



Rail Accident Investigation Branch

Rail Accident Report



Derailment at Godmersham, Kent 26 July 2015

Report 05/2016
April 2016

This investigation was carried out in accordance with:

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

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Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

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

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

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

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

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

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

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

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Derailment at Godmersham, Kent

26 July 2015

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Summary

At around 21:40 hrs on Sunday 26 July 2015, a passenger train derailed after striking eight cows that had gained access to the railway at Godmersham in Kent, between Wye and Chilham stations. There had been a report of a cow on the railway an hour earlier, but a subsequent examination by the driver of the next passing train did not find anything. There were no further reports from other trains that passed before the accident occurred.

The train involved in the accident was travelling at 69 mph (111 km/h) at the point of impact. There were 67 passengers on board plus three members of staff; no injuries were reported at the time of the accident. Because the train's radio had ceased to work during the accident, the driver ran on foot for about three-quarters of a mile towards an oncoming train, which had been stopped by the signaller, and used its radio to report the accident.

The accident occurred because the fence had not been maintained so as to restrain cows from breaching it, and because the railway's response to the earlier report of a cow on the railway side of the fence was insufficient to prevent the accident. In addition, the absence of an obstacle deflector on the leading unit of the train made the derailment more likely.

The RAIB has identified two learning points and made five recommendations. The learning points concern the railway's response to emergency situations, including the response to reports of large animals within the boundary fence and the actions to take following an accident. The recommendations address the fence inspection process, clarification of railway rules in response to reports of large animals within the boundary fence, the fitting of obstacle deflectors to rolling stock, and the reliability of the train radio equipment.

Introduction

Key definitions

- 1 Metric units are used in this report, except when it is normal railway practice to give speeds and locations in imperial units. Where appropriate the equivalent metric value is also given.
- 2 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B. Sources of evidence used in the investigation are listed in Appendix C.

The accident

Summary of the accident

- 3 At around 21:40 hrs on Sunday 26 July 2015, train 2R66¹, the 20:10 hrs Southeastern service from London Charing Cross to Ramsgate, struck eight cows that had gained access to the railway at Godmersham in Kent, between Wye and Chilham stations (figure 1). The train travelled for approximately 365 metres after the first impact and stopped with the leading carriage, which had completely derailed, leaning about 20 degrees to the left above an embankment slope (figure 2).

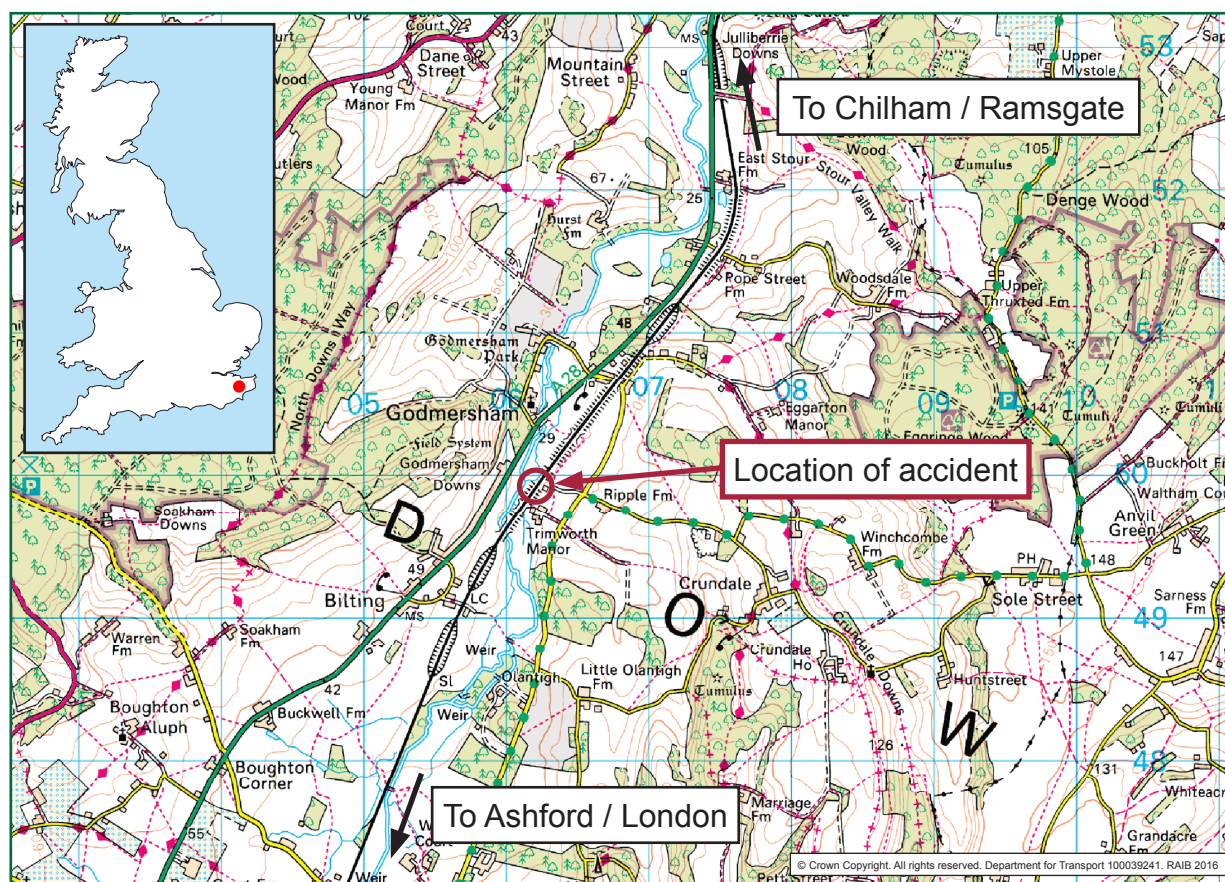


Figure 1: Extract from Ordnance Survey map showing location of accident

- 4 The train was travelling at 69 mph (111 km/h) at the point of impact and the evidence suggests that the leading *wheelset* derailed when the train struck the first two cows. It is likely that the other wheels on the leading vehicle derailed when the train subsequently struck the remaining cows.
- 5 There were 67 passengers on board the train (one of whom was in the leading carriage), plus three members of staff: the train driver, the guard and another driver riding as passenger in the rearmost carriage (referred to in this report as the ‘travelling driver’). No injuries were reported at the time of the accident.

¹ An alphanumeric code, known as the ‘train reporting number’, is allocated to every train operating on Network Rail’s infrastructure.

- 6 During the course of the derailment, the train struck a bridge parapet wall (known locally as Trimworth Bridge) on the *down* side of the railway, destroying the wall and its railings, and causing damage to the abutments. There was significant track damage, including deformation of the rails in the vicinity of the bridge (figure 3).



Figure 2: The derailed leading carriage of train 2R66



Figure 3: View of damage to the track and bridge as a result of the derailment

Context

Location

- 7 The accident occurred on the down line of the Ashford (Kent) to Ramsgate (via Canterbury West) line, which is electrified on the 750 volts direct current (DC) *third rail* system. The maximum permitted speed for trains at this location is 70 mph (113 km/h). The signalling system is *track circuit block* and is controlled from the Canterbury-Wye Area Control Centre (CWACC).

- 8 The point of first impact was approximately 28 metres past the 62¼ milepost and the train came to a stand around seven metres before reaching the 62½ milepost. The first evidence of derailment was found about 29 metres after the impact point. The cows had breached the boundary fence about 40 metres beyond the train's stopping point, some 400 metres from the point of impact, and there was evidence that they had wandered up and down the cess for some distance. These, and other key locations referred to in this report, are represented in figure 4.

