



Rail Accident Investigation Branch

Rail Accident Report



**Double fatality at Bayles & Wylies footpath
crossing, Bestwood, Nottingham
22 November 2008**

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.

© Crown copyright 2009

You may re-use this document/publication (not including departmental or agency logos) free of charge in any format or medium. You must re-use it accurately and not in a misleading context. The material must be acknowledged as Crown copyright and you must give the title of the source publication. Where we have identified any third party copyright material you will need to obtain permission from the copyright holders concerned. This document/publication is also available at www.raib.gov.uk.

Any enquiries about this publication should be sent to:

RAIB	Email: enquiries@raib.gov.uk
The Wharf	Telephone: 01332 253300
Stores Road	Fax: 01332 253301
Derby UK	Website: www.raib.gov.uk
DE21 4BA	

This report is published by the Rail Accident Investigation Branch, Department for Transport.

Double fatality at Bayles & Wylies footpath crossing, Bestwood, Nottingham

22 November 2008

Contents

Preface	5
Key Definitions	5
Summary of the Report	6
Key facts about the accident	6
Immediate cause, causal and contributory factors, underlying causes	6
Severity of consequences	7
Recommendations	7
The Accident	8
Summary of the accident	8
The parties involved	8
Location	8
Pedestrian level crossings	11
The rail vehicles involved	11
External circumstances	13
Events preceding the accident	13
Events during the accident	13
Events following the accident	14
The Investigation	15
Investigation process and sources of evidence	15
Analysis	16
Identification of the immediate cause	16
Identification of causal and contributory factors	17
Identification of underlying factors	29
Conclusions	36
Immediate cause	36
Causal and contributory factors	36
Underlying causes	37
Additional observations	38

Actions reported as already taken or in progress relevant to this report	39
Actions reported which address factors which otherwise would have resulted in a RAIB recommendation	40
Recommendations	41
Previous Recommendations	41
Recommendations to address causal and contributory factors	43
Recommendations to address other matters observed during the investigation	44
Appendices	45
Appendix A - Glossary of abbreviations and acronyms	45
Appendix B - Glossary of terms	46
Appendix C - Key standards current at the time	48
Appendix D - Safety principles and guidance for pedestrian level crossings	49
Appendix E - History of Bayles and Wylies crossing	52
Appendix F - The All Level Crossing Risk Model	53
Appendix G - RAIB investigations into other accidents at pedestrian level crossings	54

Preface

- 1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.
- 2 The RAIB does not establish blame, liability or carry out prosecutions.

Key Definitions

- 3 Trains heading from Worksop to Nottingham are running in the up direction and those from Nottingham to Worksop in the down direction.
- 4 All dimensions and speeds in this report are given in metric units, except speed and locations on Network Rail, which are given in imperial units, in accordance with railway practice. In this case the equivalent metric value is also given.
- 5 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in Appendices A and B.

Summary of the Report

Key facts about the accident

- 6 At about 18:38 hrs on 22 November 2008 a train struck and killed a woman and child who were using Bayles and Wylies footpath level crossing (Figure 1).

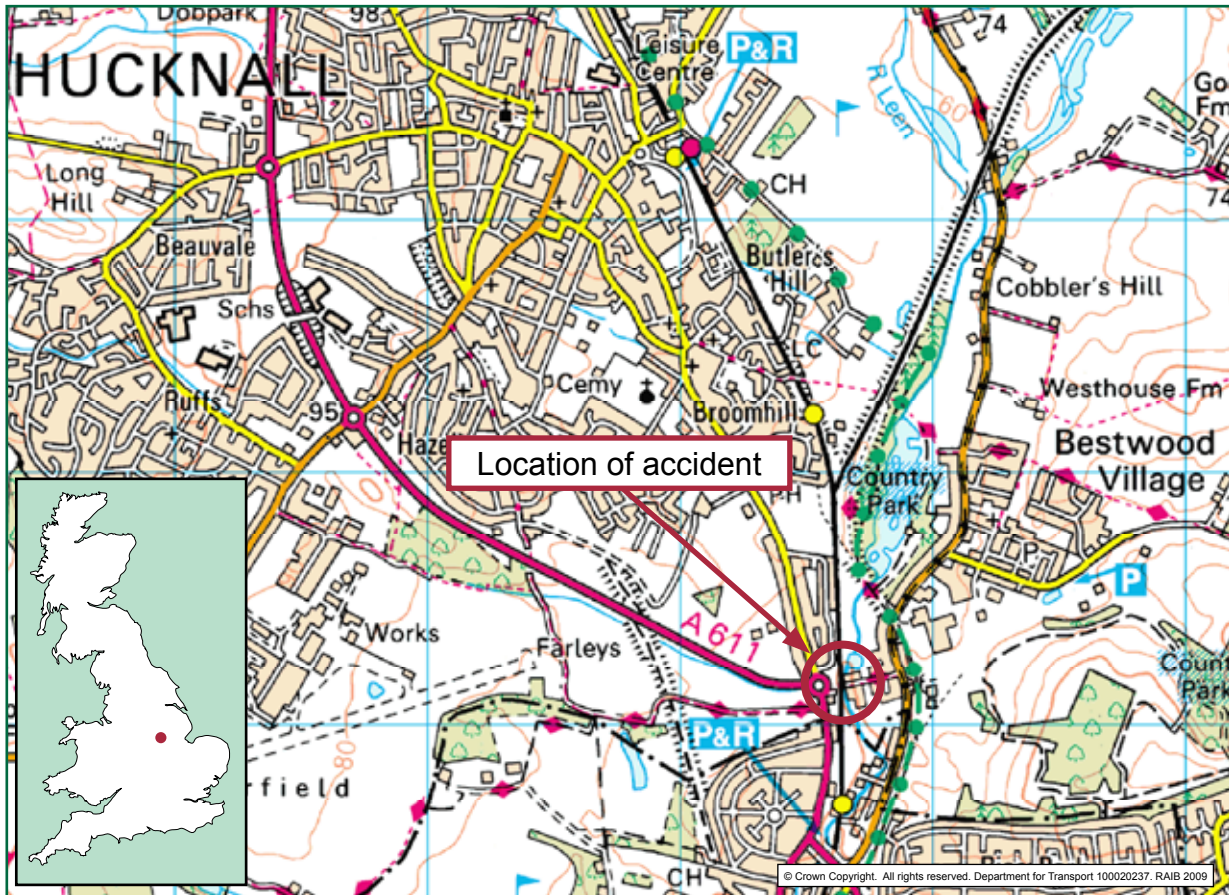


Figure 1: Extract from Ordnance Survey map showing location of accident

Immediate cause, causal and contributory factors, underlying causes

- 7 The immediate cause of the accident was the pedestrians being unaware of the oncoming train as they crossed in front of it.
- 8 Possible causal factors were that the pedestrians:
- a. either did not look to see if a train was coming; or
 - b. upon looking did not register the presence of the train; and
 - c. once having decided to cross were unaware of the train's approach until it was too late.

