different (and possibly higher) protection code than the covering SSOW pack. However, the compliance check undertaken by Network Rail (paragraph 115) found that the off-track section assigned a single protection code for all of the inspection MSTs covered by a particular SSOW pack (known as 'group reporting'). This means that the covering of multiple MSTs by a single SSOW pack was not the cause of the under-reporting in this case.

- 141 The use of ELLIPSE data as a safety monitoring tool was considered by Network Rail within the May 2012 National Core Audit Programme (NCAP)¹⁷ audit of Derby MDU. These audits use a standard assurance framework and are undertaken around every two years by specially trained staff from a separate Network Rail route. The report resulting from this audit included an observation that the level of Red Zone working within the off-track section was not reflected by the data recorded in ELLIPSE, which indicated that the section was predominantly using separated or safeguarded Green Zone SSOW. However, as this was only as an observation, no further action was taken.
- 142 The exact cause of the discrepancy between the percentage of Red Zone SSOW being used by the off-track section and that recorded by ELLIPSE remains uncertain. However, the inaccurate nature of the ELLIPSE data, and the absence of any action once its inaccuracy was reported, meant that the senior responsible manager was unable to correctly monitor the percentage of Red Zone working being undertaken by the off-track section and to take corrective action to address it.

Observations¹⁸

The reporting of the accident

143 Although there was evidence that an impact had occurred as the train passed the off-track inspector, the accident was initially reported as a near-miss. In other circumstances, this could have led to a longer delay in the off-track inspector receiving medical treatment, and in the accident having possibly more severe consequences.

- 144 During his telephone call to the signaller following the accident, the driver of the train reported the incident as being a near-miss in which no-one had been injured. This was based on the senior conductor's report to him and his own investigations (paragraph 58). He also reported to the signaller that the train had struck something. The signaller allowed the train to continue onwards based on this report and reported the driver's call to the shift signalling manager (paragraph 60).
- 145 Had the off-track inspector been unable to reach the station then the initial reporting of the incident as a near-miss could have meant that the injuries to him remained unknown either until a report was received from a train or tram driver or until he was found by his colleague (who may have realised he was overdue for their meeting at Basford Chemical Works user worked level crossing, paragraph 48) or the mobile operations manager.
- 146 Fortunately the off-track inspector was able, despite his serious injuries, to walk back to the station and seek assistance. This meant that, in this case, the initial reporting of the incident as a near-miss did not result in a significant delay in him receiving medical treatment.

¹⁷ Now known as the Functional Audit Programme (FAP).

¹⁸ 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.

The role and actions of the responsible manager

147 The section manager was unaware that he was required to approve all non-cyclic SSOW and had not been briefed on the duties of the responsible manager before undertaking the role.

- 148 As a non-cyclic task, standard NR/L2/OHS/019 required that the SSOW pack for the lineside vegetation inspection on 6 August 2012 be reviewed and approved by the responsible manager before being issued to the COSS/IWA for verification. Although the SSOW pack was not approved by the responsible manager in this case, this was not a factor in the accident (paragraph 114).
- 149 The section manager first assumed the role of a responsible manager when he was appointed to the off-track section. As the holder of an IWA competency (and a former RIMINI planner), the section manager was aware of the majority of the requirements of standard NR/L2/OHS/019 and how various SSOW were implemented. He was, however, unaware that the standard required him to review and approve all non-cyclic task SSOW packs; this was because he had not been briefed on the duties of the responsible manager before undertaking the role.
- 150 Standard NR/L2/OHS/019 does not require persons undertaking the role of responsible manager to hold a particular competence; this is in contrast to the planner and COSS/IWA, both of whom are required to hold certain competences which are periodically re-assessed.
- 151 The RAIB's investigation also found that the requirement within standard NR/L2/OHS/019 for responsible managers to approve all SSOW packs for non-cyclic tasks has been understood and interpreted differently within Network Rail's organisation. This requirement was relatively new, having been introduced by issue 8 of the standard in September 2010 (paragraph 172).
- 152 It appears that, although some Network Rail staff involved in the planning and approval of SSOW understood and observed this requirement, others were unaware of it or considered that it could be delegated to a competent planner. It appears that the lack of a mechanism to show that a pack had been approved by the responsible manager (either in SSOWPS or on the pack itself¹⁹) may have contributed to these different understandings of the requirement.
- 153 Some staff spoken to during the RAIB's investigation felt that a review by the responsible manager added little value when creating non-cyclic SSOW, given the large amount of SSOW packs a responsible manager might potentially have to approve and that a COSS/IWA is in any case required to verify and accept any packs issued to them.

