RAIB

Rail Accident Investigation Branch

Rail Accident Report

Fatal accident at Mexico footpath crossing (near Penzance)
3 October 2011

Department for Transport

Report 10/2012
June 2012

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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Fatal accident at Mexico footpath crossing (near Penzance), 3 October 2011

Contents

Summary

At around 15:50 hrs on Monday 3 October 2011, a pedestrian was struck and fatally injured by a train on Mexico footpath crossing, near Penzance in Cornwall. On approaching the crossing round a curve, the train driver had observed a person standing to the side of the line and had sounded the warning horn immediately before the train reached the crossing. However, the pedestrian then attempted to cross and was struck.

Although it is not possible to be certain why the pedestrian attempted to cross, the RAIB considers that she either misjudged the speed of the approaching train or misjudged her position in relation to the approaching train. She probably saw the train too late to make a reasoned judgement about whether she should cross.

The driver had also sounded the train's horn as required by a lineside 'whistle' board when the train was approximately 15-16 seconds from the crossing, and out of sight. If the pedestrian had heard and responded to the sounding of the train's horn at this stage, it is likely that she would not have passed through the gate and onto the crossing until the train had passed. The RAIB considers that the sounding of the horn when the train was 15-16 seconds from the crossing did not serve its function of warning the crossing user of the approaching train for one of the following reasons:

- the sound of the horn was inaudible to her; or
- she heard a horn being sounded, but did not distinguish it as coming from a train; or
- she did not register that the train horn was sounded, because she was only approaching the crossing at this time and not yet focused on crossing the railway.

The RAIB has made five recommendations. Three recommendations have been made to Network Rail regarding improvements to sighting and warning arrangements for pedestrians using Mexico footpath crossing, developing a national approach to the location and marking of decision points at level crossings and optimising warning arrangements for pedestrians at level crossings provided with whistle boards. One recommendation (in two parts) has been made to RSSB regarding improving intelligence on near-miss incidents at level crossings and enhancing its processes for reviewing the effect of changes made in 2007 to arrangements for sounding train horns at whistle boards. One recommendation has been made to First Great Western regarding a change to standards to require objective testing of horns after a train has been involved in an incident or accident.

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.

2 The RAIB does not establish blame or liability and does not carry out prosecutions.

Key definitions

3 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.

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

The accident

Summary of the accident

5 At approximately 15:50 hrs on Monday 3 October 2011, train 2C47, the 13:50 hrs service from Plymouth to Penzance, struck and fatally injured a pedestrian, Mrs Jeanette Nicholls, on Mexico footpath crossing, near Penzance in Cornwall (see figure 1).

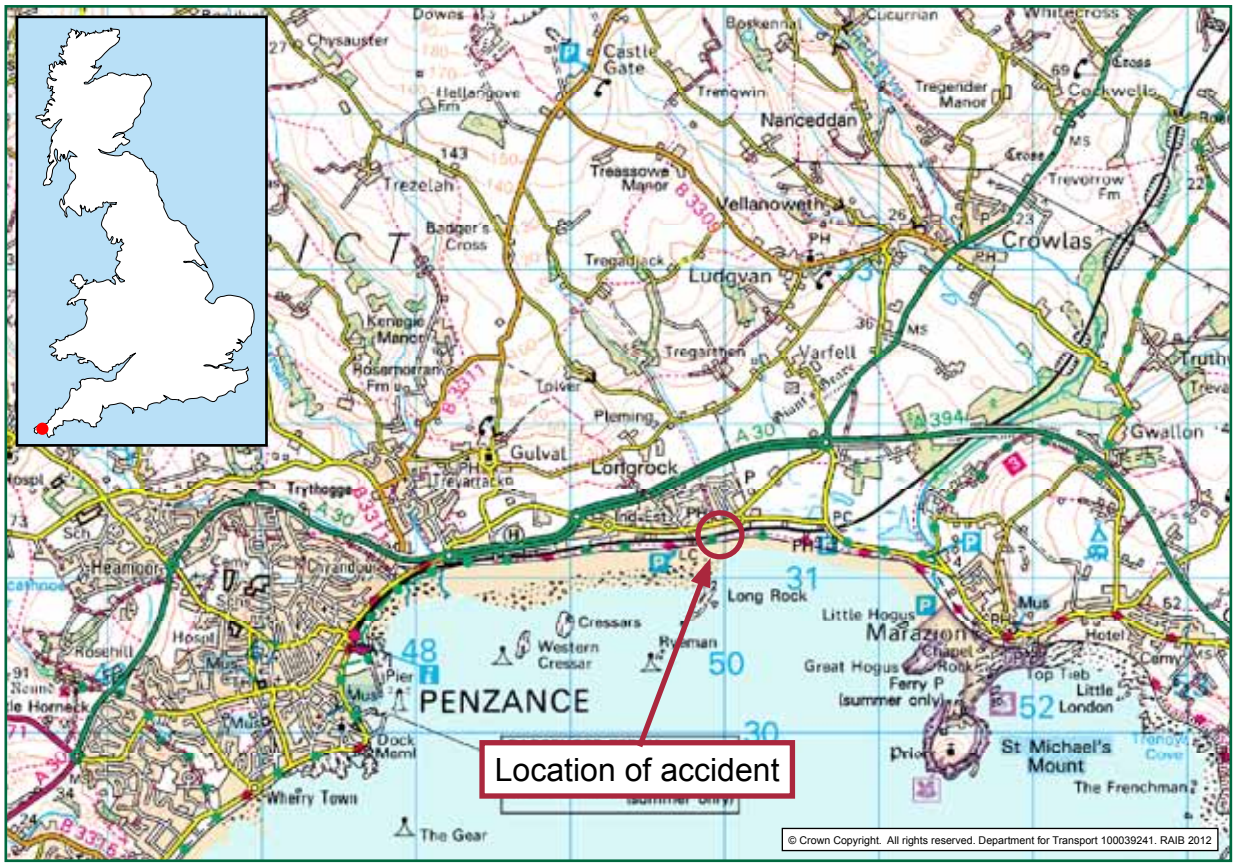

Figure 1: Extract from Ordnance Survey map showing location of accident

Context

Location

6 Mexico footpath crossing is located at 325 miles 02 chains[1] from London Paddington (via Bristol) on the main line from Paddington to Penzance. Penzance station is situated approximately one and a half miles (2.5 km) to the west of the crossing and St Erth station around four miles (7 km) to the east. Mexico footpath crossing is a basic crossing for pedestrians and is not equipped with lights, horns or barriers. Pedestrians are required to check that it is safe to cross before doing so. Long Rock level crossing is situated approximately 200 metres to the west of Mexico footpath crossing; see figures 1 and 2. Long Rock is a public road level crossing with barriers, monitored by closed circuit television (CCTV) and controlled from the signal box at Penzance.

[1] There are 80 chains in a mile.

Figure 2: Google Earth image showing overview of Mexico footpath crossing and its immediate surroundings

7 The general layout at the crossing and key dimensions are given in figure 3. The crossing is on a stretch of single line, which is used by trains in both directions. The railway runs approximately east to west at this location and the footpath crossing, which crosses the railway at right angles, is referred to in the remainder of this report as being on a north/south axis.

8 Immediately to the south of the crossing is a footpath and cycle track with access to the beach. To the north of the crossing is a track leading to the main road and the village of Long Rock; see figure 4. There is a low bank which separates the railway from the coastal path to the east and west of the crossing. A pedestrian's approach to the crossing from the south cuts through the bank, which restricts their view to the east.

Organisations involved

9 Network Rail is the owner of the infrastructure at Mexico footpath crossing and employed the staff who undertook site visits to gather data about the crossing environment and its usage and used that data for risk assessments.

10 First Great Western operated train 2C47 and employed the driver of the train.

11 Network Rail and First Great Western freely co-operated with the investigation.

Train involved

12 Train 2C47 was formed of a two-car Class 150 unit, no. 150121. The class 150 units were manufactured between 1984 and 1987 by British Rail Engineering Limited.

13 The RAIB has found no evidence to link the condition of the train with the cause of the accident.

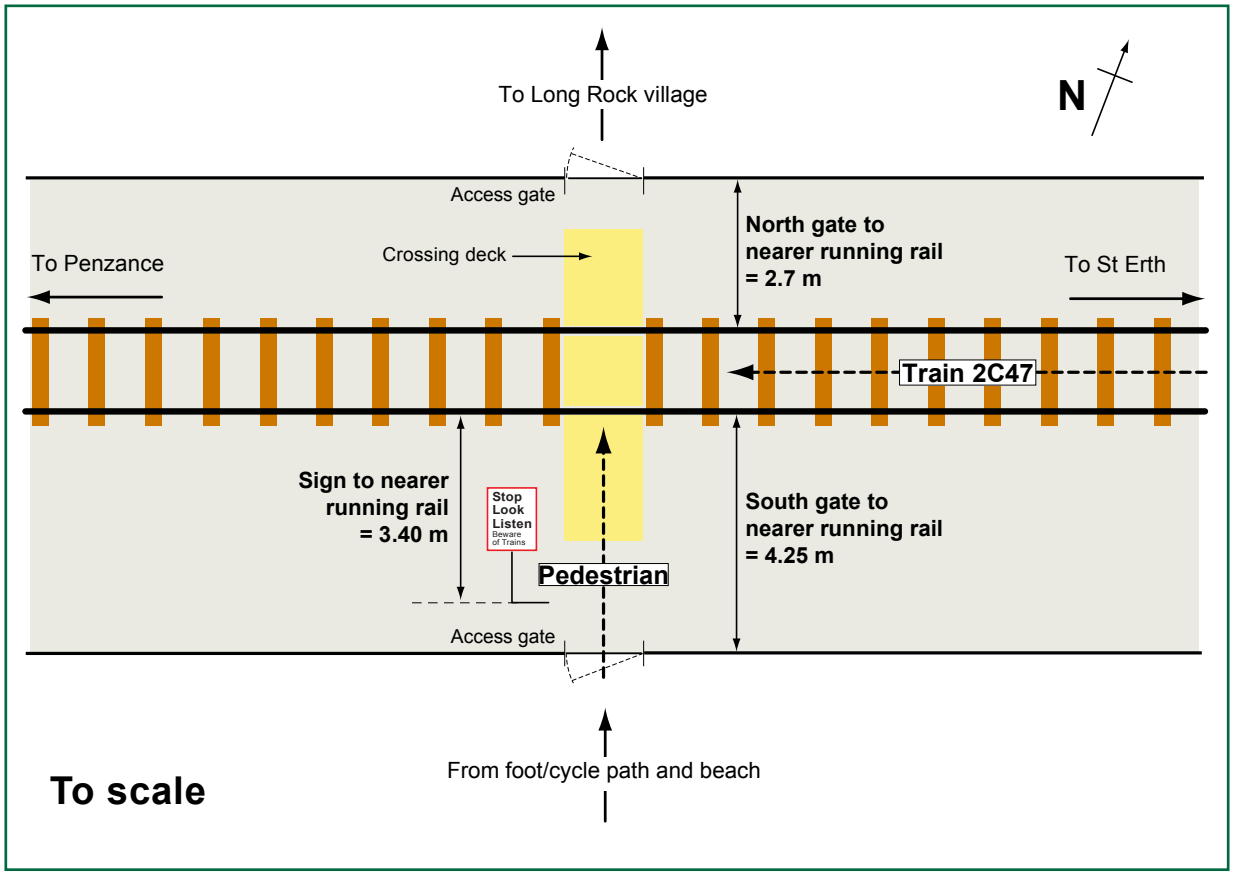

Figure 3: Layout of Mexico footpath crossing

Figure 4: Mexico footpath crossing from the south (beach) side

Level crossing infrastructure

14 The crossing is equipped with self-closing metal gates on the north and south sides and signs which instruct users to stop, look and listen and beware of trains; see figure 5. The signs correspond with the template for non-vehicular crossings contained in the Private Crossings (Signs and Barriers) Regulations 1996.