- 9 The underlying causes were:
- a. Network Rail's inspections, or processes did not identify that the *decision point* could be moved closer to the line that presented the risk to pedestrians;
 - b. the effects of the illumination at the crossing and the risk to pedestrians presented by tram operations were not considered;
 - c. Network Rail did not appreciate that crossings in darkness present different risks to users compared within during daylight hours; and
 - d. issues identified from previous accident investigations were still present at this crossing.

Severity of consequences

- 10 The woman and the child were fatally injured.

Recommendations

- 11 Recommendations can be found in paragraph 178. They relate to the following areas:
- a. provision of signs at the outer extremes of the crossing to warn pedestrians that trains and trams can approach the crossing from either direction at any time;
 - b. assessment of the street lighting at the crossing;
 - c. establishing if additional protective measures are appropriate at this crossing;
 - d. conducting crossing inspections in the hours of darkness;
 - e. amending processes to re-assess crossings when circumstances at crossing locations have changed;
 - f. revising processes to compare and resolve differences in data from different inspections;
 - g. evaluating the risk from the operation of trains with headlights that emit less luminous intensity than that required by current standards; and
 - h. applying the lessons of this accident to other similar crossings.

The Accident

Summary of the accident

- 12 At approximately 18:38 hrs on 22 November 2008, train 2D22, a two car Class 158 *diesel multiple unit* running from Worksop to Nottingham, struck and fatally injured two pedestrians on Bayles and Wylies crossing, a pedestrian crossing over the Robin Hood line in the northern suburbs of Nottingham.
- 13 Immediately before train 2D22 had reached the crossing a tram had passed over the adjacent crossing on the parallel Nottingham tram system. The tram was heading in the same north to south direction as the train.

The parties involved

- 14 Network Rail Infrastructure Ltd (Network Rail) is the infrastructure owner and the controller of the track on which the accident occurred. It employs the staff who assessed, inspected and maintained Bayles and Wylies crossing.
- 15 East Midlands Trains Ltd (East Midlands Trains) was the operator and maintainer of train 2D22, and is the employer of its driver.
- 16 Nottingham Express Transit (NET) was the operator of the tram which passed over the level crossing shortly before the accident. It is the employer of the tram driver and is the maintainer of the section of the crossing passing over its line.
- 17 Nottinghamshire County Council is responsible for the footpaths leading to Bayles and Wylies crossing, and the provision of the street lighting to the path.
- 18 All parties co-operated freely with the investigation.

Location

- 19 Bayles and Wylies footpath level crossing is located on Network Rail's Robin Hood line, which runs from Mansfield Junction, to the west of Nottingham, to Mansfield and Worksop.
- 20 The railway and tram lines over which the crossing passes are aligned approximately north to south; with the crossing aligned approximately east to west. Sections of the walkway surface (or deck) of the crossing over the Network Rail lines are at an angle to the lines. The crossing connects Bestwood Village, to the east, to Hucknall on the west (Figure 2).
- 21 The crossing crosses three railway lines; from east to west these are:
 - a disused Network Rail branch line, that led to Calverton colliery;
 - Network Rail's Robin Hood line; and
 - the NET tramway line.