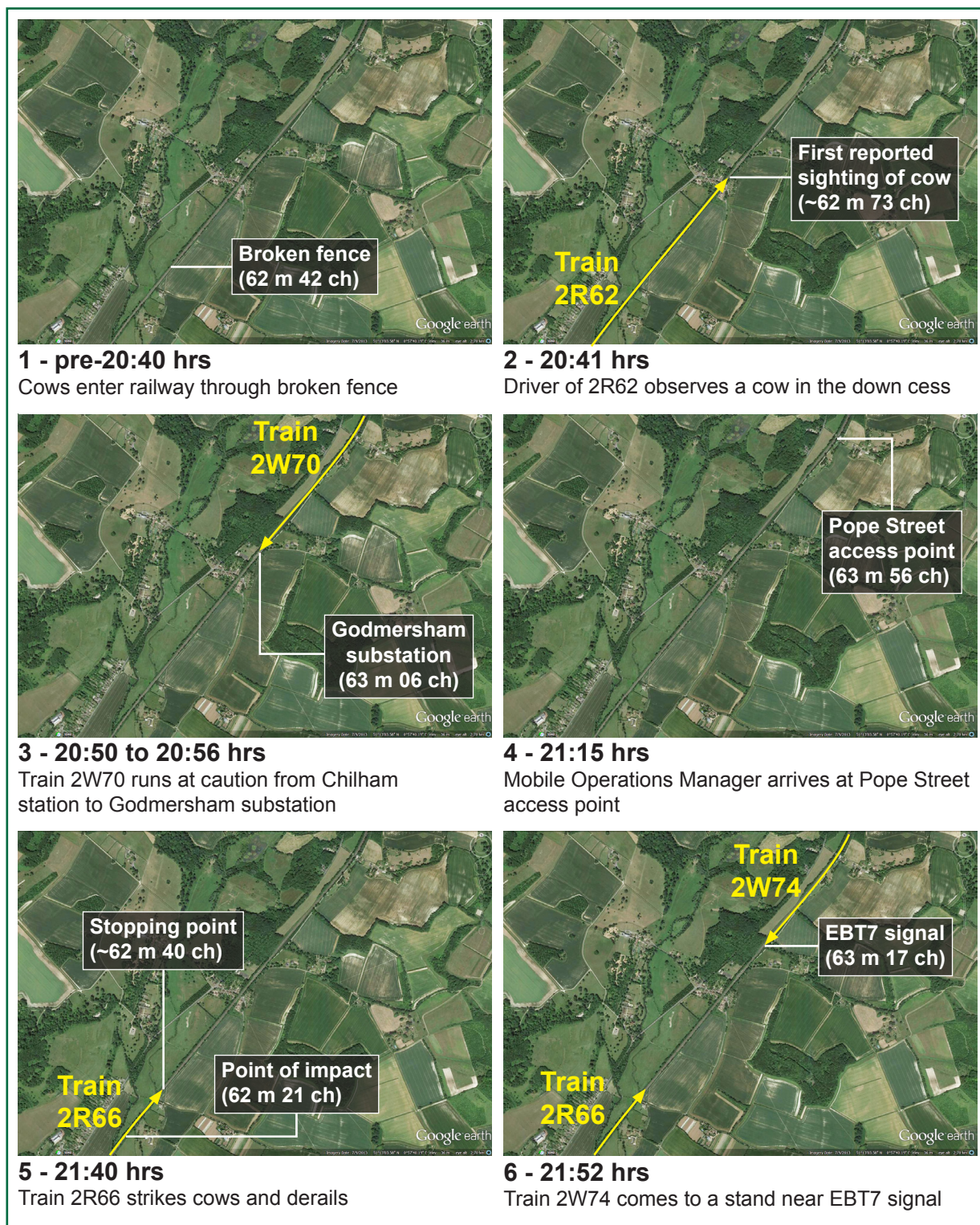


Figure 4: Google Earth view of the accident vicinity showing key locations referred to in this report (with track locations in miles and chains where relevant)

Organisations involved

- 9 The train was operated by London & South Eastern Railway Limited (LSER; trading as Southeastern), who employed the driver, the guard and the travelling driver.
- 10 Network Rail was the infrastructure manager and employer of the signaller, the fencing inspector and the *Mobile Operations Manager* (MOM) involved.
- 11 These organisations freely co-operated with the investigation.

Rail equipment involved

- 12 The railway boundary fence in this area probably dated from around 1961 when the line was electrified. At the time of the accident, the fence comprised concrete posts with 10 strands of wire, with closer spacing of the strands towards the bottom of the fence, overlaid with hexagonal netting covering the lower half of the fence (figure 5). This netting was added following an incident in 2012 when sheep managed to gain access to the railway.

Train involved

- 13 Train 2R66 was formed of two class 375 *electric multiple units*, each of four carriages, with unit 375703 leading and 375612 trailing.
- 14 The train sustained substantial damage to the bogies and underframe equipment of the leading vehicle, as well as impact damage to the exterior of the driver's cab as a result of striking the bridge. In addition, a passenger saloon window was damaged towards the rear of the leading carriage on the right-hand side (in the direction of travel). Although the outer toughened glass pane had smashed, the inner laminated pane had not been penetrated.

Staff involved

- 15 The train driver had been driving for LSER since February 2014 and, prior to the accident, his competence had been most recently demonstrated in an assessment on 2 April 2015. Although he had several years' train driving experience with another operator, he re-trained as a novice driver upon joining LSER after a career break.
- 16 The travelling driver had been driving for LSER for 16 years.
- 17 The signaller had been employed on the railway for 11 years, most of which had been spent working at the CWACC. The competence of signallers is managed by Network Rail on a three-year cycle; the signaller's cycle was last refreshed on 30 November 2014. He also passed a simulated assessment for an animal incursion in July 2013.
- 18 The fencing inspector had been employed by Network Rail for 12 years, and had been working in the *off-track section* for seven of those years. Paragraph 52 discusses competence management for fencing inspectors.

External circumstances

- 19 The weather was dry at the time of the accident; however, the light was fading. Sunset on the evening occurred at 20:53 hrs and the accident took place just after the onset of *nautical twilight*, which began at 21:34 hrs.



Figure 5: Sections of fence at Godmersham showing the site which was breached by the cows (top) and a representative area approximately 40 metres from the animal incursion (bottom)

The sequence of events

Events preceding the accident

- 20 At 20:41 hrs, the driver of train 2R62 (the 19:10 hrs service from London Charing Cross to Ramsgate) reported to the CWACC signaller that he had seen a cow in the down cess approximately 500 yards on the approach to EBT7 signal (figure 4, image 2). He reported this using the train's *GSM-R* radio system while on the move, soon after seeing the cow.
- 21 Two minutes later, the signaller informed the *Kent Integrated Control Centre* (KICC), who in turn stated that they would dispatch a MOM to the area to investigate as soon as possible. The signaller said that he would caution the next train through the section (see paragraph 57), and commented that he often received reports of animals on the line in that area (see paragraph 58).
- 22 At 20:50 hrs, the signaller contacted the driver of train 2W70 (the 20:19 hrs service from Ramsgate to London Charing Cross) while the train was at Chilham station. The signaller relayed the information he had been given about the sighting of the cow and instructed the driver to drive at caution, and to try to pinpoint the cow's location.
- 23 The driver of train 2W70 travelled at around 20 mph (32 km/h) for just over two miles after departing from Chilham, and began accelerating up to 70 mph (113 km/h) in the vicinity of Godmersham substation (figure 4, image 3). At about the same time, he also reported back to the signaller that he had not seen a cow in the area. At 20:59 hrs, the signaller reported this to the KICC and stated that he would return to normal working in the area (ie not caution any subsequent trains).
- 24 Around 21:15 hrs, the MOM stated that he had arrived at Pope Street *access point* (figure 4, image 4) and started walking towards Godmersham substation using the down cess. He spent around half an hour in the area searching for cows and inspecting the fence line for evidence of any breach, but did not find anything.