¹⁹ SSOW packs only include a space for the responsible manager to sign when granting approval for a 'same shift' verification by a COSS/IWA.

The rules and guidance available to COSS/IWA working alone concerning the calculation of warning time and sighting distance

- 154 A complete list of the factors which a COSS/IWA working alone should consider when calculating the required warning time and sighting distance is not included either in the relevant sections of the railway rule book or within Network Rail guidance. A complete list of these factors also does not appear in some versions of Network Rail form RT9909.**
- 155 The version of Network Rail form RT9909 'Record of Site Safety Arrangements and Briefing Form' printed out by SSOWPS and placed into SSOW packs uses a table to specifically prompt COSS/IWA to consider certain factors when calculating warning time. This includes allowing time to reach a position of safety and adding on time if a lookout is looking out in two directions and/or if someone is working alone (paragraph 85). This table is not included within the standard version of Network Rail form RT9909.
- 156 These factors, and the additional warning time allowances, are not discussed within the section of the railway rule book²⁰ relevant to an IWA or within Network Rail guidance for COSS/IWA²¹. In addition, the section of the railway rule book relevant to a COSS²² does not contain any reference to there being a requirement to add additional warning time if someone is working alone.
- 157 There are also no rules or guidance as to how COSS/IWA should apply additional warning time allowances (eg if a COSS/IWA working alone on a bi-directional line is to be considered in the same way as a lookout monitoring two directions).
- 158 COSS and IWA competent staff receive training in determining the required warning time and sighting distance. However the omission of information from the standard version of form RT9909 and the railway rule book means that COSS/IWA receiving a SSOW which was not generated using SSOWPS may not be prompted to consider all of the factors and additional timings needed to arrive at the correct required warning time when working alone.
- 159 The SSOW pack issued to the off-track inspector for the 6 August 2012 included an RT9909 form which contained the table, which he used to calculate the required warning time and sighting distance (paragraph 86). Although the availability of further rules and guidance may have resulted in the off-track inspector allowing more warning time (eg for the bi-directional nature of the line) there was in any case insufficient sighting distance available even for the shorter warning time which he calculated (paragraph 87). For this reason, the inconsistencies between the railway rule book and Network Rail guidance and forms were not a factor in the accident.

²⁰ Railway Group Standard GE/RT 8000, Handbook 6, Issue 2 'General duties of an individual working alone (IWA)', June 2012. http://www.rgsonline.co.uk/Rule_Book/Forms/Live_Documents.aspx.

²¹ 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>.

²² Railway Group Standard GE/RT 8000 Handbook 7, Issue 2 'General duties of a controller of site safety (COSS)', June 2012. http://www.rgsonline.co.uk/Rule_Book/Forms/Live_Documents.aspx.

Summary of conclusions

Immediate cause

160 The immediate cause of the accident was that the off-track inspector was in a position where he could be struck by train 2W06 (**paragraph 62**).

Causal factors

161 The off-track inspector had a reduced awareness of his position with respect to the line. This was probably because he was unfamiliar with the site of the inspection and therefore focussed on determining his location (**paragraph 72, no recommendation**).

162 The off-track inspector's awareness of his position with respect to the line may also have been reduced because he needed to concentrate on some elements of the lineside vegetation inspection (**paragraph 79, no recommendation**).

163 The off-track inspector was working under a planned safe system of work which was unsuitable for the inspection. Had the most appropriate safe system of work for the inspection been used, the accident would have been avoided. The off-track inspector was working under an unsuitable system because;

- a. He did not realise when implementing the safe system of work that there was insufficient available sighting distance at the site of the inspection (**paragraph 93, Recommendation 1 of RAIB report 07/2013 (paragraph 185)**); and
- b. The information provided to support his verification and approval of the safe system of work did not effectively highlight the lack of available sighting distance at the site of the inspection (**paragraph 99, Recommendation 1 of RAIB report 07/2013 (paragraph 185)**).