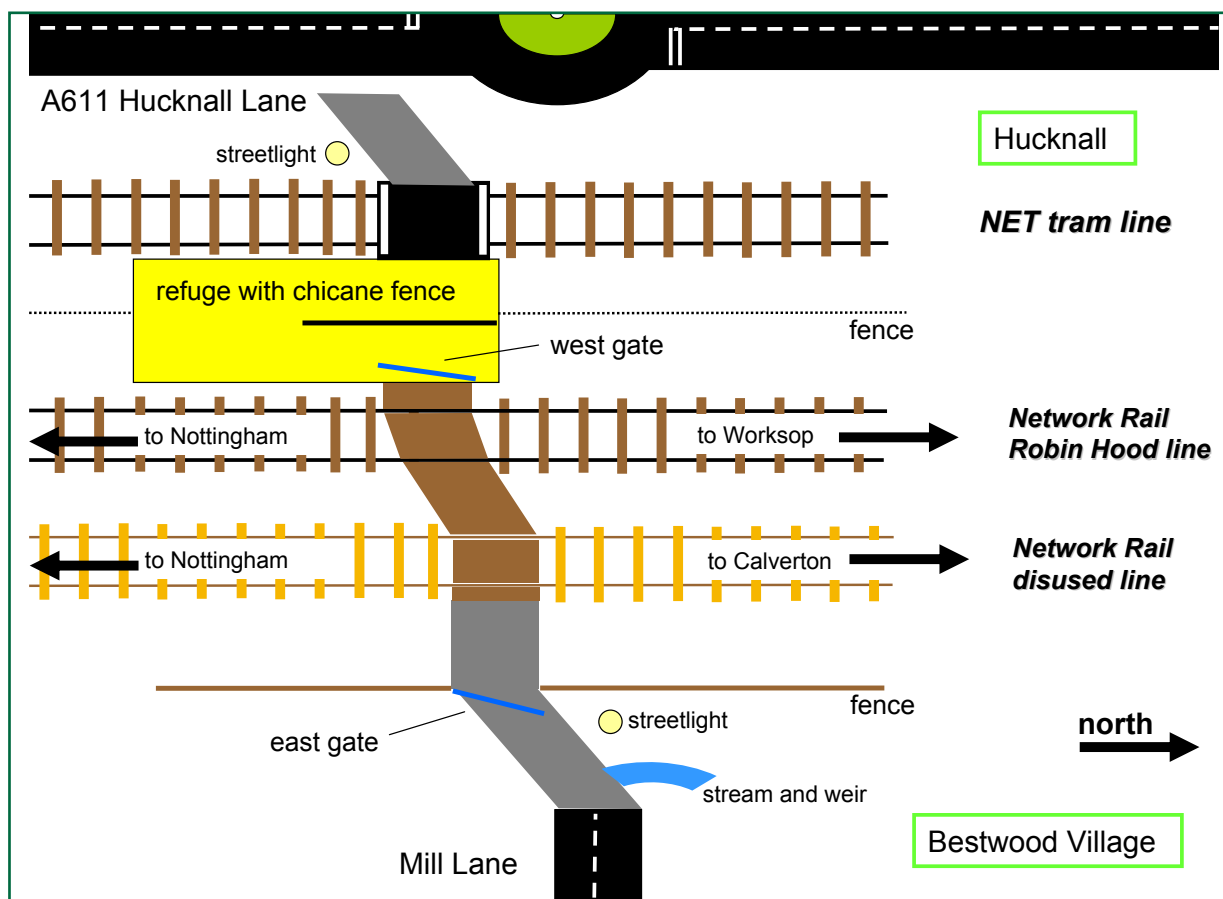


Figure 2: Location of Bayles and Wylies footpath level crossing

- 22 The railway and the tramway are separate legal entities and there is a boundary fence separating them. To allow access over the crossing there is a refuge between the train and tram lines (Figure 3). The refuge is an area for pedestrians to stand in while checking that the subsequent line(s) they intend to cross are safe to do so. The refuge contains a chicane fence which prevents users making a direct route over all the lines. This arrangement is in accordance with the guidance given to the railway industry by the *Office of Rail Regulation* (ORR) and its predecessors, through its publication 'Railway Safety Principles and Guidance, part 2, Section E, commonly known as RSPG (Appendix D).

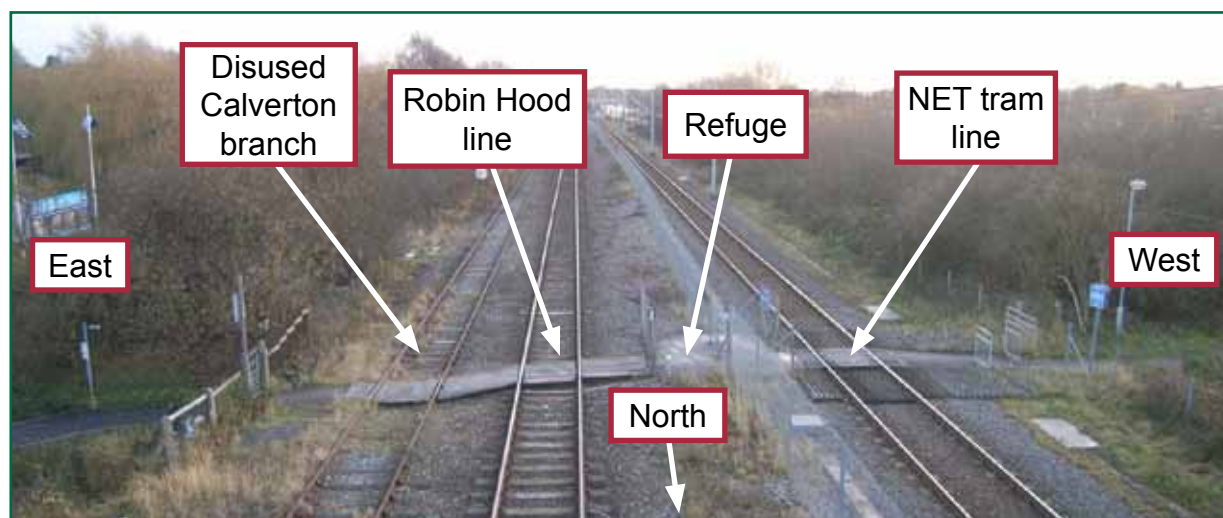


Figure 3: View of Bayles and Wylies crossing from the north

- 23 Both the Robin Hood and the NET lines are *bi-directional*. The maximum permitted speed at the crossing on the Robin Hood line is 70 mph (112 km/h), while on NET it is 80 km/h (50 mph).
- 24 Access to and from the Network Rail lines is via self-closing 'swing' gates that open away from the railway. The gate on the east leads to and from a footpath at the end of Mill Lane (Figure 4). The gate on the west leads to and from the refuge (Figure 5).



Figure 4: East-side gate from the footpath approach

- 25 Moving from east to west, the crossing surface initially consisted of a tarmac path 2.6 metres long. From this point to the central refuge, the surface consisted of a mixture of railway timbers (wooden *sleepers*) and plywood; forming a deck which was level with the top of the rails. The deck was 1.8 metres wide and its central 1 metre was covered with strips of roofing felt. The RSPG specify a minimum width of 1 metre (Appendix D). The edges of the plywood deck were showing signs of deterioration and some of the roofing felt strips were creased (Figure 5).
- 26 The service levels of trains and trams are independent, with both subject to variation. The concurrent arrival of a train and a tram from the same direction, together with a pedestrian approaching the crossing is a foreseeable, but uncommon event (paragraph 69).



Figure 5: The crossing surfaces

Pedestrian level crossings

- 27 For pedestrian crossings, the infrastructure owner is given guidance that a pedestrian should have sufficient warning to cross from a decision point. This is a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety. RSPG require that the *warning time* of an approaching train is greater than the *crossing time* for the crossing.
- 28 Train drivers, because of a train's relatively high speed and low braking rate, are usually unable to stop their train if a pedestrian is on a crossing in front of them; trains are not designed such that they can stop short of an observed obstruction. Also they are only required to sound a warning horn if there is a *whistle board* requiring them to do so, or if they see a pedestrian at risk on the railway; they are not required to apply the brakes in these circumstances. There is no specific requirement for a driver to look out for pedestrians on a level crossing. Therefore the safe crossing of pedestrians is critically dependant upon the design of the crossing and the decision of the pedestrian.
- 29 Drivers of trams, which are effectively operating as if on the highway, have to look out for pedestrians, and attempt to avoid collisions with them, by sounding warnings, slowing down, or, in extreme, using the emergency brake. Trams operate at a lower speed than trains, and have brakes that can stop the tram in a shorter distance than for a train.

The rail vehicles involved

- 30 Train number 2D22 was a two car class 158 diesel multiple unit. The leading unit was number 158862. The Class 158 train was introduced into service by British Rail's Regional Railways in 1989, and has a maximum speed of 90 mph (145 km/h) (Figure 6).



Figure 6: The leading unit 158862 of the train

- 31 The tram involved was number 205, built by Bombardier transportation for the introduction of the NET services in 2004. It has a maximum speed of 80 km/h (Figure 7).



Figure 7: A stationary NET tram close to the crossing at night

External circumstances

- 32 The accident occurred some two and a half hours after sunset, during the hours of darkness.
- 33 The level crossing was lit by street lights on each of its footpath approaches. Nottingham County Council owns and maintained these lights. The light to the east of the crossing was situated approximately 5 metres outside the east-side gate and 5 metres to the north of the footpath (Figure 2).
- 34 The weather at the time of the accident was cold, dry and clear. The wind was coming from the west and was slightly gusting between 1.6 and 11 km/h.
- 35 The crossing is close to the A611 roundabout on Hucknall Lane (Figures 1 & 2), and at the east gate road traffic noise can be heard. There is also a stream approximately 20 metres to the east with a nearby weir, which contributed to background noise.