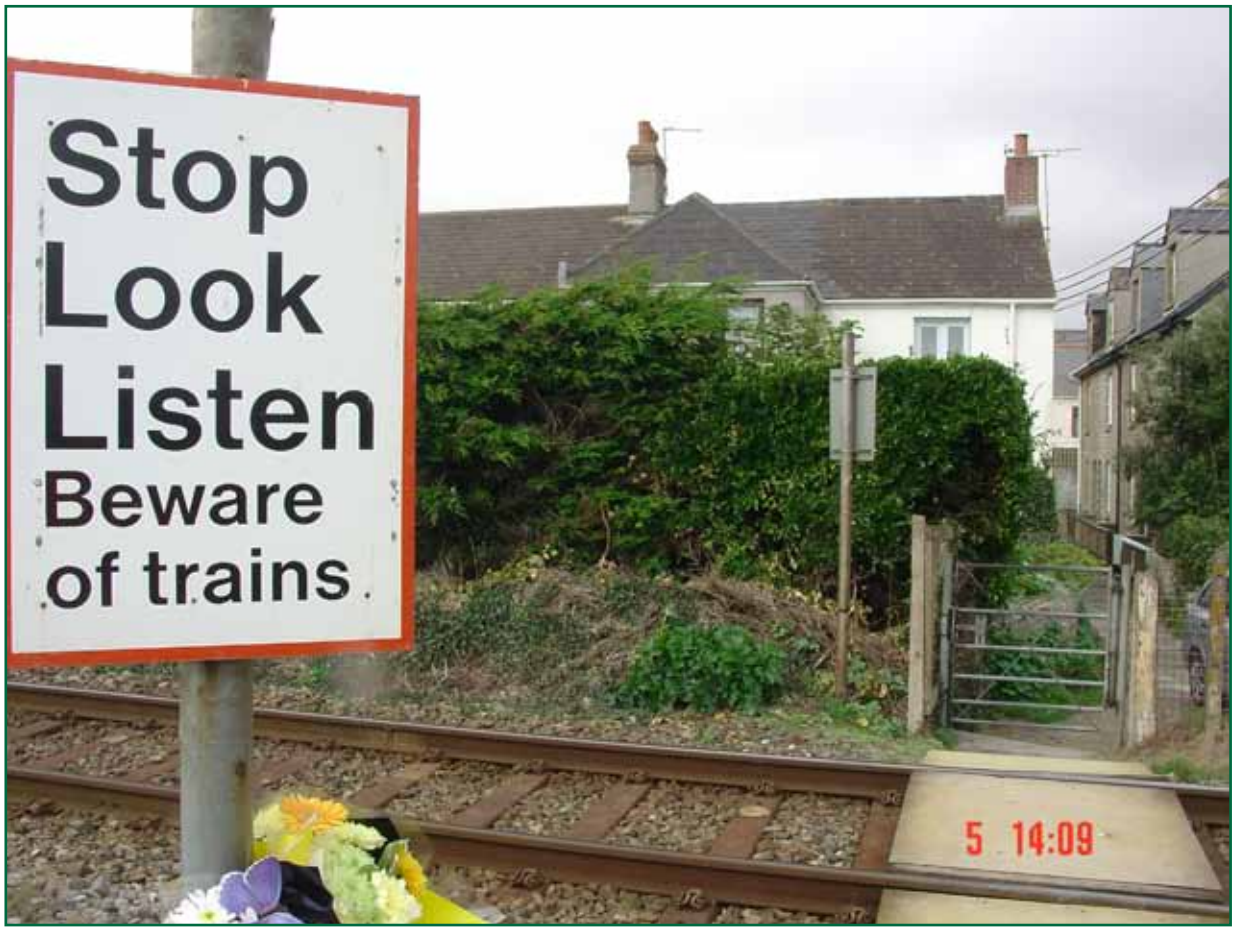

Figure 5: Signage at the crossing (view taken from south side)

15 The crossing is made of timber decking with a non-slip surface. There were no deficiencies in the condition of the crossing deck. There is a difference in height between the access lane on the north side of the crossing and the railway, which necessitates a slope between the gate and the crossing on the north side. There is a shallower slope on the south side of the crossing.

16 Trains are limited to a maximum speed of 50 mph (80 km/h) over Mexico footpath crossing when running towards Penzance and 70 mph (113 km/h) when running towards St Erth.

The pedestrian

17 Mrs Nicholls was aged 73. She was a local resident and had used the crossing for many years on a frequent basis. She was prescribed spectacles and was wearing them at the time of the accident. She had no known impairment to her hearing. She was described by her family as being fit and healthy and someone who exercised regularly.

External circumstances

18 The RAIB has obtained weather data from Penzance heliport, which is situated less than a mile from Mexico footpath crossing. Weather readings are taken at 20 minutes and 50 minutes past each hour. On 3 October 2011, the data for 15:50 hrs (almost exactly the same time that the accident occurred) was:

- Wind direction: 260 degrees (almost directly from the west)
- Wind speed: 9 knots (10.4 mph, equivalent to 4.7 m/s)
- Visibility: 6000 metres
- Weather: light drizzle
- Cloud: a broken layer at 400 ft and overcast at 600 ft
- Temperature: 17 degrees Celsius

19 It is possible that the wind may have affected the audibility of the train horn from the crossing, and the drizzle may have affected Mrs Nicholls's ability to see the approaching train clearly through the spectacles that she was wearing. These factors are discussed later in the report at paragraphs 73 and 77 to 83.

20 The railway runs along the coast as it approaches Penzance. The time of the accident coincided almost exactly with low tide. The sound of the surf breaking on the beach should not therefore have been a factor in this accident.

21 There were no flights operating into and out of the heliport during the afternoon of 3 October 2011 because of fog in the Scilly Isles. Noise made by helicopters was not a factor in the accident.

The sequence of events

22 Train 2C47 had previously stopped at St Erth, from where it departed at about 15:44 hrs. When the train was around 355 metres from Mexico footpath crossing, the driver sounded the train's horn (as required by a lineside 'whistle' board). The driver allowed the speed of the train to drop to 48.3 mph (78 km/h), slightly under the maximum permitted speed at this location (paragraph 16). As the train rounded a curve and the crossing came into view, the driver of train 2C47 stated that a pedestrian was between the crossing gate and the railway, standing to the left of the train. The pedestrian was stationary.

23 The driver sounded the train's horn as a warning to the pedestrian, who either looked, or was already looking, towards the train. Just before the train reached the crossing, the driver applied the train's brakes and then lost sight of the pedestrian, who had, at the last minute, attempted to cross and was struck.

24 Train 2C47 stopped in the vicinity of Long Rock CCTV crossing. The driver contacted the conductor and then the signaller at Penzance to report the accident. The emergency services, including British Transport Police, were called and attended the scene of the accident.

The investigation

Sources of evidence

25 The following sources of evidence were used:

- witness statements given to First Great Western and the British Transport Police;
- information obtained by the RAIB from staff and members of the public who were in the vicinity of Mexico footpath crossing at the time of the accident or who had information relevant to the crossing or previous accidents and incidents;
- data from the train's On Train Data Recorder (OTDR);
- site photographs and measurements;
- video images of a train driver's view of the route through Mexico footpath crossing;
- video images taken at Mexico footpath crossing;
- weather reports from Penzance heliport;
- the Network Rail level crossing file;
- a review of previous reported occurrences at the crossing; and
- a review of previous RAIB investigations that had relevance to this accident.

Acknowledgements

26 The RAIB would like to thank:

- Track Access Productions Ltd, who supplied video images of the train driver's view of the route through Mexico footpath crossing (normally used for driver training purposes); and
- British International Helicopters, the operator of Penzance heliport, who provided weather information for the day of the accident.

Key facts and analysis

Background information

Level crossing risk on Britain's railways

27 Data supplied by member states of the European Union to the European Rail Agency and collated by RSSB[2] in its Annual Safety Performance Report[3] shows that the UK has the safest level crossings of all the member states.

28 At the end of 2010, there were approximately 6,300 level crossings on Network Rail infrastructure, of which around 36% were footpath crossings. RSSB calculates the risk associated with level crossings on behalf of the railway industry in a safety risk model, and publishes the data in its risk profile bulletin. The information is used in the Annual Safety Performance Report; the report for 2010/11 estimates the average risk from all level crossings to be 10.6 Fatalities and Weighted Injuries[4] per year, with 62% of this risk arising from pedestrians being struck by trains.

Guidance on level crossings provided by the Office of Rail Regulation

29 Guidance on level crossings is provided by the Office of Rail Regulation[5] (ORR). Paragraphs 149 to 164 of the guidance are concerned with footpath and bridleway crossings. Extracts from the guidance that are relevant to the accident at Mexico footpath crossing on 3 October 2011 are included in table 1; the paragraph numbers in this table refer to the corresponding paragraphs in the guidance document. As the guidance was reissued in August 2011 (and again in December 2011), the equivalent clauses from the version it replaced are included with relevant paragraph numbers in the second column.

Sighting of trains for pedestrians at Mexico footpath crossing

30 Mrs Nicholls was crossing from the south (beach) side to the north. Train 2C47 was approaching the crossing from the east.

31 When approaching the crossing from the south side, the user first turns to the left (facing west) to walk parallel to the railway before encountering a gate, which is opened towards the user, allowing access to the crossing. When closed, the gate completes a barrier that is 4.25 metres from the nearer rail. The view from the gate to the east is limited by line curvature and a bank on the right; see figure 6.

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[2] The company is registered as 'Rail Safety and Standards Board', but trades as 'RSSB'.

[3] Available at www.rssb.co.uk.

[4] The figure for Fatalities and Weighted Injuries is calculated by assigning a value of 1 for each fatality, 0.1 for each serious injury and 0.005 for each minor injury.

[5] Level Crossings: A guide for managers, designers and operators. Railway Safety Publication 7, August 2011. Office of Rail Regulation.

Extracts from August 2011 guidance	Equivalent clauses in previous version
Users are expected to use reasonable vigilance to satisfy themselves that no trains are approaching before they start to cross the line. They should cross quickly and remain alert while crossing. Users should have sufficient time from first seeing, or being warned of, an approaching train to cross safely (paragraph 150).	Identical text (paragraph 138)
A sign displaying how to cross safely should be displayed at the decision point[6]. For footpath crossings, this should be not less than 2 metres from the nearest running rail… (paragraph 155).	The decision point is a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety. For footpath crossings, this should be not less than 2 metres from the nearest running rails (Appendix E).
The warning time should be greater than the time required by users to cross between the decision points at either end of a crossing (paragraph 160).	Identical text (paragraph 147)
As a guide, a walking speed of 1.2 metres/second may be used (when calculating traverse time) when the surface is level and close to rail level. In other cases 1 m/s may be more appropriate. Increase the calculated time to cross to take account of foreseeable circumstances such as impaired mobility of users, numbers of pushchairs and bicycles or where there is a slope or step up from the decision point (paragraph 161)[7].	A speed of 1.2 m/s should be used where the surface is at or near to rail level and 1 m/s where the surface is at the standard profile of the ballast. The calculated time in traversing the crossing should be increased to take account of foreseeable circumstances such as impaired mobility of users, numbers of prams and bicycles or where there is a slope or step up from the decision point (paragraph 148).
When the warning time is insufficient, additional protective equipment should be provided and may include…audible warning of trains (preferably generated at the crossing itself). Where train speeds are low and the service infrequent[8], whistle boards[9] positioned not more than 400 metres from the crossing may help give warning of a train's approach (paragraph 162).	Where the warning time is insufficient, additional protective equipment may be provided as follows: (a) audible warnings from trains – whistle boards positioned not more than 400 metres from the crossing (paragraph 149).