164 The planner had issued the off-track inspector with a Red Zone COSS/IWA safe system of work pack, even though it would be unsuitable to implement at the site of the inspection. The planner issued this pack because;

- a. She was unfamiliar with the site of the inspection due to the size of her area of responsibility (**paragraph 103, Recommendation 1**); and
- b. The information provided to support her when planning safe systems of work either did not effectively highlight the lack of available sighting distance at the site of the inspection or was found by her to be impracticable to use given her workload (**paragraph 111, Recommendations 1 and 3, Recommendation 2 of RAIB report 07/2013 (paragraph 186)**).
- c. The planner issued Red Zone COSS/IWA safe system of work packs for the majority of routine lineside vegetation and fencing inspections. This was probably because;
 - i. The off-track section had only a limited range of safe systems of work available to use when planning lineside inspections (**paragraph 118, no recommendation**);

- ii. There was probably an informal agreement reached within the off-track section that Red Zone safe systems of work packs would be issued for the majority of lineside inspections (**paragraph 125, Learning point 1**); and
- iii. Safety monitoring data provided to senior managers appeared to show that the off-track section's usage of Red Zone SSOW was within targets (**paragraph 128, Recommendation 2**).

Underlying factors

- 165 The planning workload within the off-track section planner had increased to the point where it undermined the planner's ability to effectively plan safe systems of work (**paragraph 137, Recommendation 3**).
- 166 Data from the ELLIPSE system used by senior managers to monitor the percentage of Red Zone working being undertaken by the off-track section was inaccurate (**paragraph 142, Recommendation 2**).

Observations

- 167 The initial classification of the incident as a near-miss could, in other circumstances, have resulted in a significant delay in the off-track inspector receiving medical treatment (**paragraph 147, Learning point 2**).
- 168 The section manager was unaware of all of the requirements placed on him as a responsible manager by NR/L2/OHS/019. This was because he had not been briefed on the duties of the responsible manager before undertaking the role. The RAIB found that the intent of this standard regarding responsible manager approval of non-cyclic SSOW packs has been understood and interpreted differently within Network Rail (**paragraphs 150, 151 and 152, Recommendation 4**).
- 169 A complete list of the factors which a COSS/IWA working alone should consider when calculating the required warning time and sighting distance are not included either in the relevant sections of the railway rule book or within Network Rail guidance. They also do not appear in some versions of Network Rail form RT9909 (**paragraph 154, Recommendation 5**).

Previous RAIB recommendations relevant to this investigation

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

- the checking of appropriate safe systems of work from planners (Tinsley Green; RAIB report 43/2007);
- site familiarity of COSS (West Acton; RAIB report 15/2009);
- the selection of staff to undertake safety leadership roles (Washwood Heath; RAIB report 01/2011); and
- the methods by which COSS and planners can develop their understanding of the available sighting distance when planning, verifying and implementing SSOW (Roydon; RAIB report 07/2013).

More detail of these recommendations and the actions taken in response are provided below.

Tinsley Green (RAIB report 43/2007)

171 Recommendation 6 of this report reads as follows:

Network Rail should implement a process to ensure that any person requesting that a plan be prepared by a Works Scheduler checks that an appropriate safe system of work has been selected and the adequacy of the resulting 'Record of Site Safety Arrangements and Briefing' form. This check should include a review of the accuracy of data contained and completeness of hazard identification.

172 In response to this recommendation, Network Rail reported to the Office of Rail Regulation (ORR) that issue 8 of standard NR/L2/OHS/019 would require SSOW to be approved by a responsible manager and verified by the COSS/IWA nominated to undertake the work. Issue 8 would also require cyclic tasks to be verified by the responsible manager every 12 months.

173 Issue 8 of standard NR/L2/OHS/019 was published in September 2010 and implemented in December 2010. The ORR considered in April 2011 that the intent of this recommendation had been implemented. This issue of the standard was current during the planning and implementation of the SSOW for the inspection of lineside vegetation at Bulwell (paragraphs 28 and 149).