Events during the accident

- 25 At approximately 21:40 hrs, train 2R66 struck the cows and derailed. The driver reported that, due to the fading light, he saw the first two cows only immediately before striking them. The first evidence of derailment was found about 29 metres after the impact point (paragraph 8).
- 26 The driver applied the brakes and once the train had stopped, he contacted the guard, who was in the third carriage of the train, using the train's internal communications system. The travelling driver, realising that an accident had occurred, entered the rearmost cab of the train and overheard this conversation. He then started making his way forward through the train to assist the driver and passengers.

Events following the accident

- 27 At about 21:45 hrs, the driver left the cab and applied a *short circuiting bar* across the third rail and one running rail of the down line in order to de-energise the 750 volt power supply to the train. Because his train radio had ceased to work during the accident, he then ran along the track towards Chilham to find an alternative means of contacting the signaller or warning approaching trains.
- 28 At 21:47 hrs, the travelling driver used his mobile phone to contact the LSER control centre to inform it of the situation. The LSER control centre then passed the message on to the KICC (with which it shares an office), who in turn contacted the signaller. This was the first information that the signaller received about the accident, some 10 minutes after it occurred. The KICC advised the signaller to send an emergency stop message to train 2W74 (the 21:19 hrs service from Ramsgate to London Charing Cross), which left Chilham station at about 21:50 hrs.
- 29 At 21:52 hrs, the signaller used the urgent call facility on the GSM-R system to contact the driver of train 2W74, verbally instructing him to make an emergency stop. Train 2W74 came to a stand near EBT7 signal (figure 4, image 6).
- 30 The driver of train 2R66, having run along the track from his derailed train, arrived at train 2W74 and used its GSM-R radio to contact the signaller at 21:58 hrs. At this point the signaller was in the process of arranging an emergency isolation of the 750 volt power supply to both lines.
- 31 Meanwhile, the MOM had contacted the KICC to report his findings and, in doing so, learned about the accident. During this conversation he saw train 2W74 pass at speed. He accessed the track again at Pope Street and started heading towards Godmersham, but upon seeing the lights of the trains in the distance realised that it would be quicker to return to his vehicle and drive to Godmersham substation access point. He arrived at the accident site shortly after 22:15 hrs.
- 32 The emergency services were on the scene from around 22:00 hrs and, after setting up suitable access to and from the railway, evacuated the passengers from train 2R66 by 23:38 hrs. The 11 passengers on train 2W74 were taken to Canterbury West station where taxis were arranged for their onward travel.
- 33 The derailed train was re-railed on the morning of 28 July 2015 and initially moved to Canterbury West, before being moved to LSER's depot at Ramsgate overnight on 29-30 July 2015. The damaged track was repaired and normal working was resumed on 30 July 2015 with a 50 mph (80 km/h) emergency speed restriction, which was lifted on 7 August 2015.
- 34 On 11 October 2015, two train drivers passing Godmersham substation reported seeing eight sheep on the lineside. This incident was the result of criminal activity. Temporary fencing, which had been erected while renewal of the original fence was taking place, had been damaged and equipment at the site was stolen. The renewals were completed in November 2015 (see paragraph 111).

Key facts and analysis

Background information

Management of the railway's boundary fence

- 35 In Britain, responsibility for the railway's boundary fence rests with the infrastructure manager (ie Network Rail at Godmersham) under the Railway Safety (Miscellaneous Provisions) Regulations 1997. This requirement is based on the principle of preventing unauthorised access to the tracks by people or animals, dating back to Acts of Parliament from 1842.
- 36 Network Rail manages and maintains the boundary according to its company standard NR/L2/TRK/5100, 'Management of Fencing and Other Boundary Measures'². This standard describes the fence inspection regime, specifies an appropriate type of barrier dependent on a risk rating derived from those inspections, and refers to relevant parts of British Standard BS 1722 'Fences' for the detailed requirements of such fences. Fence inspections are carried out as part of the work of local off-track sections within Network Rail.
- 37 The risk rating comprises a score for likelihood of unauthorised access (from 1 to 4), which depends on factors such as the adjacent land use (for instance, grazing livestock results in a score of 3), and a consequence score (also 1 to 4), which is driven primarily by the category of railway (third rail electrification is considered to be a very high risk, scoring 4). Multiplying these two scores (Likelihood × Consequence) then determines the type of barrier required according to a risk matrix (figure 6). For example, a class I barrier could be a brick and mortar wall, a class II barrier includes a chain link fence, while a post and wire fence is an example of a class III barrier. Note that some cells of the risk matrix (figure 6) allow for a relaxation in barrier class to *stock fencing* (ie post and wire) where only livestock are present in the adjacent land.

		Consequence			
		4	3	2	1
Likelihood	4	I	II	II	III
	3	II*	II*	II*	III
	2	II	II	III	III
	1	III	III	III	III

* For livestock, stock fencing may be considered as standard

Figure 6: Risk matrix for determining fence classification (I, II or III) required at a given location, according to NR/L2/TRK/5100

² Issue 2, 26 August 2008.

- 38 In addition, a three-point rating scale is used to record the condition of the fence, which determines any further maintenance action. The condition scores are defined as follows:
- Score 0: Good = fit for current use, no work required
 - Score 2: Poor = fit for current use, but maintenance required
 - Score 4: Very Poor = inadequate condition, maintenance or renewal proposal or enhancement proposal required
- 39 In order to determine a priority for repairs or renewals, all of these scores are combined according to the following equation:

$$\text{Priority} = (\text{Likelihood} \times \text{Consequence}) + \text{Condition}$$

The score obtained from applying this equation is used when a repair or renewal is needed, to determine whether such work is of low priority (score 3-6), medium priority (score 7-12) or high priority (score 13-20). The standard does not indicate any timescales for such repairs, although a subsequent letter of instruction³ did offer guidance for renewals where there had been a change in adjacent land use. In these cases, renewals should be implemented within 3, 12 and 18 months for sites designated high, medium and low risk respectively.

- 40 For post and wire fences such as those installed at Godmersham (paragraph 12), NR/L2/TRK/5100 refers to British Standard BS 1722-2:2000 ('Fences – Part 2: Specification for strained wire and wire mesh netting fences'). A more recent version of this standard (BS 1722-2:2006) states that the use of seven- or nine-strand post and wire is suitable for retaining cattle, and specifies wire spacings that decrease from top to bottom. It also states that hexagonal netting be used for retaining pigs, sheep, rabbits and deer. The British Standard sets out further detailed requirements including, for example, wire diameters for different applications and associated wire tensions, as well as offering a method for testing tension.
- 41 In 2013, Network Rail issued its own specification for stock fencing to be used on all relevant fencing renewals. This specification makes reference to BS 1722-2:2006 and specifies wire diameters, fence height, and other requirements. It is referred to in a company document providing instructions for installing such fences, and Network Rail published a version of this specification as a sub-part⁴ to NR/L2/TRK/5100 on 11 July 2015, although circulation of this document has not yet been widespread within the company.