Table 1: Extracts from guidance provided by the ORR on design and operation of level crossings showing relevant clauses from the August 2011 and previous versions

[6] Network Rail's practice is to increase traverse time by 50% if there is a 'higher than usual' number of vulnerable people using the crossing. Network Rail defines vulnerable people as 'children, elderly, disabled, vision impaired, pushchair users and those with learning difficulties'.

[7] The Office of Rail Regulation's guidance does not define 'low train speeds' or 'infrequent services'.

[8] A lineside sign instructing a train driver to sound the train's horn.

[9] The decision point is defined in the Office of Rail Regulation's guidance as '…a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety'.

Figure 6: View east from the gate on the south side of the crossing (4.25 metres from the nearer rail)

32 The sign which instructs users how to cross safely was located between the gate and the track at a distance of 3.40 metres from the nearer rail. At this location, the view to the east for a user is marginally better than that from the gate; see figure 7.

Figure 7: View east from a position alongside the sign on the south side of the crossing (3.40 metres from the nearer rail)

33 When assessing *sighting distances* at level crossings, it is Network Rail's practice in its Western route (which includes Mexico footpath crossing) to take measurements from a position two metres from the nearer rail; see figure 8. This corresponds with the minimum distance defined in the guidance from the Office of Rail Regulation (table 1). At two metres from the nearer rail, a user can see further to the east than is possible from 3.40 metres.

Figure 8: View east from a position on the south side of the crossing (2 metres from the nearer rail)

34 From all three locations, the crossing user's view to the east is partially obstructed by an equipment case and the signal post, but an approaching train can still be seen because of its height and width in relation to the structures. This is discussed later in the report (paragraph 65 and figure 10).

35 In order to establish the actual sighting distance towards St Erth from the south side of the crossing, the RAIB filmed two *down trains* – one from a position 3.40 metres from the nearer rail and the second from a position 2 metres from the nearer rail. Using OTDR data from those two trains to confirm their speed, it was possible to establish a more exact sighting distance for down trains approaching at 50 mph (80 km/h); see table 2. The RAIB's measurements were taken from the time at which the whole of the front of the train was visible. The measurements were taken from a height of 1.45 metres above ground, which corresponds approximately with the view that Mrs Nicholls would have had.

36 Table 2 also includes an RAIB estimate of sighting distance from the gate using laser measuring equipment and Network Rail's 2010 estimate of sighting from a point two metres from the nearer rail, using laser measuring equipment. Both of these measurements were taken from a height of 1.6 metres above ground, which is where Network Rail normally takes its measurements for sighting purposes. The RAIB also filmed one of the trains referred to in paragraph 35 at 1.6 metres above ground level and confirmed that the difference between the viewing heights of 1.45 metres and 1.6 metres had no effect on the time at which a train could first be seen from the crossing.

Location	Sighting eastwards (metres)	Comment
Gate (4.25 metres from nearer rail)	c. 125	RAIB estimate (October 2011) using laser measuring equipment
Sign (3.40 metres from nearer rail)	c. 150	RAIB calculation using video and OTDR evidence (May 2012)
2 metres from nearer rail	c. 190	RAIB calculation using video and OTDR evidence (May 2012)
2 metres from nearer rail	c. 210	Network Rail estimate (November 2010) using laser measuring equipment

Table 2: Sighting to the east from various locations on the south side of the crossing

Warning times and traverse times for pedestrians at Mexico footpath crossing

37 The traverse distance at Mexico footpath crossing, based on the definition of the decision point given in Office of Rail Regulation guidance (table 1), would be measured from 3.40 metres from the nearer rail on the south side of the crossing to two metres beyond the further rail on the north side of the crossing. However, this is the minimum traverse distance because it takes the decision point on the south side of the crossing as being the last place at which guidance on crossing safely is visible. The guidance is also visible from the gate (4.25 metres from the nearer rail) and it is possible that users could make their decision to cross at that location, thereby increasing traverse distance and traverse time.

38 Table 3 provides a calculation of the required traverse times from the three locations referred to in table 2 and the sighting time at each point, based on the sighting distances referred to in table 2. Trains approaching the crossing from the east are limited to a maximum speed of 50 mph (80 km/h), which is equivalent to 22.35 metres/second. The traverse distance is measured from the defined location to a point two metres beyond the further rail. The distance between the outer edges of the two rails is 1.6 metres.

	Traverse distance (metres)	Required traverse time (seconds) at 1.2 m/s	Required traverse time for vulnerable users (seconds) at 0.8 m/s	Sighting eastwards (metres)	Available sighting time (seconds)	Available warning time (from train horn) (seconds)
Gate (4.25 metres from nearer rail)	7.85	6.6	9.9	c.125	5.5	15
Sign (3.40 metres from nearer rail)	7.0	5.9	8.8	c.150	6.9	15
2 metres from nearer rail (RAIB measurement 18/05/12)	5.6	4.7	7.0	c.190	8.5	15
2 metres from nearer rail (Network Rail measurement 09/11/10)	5.6	4.7	7.0	c.210	9.4	15

Table 3: Comparison between traverse time and warning time for trains approaching from the east at various locations on the south side of the railway

39 Table 3 shows that based on an assumed walking speed of 1.2 m/s, there was insufficient sighting time available if a decision to cross was made from the gate, and sufficient warning time if a decision to cross was made from the sign or two metres from the nearer rail. For vulnerable users with an assumed walking speed of 0.8 m/s, there was insufficient warning time available if a decision to cross was made from the gate or from the sign and sufficient warning time if the decision was made two metres from the nearer rail.

40 The measurement of sighting distance from 3.40 metres on the south side of the crossing corresponds with ORR guidance, as this is the last point at which a sign displaying information on how to cross safely can be seen. Table 3 shows that when allowance is made for vulnerable users (the need to do so is referred to later in the report), sighting time was insufficient from this location and additional warning was required.

41 Additional warning was provided at Mexico footpath crossing by whistle boards. On the eastern approach, one was located 348 metres from the crossing, and therefore within the maximum specified value of 400 metres (table 1). A horn sounded by the driver of a train at this location would provide a warning to crossing users around 15 seconds before the train arrived, if it was heard. The available warning time is shown in the last column of table 3.

42 One further factor which could have affected traverse time was the slope on the north side of Mexico footpath crossing (paragraph 15). The ORR's guidance refers to increasing traverse time if there is a slope between the decision point and the railway. The RAIB estimated the slope on the north side of Mexico footpath crossing to be at a gradient of around 17.5% (approximately 1 in 6). However, the ORR guidance that was in place before August 2011 merely referred to increasing the traverse time in the event of there being a gradient, and the August 2011 guidance referred to 1 m/s being a more appropriate traverse speed in circumstances other than when the crossing surface is level and close to rail level. As referred to in footnote 4 to table 1, Network Rail increased traverse time to 0.8 m/s if vulnerable users were seen, which was a slower walking speed than the 1.0 m/s suggested by the ORR in its August 2011 guidance. It is therefore doubtful whether the presence of a slope would have merited an assumed traverse speed of less than 0.8 m/s, even if vulnerable users had been identified as well. However, because a horn sounded at the whistle board provided 15 seconds' warning time, a traverse speed of around 0.5 m/s from the sign to a place of safety would still have been sufficient for the crossing to be compliant with the ORR's guidance and Network Rail's own standards.

Network Rail's risk assessment at Mexico footpath crossing

43 Network Rail's operations manual includes its process and requirements for level crossing risk assessment and mitigation. The operations manual identifies the roles and responsibilities of key staff involved in this process:

- Trained staff carry out level crossing site visits for the purposes of gathering information such as measuring sighting distances, undertaking a usage census and noting any other factors which might affect the safety of crossing users, including the presence of signage and general condition of the crossing infrastructure. In Network Rail's Western route (which includes Mexico footpath crossing), it has been the practice for an Operations Risk Control Co-ordinator to gather this information. Elsewhere on Network Rail, the data gathering task has been performed by Mobile Operations Managers, who then forward the information to the Operations Risk Control Co-ordinator.
- The data gathered at the crossing is used by the Operations Risk Control Co-ordinator, who is responsible for:
  - managing the programme of level crossing risk assessments;
  - identifying and analysing risk reduction and mitigation measures;
  - providing advice on level crossing matters; and
  - maintaining level crossing records.
- The Operations Risk Control Co-ordinator reports to an Operations Risk Advisor who is responsible for ensuring that all completed level crossing risk assessments are reviewed, and for considering possible risk reduction measures.

44 Network Rail's operations manual requires that a risk assessment of each footpath crossing is carried out at least once in three years. Additional risk assessments are required when there has been an accident or incident (such as a near-miss) or where a concern about the level crossing has been raised by Network Rail, a train operating company or relevant authority (such as a local council or highways authority). However, there is no requirement to re-assess a crossing where a second near-miss occurs within one year of a previous near-miss, providing a risk assessment was carried out after the first near-miss.

45 Network Rail introduced the All Level Crossing Risk Model (ALCRM) as part of the level crossing risk assessment process in 2007. The results from ALCRM are particularly sensitive to the number of trains and the number of pedestrians using the crossing. Local factors such as near-miss history and specific sighting problems are considered separately by the Operations Risk Advisor's team when reviewing the factors which affect risk at a crossing. The ALCRM provides a prediction of risk which it classifies in the following ways:

- individual risk of fatality (identified by a letter A (high) to M (low)), which relates to the risk of death for an individual using the crossing on a frequent basis (500 times per year); and
- collective risk (identified by a number 1(high) to 13 (low)), which relates to the total risk generated by the crossing. This takes into account the overall risk of death and injury for crossing users, train crew and passengers.

46 Once an ALCRM assessment has been undertaken, Network Rail uses a web-based system known as the Level Crossing Risk Management Toolkit (LXRMTK)[10] to identify possible risk mitigation measures. It provides a listing of options for consideration and indicative costs for each one. The list can be filtered to include only those measures that are relevant to specific crossing types. The principal factors that are considered when assessing the potential benefits of a risk mitigation proposal are the effectiveness and longevity of risk reduction against the cost of the measure proposed.

47 Table 4 provides a summary of key data obtained in the three risk assessments carried out at Mexico footpath crossing before the accident on 3 October 2011. They were completed in accordance with the requirements of Network Rail's operations manual referred to in paragraph 44. Table 4 shows that the risk rating of the crossing fluctuated in the period, the variation being possibly explained by the census data obtained during the visit. However, the ALCRM was being refined and re-calibrated in the period and this also had an effect on risk scores, which makes comparison between them difficult. Variations in sighting distances may be explained by the method used for obtaining the sighting (eg laser measuring device or measuring wheel) or the time of year, when vegetation can sometimes have an impact. Time of year would also have had an impact on the census results (this is discussed later in the report).

48 Information supplied by Network Rail shows that risk mitigation measures were considered for Mexico footpath crossing after each of the risk assessments. The first risk mitigation option considered was closing the crossing, which eliminated the risk, but required the agreement of Cornwall Council (which had not been forthcoming).

[10] The Level Crossing Risk Management Toolkit is managed by RSSB and is available to view at www.lxrmtk.com.