Events preceding the accident

- 36 The two people involved in the accident were Mrs Jean Hoggart, a 56 year-old grandmother and her 7 year-old grandson, Mikey Dawson. They were returning to the grandmother's home, having left her daughter's house at around 18:30 hrs. Their journey from Bestwood Village to Hucknall, with which they were familiar, took them over the crossing, in an east to west direction.
- 37 Train 2D22 departed from Hucknall station, a mile and thirty three *chains* (2.3 km) north of the crossing, at 18:36 hrs, heading south towards Nottingham. The journey had been uneventful prior to the accident. There were 32 passengers on board the train.
- 38 Tram number 205 left Butlers Hill tram stop, 1.1 km north of the crossing, at 18:37 hrs heading south towards Moor Bridge tram stop.

Events during the accident

- 39 Data from train 2D22's *On Train Data Recorder* (OTDR) shows that the train driver correctly sounded the horn when he reached the whistle board to the north of the crossing.
- 40 Before tram 205 reached the crossing, its driver switched the headlights to the full beam setting, in accordance with NET guidance for the operation of the tram.
- 41 When the tram arrived at the crossing it was travelling at between 70 and 75 km/h, and starting to brake for the Moor Bridge stop, some 450 metres ahead. Train 2D22 was then some 160 metres north of the crossing, travelling at 62.6 mph (101 km/h).
- 42 The tram took approximately two seconds to pass over the crossing; when it cleared the crossing train 2D22 was still some 90 metres to the north.
- 43 When train 2D22 was some 50 metres from the crossing, the driver sounded the train horn for a second time, and then saw the pedestrians. He continued to sound the horn for a total of 1.4 seconds.

- 44 The pedestrians at this time were crossing the Robin Hood line (Figure 3). On hearing the horn, witness evidence indicates that the grandmother looked towards the train, but did not have time to move clear. The right-hand side of the train struck and fatally injured both pedestrians, and its driver applied the emergency brake, stopping some 420 metres beyond the crossing, just short of Moor Bridge tram stop.
- 45 The OTDR shows that the time that elapsed between the driver starting to sound the horn for the second time and his application of the emergency brakes was 1.9 seconds, which is 0.5 seconds after he released the horn.
- 46 No-one on the train was physically injured by the accident.

Events following the accident

- 47 Once the train had stopped, its driver contacted the signaller to report the accident. The signaller then contacted the emergency services. An emergency call was also made by a member of public who had witnessed the accident from the footpath to the east of the crossing.
- 48 Paramedics attended the site along with representatives of Network Rail, East Midlands Trains, British Transport Police and members of Nottinghamshire Constabulary. Representatives of ORR, which is the safety authority for both systems, also attended that evening.
- 49 The passengers were taken off the train and escorted on foot into Moor Bridge tram stop.
- 50 The site was reopened for rail services at 22:50 hrs.

The Investigation

Investigation process and sources of evidence

51 The following sources of evidence were used:

- witness statements;
- the train's OTDR data;
- CCTV recordings taken from tram number 205;
- CCTV recordings of other pedestrian level crossing incidents;
- site photographs and measurements;
- sound and light measurements carried out by the RAIB on the tram, the train and the site;
- weather reports and observations at the site;
- a human factors report commissioned by the RAIB;
- the Network Rail level crossing file;
- a review of previous reported occurrences at the crossing, (none of which transpired to be relevant to this accident); and
- a review of previous RAIB investigations that had relevance to this accident.

Analysis

Identification of the immediate cause¹

52 The immediate cause of the accident was the pedestrians being unaware of the oncoming train as they crossed in front of it.

- 53 Witness evidence from the train driver and a witness at the crossing indicates that the grandmother and the child were walking normally across the crossing, side by side, with the grandmother on the right, closer to the approaching train. She was seen to be looking down, and then to look up at the train after the second sounding of the horn. By this time she was unable to take any action to save either herself or her grandson. Analysis of their injuries is consistent with this evidence.
- 54 The grandmother was a reasonably regular user of the crossing, with an estimated usage of about four times a month over a period of years. She had used the crossing earlier in the day and was not under any time pressure on the evening of 22 November.
- 55 There is no evidence that the grandmother:
- suffered from any medical condition that affected her behaviour on the crossing;
 - had any eyesight or hearing difficulties; or
 - tripped or slipped on the crossing.
- 56 The grandmother was not:
- under the influence of any medication, drugs or alcohol, as confirmed by post mortem examination;
 - wearing any clothing that could have obstructed her vision or hearing; or
 - using any electronic equipment that could have distracted her or obstructed her hearing.
- 57 There is no evidence that the young boy behaved in any inappropriate way that might have distracted his grandmother. The evidence from witnesses is that he walked alongside her at a steady pace as they crossed the line.
- 58 The manner in which tram 205 was driven did not contribute to the accident. The tram had cleared the crossing before the pedestrians reached the Robin Hood line, and all available evidence indicates that the driver drove the tram in accordance with the relevant procedures, putting his headlights to main beam, but not sounding any warning bell or horn. There is no requirement for tram drivers to sound a warning on the approaches to the crossing; they will only do so should they see pedestrians nearby and wish to warn them of their approach. The tram driver reports, and CCTV evidence supports, that he saw no pedestrians at the crossing.

¹ The condition, event or behaviour that directly resulted in the occurrence.

- 59 The manner in which train 2D22 was driven did not contribute to the accident. The train was being driven within the speed limit of 70 mph (113 km/h). The driver sounded the horn at the appropriate location, 340 metres north of the crossing, in accordance with the instructions that he had been given (paragraph 90). The train driver's evidence is that, although not required to (paragraph 28) he was keeping a lookout at the crossing as he approached, but was focussed on the western approach, in case a pedestrian came from behind tram 205. He was neither looking to the east, nor required to look for pedestrians. The OTDR data shows he had made a precautionary service brake application 1.7 seconds before he sounded his horn again, some 50 metres from the crossing. He only saw the pedestrians after sounding the horn a second time – both were wearing dark clothing. He had initially sounded the horn a second time as a precautionary measure, because he was catching up tram 205 and was concerned whether anyone would cross from the west side, not because he had seen the pedestrians.
- 60 There is no evidence that the train driver was fatigued, or in any way unfit for his duties.
- 61 Testing of the train's control and braking systems after the accident found no faults that might have contributed to it. The braking capability of the train was not a factor in this accident.