The accident at Polmont

- 42 A fatal accident occurred when a train struck a cow near Polmont, Falkirk, at 17:55 hrs on 30 July 1984. An Edinburgh to Glasgow express passenger train travelling at about 85 mph (137 km/h) struck a cow on the line and the whole train derailed. The leading carriage ran up the slope of a cutting and came to rest on its side. Thirteen people on the train lost their lives and a further 17 were seriously injured.

³ NR/BS/LI/322 'Framework for the consistent assessment of fencing repairs based on risk' (issue 1, March 2014).

⁴ NR/L2/TRK/5100/3/PSN 2015 rev A specification 'High Tensile Agricultural Stock Fence' (July 2015).

- 43 The investigation report⁵ concluded that the cow probably got onto the line through fencing that had been damaged by trespassers. The report recommended a review of fencing inspection and management arrangements in order to ensure that fences are livestock-proof.
- 44 A few minutes before the accident, the driver of a train on the opposite line saw a cow inside the railway boundary but not actually on the line. He decided to report this at Polmont, his next station stop, because he did not perceive there to be any immediate danger to trains. While he was in the process of doing so, the train involved in the accident passed through the station without receiving a warning about the cow. The report recommended changes to the railway *Rule Book* such that any large animal inside the boundary fence should be treated as an immediate danger to trains. It further recommended that trains should be equipped with radio so that in an emergency, drivers could contact the relevant signaller immediately.
- 45 A factor in the derailment at Polmont was the leading vehicle's relatively low *axle load* and its limited ability to deflect the animal from the path of the train. The report recommended that *obstacle deflectors* should be fitted to trains of the same type, and that consideration should be given to fitting deflectors on other types of rolling stock with relatively low axle loads. This later became a requirement in the relevant Railway Group Standards (see paragraph 66).

Identification of the immediate cause

46 The train derailed as a result of striking a herd of cows on the line.

- 47 Witness evidence and the RAIB's site examination suggest that the train initially struck two cows and at least one wheelset derailed as a result of this initial impact (paragraph 25). Several other carcasses were found under the train, on the tracks behind the train, and on the lineside. The farmer who used the adjacent field reported that eight of his cows were unaccounted for, which is consistent with the number of carcasses found on site.

Identification of causal factors

- 48 The accident occurred due to a combination of the following causal factors:
- a. the fence had not been maintained so as to restrain cattle (see paragraph 49);
 - b. the railway's response to an earlier report of a cow within the boundary fence was insufficient to prevent the accident (see paragraph 55); and
 - c. the absence of an obstacle deflector on the leading unit of the train made the derailment more likely (see paragraph 61).

Each of these factors is now considered in turn.

⁵ http://www.railwaysarchive.co.uk/documents/DoT_Polmont1984.pdf.

The condition of the fence

49 The fence had not been maintained so as to restrain cattle.

- 50 Before the accident on 26 July 2015, the fence in this area was inspected on an annual basis in accordance with standard NR/L2/TRK/5100. Its last inspection was on 2 July 2015 (ie 24 days before the accident). In terms of the risk ratings described at paragraphs 37-38, the inspection report recorded a 'high' likelihood score (3 – as there were grazing livestock in the field at the time of the inspection), a 'very high' consequence score (4 – due to the presence of third rail electrification) and a 'poor' condition score (2 – fit for current use, but maintenance required). This gave it a total risk priority score of 14 out of 20 (ie a high priority; paragraph 39). The inspector also recorded in a separate box on the form that no work was required on this section of fence.
- 51 However, site observations after the accident found evidence of leaning posts, low wire tension and wire corrosion (figure 7).



Figure 7: Degraded section of fence at Godmersham (unaffected by the animal incursion)

- 52 There is no formal competence standard for fencing inspectors within Network Rail, nor is there any guidance to benchmark the condition score for a section of fence against objective criteria. In 2012, Network Rail introduced a training course on boundary inspection, which includes instruction on applying condition scores. However, to date, only a small proportion of relevant staff has completed the course; nobody in the off-track section within Network Rail's *delivery unit* (DU) at Ashford, which is responsible for this area, was aware of the course and the fencing inspector at Godmersham had not attended it. Knowledge is otherwise acquired on the job and through experience, leading to the potential for inconsistency in the ratings given by different inspectors. Similarly, there is no cross-checking or compliance reporting regarding the consistency between different fencing inspectors' assessments.
- 53 Witnesses were critical of the nominal categories available for condition ratings, with no intermediate score between 'good' and 'poor'. The system used in NR/L2/TRK/5100 is derived from earlier company standards that offered a wider scoring range, but the range was compressed when separate standards were combined into one; Network Rail has been unable to explain why the scoring system was changed in this way. The RAIB also noted the apparent ambiguity in the definition of 'poor' condition (fit for current use, but maintenance required).
- 54 The risk rating system provides little sensitivity to discriminate between maintenance priorities in an area such as Kent, where the prevalence of third rail electrification means that most of the risk scores are calculated to be of high priority (paragraphs 38 and 50). Consequently, the off-track section within Ashford DU relies heavily on subjective reports from its fencing inspectors in order to determine which fences need to be prioritised for repair or renewal. The fence at Godmersham was not identified as requiring repair or renewal.

Actions following earlier reports of a cow on the railway

55 The railway's response to an earlier report of a cow within the boundary fence was insufficient to prevent the accident.

- 56 Following recommendations from the Polmont accident in 1984 (paragraph 42) regarding large animals within the railway boundary, the relevant module of the Rule Book⁶ in force at the time of the accident at Godmersham instructs a driver seeing a cow, bull or other large animal inside the boundary fence to:
- a. use the emergency call facility on the train radio equipment;
 - b. warn the driver of any approaching train by sounding the horn, showing a red light or switching on hazard warning indications;
 - c. place a *track-circuit operating clip* and three *detonators* on each affected line, approximately 2 km (1.25 miles) from the obstruction; and
 - d. tell the signaller in the quickest way possible.

The driver of train 2R62 reported that he had seen a cow within the boundary fence to the signaller immediately using the train's GSM-R radio (paragraph 20).

⁶ GE/RT8000/TW1 'Preparation and movement of trains' (issue 9, September 2013), paragraph 43.1.

- 57 The signaller's Rule Book module⁷ states that the signaller must arrange for the line to be cleared if they become aware of a large animal within the boundary fence. It further states that each train should be stopped before entering the affected section and its driver instructed to proceed at caution. This situation must continue until the signaller is sure that the line is again clear, although the Rule Book does not specify what constitutes such assurance.
- 58 The signaller instructed the driver of train 2W70 to proceed at caution and, when the driver reported back that he did not see a cow in the area, the signaller took this as his assurance that the line was clear. He stated that he was also mindful of delaying trains, and that he had in the past received a number of reports of animals on the line in that area which turned out to be false alarms (as drivers perceived animals to be inside the railway boundary fence when in fact they were next to the fence, but in the field). The signaller also knew that the KICC had dispatched a MOM to investigate. Given all this information, and in the absence of clearer guidance about when to resume normal working, the signaller decided to stop cautioning trains after the passage of train 2W70.
- 59 During the conversations between the signaller and the drivers of trains 2R62 and 2W70 each party formed a slightly different understanding about the location of the cow due to some informality and ambiguity in the description of the cow's location, coupled with variations in local knowledge. Consequently, the driver of train 2W70 stopped driving at caution shortly before passing the location at which the cow was reportedly seen (paragraph 23). At this point in the evening, the sun had just set and light was starting to fade (paragraph 19). Furthermore, train 2W70 was an up train and the cows had been seen in the down cess (by the driver of a down train). The view of the down cess as seen by the driver of an up train would have been limited by the presence of the corridor connection on the front of class 375 units, which partially obstructed the driver's view to the right.
- 60 Nevertheless, two more trains passed through the area in the time between the passage of train 2W70 and the accident involving train 2R66, with no further reports being made to the signaller. The last of these passed Godmersham on the up line only a few minutes before the accident occurred.