Date	Risk score	Sighting (from south side to trains approaching from the east)	Census results
18/05/07	C5	119 metres to lineside cabinet; 179 metres to beyond lineside cabinet	1 (in 30 minutes)
24/06/09	C2	158 metres	20 (including 8 children) in 30 minutes
09/11/10	C6	210 metres	6-9/hr (estimated as none seen)

Table 4: Summary of key data obtained at risk assessments at Mexico footpath crossing between 2007 and 2010

49 The second risk mitigation option considered was the provision of *miniature stop lights* (sometimes referred to as miniature warning lights). At the time that the risk assessments were undertaken, the ALCRM showed that the use of miniature stop lights actually increased the risk at footpath crossings (for example, in 2009, the introduction of miniature stop lights at Mexico footpath crossing was shown to increase the risk score from C2 to B1). The RAIB commented on this counter-intuitive outcome in its investigation into the fatal accident at Penrhyndeudraeth User Worked Crossing on 2 September 2009 (RAIB bulletin 07/2010, published June 2010). In December 2010, the ALCRM was recalibrated after RSSB conducted research into the issue ('T821 Further work on miniature warning lights at user worked crossings'[11]). However, this was after the last of the three risk assessments referred to in table 4 was undertaken. The adoption of any measure that appeared to increase risk at the crossing would not have been considered.

50 However, even if the ALCRM had shown that miniature stop lights reduced risk at Mexico footpath crossing, they would not have been seen as a reasonably practicable control measure. The ALCRM calculates a figure for the sum of money that could justifiably be spent on measures to mitigate the estimated risk at each crossing. Over the period 2007-2010, the maximum value calculated by the ALCRM for risk mitigation at Mexico footpath crossing was £46,800. This compared with a projected cost of £500,000 for miniature stop lights.

The circumstances of previous incidents at Mexico footpath crossing

51 Since May 2007, Network Rail has recorded five near-miss incidents at Mexico footpath crossing, one report of children playing 'chicken' and one report of a driver applying the emergency brake on sighting ten pedestrians with pushchairs on the crossing (not classified as a near-miss by the driver)[12]. Network Rail was also advised by letter of a further incident involving two people being surprised by an approaching train on Mexico footpath crossing in June 2008. In this case, the train driver did not notify the signaller of the incident and it was also not recorded as a near-miss.

[11] RSSB research projects are published on RSSB's website, www.rssb.co.uk.

[12] The recording of near-misses is dependent on a train driver's own interpretation of the incident as such. Train drivers tend to use criteria such as whether they have been forced to engage the emergency brake in deciding whether to report an incident as a near-miss.

52 Ignoring the report of children playing chicken, but including the two incidents referred to in paragraph 51 that were not reported as near-misses by the drivers, the circumstances of the seven incidents featured:

- three trains running towards Penzance and four trains running towards St. Erth;
- six instances of diesel multiple units (the same as, or similar to, the class 150 unit involved in the accident on 3 October 2011) being involved and one instance of an 'Inter-City 125' train being involved; and
- one instance of a near-miss involving someone crossing from the coast to the village side of the crossing and one instance of them crossing in the opposite direction (no information is available for the other five incidents).

Discounted factor

The operation of train 2C47

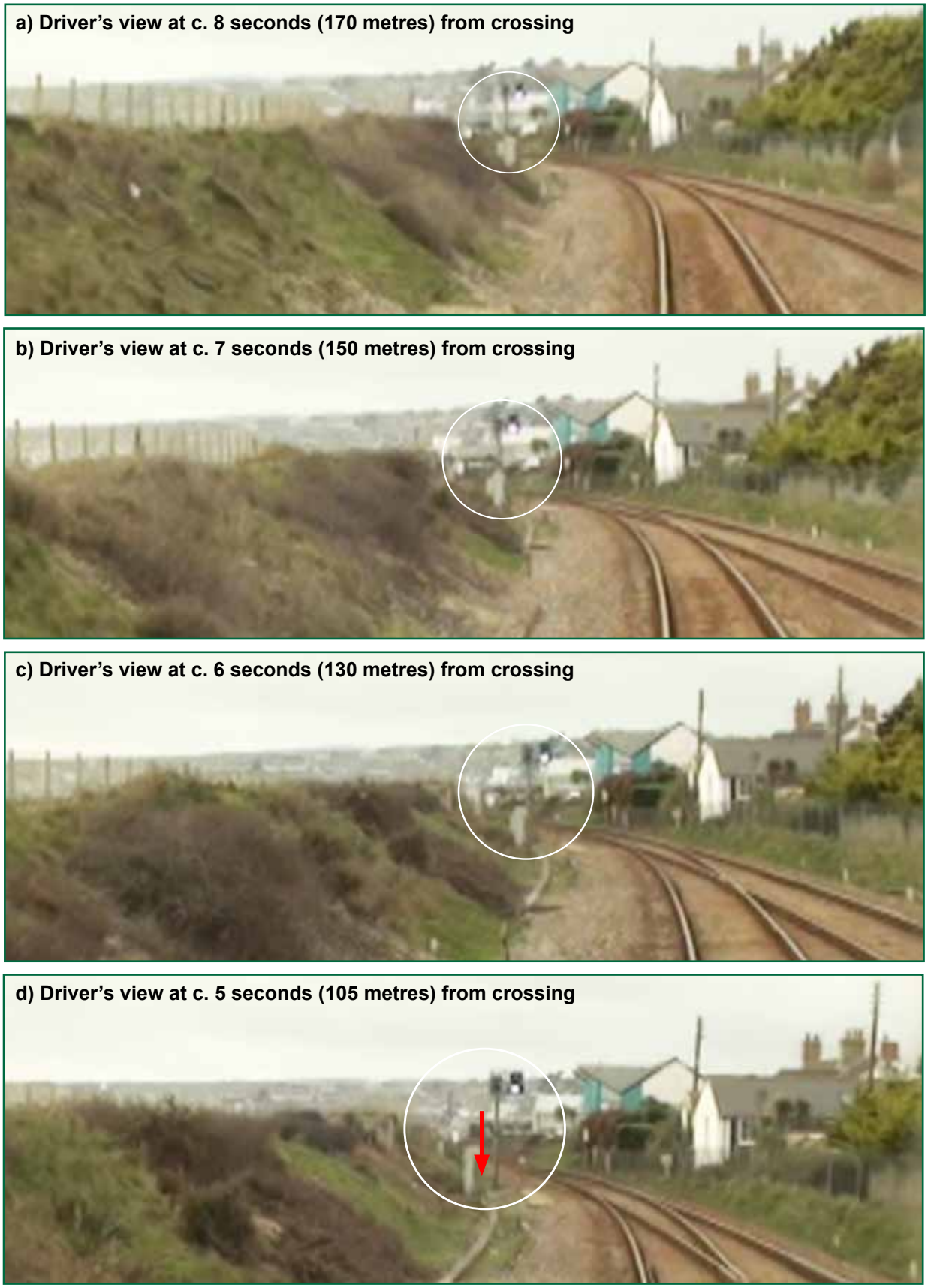
53 The RAIB has examined data from the OTDR from train 2C47. Table 5 shows the key information obtained.

Event	Start time (to nearest half second) (HH:MM:SS)	Distance from crossing (to nearest metre)	Speed (mph)
Driver sounds horn for 0.9 seconds	15:47:52	- 355	50.3
Driver sounds horn for 1.8 seconds	15:48:06	- 59	48.3
Driver applies brake in step 1	15:48:08	- 19	48.3
Accident	15:48:08.5	0	48.3
Driver applies brake in step 3	15:48:09	+15	48.3
Driver applies emergency brake	15:48:14	+99	41.1
Train stops	15:48:31	+271	0

Table 5: Key information from the data recorder on train 2C47

54 The RAIB reviewed the OTDR evidence in conjunction with a video recording of the view that a driver has when approaching Mexico footpath crossing from the east. The driver first sounded the train horn when passing the whistle board at 15-16 seconds running time from the crossing. At this stage, the crossing was out of sight. The line approaches the crossing round a left-hand curve. The driver's view of the left side of the crossing is initially obstructed by a signal and an equipment case (paragraph 34), and it is not until the train is approximately 105 metres from the crossing (around five seconds' running time at 48.3 mph (78 km/h)) that a driver would be able to gain a clear view of the location where Mrs Nicholls was likely to have been standing; see figures 9a to 9d.

55 The OTDR data shows that the train driver sounded the horn when the train was 2.8 seconds from the crossing or 59 metres away at 48.3 mph (78 km/h).



Figures 9a to 9d: The train driver's view approaching Mexico footpath crossing. It can be seen that the driver's view of the area (circled) immediately to the left of the crossing (the location where Mrs Nicholls was most likely to have been standing and arrowed in figure 9d) was initially obscured by the signal and the equipment cases, and it is not until the train is approximately five seconds from the crossing that the relevant area becomes visible to the driver. Note that the green signal that can be seen clearly in the photograph is mounted to the right of the post that comprises part of the obstruction to the driver's view.

56 The RAIB has tried to estimate when the train driver first saw Mrs Nicholls, based on the time it would take the driver to react to her presence. Published research[13] indicates that reaction times vary from person to person and situation to situation. The first of the two references makes a distinction between reaction times for expected hazards (0.5 seconds perception time, plus 0.2 seconds action time, ie move hand or foot to sound horn or apply brake), unexpected hazards (1 second perception time plus 0.2 seconds action time) and surprise hazards (1.2 seconds perception time plus 0.3 seconds action time). The research published by the Transport Research Laboratory examines road vehicle driver reaction times to various hazards and supports an earlier conclusion by another researcher that most drivers will respond within 1.5 seconds of the appearance of a familiar but unexpected hazard. The same research also indicates that where a driver has choices in their response (such as sound horn or apply brakes), this will increase the reaction time.

57 It is not possible to know exactly when the train driver first saw Mrs Nicholls. If, for example, it is assumed that the combination of the train driver's perception and reaction times is 1.2 seconds, this suggests that the driver first saw her when the train was four seconds from the crossing (around 87 metres away). The left side of the crossing only comes into the driver's view when the train is approximately five seconds away (paragraph 54). This implies that the driver of train 2C47 saw Mrs Nicholls within one second of the earliest time that she was visible.

58 Once the driver saw someone close to the crossing, the choices available were to sound the horn, and/or apply the train's brakes. Applying the brakes would have had no effect on train speed over the 59 metres to the crossing (it takes between two and three seconds for train brakes to begin to retard the speed of a train[14]), whereas sounding the train's horn gives a warning that is intended to alert people to the presence of the train.

59 It is not a fundamental requirement for the safe operation of level crossings such as Mexico footpath crossing that train drivers should be aware of, and react to, the presence of pedestrians. Trains are not normally required to slow down on the approach to such crossings, and in hours of darkness or if there is thick fog, a train driver will not be able to see whether anyone is at the crossing until the train reaches it. The onus is on the infrastructure owner to assess sighting and warning times at the crossing and provide signage and additional safety equipment as deemed necessary, and on the pedestrian to take care when crossing. Train drivers may be able to provide an additional warning if circumstances permit, as happened at Mexico footpath crossing on 3 October 2011.

60 The RAIB considers that the train driver's actions were appropriate to the circumstances and the way in which the train was driven was neither causal nor contributory to the accident.

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[13] See http://www.visualexpert.com/Resources/reactiontime.html and research published by the Transport Research Laboratory, http://www.trl.co.uk/online_store/reports_publications/trl_reports/cat_road_user_safety/report_driver_reaction_times_to_familiar_but_unexpected_events.htm.

[14] The short delay arises because of the need to build up sufficient air pressure to apply the brake blocks to the wheel tread. The class 150 is one of the relatively few types of passenger train running on the national rail network that still employs tread braking, but brake build-up time is also a feature of units with more modern braking systems.