Identification of causal² and contributory³ factors

- 62 The RAIB identified three causal factors in investigating why the grandmother reached a position where she was at such risk. These are:
- either she decided to cross the line without looking to the north, from where train 2D22 was approaching; or
 - she decided to cross the line after looking to the north, but did not register the approaching train; and
 - in both cases, she continued to cross the line without realising that the train was approaching her.

It is not possible to say with certainty which combination of these factors caused the accident, but each is now examined in detail.

Not looking to the north before crossing

- 63 It is possible that the grandmother did not consider the possibility that there might be a train approaching the crossing as well as the tram, which was brightly illuminated and in her immediate field of vision, and that consequently she did not look to see if a train was approaching.**

- 64 There is no evidence that the grandmother was careless in her approach to the crossing; the way that they were observed to cross the line indicates a steady approach.

² Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

³ Any condition, event or behaviour that affected or sustained the occurrence, or exacerbated the outcome. Eliminating one or more of these factors would not have prevented the occurrence but their presence made it more likely, or changed the outcome.

- 65 It is probable that she saw tram 205 moving towards the crossing as she approached the east gate, and she may not have considered the possibility that a train could also be approaching from the same direction. She thus might not have looked to see if there was a train to the north.
- 66 The RAIB has analysed the positions of train 2D22 and tram 205 relative to its reconstruction of the pedestrians' likely movements. The RAIB has used walking speeds of 1 and 1.2 metres per second (Appendix D, clause 148) in its analysis. On this basis, twelve seconds before the accident they would have been between two and four metres outside the east gate on the footpath.
- 67 At this time the tram was some 160 - 180 metres to the north of the crossing. The tram driver had put his headlights on to full beam, so he could see pedestrians on the crossing. The headlights had a *luminous intensity* of approximately 2,900 candelas when viewed from two metres before the gate, (tram headlights are designed to give a similar light output as road vehicles). The tram would have been visible, but train 2D22 would not have been in view, from between two to four metres outside the gate (Figures 8 and 9).

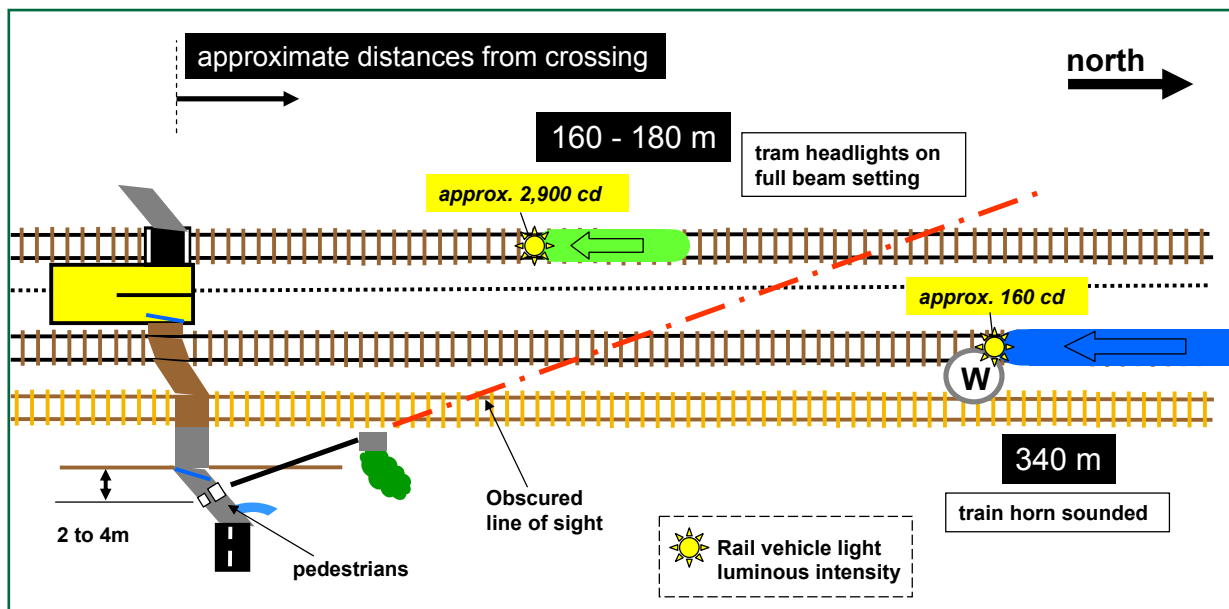


Figure 8: Calculated position of the pedestrians, tram and train 12 seconds before the accident



Figure 9: Daytime view to north from two metres outside east-side gate

68 Nine seconds before the accident the RAIB's analysis indicates that the pedestrians were at the gate, and the tram was 100 metres to the north. The luminous intensity of the tram's headlights reduced as the effective angle between the tram and the pedestrians increased. However, the tram headlights still had a luminous intensity of 985 candelas when viewed from the gate. In addition, the saloon of the tram was illuminated, and would have been in the grandmother's line of vision (Figures 10 and 11).

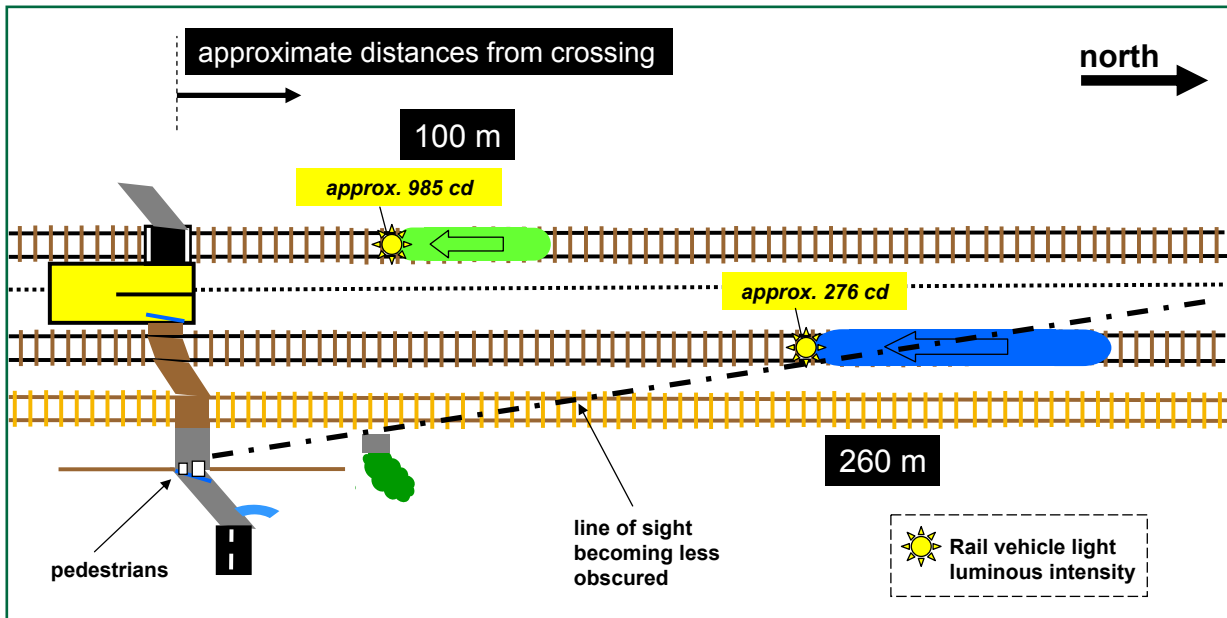


Figure 10: Calculated position of the pedestrians, tram and train 9 seconds before the accident