The absence of obstacle deflectors on the train

61 The absence of an obstacle deflector on the leading unit of the train made the derailment more likely.

- 62 The leading unit of the train, 375703, was not fitted with obstacle deflectors, whereas the trailing unit, 375612, was equipped with them.
- 63 Obstacle deflectors are designed to shield the leading wheels and remove large obstacles (ie cars, trees and large animals) from the path of the train. Their benefit is primarily in preventing derailment as a result of such a collision. RSSB research project T189 ('Optimal design and deployment of obstacle deflectors and lifeguards') found, based on data from 1991 to 2000, that the relative derailment rate (per mile) for trains without obstacle deflectors involved in such collisions is about 75% higher than that for trains with obstacle deflectors.

⁷ GE/RT8000/TS1 'General signalling regulations' (issue 9, September 2014), paragraph 18.2.

- 64 RSSB research project T189 also estimated that the obstacle deflectors already fitted to existing rolling stock (at the time of the report's publication in 2003) save an estimated 0.49 *fatalities and weighted injuries* (FWI) per year; furthermore, that an additional 0.68 FWI could be saved per year if they were retrofitted to the rest of the applicable rolling stock.
- 65 If unit 375703 had been fitted with obstacle deflectors, then it is less likely to have derailed after the impact with the cows. However, there have been instances involving collisions with multiple cows in which the train derailed even though it was fitted with obstacle deflectors, so it is not certain whether this would have prevented the derailment at Godmersham.

Fitting of obstacle deflectors

- 66 Class 375 units are part of a family of units known as Electrostars, and were built between 1999 and 2005. The vehicle standards in force at the time⁸ specified requirements for obstacle deflectors in line with the Polmont recommendations (paragraph 45). These stated that obstacle deflectors should be fitted to vehicles with operational speeds of 145 km/h (90 mph) and above, unless their axleload was above 170 kN, or if they operated only on third rail lines. In the latter case, obstacle deflectors should be fitted to vehicles with operational speeds above 160 km/h. The class 375 units were specified with a maximum operating speed of 100 mph which, for the purposes of the standard, was deemed to be equivalent to 160 km/h.
- 67 According to the associated guidance note⁹ to the vehicle standard, the rationale for the easement in speed above which obstacle deflectors must be fitted to vehicles operating only on third rail lines (ie from 145 km/h to 160 km/h) is that trackside fencing on third rail lines is considered to be more secure than on other lines. Furthermore, the presence of the third rail was thought to discourage trespass (and hence reduce damage to fencing). These conclusions are drawn in a number of historical documents, including the Polmont inquiry report, and are supported by RSSB research (under project T189, using accident data for the year 2000) which found that only a small proportion of total animal strikes occur on lines with third rails.
- 68 However, RAIB's review of these historical documents concludes that the requirements for better fencing on third rail lines are primarily intended to protect against the risk of trespass by (and potential consequent electrocution of) people, especially children, rather than animals. As paragraph 37 explains, Network Rail's standard allows a lower barrier class on third rail lines when only livestock occupy the adjacent land. Analysis of data from RSSB's *Safety Management Information System* (SMIS; see table 1) covering the period 2005-2015 found no evidence that the proportion of animal strikes in the south-east region (which consists primarily of third rail lines) was significantly lower than that for the rest of England or Wales when normalised for passenger train mileage over the same period (the data suggest relatively low rates of collision across England and Wales while Scotland accounts for a disproportionately high number of animal strikes). These findings do not support the assumption that the boundary fence is more secure in the south-east, at least as far as animal incursions are concerned.

⁸ GM/RT2100 'Structural requirements for railway vehicles' (issue 2, April 1997 and issue 3, October 2000. Issue 3 was withdrawn in March 2011).

⁹ GM/GN2560 'Guidance Note: Structural Requirements for Railway Vehicles' (issue 1, October 2000; withdrawn in March 2011).

Region	Number of animal strikes (%)	Passenger train mileage, millions (%)	Animal strikes per million miles
South East	227 (13.4)	627.3 (21.2)	0.36
Rest of England	848 (50.1)	1,936.2 (65.4)	0.44
Scotland	579 (34.2)	256.4 (8.7)	2.26
Wales	39 (2.3)	139.0 (4.7)	0.28

Notes:

- 1) For the purpose of this analysis, the South East region excludes Anglia.
- 2) Train mileage for South East region is based on Southeastern, Southern and South West Trains operators; for Scotland is based on ScotRail, and for Wales is based on Arriva Trains Wales.
- 3) These data do not take into account the distribution of large animals across Great Britain.

Table 1: SMIS data for the number of large animal strikes by area, 2005-2015, and passenger train mileage for those regions (based on ORR data).

- 69 The first batch of 30 class 375 units to be produced, numbered 3756xx, were originally equipped for running both on third rail lines and overhead electrified lines. As such, these were fitted with obstacle deflectors in accordance with the Railway Group Standard. Subsequent units, including the 3757xx series, were intended for running on third rail lines only and so did not have obstacle deflectors fitted (figure 8). Nevertheless, as they are based on the same underframe, the mounting brackets for fitting obstacle deflectors are present.
- 70 Some similar classes of rolling stock built around the same time follow the same pattern (eg the class 377 units that run only on third rail lines do not have obstacle deflectors, while those in the same class that also operate on 25kV lines are fitted with obstacle deflectors). However, there are examples of other comparable rolling stock (eg class 444 and 450 units) that do have obstacle deflectors fitted, even when designed to run only on third rail lines.
- 71 In 2008, a new European Standard¹⁰ was issued which requires obstacle deflectors for all trains running on the national network. The current version of the Railway Group Standard¹¹ for vehicles, and the relevant European *Technical Specification for Interoperability*¹², mandate the European Standard requirements in this respect.

¹⁰ BS EN 15227:2008 'Railway applications – Crashworthiness requirements for railway vehicle bodies'.

¹¹ GM/RT2100 'Requirements for Rail Vehicle Structures' (issue 5, June 2012).

¹² Commission Regulation (EU) No 1302/2014 of 18 November 2014 concerning a technical specification for interoperability relating to the 'rolling stock – locomotives and passenger rolling stock' subsystem of the rail system in the European Union (LOC & PAS TSI).



Figure 8: Comparison of the leading end of unit 375612 (top) and the leading end of unit 375703 (bottom), showing the presence or absence of obstacle deflectors respectively (obstacle deflectors and mounting brackets circled in red; one mounting bracket not visible in bottom image). Note that the unit in the bottom image is mounted on wheel skates for recovery purposes.

Factors affecting the severity of consequences

Crashworthiness

72 The interior of the leading carriage of the train was not significantly damaged in the derailment.

73 Despite the speed of the train at impact (69 mph (111 km/h)) and the potentially severe nature of the accident (see paragraph 75), the driving cab and passenger compartment sustained relatively minor damage as a consequence of the accident. Neither the driver nor the passenger in the leading carriage were physically injured.