Identification of the immediate cause[15]

61 **The immediate cause of the accident was that Mrs Nicholls moved into the path of train 2C47 as it approached Mexico footpath crossing.**

62 The evidence from the driver of train 2C47 was that a pedestrian was standing between the gate and the crossing when first seen. At this stage, the train was around four seconds' running time from the crossing (paragraph 57). The driver reacted to seeing the pedestrian by sounding the horn for a period of 1.8 seconds, by which time the train was close to the crossing. The driver's evidence suggests that Mrs Nicholls moved onto the crossing over the next one to two seconds and with insufficient time to reach a place of safety on the north side of the crossing. The RAIB is not aware of any evidence to suggest that she intended to do anything other than be in a position of safety on the north side of the crossing by the time that the train arrived.

Identification of causal factors[16]

The actions of Mrs Nicholls immediately before the accident

63 **Mrs Nicholls moved into the path of train 2C47 either because she misjudged the speed of the approaching train or because she misjudged her position in relation to the approaching train, having probably seen the train too late to have time to make a reasoned judgement about whether she should cross. This was a causal factor.**

64 It cannot be established with certainty where Mrs Nicholls was standing as train 2C47 approached. The evidence from the driver of the train was that she was standing between the gate and the crossing, and the RAIB has assumed that this would place her approximately two metres from the line, and in a position of safety. In order to establish when Mrs Nicholls might have been able to see the approaching train, the RAIB undertook filming at the crossing with the camera located at two metres from the nearer rail and at Mrs Nicholls's approximate height (figures 10a to 10f).

65 Figures 10a to 10f show that although the train is visible when it is around nine seconds running time from the crossing, the lower half of the train is obscured by two equipment cases for a period of around one second as it moves towards the crossing. The marker light which helps a pedestrian to distinguish the train as it approaches is obscured at this point, although the upper half of the front of the train and the side of the train are still visible. These findings are valid for someone looking from a position of 1.45 metres above ground. The RAIB noted that when the same train is viewed from 1.6 metres above ground (current Network Rail practice), the period of time over which the marker light disappears is shorter. This is because the roof of the equipment case is pitched and the higher the viewpoint, the narrower the obstruction to the user's view of the marker light (for a tall person, there would probably be no obstruction at all). The signal post also obscures the marker light, but at this point the train is closer and the period over which the marker light disappears is shorter.

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

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

Figures 10a to 10f: Views from the south side of Mexico footpath crossing towards a train approaching from the east taken at 1.45 metres above ground level and at 2 metres from the nearer rail. The images show that although part of the train is always in view, the distinctive marker light at the front of the train is temporarily hidden by the equipment cases at 7 seconds from the crossing and by the signal post at 4 seconds from the crossing.

66 It can never be established with certainty why Mrs Nicholls moved into the path of train 2C47 as it approached, but the RAIB considers that there are two possible explanations, based on statements provided by the driver to First Great Western and to the British Transport Police on 4 October 2011. The statements are similar in all key respects, except that in the former the driver states that the person to the left of the crossing looked towards the train before the horn was sounded (just before the accident), while in the latter, the driver states that the person turned to look towards the train when the horn was sounded.

67 If Mrs Nicholls was aware of the approaching train before the driver sounded the horn, it is possible that she misjudged its speed and thought that she had time to cross before it arrived. She was struck by the right-hand side of the front of the train in a position approximately in line with the right-hand running rail (in direction of travel). It is likely that she had covered between three and four metres from the position in which the train driver had seen her standing, which would have been possible for someone moving quickly (a typical walking speed is around 1.2 m/s and twice this speed would be feasible for someone in a hurry).

68 Guidance to the railway industry on risk management at level crossings[17] states that it can be difficult for pedestrians to judge the speed of approaching trains and identifies the following perceptual problems that contribute to decision-making error:

- *large objects appear to move more slowly than smaller objects travelling at the same speed;*
- *when looking head-on at an approaching train, the rate at which the train's size on the retina increases is slow and it is not until the train is much closer (and therefore larger in size on the retina) that it becomes easier to determine its actual speed and distance accurately[18]; and*
- *crossing users often make the mistake of using their knowledge of road vehicle movement for estimating train speed, distance travelled over time and potential stopping distances.*

69 Alternatively, if Mrs Nicholls was not aware of the approaching train until the driver sounded the horn 2.8 seconds before the train arrived at the crossing, it is possible that when she heard the horn, she believed that she was standing in a position where she would be struck and therefore had to move.

70 The RAIB has been told that Mrs Nicholls, who used Mexico footpath crossing frequently (paragraph 17), was in the habit of looking at the position of the barriers at Long Rock crossing to determine whether a train was expected. Barriers at crossings monitored by CCTV are lowered well before the arrival of a train and can thus provide an indication that while a train cannot necessarily be seen, one will be approaching shortly. The RAIB observed on site that this strategy was adopted by other frequent users of the crossing.

71 Taking the evidence from paragraph 70 into account, the RAIB considers that a possible sequence of events in the few seconds before the accident happened is:

- Mrs Nicholls walked through the gate and approached the railway, stopping and looking to the left to see whether the barriers at Long Rock CCTV crossing were up or down (they were down at the time). It is also possible that she may have first glanced to the right while part of the approaching train including its marker light was obscured by the equipment case and therefore may not have seen it;
- Her attention was then drawn to the approaching train by the sounding of the horn, when the train was about 60 metres from the crossing;

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[17] The Level Crossing Risk Management Toolkit, see paragraph 46 and footnote 10.

[18] RSSB has provided the following amplification of this phenomenon: 'For level crossing users, information on train speed is obtained via expansion of the image of the train on the observer's retina. This is a perceptual phenomenon called 'looming motion'. Much of the research on looming has come from road user behavioural analysis on rear-end collisions, specifically the judgement of time-to-collision (TTC).

'The relationship between retinal image growth and TTC was first noted by Astronomer Fred Hoyle (Hoyle, 1957) and later by Weinberger (1971). Lee (1976) developed the 'Tau hypothesis' which related the phenomenon directly to driver behaviour and collision avoidance.

'An important part of the Tau hypothesis is that when an object is distant, the retinal expansion rate is so slow that a person cannot detect the motion and could not use this looming cue or any similar optical variable to perceive closure. As the target object (train) approaches, the expansion rate increases until it reaches motion detection threshold. At this point, there is theoretically sufficient sensory information to precisely determine the TTC.

'Motion thresholds are usually expressed as angular velocity, degrees/second or more often as radians/second. Green et al (2008) estimated the motion threshold for normal drivers under good daylight conditions to be about 0.004 to 0.008 radian/second (which equates to approximately 130-70 metres away). Motion thresholds will be higher (and thus looming distances shorter) in low contrast conditions such as fog and dim light.'

- On seeing the train, she had to make an immediate judgement about whether she was in a safe place relative to the train, and considered that she was not; and
- She made an instant decision to try to secure her own safety by hurrying to the other side of the crossing rather than by stepping back.

72 For both options discussed in paragraphs 67 to 71, there is a measure of reaction time required to recognise the approaching train and decide on the course of action to take. One course of action is to stand still. However, in both of the two options described above, Mrs Nicholls took the decision to try to cross. The time taken for her to make that decision and act upon it was a factor in her having insufficient time to reach the safety of the north side of the crossing before the train arrived.

73 The weather at the time of the accident was recorded as being drizzly (paragraph 18). Mrs Nicholls was wearing spectacles. It is possible that the effects of moisture on the lenses may have made it more difficult for her to judge the speed of the approaching train or her position in relation to it.

The actions of Mrs Nicholls when the train horn was sounded at the whistle board

74 A whistle board was located 348 metres from Mexico footpath crossing (paragraph 41). Evidence from the OTDR shows that the driver of train 2C47 sounded the train horn for 0.9 seconds as the train passed the board (and that it was thus sounded in the period when the train was 355-335 metres from the crossing).

75 At this stage, the train was about 15-16 seconds' running time from the crossing and Mrs Nicholls was likely to have been approaching the crossing gate rather than on the crossing itself. The RAIB considers it likely that if she had been alerted by the sounding of the train horn, she would either have waited until the train passed before going through the gate, or, being mindful of the approaching train, waited just inside the gate until it had passed.

76 The RAIB has considered why Mrs Nicholls was not alerted to the approaching train when its horn was sounded around 15-16 seconds before the train reached the crossing. It is not possible to be certain why this happened, but the RAIB has identified three possibilities:

- the horn was inaudible to Mrs Nicholls (paragraphs 77 to 83);
- she heard the horn, but did not recognise that it was a train horn (paragraphs 84 to 96); or
- she heard the horn, but was not focused on the railway at the time (paragraphs 97 and 98).

Audibility of the train horn

77 **It is possible that when the train horn was sounded at the whistle board, it was inaudible to Mrs Nicholls.**

78 The wind speed was measured at 10.4 mph (4.7 m/s) from a westerly direction at around the time of the accident (paragraph 18). This probably had the effect of reducing the audibility of train horns sounded to the east of Mexico footpath crossing.

79 The RAIB has been told that Mrs Nicholls did not suffer from any known hearing impairment (paragraph 17) and the train horn was tested after the accident and found to be functioning correctly. The testing regime for train horns is referred to later in this report (paragraphs 113 to 116).

80 The RAIB undertook measurements of train horn audibility at Mexico footpath crossing on 18 and 19 January 2012. In addition, the inspectors on site noted the extent to which they were able to distinguish the sound of the horn when standing at the crossing. At the times that the measurements were taken, the direction of the wind was westerly and at speeds ranging from 1.2 m/s to 5.4 m/s, comparable with the circumstances at the time of the accident (paragraph 18). The principal observations from the site visit were:

- Two trains identical to the type involved in the accident (class 150/1) passed over the crossing running towards Penzance in the period when inspectors were present. In one case the train horn was audible at the crossing; in the other it was not. On the occasion that the horn was not audible, the wind was gusting between 3 m/s and 5 m/s and the horn was sounded when the train was around 50 metres from the whistle board (ie about 400 metres from the crossing). On the occasion that the horn was audible, it was sounded when the train was slightly further away (around 420 metres), but the wind speed was not recorded.
- On all other occasions, the train horn was audible at the crossing, but sometimes the sound was difficult to distinguish above background noise. The trains were either Inter-City 125 'high-speed trains' or Class 150/2 units (the Class 150/2 differs from the class 150/1 in that the former has a corridor connection at the front of the train, but the horn arrangements are identical in the two sub-classes). Generally, the sound measuring equipment was not able to distinguish the noise of the horns sounded on down trains above background noise levels. It was, however, noticeable that the sound measuring equipment did register the sound of a horn being sounded by a train running towards St Erth. Although the whistle board for *up trains* is located at a similar distance from the crossing as that for down trains, it is likely that the audibility of the horn sounded by up trains was enhanced by the westerly wind and possibly by the flatter nature of the terrain to the west of the crossing.

81 Mrs Nicholls's exact location at the time the train horn was sounded at the whistle board is not known. It is possible that she was still on the footpath on the south side of the railway, although in close proximity to the crossing gates. The RAIB has not taken measurements at any location other than at the crossing, but the presence of the cutting between the railway and the footpath would have had an effect on the audibility of the horn, whether a pedestrian was at the crossing gates or approaching them.

82 The prevailing wind at this location is from the west and was frequently measured at the speeds referred to in paragraph 80. Publicly available weather information from the measuring station at nearby RAF Culdrose indicates that in 2011, wind direction for that part of Cornwall was in the NW to SW quadrant and with average wind speed exceeding:

- 3 m/s on 42% of the days in the year;
- 4 m/s on 33% of the days in the year; and
- 5 m/s for 28% of the days in the year.