Figure 11: A tram 100 metres north of Bayles and Wylies crossing as seen from the gate in darkness

- 69 The trains and trams run to different, and independent, timetables. There were 28 passenger trains per day in each direction on the Robin Hood line at the time of the accident, and on a Saturday trams ran every ten to twelve minutes at peak times, and every fifteen to twenty minutes at the time of the accident. Both travel at different, and variable, speeds and both can operate at different times to the timetable. The RAIB carried out a user survey at the crossing (paragraph 95), and found that nearly 70% of the users questioned had never seen a train and a tram arrive at the crossing at the same time.
- 70 As far as the RAIB and the ORR are aware, Bayles and Wylies crossing is the only location in the UK where there is a pedestrian level crossing over a railway and a tramway operating alongside each other. There are only two other crossings in the UK where trains on two different railway systems run over the same pedestrian crossing, both associated with the Tyne and Wear Metro and Network Rail.
- 71 Given the unique nature of the crossing, and the uncommon occurrence of a train and tram arriving together from the same direction, unless they are a very frequent user, they are unlikely to have experienced a concurrent arrival. A pedestrian arriving at the east gate may thus often not be expecting a train and a tram to arrive concurrently and hence may not think that any extra care might be necessary.
- 72 The crossing is designed in two separate sections, in accordance with RSPG, Part 2, Section E, paragraph 143. As a result, none of the signage warns of the possibility of a train and a tram approaching together from the same direction.

Looking to the north before crossing, but not registering the approaching train

- 73 It is possible that the grandmother did look to the north before she decided to cross the railway, but did not see or hear the approaching train, because of the effects of the tram's lights, and the background noise.**

The location where the grandmother decided to cross the line

- 74 The RAIB considers that the grandmother took the decision to cross the line at the east-side gate.
- 75 As a pedestrian approaches the crossing from the east the only sign indicating that there is a railway, and how to behave on it, is at the gate. The sign is a standard railway sign, stating 'Stop Look Listen. Beware of trains'. The base of the sign is 2.25 metres from the ground (Figure 12).
- 76 The east gate is situated 2.9 metres from the nearest rail of the disused Calverton line, and 6.2 metres from the nearest rail of the Robin Hood line (Figure 12). The approach to the gate on this side is by a slightly rising tarmac footpath. There was no indication to a pedestrian that the Calverton branch was out of use.
- 77 The RAIB considers that a pedestrian would be aware of the Calverton line, and would decide at the gate whether or not it was safe to cross.

Relative visibility of the train and tram

- 78 The tram would have been clearly in the grandmother's view when she was at the gate, but the train would have been either hidden behind obstructions or only just coming into a position where it could have been seen.