West Acton (RAIB report 15/2009)

174 Recommendation 1 of this report reads as follows:

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.*

- 175 In response to this recommendation, Network Rail reported to the ORR that it had re-briefed the requirement for the COSS to have sufficient geographical knowledge to verify the adequacy of the SSOW pack 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.
- 176 The national briefing document referred to in Network Rail's response is safety bulletin IGS 217 'Local Knowledge and Safe Systems of Work'²³. 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'.*
- Network Rail has confirmed to the RAIB that the contents of this safety bulletin were incorporated into issue 8 of standard NR/L2/OHS/019 and that it remains in effect.
- 177 Network Rail also reported that compliance to standard NR/L2/OHS/019 had also been included within audits of Infrastructure Maintenance Delivery Units and Infrastructure Projects Programmes. Based on these responses, the ORR considered in June 2010 that this recommendation had been implemented. The audit of Derby MDU undertaken in May 2012 included within its scope the compliance of the off-track section to the requirements of NR/L2/OHS/019 (paragraph 141).

Washwood Heath (RAIB report 01/2011)

- 178 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.

- 179 In response to this recommendation, Network Rail reported to the ORR that it had introduced an element of pre-selection against a range of behavioural markers into its training course for new COSS in December 2010. This assessment against behavioural markers had been extended to cover the recertification of existing COSS from June 2011.
- 180 Network Rail has also developed a training course entitled 'Managing Site Safety', which is mandatory for front line supervisors and team leaders (a category which includes off-track inspectors). The training course is intended to help attendees understand the role they have in developing and leading a safety culture within Network Rail. The course covers subjects including work planning, challenging unsafe practice and the implications of not complying with procedures. The first course took place in May 2011.
- 181 Based on these responses, the ORR considered in November 2012 that this recommendation had been implemented.

²³ Network Rail Infrastructure Group Safety Bulletin IGS 217 'Local Knowledge and Safe Systems of Work', 2009.

- 182 Network Rail has stated to the RAIB that, by the end of November 2012, 2,647 staff had attended and passed the 'Managing Site Safety' course, with around 1,000 staff still needing to attend. Network Rail has also confirmed that the off-track inspector involved in the accident at Bulwell had attended and passed the course.
- 183 Network Rail has additionally reported that existing holders of a COSS competence working for either Network Rail or its principal contractors will be required to undertake a 'Non-technical Skills' (NTS) development day. This is intended to develop the thinking and interpersonal skills needed to undertake the COSS role.
- 184 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.

Roydon (RAIB report 07/2013)

- 185 Recommendation 1 of this report reads as follows:

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.*

- 186 Recommendation 2 of this report reads as follows:

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.*

- 187 There has not yet been a response from Network Rail to the ORR in relation to these recommendations, which have not been remade in this report in order to avoid duplication.

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

- 188 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 alternative SSOW for the same activity, if different systems could potentially be adopted by the COSS/IWA depending on the conditions at site. This is termed as having ‘parallel’ SSOW;
 - A modified RT9909 form is produced as part of the SSOW pack. This allows COSS/IWA to calculate multiple warning times and sighting distances within a single form.
 - There is an automatic interface with the sectional appendix and national hazard directory, which will insert targeted extracts of both into the SSOW pack. This should reduce the amount of data which planners and COSS/IWA have to consider when planning, verifying and implementing SSOW.

Network Rail has reported that SSOWPS 2 was shown to be quicker to use in trials than the previous version. Network Rail expects that its introduction will reduce the workload of planners.