83 There is no obvious reason why the whistle board is positioned 348 metres from the crossing, but it has been there since at least 1990. Table 3 (above paragraph 39) shows that in the most extreme case of a vulnerable user making a decision to cross from the gate on the south side of the crossing, around 10 seconds' warning would be sufficient for someone able to walk at 0.8 m/s. This means that there may be scope for moving the *up* and *down line* whistle boards closer to the crossing, which could increase the probability of a horn on a train approaching from the east being heard and may be particularly beneficial given the prevailing westerly wind and the topography at this location.

Distinguishing the horn as coming from a train

84 **It is possible that Mrs Nicholls heard a horn being sounded as the train passed the whistle board, but did not distinguish it as coming from a train.**

85 During 2006, research was undertaken by RSSB on behalf of the railway industry into the issue of train horns. An industry steering group had been convened to consider a significant number of complaints from people living close to the railway about the excessive volume of train horns on new train fleets being introduced at the time, and also from people who had been affected by the installation of new whistle boards. The research indicated that the health disbenefits arising from the use of train horns (to people living adjacent to whistle board locations) exceeded the benefits to crossing users from the warning provided.

86 Following the review, the steering group recommended a night-time (23:00 hrs to 07:00 hrs) quiet period during which train horns would not be used (unless there were compelling local reasons for continuing use of the horn). In addition, the steering group recommended that only the low tone of the two-tone horn should be sounded at whistle boards for level crossings (this was subject to the caveat 'where technically possible' because on some types of rolling stock, both tones are sounded automatically while on others, the driver can select high or low tone). The specialists advising the steering group had indicated that although there was no difference in the volume of the two tones, the pitch of the high tone was more irritating to those people adversely affected by the noise from train horns. This impinging of the high tone on an individual's hearing was found to cause harm to people routinely exposed to it as a result of living close to whistle boards. RSSB has advised that in making these recommendations, the steering group and the industry were aware that they were slightly reducing the benefit of train horns to level crossing users.

87 Some individuals from within the railway industry and some members of the public have commented to the RAIB that the sounding of only the low tone of a train horn makes it less recognisable as coming from a train as compared, for example, with an air horn on a road vehicle or even a ship (as might be relevant in the vicinity of Mexico footpath crossing). The sounding of both tones of a two-tone horn has been associated with trains since the replacement of steam locomotives (which used whistles). It is possible that the sounding of the single tone only does not register with members of the public in the same way that the sounding of two tones does.

88 Although there is no hard evidence to support the assertions in paragraph 87, the RAIB has considered whether the recorded behaviour of level crossing users indicates any trend which might support or undermine the arguments made.

89 The change to sounding the low tone only at whistle boards was implemented from April 2007, and formalised with a change to the railway rule book in June 2007. For Mexico footpath crossing, the near-miss data[19] held by Network Rail shows:

- between 1 January 2002 and 10 May 2007, there were no reported incidents on the crossing; and
- from 11 May 2007, there were five near-misses reported by drivers and two other incidents involving people crossing in front of approaching trains (paragraph 51).

90 The RAIB has reviewed data on accidents and near-misses involving pedestrians on level crossings nationally between 2001 and 2011. Figure 11 shows that there has been no discernible trend in fatal accidents to pedestrians at footpath and user-worked crossings in this period.

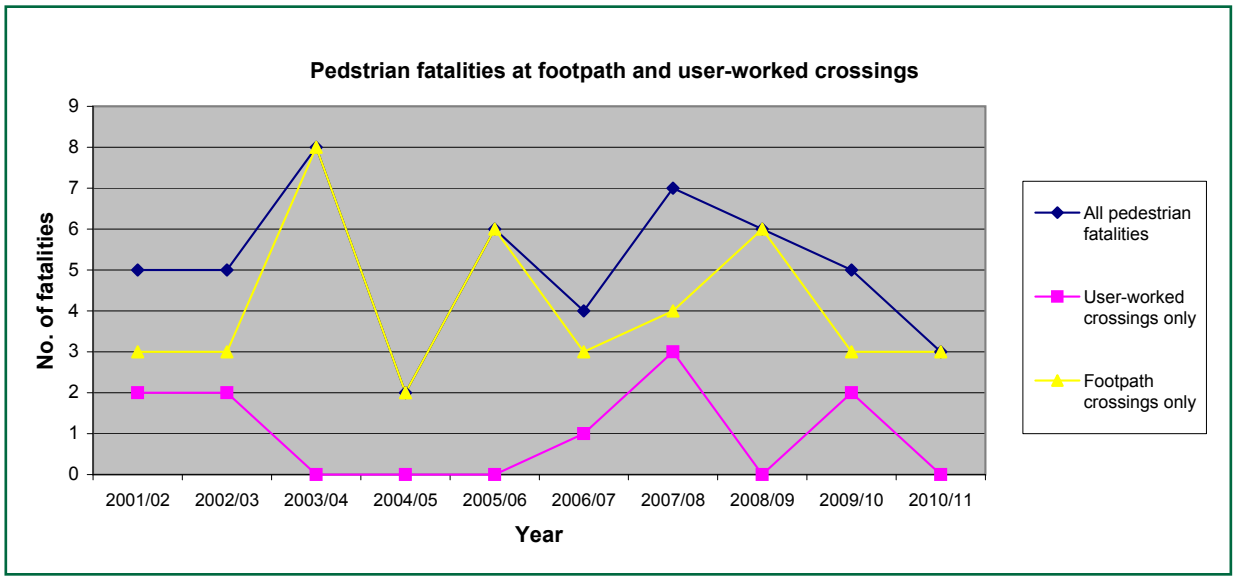

Figure 11: Fatal accidents to pedestrians on footpath and user-worked crossings, 2001-2011

91 The data in figure 11 relates to pedestrian fatalities on both 'active' and 'passive' crossings. On active crossings, a positive indication is given to users of the approach of a train (eg miniature stop light or barriers which close automatically as a train approaches), whereas on passive crossings (such as Mexico footpath crossing), there is no such indication. With regard to near-miss incidents, figure 12 shows that while there has been an increase in the number of near-miss incidents on passive crossings since 2007, the number was increasing throughout the period from 2001 to 2011 and the rate of increase did not change significantly after 2007.

[19] Network Rail records instances of near-misses and misuse of its crossings. The Western Route, which is responsible for Mexico footpath crossing, considers that the recording of such incidents is complete from 2002 onwards.

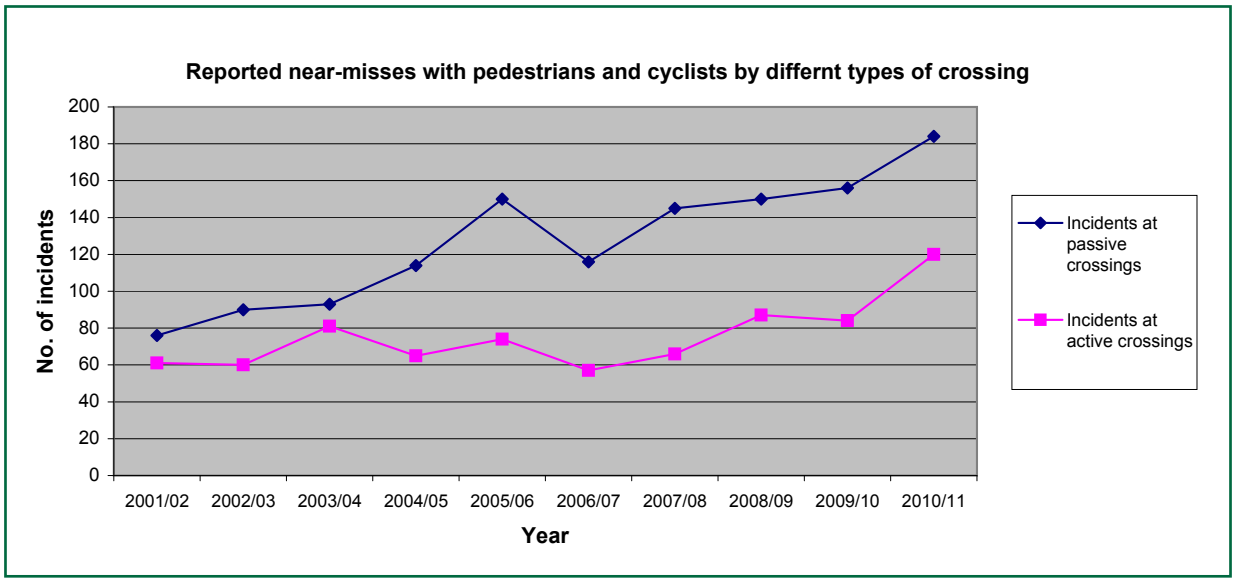

Figure 12: Near-miss incidents on active and passive crossings, 2001-2011

92 Not all passive crossings are equipped with whistle boards. The data reflected in figure 12 does not allow any determination of whether trends at whistle board crossings in the period from 2001 to 2011 are different from those at crossings without whistle boards. In order to determine if the change to sounding only the low tone at whistle boards is a significant factor in the increase in near-miss incidents since 2007, it would be necessary to separate the passive crossing data into crossings with and without whistle boards.

93 Near-miss data is held on RSSB's Safety Management Information System (SMIS) database, which includes details of accidents and incidents on the main-line railway network. Data on level crossings is held in Network Rail's ALCRM database. The RAIB has reviewed information from each source, but found that the level of correlation between the two does not allow the 2001-2011 data to be broken down between the two types of crossing. Only around 30% of 300 recorded incidents on the SMIS database could be traced to a specific level crossing on the ALCRM database.

94 There are a number of possible explanations for this.

- When inputting incident data to the SMIS database, the user can only select a location from a drop-down list. Not all crossing locations are included on SMIS. A witness who was involved with the SMIS database when it was set up has advised that the initial arrangement for capturing the location of an event included the names of stations or other significant points (signal boxes, tunnels, etc), but was never intended to include every location on the railway. Over time, additional locations have been added, but the listing is still not comprehensive.
- The principal source of intelligence on near-miss incidents comes from train drivers. It is possible that they may not know the names of every crossing they pass over.
- When travelling at speed, drivers may not be in a position to distinguish the relevant crossing when passing several crossings in quick succession. This may lead to their use of nearest station or general locality when describing the location of an event to a signaller.

- The names of some crossings change over time and an 'old' name might be used. Sometimes a crossing is known by more than one name and this is not always reflected in the ALCRM database.

95 It is possible that the tendency of drivers to report near-misses at level crossings in the period under review has increased, although there has been no equivalent increase in the number of reports of other types of near-miss incidents (eg between trains and people working on the track).

96 Near-miss incidents are a key precursor to accidents. It is important that the railway industry has the data necessary to understand the rising trend in near-misses at level crossings so that appropriate action can be taken to deal with it. Network Rail and East Midlands Trains have been trialling a strategy to improve reporting of level crossing misuse incidents. Drivers have been provided with a document detailing the location, name and type of all level crossings between Lincoln and Peterborough. The document also gives contact phone numbers for all signal boxes, the control centre and the British Transport Police. The document is designed to help drivers reach a clear understanding with the signaller about exactly what has happened and where so that incidents of misuse are reported promptly and accurately.

Registering the significance of the train horn

97 **It is possible that Mrs Nicholls did not register that the train horn was sounded at the whistle board because she was not focused on crossing the railway at the time.**

98 At the time that the train horn was sounded, it is likely that Mrs Nicholls was approaching the crossing gates, but had not yet passed through. It is possible that she was not particularly focused on crossing the railway at this stage and not necessarily listening for a train horn. This factor, taken in conjunction with the effects of the wind and possible difficulties in distinguishing a train horn from other noises, may have caused her not to register that the horn had been sounded or therefore its significance.