74 Two small lighting panels in the centre of the carriage became unhinged, and one door header panel in the forward vestibule detached. A window towards the rear of the carriage was shattered but not penetrated during the derailment (paragraph 14).

The derailment path

75 The train was constrained from falling down the embankment slope.

76 The RAIB's analysis of the derailment path suggests that the consequences were mitigated by two external factors. The first was the impact with Trimworth Bridge (paragraph 6), which deflected the train back towards the railway. Secondly, the path of the leading carriage was constrained by the right-hand wheels running against the inside face of the left-hand rail. These factors reduced the probability of the train falling further down the embankment.

Observations

Post-accident actions

77 The actions of the driver and the signaller following the accident were not fully in accordance with the Rule Book.

78 Rule Book module M1 ('Dealing with a train accident or train evacuation', issue 2, March 2012) states that the driver should take a number of actions to protect the line after an accident. These include showing warning lights on the train, telling the signaller about the accident in the quickest way possible, and carrying out emergency protection if it has not been possible to contact the signaller. Emergency protection includes placing track-circuit operating clips and detonators on lines that have been affected by the accident.

79 Although the Rule Book instructs drivers to use track-circuit operating clips, these will have no effect in areas that use *axle counters* as a means of train detection. In such areas, emergency protection is largely dependent on being able to make an emergency radio call to the signaller in order to stop train movements. Godmersham is a track-circuited area.

- 80 The driver of train 2R66 was understandably distressed after the accident. Upon noticing that the GSM-R radio in his cab was inoperative, he placed a short circuiting bar on the down line and then ran along the track carrying a red light to warn any approaching train (paragraph 27). He did not realise that the GSM-R radio in the rear unit was still operational, so he intended to use a telephone on a signal (if he reached one before an up train approached) to contact the signaller. At the time he placed the short circuiting bar, train 2W74 had not yet passed signal EBT6 at Chilham station, which was the last stop signal on the up line before the accident site. Had he placed track-circuit operating clips on the up line at this time instead, then train 2W74 would have been held at Chilham station because the stop signal would have reverted to red when the clips were applied. However, the driver felt that he was acting in the best interests of passengers' safety by short-circuiting the conductor rail and then going forward to warn an approaching train and/or contact the signaller from a signal post telephone. At that time, the up line was still energised (until it was switched off at 21:56 hrs).
- 81 The Rule Book also states that the signaller must immediately protect the lines, take action to prevent trains approaching the accident and make an emergency broadcast to trains in the area concerned. However, the signaller instead used the urgent call facility to contact the driver of train 2W74 and gave him verbal instructions to make an emergency stop (paragraph 29).

82 None of these actions had an adverse effect on the outcome of the accident.

The inoperative GSM-R train radio

83 The GSM-R radio in the leading unit of the train became inoperative as a result of the accident, which meant that the driver could not use it to immediately contact the signaller to report the accident.

84 Although there are other forms of communication available to drivers (such as signal post telephones), the GSM-R radio is the primary means of communication between drivers and signallers, and its functionality becomes particularly crucial in the immediate aftermath of an accident. Post-accident inspections of the train showed that the *miniature circuit breakers* (MCBs) for the GSM-R radio had tripped in both cabs of the leading unit. This is likely to have been the result of a transient electrical fault during the derailment (the manufacturer of the radio unit, Siemens, advises that this was not a scenario that was considered during the development of the GSM-R cab radio units). Post-accident testing in the depot by LSER showed that the radio successfully re-started when the MCB was reset. However, in the immediate aftermath of the derailment, at a time when the driver was experiencing increased stress, he did not realise that the MCB had tripped and so did not consider that resetting it might have remedied the problem.

- 85 The relevant rail industry standard¹³ requires that, in the event of failure of the 750 volt power supply, the GSM-R radio is capable of maintaining continuous operation for a minimum period of two hours. In practice, this means that the GSM-R is powered by the train's battery during this time. Additional documentation associated with the GSM-R system notes that if the train's batteries have been isolated or have gone flat, then continued operation depends on whether the radio itself is fitted with a secondary power supply that is independent of the train's battery (eg internal batteries). Some train operators do have such a secondary power supply fitted to their GSM-R radios.
- 86 None of the units operated by LSER have a secondary power supply. Ongoing work by the industry in collaboration with the GSM-R manufacturer is currently inconclusive as to whether the radio could have remained functional for the driver after the accident if such a secondary power supply had been fitted; this would have depended on how the power supply had been designed and fitted.

Previous occurrences of a similar character

- 87 As well as the accident at Polmont (paragraphs 42 to 45), a fatal accident occurred in Germany on 13 January 2012 involving a passenger train which collided with a herd of 14 cattle on the line from Stedesand to Langenhorn. The train derailed and the leading carriage overturned. One passenger was killed and two more were seriously injured.
- 88 The RAIB investigated an accident at Letterston Junction, Pembrokeshire, on 12 July 2012 ([RAIB bulletin 05/2012](#)), in which a class 150 train struck several cows and derailed in a similar manner to the train at Godmersham. The RAIB investigation found that the fence had recently been repaired but not to the required standards; also, the train involved was fitted only with a minor obstacle deflector (ie not to the Railway Group Standard specification – although the train was not required by standards to have a full-strength obstacle deflector). The RAIB identified one learning point, which is discussed further at paragraph 105.
- 89 On 28 November 2015, the RAIB attended a derailment at Dalreoch, near Dumbaron, after a class 334 train struck three cows and came to a stop. The train then derailed when the driver attempted to move it clear of the injured cows. Network Rail's preliminary examination identified that the condition of the fence was a potential factor, with a weak point between two adjoining fencing types following renewal works approximately six years before the accident. According to site observations, it appeared that this location coincided with an area where the cows had gathered in order to shelter from driving rain. The fence had last been inspected on 3 February 2015 with a condition score of 0 ('good') and a consequence score of 2 which, when combined with the likelihood score of 3 (for grazing livestock) gave an overall risk score of 6. No renewal or repair work had been planned for this section of fence at the time of the accident.

¹³ RIS-0794-CCS 'Rail Industry Standard for GSM-R Train Voice Radio' (issue 1, March 2013).

Summary of conclusions

Immediate cause

90 The train derailed as a result of striking a herd of cows on the line (**paragraph 46**).

Causal factors

91 The causal factors were:

- a. The fence had not been maintained so as to restrain cattle (**paragraph 49, Recommendation 1**).
- b. The railway's response to an earlier report of a cow within the boundary fence was insufficient to prevent the accident (**paragraph 55, Learning point 1 and Recommendation 2**).
- c. The absence of an obstacle deflector on the leading unit of the train made the derailment more likely (**paragraph 61, Recommendations 3 and 4**).

Factors affecting the severity of consequences

92 Factors that mitigated the consequences of the event were as follows:

- a. The interior of the leading carriage of the train was not significantly damaged throughout the derailment (**paragraph 72, no recommendation**).
- b. The train was constrained from falling down the embankment slope (**paragraph 75, no recommendation**).

Additional observations

93 Although not linked to the accident on 26 July 2015, the RAIB observes that:

- a. The actions of the driver and the signaller following the accident were not fully in accordance with the Rule Book (**paragraph 77, see paragraph 99 and Learning point 2**).
- b. The GSM-R radio in the leading unit of the train became inoperative as a result of the accident, which meant that the driver could not use it to immediately contact the signaller to report the accident (**paragraph 83, Recommendation 5**).