- 189 Network Rail is introducing a new electronic asset management information system known as ORBIS. This will initially feature digitised infrastructure diagrams, with further layers of data (such as overhead line equipment and access points) being added by 2018. As part of the roll-out of this system, Network Rail has launched a pilot study which involves this data being accessed remotely by staff using smart phones and tablet computers; this is expected to improve their site familiarity.
- 190 Network Rail is also developing a system called TrackView, which is intended to provide photographs of any location on their infrastructure both from above and also forwards and rearwards, as if viewed from a train. This new system is again expected to improve the site familiarity of staff, once it is introduced.
- 191 Network Rail has stated within its ‘Transforming Safety & Wellbeing vision and strategy document for 2012 – 2024’ that it plans, by 2015, to prohibit the use of Red Zone lookout (including COSS/IWA) SSOW when working near junctions and for moving work-sites, such as inspections on foot. Staff will be required from this point onwards to use a more protective type of SSOW from within the hierarchy of safe systems of work.
- 192 Network Rail’s East Midlands route has briefed all responsible managers across the route as to the requirements of issue 8 of NR/L2/OHS 19, including the requirement for responsible managers to review and accept SSOW packs (paragraph 28). In addition, senior managers at Network Rail have tried to improve the availability of line blockages to infrastructure maintenance teams based at Derby MDU by both increasing the number of line blockages which each signaller can manage simultaneously and also by working to reduce the number of conflicting line blockages granted by GZAC.

Learning points²⁴

193 The RAIB has identified the following key learning points.

- 1 It is important that the principles of the hierarchy of safe systems of work (as stated in standard NR/L2/OHS/019) are properly applied during the planning, approval and verification of SSOW (**paragraph 164c(ii)**).
- 2 Staff are advised that, when a train has struck something whilst passing persons working on or around the line, this should be treated as an accident for the purposes of Module M1 of the railway rule book until such time as it can be established that no person was struck by the train (**paragraph 167**).

²⁴ '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.

Recommendations

194 The following recommendations are made²⁵:

- 1 *The intent of this recommendation is that Network Rail provide information to those responsible for the planning, approval and verification of safe systems of work as to which safe systems of work it considers are appropriate for specific locations and circumstances.*

Network Rail should make information available to those responsible for the planning, approval and verification of safe systems of work about which safe systems of work it considers to be appropriate for a specified section of the line. This information should support the application of the principles of the hierarchy of safe systems of work. Network Rail should ensure that the information:

- takes account of variations such as different types of work, resource levels, times of day and environmental conditions;
- is periodically validated and maintained; and
- is easily accessible to those responsible for the planning of safe systems of work.

(paragraphs 163b, 164a and 164b).

- 2 *The intent of this recommendation is to ensure that the use of Red and Green Zone safe systems of work is being effectively monitored.*

Network Rail should review the effectiveness of the current arrangements in place to monitor the usage of Red and Green Zone safe systems of work. It should identify and implement any appropriate measures identified as necessary for this monitoring to be effective (paragraphs 164c (iii) and 166).

continued

²⁵ 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 them to carry out their 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.

- 3 *The intent of this recommendation is for Network Rail to ensure that the resources required to plan and approve safe systems of work are adequate within off-track sections.*

Network Rail should determine what resources are necessary for the effective planning and approval of safe systems of work within off-track sections. It should take action to ensure that the required resources are available and that systems are put in place to ensure that they will remain so should additional tasks be assigned to these sections in the future (paragraphs 164b and 165).

This recommendation may also apply to other parts of Network Rail where staff are required to work on or near the line.

- 4 *The intent of this recommendation is for Network Rail to examine if the role of responsible manager has been effectively implemented within its organisation.*

Network Rail should establish if the requirement within NR/L2/OHS/019 issue 8 for non-cyclic safe systems of work to be approved by the responsible manager has been effectively implemented. In doing this it should specifically consider:

- how the requirement was promulgated throughout its organisation;
- the briefing and training of responsible managers; and
- other barriers to implementation.

It should develop a plan to implement any appropriate changes identified (paragraph 168).

- 5 *The intent of this recommendation is to provide staff required to go on or near the line with clear and consistent information regarding the calculation of required warning times when working alone.*

Network Rail, in conjunction with RSSB, should review, and improve where necessary, the sections of the railway rule book and any standards, guidance and forms relevant to the patrolling, examining or inspecting of an open line when working alone. The review and any improvements made should aim to provide clear and consistent information regarding the calculation of required warning times (paragraph 169).