Observations[20]

Network Rail's management of risk at the crossing

The measurement of sighting distance

99 Table 1 summarises the guidance provided by the Office of Rail Regulation on footpath crossings, including the process of measuring sighting/traverse distances from a 'decision point' to determine whether there is adequate sighting for crossing users. Footnote 6 to table 1 describes the decision point as being a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety. While decision points are not usually marked (see paragraphs 103 to 106), and it is not known exactly where users actually make their decision to cross, the guidance from the ORR suggests that at Mexico footpath crossing, that point was a minimum of 3.40 metres from the nearer running rail on the south side of the crossing.

[20] 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.

100 However, the practice on Network Rail's Western route was to measure sighting distance from a point two metres from the nearest running rail. This corresponds with the minimum dimension referred to in ORR's guidance (table 1), but does not meet the criterion of being a point where guidance on crossing safely is visible, where signage is positioned more than two metres from the nearest rail (as was the case at Mexico footpath crossing). Using a point two metres from the nearest rail has the effect of reducing calculated traverse time and possibly changing measured sighting distance. Table 2 shows that at Mexico footpath crossing, it affected both parameters.

101 At Mexico footpath crossing a whistle board was in place to provide additional warning of approaching trains. It is, however, possible that additional warnings have not been provided at other crossings because sighting distance is deemed to be adequate, based on its measurement at two metres from the nearest rail.

102 On Network Rail's Anglia route, guidance given to staff involved in risk assessments at level crossings is that sighting should be measured from the decision point, which is defined as the gate or sign or, in the absence of both, the place where the user would make their decision to cross. This approach is consistent with the guidance provided by the Office of Rail Regulation (paragraph 99).

Signs and the decision point

103 As referred to in paragraph 99, the sign on the south side of Mexico footpath crossing was located 3.4 metres from the nearer rail. Table 2 shows that sighting of down trains is better from a position two metres from the nearer rail. There is little difference in the sighting distance for up trains, or in the user's view of the barriers at Long Rock CCTV crossing (paragraph 70), between the two locations. As with many crossings, the point at which users at Mexico footpath crossing make their decision to cross is not known and there is no signage at the crossing to indicate the optimum decision point.

104 The RAIB has recommended in two previous investigations that the optimum decision point at level crossings should be marked (see table 6 following paragraph 133), but the recommendations were rejected by Network Rail principally on the grounds of perceived practical difficulties in marking a decision point on the ground and seeking to avoid clutter and too much information to users at crossings. A further recommendation made by the RAIB to provide risk assessors with guidance on when the decision point should be marked was accepted by Network Rail and briefed to a meeting of Operations Risk Advisors on 27 October 2010. However, the Operations Risk Control Co-ordinator responsible for Mexico footpath crossing had no recollection of being briefed.

105 As a consequence, the marking of the decision point was never considered as a risk mitigation measure at Mexico footpath crossing. After the accident on 3 October 2011, Network Rail moved the sign on the south side of the crossing to a position two metres from the nearer rail. Network Rail considered that this had the effect of establishing the decision point as being at two metres from the nearer rail, although there is no evidence that users do make their decision to cross at the sign. Network Rail's guidance to risk assessors indicates that the sign should be at the decision point and suggests moving them if they are not. This implies that Network Rail considers that the sign is the decision point and that the decision point can be changed by moving the sign.

106 Although it has rejected the RAIB's recommendation on marking the decision point (paragraph 104), Network Rail is a member of the industry's Road Rail Interface Safety Group that has recently requested RSSB to commission project T-984, 'Research into the causes of pedestrian accidents at level crossings and potential solutions'. This research is intended to examine all the possible factors that cause pedestrian accidents at level crossings and review the effectiveness of current and possible new mitigation measures. It is intended to provide a comprehensive examination of pedestrian safety at level crossings and will take into account all factors that affect risk, including signage, layout and the use of technology to enhance users' safety. It will also address the issue of the marking of decision points for pedestrians at level crossings. However, it may take up to two years for the results from the research to be published and advice and guidance on the marking of decision points to be made available.

Intelligence on crossing usage

107 Mexico footpath crossing is located in close proximity to the beach and the extent of its usage varies throughout the year. The type of user also varies, with local people comprising the majority of users during the winter months and a greater number of unfamiliar users, including children, at other times of year, particularly during the summer.

108 Since 2007, Network Rail had undertaken three censuses of use at Mexico footpath crossing over a period of 30 minutes and the recorded use ranged between 0 and 20 people (table 4). The RAIB undertook a two-hour census on 18 May 2012 between 14:00 hrs and 16:00 hrs and observed 27 people using the crossing.

109 One of the incidents referred to in paragraph 89 referred to 'ten pedestrians with pushchairs' and another to children playing on the crossing. The RAIB's own observations at the crossing in October 2011 and January 2012 showed that there was a high proportion of elderly users and of the 27 people observed using the crossing in May 2012, 18 could have been described as elderly.

110 Footnote 7 to table 1 indicates that Network Rail's guidance on vulnerable users defines 'children, elderly, disabled, vision impaired, pushchair users and those with learning difficulties' as falling within this category. Although there was evidence that Mexico footpath crossing was being used by significant numbers of vulnerable people (paragraph 109), Network Rail did not define it as having a higher than usual proportion of such users.

111 Network Rail's risk assessments for Mexico footpath crossing used the most recent data gathered in the census, rather than looking at the information that was available from previous censuses or near-miss incidents. A more accurate picture of crossing usage could have been obtained by using all the censuses that were undertaken in the period 2007 to 2011 and the near-miss data, which includes one incident involving a number of pushchair users (paragraph 51).

112 There had been a significant change in the incident history at Mexico footpath crossing from May 2007 onwards (paragraph 89). However, this was not reflected in the risk score at the crossing because the detail of a crossing's risk history is not an input into the ALCRM model used by Network Rail in evaluating risk at level crossings. The RAIB identified this issue in its investigation into the fatal accident at Halkirk in September 2009 (the RAIB's report was published in September 2010) and made a recommendation to address it. See table 6 following paragraph 133.

Testing train horns after accidents and incidents

113 Railway Group Standard GM/RT2273, 'Post Incident and Post Accident Testing of Rail Vehicles' contains no requirements for testing of train horns after incidents or accidents.

114 Although there is no mandated requirement through standard GM/RT2273, First Great Western's own procedure for post-accident testing does include testing of train horns. The horn on the train involved in the accident on 3 October 2011 was tested two days afterwards and its performance was classified as 'good' (the other options were 'satisfactory' or 'poor'). The classification is based on the subjective judgement of the individual carrying out the test.

115 Railway Group Standard GM/RT2484, 'Audibility Requirements for Trains' specifies minimum and maximum sound pressure levels for train horns and describes a testing regime to confirm that the requirements are met. However, this testing regime applies only to new rolling stock when first introduced into service or when the horn is modified or replaced.

116 There is no apparent requirement for the testing of train horns using measuring equipment to confirm that they were meeting the specified requirements at the time of an incident or accident. The RAIB considers that testing of the horn after a train has been involved in an incident or accident where the horn had been sounded as a warning should be mandated, and that the performance of the horn should be evaluated on the basis of an objective rather than a subjective assessment.

Optimising warning arrangements at crossings

117 There are two competing considerations which may influence the positioning of a whistle board:

- the closer the whistle board is to the crossing, the more likely it is that the horn will be heard (less opportunity for the sound to be obstructed, muffled or decay) and the greater the chance that the pedestrian is close enough to the crossing to be receptive to a warning (paragraph 98); but
- the further away the whistle board is from the crossing, the greater the warning period is to crossing users of an approaching train, providing that the horn is audible.

118 The generation of a warning by a train hundreds of metres from a crossing is not the most reliable method of alerting crossing users to an approaching train because its effectiveness can be undermined by factors such as wind, other noise sources, the driver not remembering to sound the horn or sounding it too early. The recent version of the guidance prepared by the Office of Rail Regulation on design and operation of crossings (table 1) now indicates that it is preferable to generate audible warnings at the crossing itself. It is possible that the volume of such a warning could be significantly lower than the volume of a train horn, because it would be generated in close proximity to the person at whom it was directed, rather than having to be projected for a distance of up to 400 metres.

119 A review of whistle board positioning in one Network Rail route found that of its crossings equipped with whistle boards, about one third of them had the boards positioned in a sub-optimal location (Network Rail advises that action has been taken or is in hand to deal with these locations). Network Rail does not currently mandate testing of the audibility at level crossings of train horns sounded at whistle boards and it is likely that the position of many of them has remained unchanged since installation. This does not necessarily mean that they are in the wrong location, but it does mean that a review is desirable, particularly if circumstances such as train speed have changed since their installation.

120 Audible warnings are not the only method of alerting crossing users to approaching trains. Miniature stop lights provide a visual indication of an approaching train for crossing users. Until recently their cost (estimated at £500,000 per installation) has tended to inhibit widespread use. However, Network Rail has recently been conducting trials on the Sudbury branch line with visual warning devices that cost significantly less. If successful, it is possible that such visual warnings could be a cost-effective alternative to whistle boards at a number of footpath and user worked crossings.

The sounding of the train horn at whistle boards

121 Section 10.2 of railway rule book module TW1 states that drivers must sound their train horns 'when passing' a whistle board between 07:00 hrs and 23:00 hrs. The driver involved in the accident at Mexico footpath crossing on 3 October 2011 did exactly that.

122 However, when RAIB inspectors undertook testing at the crossing on 18 and 19 January 2012 (paragraph 80), they noted that some drivers were sounding the horn 50-70 metres from the whistle board.

123 Although there may occasionally be reasons for drivers to sound the train horn before they reach a whistle board (for example, they may be aware that they will be undertaking other activities at that time such as braking, etc.) such circumstances should be the exception rather than the rule. Given that train horn audibility diminishes with distance, it is important that drivers sound their horns when passing whistle boards rather than at a significant distance beforehand.

Previous occurrences of a similar character

124 There was a fatal accident to a pedestrian on Mexico footpath crossing on 20 October 1972. Little information is now available about this accident, although the RAIB understands that the circumstances under which it occurred involved the pedestrian attempting to retrieve a dog that was in the vicinity of the line.

125 The RAIB has conducted seven investigations into accidents involving pedestrians at level crossings since becoming operational on 17 October 2005. None of these accidents had circumstances which were similar to those of the accident at Mexico footpath crossing on 3 October 2011. However, the RAIB made recommendations in three of those investigations that were relevant to issues found in the investigation into the accident at Mexico footpath crossing. Details of those recommendations and of two other relevant recommendations made following investigations into other accidents at level crossings can be found in table 6 (following paragraph 133).

126 The RAIB is currently investigating a fatal accident that occurred at Gipsy Lane footpath crossing, near Needham Market on 24 August 2011 and a fatal accident that occurred at Johnson's footpath crossing, near Bishops Stortford on 28 January 2012. In both cases, the accidents featured pedestrians moving from a position of safety into the path of an approaching train, while apparently being aware of the presence of the train.

Summary of conclusions

Immediate cause

127 Mrs Nicholls moved into the path of train 2C47 as it approached Mexico footpath crossing (**paragraph 61**).

Causal factors

128 The following factor was causal:

a. Mrs Nicholls either misjudged the speed of the approaching train or misjudged her position in relation to the approaching train, having probably seen the train too late to have time to make a reasoned judgement about whether she should cross (**paragraphs 63, 65 and 72**, **Recommendation 1**).

129 The following factors were possibly causal:

a. when the train horn was sounded at the whistle board, it was inaudible to Mrs Nicholls (**paragraph 77, Recommendation 1**); or

b. Mrs Nicholls heard a horn being sounded at the whistle board, but did not distinguish it as coming from a train (**paragraph 84, Recommendations 1 and 2**); or

c. Mrs Nicholls did not register that the train horn was sounded at the whistle board because she was not focused on crossing the railway at the time **(paragraph 97, Recommendation 1**).