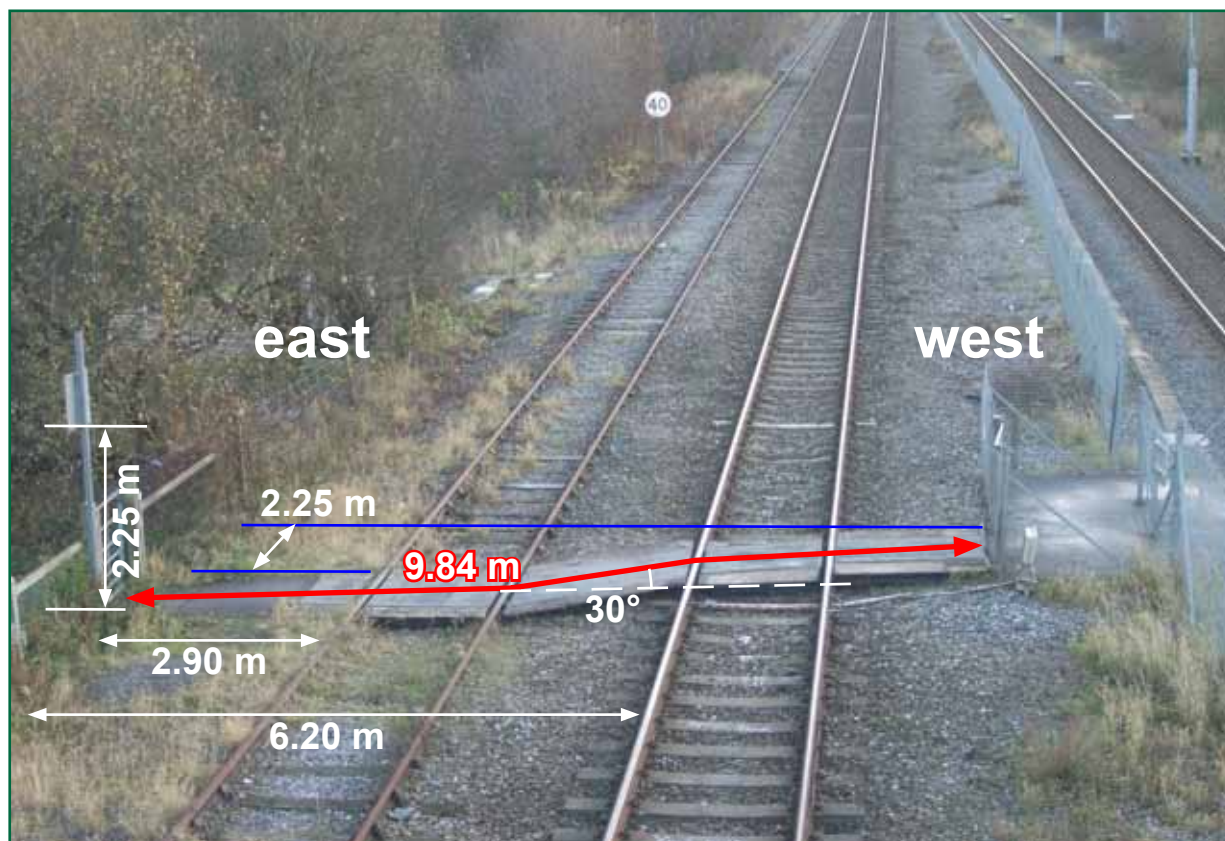


Figure 12: Key dimensions of the crossing

- 79 Nine seconds before the accident, when the pedestrians were at the gate, the tram would have been some 100 metres north of the crossing, and the train some 260 metres north of the crossing (Figure 10).
- 80 With the train at this position it would only just be coming into the sight of a person standing at the gate and looking to the north. To the north of the gate there is a railway signalling equipment cabinet, and also some vegetation. These limit visibility of the Robin Hood line to some 400 - 450 metres at the gate. The visibility alters rapidly depending on exactly where a pedestrian is standing. After dark it is not possible to see either the metal box or the vegetation, so a pedestrian would not know that visibility was limited. It is possible that the grandmother looked to the north at the gate, but did not see the train as it was hidden by these obstructions. This is particularly likely if she looked to the north when she was outside the gate.
- 81 If the train had come into sight, then its relatively dim headlights, compared with the tram, would have made seeing it more difficult.
- 82 The tram was fitted with headlights suitable for running on the road, and these were on main beam for the level crossing. With the tram 100 metres from the crossing, as it was when the pedestrians were at the gate, the headlight's luminous intensity measured from the gate was 985 candelas. The luminous intensity of the train's night-time headlight was 276 candelas at this time. The interior lights of the tram, and its cab, were also clearly visible. The interior of the train cab was not illuminated, and its interior lights would not have been visible from the gate as the train presented a predominantly front view to the pedestrians.

Luminous intensity of train headlights

- 83 The luminous intensity of the train's headlights was below that required at the time of its construction, and there is no requirement to test or measure this value in service.
- 84 The rearward facing CCTV of the tram (Figure 13), and post-incident tests, both confirm that the night-time head light on train 2D22 was working at the time of the accident. However, the RAIB measured its luminous intensity when viewed from the east gate as 276 candelas when the train was 260 metres away, and 514 candelas when it was 180 metres away. At these distances the horizontal angle from the geometrical axis passing through the centre of the front of the train was between 1.3 and 2 degrees (Figure 14). This compares with a requirement in British Rail (BR) 'Technical specification for headlights for traction units' TEE/C/85/R/76, of March 1988, which was valid at the time that the Class 158 was designed in 1989, for a luminous intensity of 3500 (at 3 degrees) and 10000 candelas (at zero degrees). The current *railway group standard* for train headlight luminous intensity, GM/RT2483, 'Visibility requirements for trains', requires a luminous intensity of 32000 candelas at zero to 3 degrees, and 4500 candelas at 2 to 5 degrees.

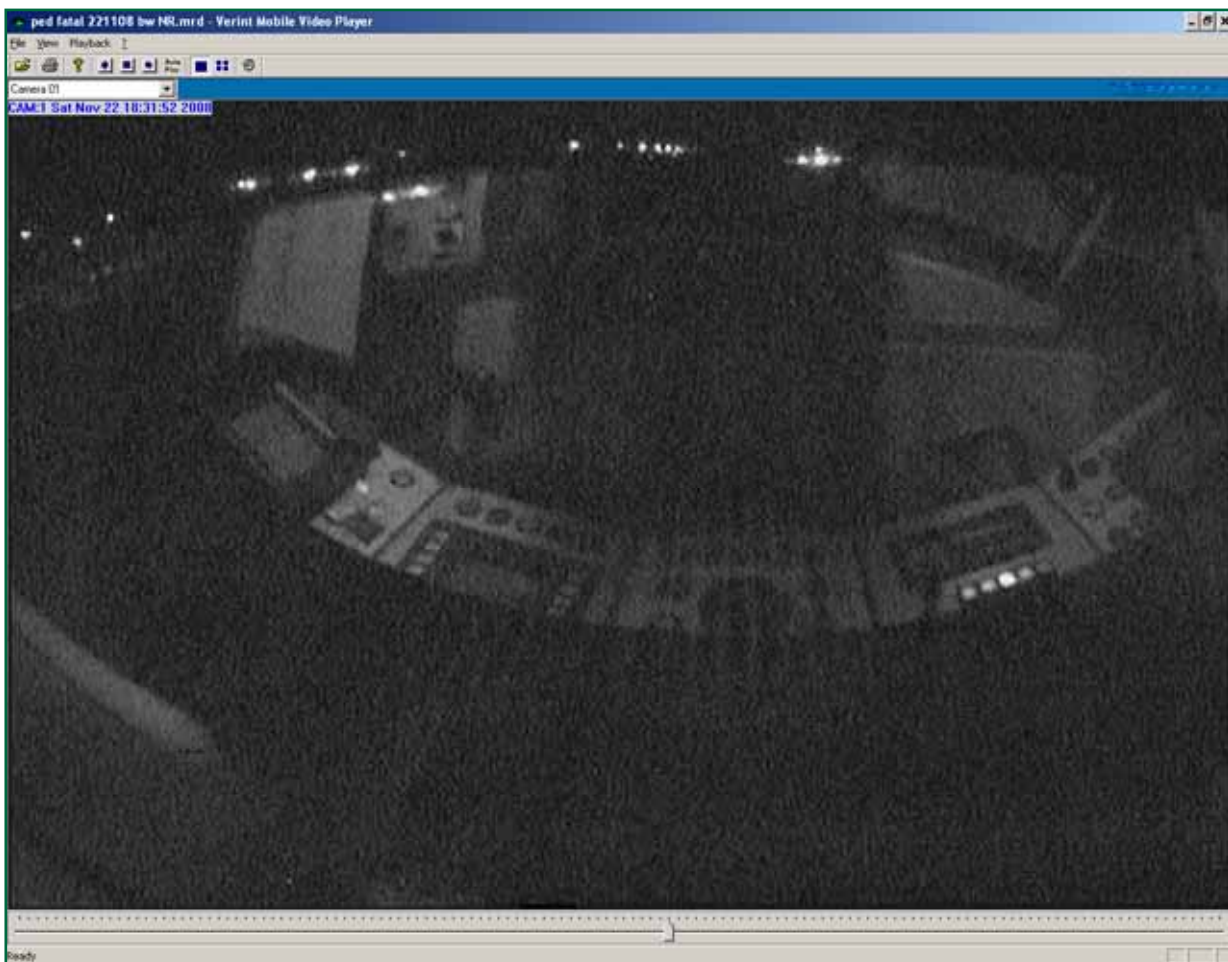


Figure 13: CCTV view from the rear of tram 205 as it crossed Bayles and Wylies crossing showing the lights of train 2D22