Appendices

Appendix A - Glossary of abbreviations and acronyms

AiTL	Assessment in The Line
COSS	Controller of Site Safety
DMU	Diesel Multiple Unit
FFCCTV	Forward Facing Closed Circuit Television
IME	Infrastructure Maintenance Engineer
IWA	Individual Working Alone
LOWS	Lookout Operated Warning System
MDU	Maintenance Delivery Unit
MST	Maintenance Scheduled Task
ORBIS	Offering Rail Better Information Services
ORR	The Office of Rail Regulation
PTS	Personal Track Safety
RAIB	Rail Accident Investigation Branch
SSOW	Safe System of Work
SSOWPS	Safe Systems of Work Planning System
TOWS	Train Operated Warning System
WAIF	Work Arising Identification Form

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.

Assessment in the line (AiTL)	A system used by Network Rail to manage the competence of its employees involved in work that can affect operational safety or performance.
Ballasted area	For the purposes of a lineside vegetation inspection, this is defined as the area between the outside edges of the ballast shoulders.
Basic visual track inspection	An inspection of the track by a competent person which is intended to identify defects that, if uncorrected, could affect the safety or reliable operation of the railway before the next inspection. Generally undertaken on foot.
CCTV level crossing	A level crossing which is checked by the signaller by means of CCTV to ensure that it is clear before the barriers are lowered.*
Cess	The area alongside the railway. For the purposes of a lineside vegetation inspection, this is defined as the ground from the outer edge of the ballasted area to 3 metres from the running rail.
Cess strip	For the purposes of a lineside vegetation inspection, this is defined as the ground 3 to 5 metres from the running rail.
Chain	A unit of length equal to 66 feet or 22 yards (20.1168 m). There are 80 chains in one standard mile.*
Core planner skills 1	A now obsolete safe system of work planning competency. Person holding this competency could plan safe systems of work in accordance with NR/L2/OHS/019 but only under the authority of a responsible manager who held a core planner skills 2 competency. Replaced in 2011 by the safe systems of work planner competency.
Core planner skills 2	A now obsolete safe system of work planning competency. Person holding this competency could plan safe systems of work in accordance with NR/L2/OHS/019. Replaced in 2011 by the safe systems of work planner competency.
Cyclic task	An inspection or maintenance task which is performed to a frequency schedule specified in Network Rail standards.
Control centre of the future	A system providing computerised enhancements to the facilities available in railway control rooms.*
Controller of site safety (COSS)	A person certified as competent to implement a safe system of work for a group of persons on Network Rail controlled infrastructure.
Diesel multiple unit	A multiple unit train whose source of power is a diesel engine.*

Down	In a direction away from London, the capital, the original railway company's headquarters or towards the highest mileage.
ELLIPSE	A work management system used by Network Rail to record details of assets, cyclic tasks and arising work.
Emergency brake application	A brake application that uses a more direct and separate part of the control system than that used for a full service brake application.
Five mile line diagrams	A straight line diagram of a section of Network Rail controlled infrastructure which shows the location of stations, access points, signals and bridges. It may also include details of curve radii.
Geospatial information portal (GI portal)	An electronic database maintained by Network Rail which provides geographic information on the layout of the track, stations, level crossings and the boundaries of the railway. Information is presented using schematic drawings, maps and photographs. Part of this system was formerly known as MARLIN.
Green zone	A site of work on or near the line within which there are no train movements (other than within work sites where there may be movements of engineering trains or on-track plant at walking pace) or where a safe distance from the line can be maintained.
Green zone guide	<p>A Network Rail publication made available to all who need to plan or undertake work on their infrastructure. The guide details;</p> <ul style="list-style-type: none"> ● 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.
Linespeed	The maximum permitted speed at which trains may run when not subject to any other instruction or restriction.*
Lookout	A competent person whose duties are to watch for and to give an appropriate warning of approaching trains by means of whistle, horn or lookout operated warning system.*
Lookout operated warning system (LOWS)	A system in which approaching trains are detected by a lookout who triggers a warning of flashing lights and sirens and/or personal warning devices.
Lone working	Work being undertaken by a person working alone.