Additional observations

130 In addition to the above, the RAIB observes that:

a. Network Rail is not consistent in the approach that it takes to measuring sighting distances at level crossings (**paragraphs 99 to 102, Recommendation 3**).

b. The decision points were not marked at Mexico footpath crossing; the industry has made little progress to date in researching the issue of marking decision points despite previous RAIB recommendations in this area (**paragraphs 103 to 106, see paragraph 131 and Recommendation 3**).

c. Near-miss data and data from different censuses on crossing usage at Mexico footpath crossing was not being used in a manner that enabled Network Rail to establish an accurate estimate of the risk at Mexico FPC (**paragraphs 107 to 112, see reference to recommendation 4 in the RAIB's Halkirk investigation report (table 6 following paragraph 133)**).

d. Train horn testing is not mandated following relevant accidents or incidents and there is no requirement for the objective testing of train horn volume (**paragraphs 113 to 116, Recommendation 4**).

e. The positioning of whistle boards at level crossings across the main line railway network has not been optimised (**paragraphs 117 to 120, Recommendation 5**).

f. Drivers sometimes sound train horns a significant distance before a whistle board, rather than when passing it, as required by the railway rule book (**paragraphs 121 to 123, see Learning Point 1**).

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

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

131 Network Rail has moved the sign on the south side of Mexico footpath crossing to a position two metres from the nearer rail. This happened towards the end of January 2012 (paragraph 130b).

Other reported actions

132 Network Rail has applied to Cornwall Council to have Mexico footpath crossing closed, diverting users to the nearby Long Rock CCTV crossing, where they would be fully protected from the railway by barriers when trains are approaching. Historical information held by Network Rail indicates that:

- Mexico footpath crossing had been a vehicular right of way until 1961. When the crossing was closed to vehicles at that time, Cornwall County Council said that there was a prescriptive right of way through the crossing and that it could not be closed to all users.
- British Rail had applied again to close the crossing in 1991, but this was rejected by County, District and Parish Councils.

Previous RAIB recommendations relevant to this investigation

133 The following recommendations were made by the RAIB as a result of previous investigations, which address factors identified in this investigation.

Investigation	Recommendation	Current status
Fatal accident at Tackley station level crossing 31/03/08 RAIB report 09/2009	**Recommendation 3** Network Rail should, at unprotected crossings where the location of the decision point is between the instruction sign and the track and therefore potentially counter-intuitive, propose measures to clearly mark the point at which the final decision to cross should be made for acceptance by the ORR. This is for the benefit of crossing users and for the guidance of persons making inspections of the crossing.	**Not implemented** Network Rail did not consider it feasible to provide a consistent durable marking on the ground and did not implement the recommendation. The ORR, in accepting non-implementation, noted that the RAIB had made a further recommendation in this area (see recommendation 3 from the Fairfield crossing, Bedwyn, investigation below).
Investigation into safety at user worked crossings RAIB report 13/2009	**Recommendation 2 (part)** Network Rail should include in the risk assessments that it carries out for UWCs … an evaluation of whether there is sufficient information for users on where they should make a decision on whether it is safe to cross, based on the best sighting of approaching trains. Where deficiencies are identified consideration should be given to the provision of an additional sign or visual feature to mark a point where users can wait in safety, clear of the line, and have sufficient sighting of approaching trains (ie at the final decision point). **Recommendation 3 (part)** Network Rail should initiate research into reasonably practicable methods of marking the final decision point at those UWCs where such a solution is assessed as being appropriate.	**Not implemented** Network Rail did not consider it possible to apply consistent durable marking of the decision point. The ORR accepted that Network Rail had measures in place to manage the risk, but would keep Network Rail's management of level crossing risk under review. **Not implemented** Network Rail considered that the introduction of additional signage would create too much clutter at level crossings. ORR accepted Network Rail's response and said that they were unable to force duty holders to undertake research, but would continue to monitor the quality of Network Rail's on-site inspections and risk assessments.

Investigation	Recommendation	Current status
Double fatality at Bayles and Wylies footpath crossing 22/11/08 RAIB report 32/2009	**Recommendation 6** Network Rail should revise its management processes for inspecting and assessing level crossings to compare previous inspections and assessments, and identify and resolve any substantial variations in the data presented.	**In progress** Network Rail has proposed improved training on data gathering techniques for mobile operations managers. The ORR has concerns that Network Rail's approach to risk management at level crossings still does not address the overall intent of this recommendation and is seeking confirmation that further action is being taken.
Fatal accident at Fairfield crossing, Bedwyn 06/05/09 RAIB report 08/2010	**Recommendation 3** Network Rail should provide guidance to risk assessors on the circumstances in which there is likely to be safety value in providing additional marking of the final decision point at footpath and bridleway crossings, and the best means of doing so.	**Implemented** Network Rail has updated the level crossing risk management toolkit to include the marking of decision points as a risk mitigation option and briefed its Operations Risk Advisors on the change and the circumstances under which such markings would be necessary. The ORR considers that the recommendation has been implemented.
Fatal accident at Halkirk level crossing, Caithness 29/09/09 RAIB report 16/2010	**Recommendation 4** Network Rail should issue improved guidance, and brief its staff, on assessing the risk from factors that are not currently included in the All Level Crossing Risk Model when carrying out risk assessments and making decisions on implementing risk reduction measures at crossings. This should include methods to be adopted when taking into account local factors such as the previous incident and accident history.	**Implemented** Network Rail has reported that they are developing a process to take into account the previous history of a level crossing when carrying out risk assessments. The ORR considers that the recommendation has been implemented.

Table 6: Status of previous relevant RAIB recommendations

Learning point[21]

134 The RAIB has the following learning point for the train operating companies:

Learning point 1

It is important that drivers sound train horns when passing whistle boards rather than at some distance on the approach to them, in order to ensure that the likelihood of the horn being heard at the crossing is maximised (paragraph 130f).

[21] An issue which the RAIB wishes to draw to the attention of industry bodies and railway staff so that they can take appropriate action.

Recommendations

135 The following recommendations are made[22]:

1 *The intent of this recommendation is for Network Rail to improve safety for all users at Mexico footpath crossing by considering whether improvements can be made to sighting for pedestrians at the crossing and also by considering whether it is possible to move the whistle boards closer to the crossing, taking account of factors that affect audibility (such as local topography) and any other effects that might arise from changing the location of the whistle boards.*

Taking account of the deficiency in sighting time for vulnerable users, Network Rail should:

a. Consider whether improvements can be made to sighting towards the east for pedestrians on the south side of Mexico footpath crossing (paragraph 128a).

b. Determine the optimum position of the whistle boards at Mexico footpath crossing and make any required adjustments. The assessment should identify a better location for the boards that will improve the audibility of train horns at the crossing, taking account of the need to provide adequate warning for all users and including consideration of any local factors which may have a bearing on the decision (paragraphs 129a, 129b and 129c)

continued

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

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

(a) ensure that recommendations are duly considered and where appropriate acted upon; and

(b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 167 to 171) can be found on RAIB's website www.raib.gov.uk.

2 *The intent of this recommendation is for RSSB to consider what additional data needs to be captured within SMIS to allow a full evaluation of risk at level crossings and to use it, together with any other relevant data, to enhance its current processes for reviewing the effect of the change made in April 2007 to sounding only the low tone of the train horn for passive crossings between 07:00 hrs and 23:00 hrs.*

RSSB should:

a. identify any additional data that should be captured within SMIS from accidents and near-miss incidents to inform future safety decision-making about level crossings and make the necessary arrangements for that data to be collected by duty holders; and

b. using the data obtained from implementing part a of this recommendation and any further intelligence contained within SMIS or other sources, enhance its current approach to reviewing the impact of the change to sounding only the low tone of the warning horn for whistle boards at level crossings between 07:00 hrs and 23:00 hrs and take actions, if appropriate (paragraph 129b).

3 *The intent of this recommendation is for Network Rail to undertake a project to develop and implement a national approach to the location and marking of decision points and the measuring of sighting distances at level crossings. This work should be expedited and undertaken as a discrete exercise rather than as part of the three-yearly crossing risk assessment cycle and take account of the emerging findings from RSSB research project T-984 'Research into the causes of pedestrian accidents at level crossings and potential solutions' where relevant.*

Network Rail, in conjunction with RSSB where appropriate, should undertake a project to develop a standard national approach to:

- identifying the optimum decision point at each footpath and user worked crossing used by pedestrians;
- marking and signing the optimum decision point at each crossing;
- using that decision point in estimates of sighting distance at footpath and other crossings; and
- briefing staff involved in crossing risk assessment with regard to the approach.

continued

When addressing issues in relation to the marking of decision points, Network Rail should liaise with RSSB on emerging findings from research project T984 'Research into the causes of pedestrian accidents at level crossings and potential solutions', and give consideration to the need to draw upon relevant elements of that research project to inform the development of the national approach. In this context RSSB should prioritise those elements of research project T984 that deal specifically with the marking of decision points, so that they are completed at an early stage in the programme. Once the approach has been developed, Network Rail should implement a programme to review and modify crossings accordingly (paragraphs 130a and 130b).

4 *The intent of this recommendation is for First Great Western to propose changes to Railway Group Standards so that an objective train horn testing regime is mandated after a train has been involved in certain types of accident or incident.*

First Great Western should make a proposal to RSSB to modify relevant Railway Group Standards to mandate the requirement to test train horns in an objective manner when a train has been involved in any accident or incident involving circumstances where the sounding of the train horn was either required by the rule book or employed by the driver during the event (paragraph 130d).

5 *The intent of this recommendation is for Network Rail to conduct a network-wide project to optimise warnings for pedestrians at level crossings equipped with whistle boards, taking account of emerging technology and the ability to generate local warnings audibly or visually.*

Network Rail should conduct a review of the arrangements for providing warnings for pedestrians at level crossings currently equipped with whistle boards. The review should address:

a. the costs and benefits at each crossing of providing audible or visual warnings at the crossing itself rather than by approaching trains (taking account of the possibility of the significantly reduced costs of visual warnings referred to in paragraph 120); and

b. at crossings where whistle boards will remain, whether the position of the board at each crossing has been optimised taking account of all relevant local factors including (but not limited to) prevailing wind, local topography, sources of noise and the traverse time for crossing users and the positive and negative effects on railway neighbours (paragraph 130e).

Appendices

Appendix A - Glossary of abbreviations and acronyms

ALCRM	All Level Crossing Risk Model
CCTV	Closed Circuit Television
ORR	Office of Rail Regulation
OTDR	On-Train Data Recorder
RAIB	Rail Accident Investigation Branch
RSSB	Rail Safety and Standards Board
SMIS	Safety Management Information System

Appendix B - Glossary of terms

Down line	The line used by trains running between St Erth and Penzance where the railway is double track.
Down trains	Trains running between St Erth and Penzance.
Miniature stop lights	Small red and green lights mounted on a board adjacent to a user worked level crossing or footpath crossing. The lights are operated by the passage of trains. They are sometimes called miniature warning lights.
Sighting distance (at level crossings)	The distance between the point from which the measurement is being taken (at a level crossing) and the point at which an approaching train is clearly in view.
Up line	The line used by trains running between Penzance and St Erth where the railway is double track.
Up trains	Trains running between Penzance and St Erth.

Appendix C - Key standards current at the time

Rule book GE/RT 8000 Module TW1, Issue 8, October 2008	Preparation and movement of trains
Railway Group Standard GM/RT2273, Issue 3, June 2011	Post Incident and Post Accident Testing of Rail Vehicles
Railway Group Standard GM/RT2484, Issue 2, April 2007	Audibility Requirements for Trains

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