Previous RAIB recommendations and learning points relevant to this investigation

94 The following recommendations and learning points, which were made by the RAIB as a result of previous investigations, have relevance to this investigation.

Previous recommendation that had the potential to address one or more factors identified in this report

Accident at Lavington, Wiltshire, 10 July 2010, RAIB report 08/2011, Recommendation 4

95 The RAIB considers that wider implementation of recommendation 4 in [RAIB report 08/2011](#) could have mitigated the risk associated with the loss of GSM-R radio functionality, as observed in this accident.

96 This recommendation read as follows:

Recommendation 4

First Great Western should review its policy for the use of mobile telephones to take account of Rail Industry Standard on the use of Mobile Telephonic Equipment in Driving Cabs, RIS-3776-TOM. This review should include consideration of how to make current emergency contact numbers available to traincrew.

97 First Great Western responded that all its drivers have contact numbers for signallers and that the drivers were briefed to store these numbers in their company mobile phones. It also briefed drivers on emergency contact numbers for Network Rail control centres and the circumstances under which these should be used (such as the loss of train radio).

98 The ORR¹⁴ considered this response, along with other actions taken by First Great Western, and reported to the RAIB on 23 November 2011 that the recommendation had been implemented.

99 Although this recommendation was addressed to First Great Western (the train operator involved in the accident at Lavington), the RAIB considers that if LSER had taken similar action, then the driver of train 2R66 might have been able to use a mobile phone to contact the signaller or the KICC once he found that the GSM-R radio was not working (paragraph 83). LSER advises that emergency contact numbers are made available to drivers during their training and through *Periodical Operating Notices* (PONs), and through an application on their mobile phones. In the transition from one type of mobile phone to another, the availability of signal box numbers was temporarily lost, but LSER is now rectifying this.

Incident at Greenford, 20 March 2014, RAIB report 29/2014, Recommendation 3

100 The RAIB considers that implementation of recommendation 3 in [RAIB report 29/2014](#) would probably have prompted the signaller to make an emergency broadcast.

¹⁴ Office of Rail and Road, formerly the Office of Rail Regulation. See www.orr.gov.uk.

101 This recommendation was:

Recommendation 3

Network Rail should review and modify as necessary the training given to signallers in the use of GSM-R, so that signallers are given adequate opportunity to become familiar with the use of railway emergency calls, by practice, simulation or any other appropriate means.

102 Network Rail told the ORR that it had reviewed its signaller training programme and is in the process of rolling out a new national GSM-R refresher training programme.

103 The ORR considered this response and reported to the RAIB on 4 December 2015 that the recommendation had been implemented.

104 Because Network Rail is taking action to implement the recommendation, the RAIB does not need to make it again in relation to the signaller's response to the accident (paragraph 81).

Relevant learning points from previous RAIB investigations

Accident at Letterston Junction, 12 July 2012, RAIB bulletin 05/2012, learning point

105 The RAIB identified one learning point as a result of the investigation into the accident at Letterston Junction ([RAIB bulletin 05/2012](#)), which is relevant to this accident:

...the occurrence of this accident demonstrates the importance of preventing livestock from getting onto the railway line. Railway infrastructure managers should ensure that they have adequate arrangements in place to inspect, repair and renew lineside fences and gates, and that their fences and gates are built and installed to a standard which is appropriate for the location and is, where necessary, stock proof.

106 Whilst the current investigation has identified a number of issues associated with management of the boundary fence (paragraph 49), the above learning point remains valid.

Accident at Windsor & Eton Riverside, 30 January 2015, RAIB report 18/2015, learning point 2

107 The RAIB identified four learning points in its investigation into a train fire at Windsor & Eton Riverside ([RAIB report 18/2015](#)), of which the second is relevant to this accident:

This event reinforces the need for train operating companies to provide adequate instruction, information and training to train crew so that they understand the possible ways in which on-train systems, including emergency lighting, can behave when power is cut off, and what can be done to reset systems that have been disabled unintentionally.

108 The relevance of this learning point to the accident at Godmersham is with respect to the driver's awareness of, and response to, the fact that the MCB for the GSM-R radio had tripped, causing the radio to become inoperative (paragraph 83).

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

- 109 Network Rail is in the process of reviewing its boundary management standard (NR/L2/TRK/5100), due for completion in April 2016. This review was already taking place under a wider programme (known as Business Critical Rules) to review its entire standards catalogue, and was not in response to the accident at Godmersham. The RAIB has seen some draft extracts of the off-track Business Critical Rules, in which there does appear to be more detail about the nature and method of fence inspections than was present in NR/L2/TRK/5100. However, there is currently no evidence that it fully addresses the factors identified in this investigation, such as competence and consistency amongst fencing inspectors (paragraph 52), and sensitivity of the risk rating system (paragraph 54). Network Rail is also producing standard design drawings for all its approved fencing specifications.
- 110 In September 2014, Network Rail completed a review of the risks associated with objects obstructing the line. The outcome of this review included a number of actions relevant to mitigating the risks arising from animals on the line, including research to review the configuration of the railway boundary (including fencing).
- 111 Locally, the off-track section at Ashford DU has replaced around 1300 metres of boundary fence at Godmersham, which includes the site of the cow incursion, with chain link fencing. In terms of Network Rail's company standard (NR/L2/TRK/5100), this represents an upgrade to a class II barrier (see paragraph 37).
- 112 Fencing inspectors at Ashford DU have been re-briefed to use a condition score 2 (ie poor – paragraph 38) only if the fence requires maintenance. Otherwise, the condition score 0 (ie good) should be used when no work is required.
- 113 The Ashford off-track section has also instigated a process to review its boundary risk assessments and, where necessary, accelerate the programme for repairs or renewals at high risk sites. It has also been trialling the use of additional measurement tools to quantify the condition of the fence (such as wire diameter and tension).
- 114 LSER, in conjunction with Network Rail and the manufacturer of the GSM-R train radio system, Siemens Rail Automation Ltd, is in the process of investigating the nature of the problem with the radio unit (paragraph 83). As part of this work, LSER issued a *National Incident Report* on 25 November 2015 (which was updated on 26 February 2016) to raise awareness of this issue among other train operators. Work is ongoing to confirm the failure mode, to determine the wider implications for other electric stock types and the impact, if any, of fitting a secondary independent power supply.
- 115 LSER has also instigated a programme of work to evaluate the safety case for retrofitting obstacle deflectors to the class 375 fleet.

Learning points

116 The RAIB has identified the following key learning points¹⁵:

- 1 This accident serves as a reminder of the importance of treating large animals within the boundary fence as an emergency, and staff responding according to the Rule Book (paragraph 91b).
- 2 This accident highlighted the importance of railway staff being familiar with the Rule Book requirements for actions to be taken after an accident (paragraph 93a). There may be some value in refreshing drivers and signallers on the appropriate actions to take following a train accident, such as:
 - through practising responses to emergency situations; and/or
 - providing a simple set of basic instructions (eg a checklist or prompt card) in the signalbox or train cab to guide them through the initial actions in case of emergency.

¹⁵ '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

117 The following recommendations are made¹⁶:

- 1 *The intent of this recommendation is to improve the fence inspection process such that potentially substandard fences are properly identified for repair or renewal. This might be accomplished as part of the Business Critical Rules review of standards.*

Network Rail should modify its risk rating methodology for fencing inspections to include guidance on:

- a) the design of the fence and its appropriateness for the adjacent land use; and
- b) condition ratings based on objective and relative (benchmarked) criteria.