Maintenance scheduled task (MST)	A cyclic inspection or maintenance task which has a frequency prescribed in Network Rail standards and which is scheduled using the ELLIPSE system.
National hazard directory	A database that identifies the hazards on Network Rail controlled infrastructure. It also contains access point information and information about other locations on the rail infrastructure.
Non-cyclic task	Any task which is not being performed to a frequency schedule specified in Network Rail standards. For the purposes of planning safe systems of work, this would include any cyclic task which has not yet been verified by the responsible manager, in conjunction with a COSS/IWA who is familiar with the area.
Non-driver's side	The opposite side of a train from the driving position. On the mainline railway this is usually the right hand side of the train in the direction of travel.
Off-track inspector	A Network Rail member of staff responsible for inspecting and recording the condition of off-track assets. Tasks undertaken may include the inspection of drainage systems, lineside fencing, access points, lineside vegetation and some elements of level crossings.
Off-track section	A Network Rail infrastructure maintenance section with responsibility for the inspection and maintenance of drainage systems, lineside fencing, access points, lineside vegetation and some elements of level crossings.
On or near the 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.
On train data recording system (OTDR)	Equipment fitted on-board the train which records the train's speed and the status of various controls and systems relating to its operation. This data is recorded to a crash-proof memory and is used to analyse driver performance and train behaviour during normal operations or following an incident or accident.
Personal track safety (PTS)	A qualification required by people who need to go on or near the line.
Planner	A person certified as competent to plan safe systems of work.
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	Defined by Network Rail standard NR/L2/OHS/019 as a site of work on or near the line, which is not protected from train movements.
Red zone prohibited	An area where the use of a Red Zone safe system of work is not permitted because the movement of trains presents an unacceptable risk eg where there is no available position of safety or where the sighting distance that can be achieved is insufficient to provide the warning time required.
Responsible manager	The person responsible for the management of staff working on or near the line. This would typically be a line manager or an on-call manager.
RIMINI planner	A former role within Network Rail's organisation that was responsible for planning safe systems of work under the risk minimisation (RIMINI) principle. Superseded by the planner.
Safe system of work (SSOW)	Arrangements to make sure a workgroup that is required to walk or work on or near the line is not put in danger by the movement of trains.
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.
Safe systems of work planner	An individual certified as competent to plan a safe system of work for themselves, an individual or group of people required to go on near the line in accordance with NR/L2/OHS/019.
Safe systems of work planning system (SSOWPS)	A Network Rail computer system used to plan safe systems of work and which creates the documents used to form the safe system of work pack.
Sectional appendix	A Network Rail publication which details the layout, direction and maximum permitted speed of running lines. It also shows the location of stations, tunnels, level crossings and other relevant lineside features. Running lines are shown schematically and without geographic context (such as curvature).
Sighting distance	The distance at which trains must be seen in order to give adequate warning time.
Site warden	A member of staff appointed to warn staff working near tracks that are open to traffic if they move outside their safe working area.
Sleeper	A beam made of wood, pre- or post-tensioned reinforced concrete or steel placed at regular intervals at right angles to and under the rails.*
Train Operated Warning System (TOWS)	A system which detects an approaching train automatically via signalling equipment and gives a warning via sirens.

Up	In a direction towards London, the capital, the original railway company's headquarters or the lowest mileage.
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.
Work Arising Identification Form (WAIF)	A form used to generate a new work order or to update or modify a work order already recorded on the ELLIPSE system.

Appendix C - Key standards current at the time

Network Rail Standard NR/L2/OHS/019 Issue 8	'Safety of people working on or near the line'
Network Rail Standard NR/L2/TRK/5201 Issue 4	'Management of lineside vegetation'
Network Rail Form TEF/3079 Issue 1	'Lineside vegetation inspection form'
Network Rail Standard RT 3170 Issue 9	'A Guide to Personal Track Safety'
Railway Group Standard GE/RT 8000 Handbook 1, Issue 2	'General duties and track safety for track workers'
Railway Group Standard GE/RT8000 Handbook 6, Issue 2	'General duties of an individual working alone (IWA)'
Railway Group Standard GE/RT8000 Handbook 7, Issue 2	'General duties of a controller of site safety (COSS)'

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