If necessary, Network Rail should commission research to establish the relevant criteria (paragraph 91a).

- 2 *The intent of this recommendation is to improve the railway's response to reports of large animals within the boundary fence in order to reduce the probability, or mitigate the consequences, of any subsequent accident.*

Network Rail should provide clarification for signallers in terms of how they may interpret the Rule Book regarding their response to reports of animal incursions, including guidance on how long to continue cautioning trains and what constitutes being 'sure' that the line is again clear, and re-brief as appropriate (paragraph 91b).

continued

¹⁶ Those identified in the recommendations have a general and ongoing obligation to comply with health and safety legislation, and need to take these recommendations into account in ensuring the safety of their employees and others.

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

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

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

- 3 *The intent of this recommendation is to reduce the risk of derailment arising from collisions with obstacles for electric multiple units operating exclusively on third rail lines.*

London & South Eastern Railway Limited, in conjunction with Govia Thameslink Railway, Porterbrook Leasing Company Limited¹⁷ and Eversholt Rail Group should develop, and then implement, a programme for retrofitting obstacle deflectors to Electrostar units that are not currently fitted, but are equipped with mountings for such deflectors (paragraph 91c).

- 4 *The intent of this recommendation is to address the residual risk of derailment arising from collisions with obstacles for other units on the national network that are not currently fitted with obstacle deflectors, taking a targeted approach by identifying those fleets that are most likely to offer a positive case for fitting of obstacle deflectors.*

RSSB, in consultation with the industry, and involving due industry process, should consider the case for retrofitting obstacle deflectors to units that are not currently equipped, other than those referred to in Recommendation 3 (paragraph 91c). The analysis should include re-evaluation of the findings of previous research in the light of this investigation and select for initial analysis the fleets that are most likely to have a positive case for retrofitting obstacle deflectors.

continued

¹⁷ Govia Thameslink Railway operates Electrostars on another part of the national rail network. Porterbrook Leasing Company and Eversholt Rail Group own the Electrostar vehicles of Govia Thameslink Railway and LSER respectively.

- 5 *The intent of this recommendation is to ensure that drivers have continuous access to a railway emergency call facility in the event of an accident that affects the on-board train radio.*

London & South Eastern Railway Limited, in conjunction with Siemens Rail Automation Ltd and Network Rail, should complete their work to understand the nature of the problem with the GSM-R train radio system in this accident, and then implement reasonably practicable measures to ensure that its drivers have the facility to make an emergency call in similar situations in future (paragraph 93b). Examples of such measures may include:

- a) improving the resilience of the GSM-R radio system following an accident such as a derailment;
- b) providing drivers with GSM-R handheld units;
- c) ensuring that all relevant signalbox telephone numbers are stored in drivers' company mobile phones; and/or
- d) providing guidance to drivers on the actions to take if the GSM-R radio becomes inoperative.

On completion of its work, LSER should update the National Incident Report it raised on this matter (paragraph 114).

Note: This recommendation may be applicable to other train operators.

Appendices

Appendix A - Glossary of abbreviations and acronyms

CWACC	Canterbury-Wye Area Control Centre
DU	Delivery Unit
FWI	Fatalities and Weighted Injuries
GSM-R	Global System for Mobile Communications – Railways
KICC	Kent Integrated Control Centre
MCB	Miniature Circuit Breaker
MOM	Mobile Operations Manager
PON	Periodical Operating Notice
SMIS	Safety Management Information System

Appendix B - Glossary of terms

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

Access point	A designated point along a railway at which entry to railway property may be made safely.*
Axle counter	A track-mounted device that accurately counts passing axles to determine whether the section is clear or occupied.*
Axle load	The loading imposed on the track by a given axle on a train.*
Cess	The space alongside the line.*
Delivery Unit	A unit consisting of staff responsible for the maintenance of an area of railway.*
Detonators	A small disc-shaped explosive warning device designed to be placed on the rail head for protection and emergency purposes. It explodes when a train passes over thus alerting the driver.*
Down	The line normally used by trains travelling away from London.
Electric multiple unit	A multiple unit that can be driven and controlled as a single unit from the driving cab at the leading end and whose motive power is electrically supplied externally from (in this case) the conductor rail.*
Fatalities and weighted injuries	A concept used by the railway industry when recording safety performance or comparing risk; one fatality is deemed equivalent to ten major injuries, or 200 minor injuries.*
Global System for Mobile Communications – Railways	A national radio system which provides secure voice communications between trains and signallers.*
Kent Integrated Control Centre	A facility based at Blackfriars, London, where staff from Network Rail Control and their counterparts from LSER are co-located.
Miniature circuit breaker	An automatic switch designed to protect an electrical circuit from damage caused by overload or short circuit.*
Mobile Operations Manager	An operations manager who provides first-line response to incidents.*
National Incident Report	A railway industry wide system to communicate technical and safety issues to all bodies.
Nautical twilight	The period when the centre of the sun is between 6 and 12 degrees below the horizon; large objects may be seen but no detail can be distinguished ¹⁸ .

¹⁸ <http://astro.ukho.gov.uk/nao/miscellanea/twilight/>.

Obstacle deflector	A structural device placed at the leading end of a rail vehicle with the objective of shielding the leading wheelset and removing any large obstacles from the path of the train ¹⁹ .
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.
Periodical Operating Notice	A bi-monthly publication containing notices concerning operations on the railway.*
Rule Book	Railway Group Standard GE/RT8000, which is the publication detailing the general responsibilities of all staff engaged on the railway system, and the specific duties of certain types of staff such as train drivers and signallers.*
Safety Management Information System	A database of incidents and accidents occurring on the national railway network, managed on behalf of the railway industry by RSSB.*
Short circuiting bar	A heavy L-shaped metal bar which is hooked over the running rail and dropped onto the conductor rail in order to either maintain the conductor rail in a discharged state or to discharge the traction current in an emergency.*
Stock fencing	Post and wire fencing of a specification suitable to retain livestock (as defined in Network Rail's standard NR/L2/TRK/5100).
Technical specification for interoperability	European legislation which mandates certain (minimum) common standards across the European Union, allowing 'inter-operation' without the need for territory specific modifications to vehicles.*
Third rail	Common term for a single conductor rail positioned on the sleeper ends.*
Track circuit block	A signalling system where the line beyond each signal is automatically proved clear to the end of the overlap beyond the next signal using track circuits or another means of automatic train absence detection, such as axle counters.*
Track circuit operating clip	A pair of spring clips connected by a wire, used to short out track circuits by connection across the rails in times of emergency.*
Wheelset	Two rail wheels mounted on their joining axle.*

¹⁹ GM/GN2686 'Guidance on rail vehicle bodyshell, bogie and suspension elements' (issue 1, December 2010).

Appendix C - Investigation details

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

- Information provided by witnesses;
- Information taken from on-train data recorder (OTDR) and forward-facing closed-circuit television systems on relevant trains;
- Site photographs and measurements;
- Weather reports and observations at the site;
- Voice recordings of communications with the signaller, signalling data and signalbox written records;
- Fence inspection reports and associated maintenance files;
- Relevant Network Rail standards, Railway Group Standards and British Standards;
- Research reports from British Rail, Network Rail and RSSB;
- A review of similar reported accidents and incidents;
- Legislative documents relating to management of the railway's boundary; and
- A review of previous RAIB investigations that had relevance to this accident.

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