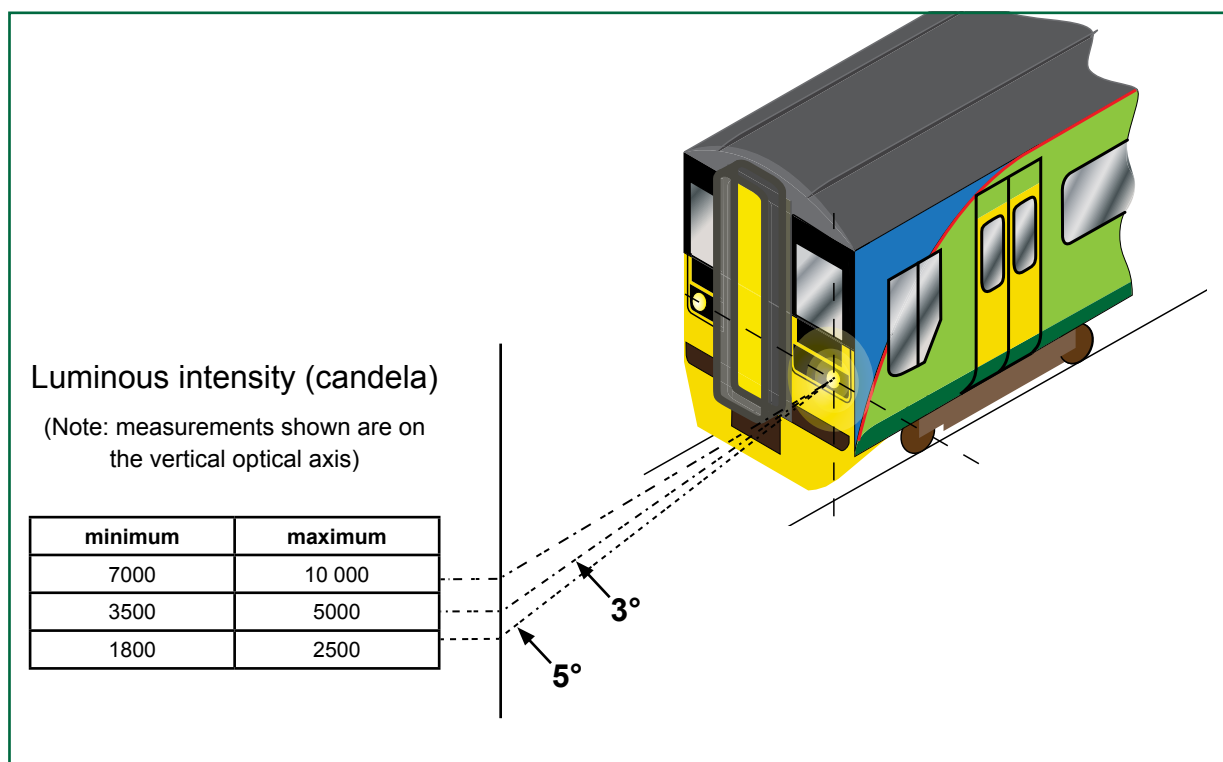


Figure 14: Diagram showing the change of luminous intensity with change of viewing angle towards a train's night-time headlight

- 85 TEE/C/85/R/76 makes no reference to maintaining the intensity level of headlights. GM/RT2483 states that 'lights shall be subject to a cleaning requirement to enable their optical performance to meet the requirements'. Railway group standards are not retrospective, and although East Midlands Trains test the working of Class 158 headlights regularly, they do not test their luminous intensity or their alignment.

Relative audibility of the train and tram

- 86 The pedestrians may not have heard the various audible prompts from the approaching train due to the background noise and the noise of the tram.
- 87 Three hundred and forty metres to the north of the crossing is a 'whistle board'. This is an instruction to the driver of a train to use the horn. Such boards are installed where the visibility of trains from a crossing may be obstructed with the aim of ensuring an adequate warning time is available for pedestrians (see Appendix D).
- 88 Whistle boards have been present at the crossing for many years and this particular board was retained because of a signal gantry which partially obstructs the visibility to the north for pedestrians entering the Network Rail crossing from the west (Figure 15).
- 89 Class 158 trains have a two tone horn, and drivers can use a lever to sound either or both tones. The OTDR data shows that the driver of train 2D22 did sound his horn 12 seconds before reaching the crossing, which equates to the position of the whistle board, but does not show whether the driver used the high or low tone. From the data, and the RAIB's tests and analysis the horn would have been audible for approximately half a second, which is too short to have been both tones.



Figure 15: Signal gantry as seen from west-side gate

- 90 The industry's rule book⁴ (railway group standard GE/RT8000), module TW1, Preparation and movement of trains (General) covers the use of a warning horn in section 10.2. Drivers are instructed 'You must sound the horn when passing a whistle board between 0700 and 2300. You must not sound the horn when passing a whistle board between 2300 and 0700 (except in an emergency or when anyone is seen on or near the line)'. The section also instructs drivers to use the low tone only 'when passing a whistle board between 0700 and 2300'.
- 91 The rule book clauses about not sounding horns at night were inserted in April 2007 after complaints about the noise of train horns at night. Discussions with drivers indicate that as a result of this they have tended to reduce the duration of sounding their horns overall.
- 92 The RAIB has measured the sound of train horns, trains and trams at Bayles and Wylies crossing in similar weather conditions to the accident (paragraph 34) and at the same time of day, albeit during a weekday. The background noise level at the crossing of 59 *decibels (A)* (dB(A)) was mostly due to road traffic noise from the nearby roundabout and from the stream on the east side (paragraph 35). The level of a single tone of the train horn at the whistle board was recorded as 66 dB(A). Apart from this brief increase in sound level the train's noise was initially comparable with or below the background level. Accordingly, apart from when the horn sounded, the train would have been inaudible at the time that the grandmother was deciding whether or not to cross the line.

⁴ Railway Safety and Standards Board - <http://www.rssb.co.uk/rgs/rulebook/index.asp>

- 93 The duration of the horn sounding was very short, and it is not possible to say whether they would have heard it, as there may have been other distractions, such as a conversation, that prevented her hearing it.

Perception of train horns

- 94 If the grandmother heard the train horn it is possible that she may have associated it with the clearly visible tram rather than the approaching train.
- 95 The RAIB arranged a user survey of Bayles and Wylies crossing on a weekday between the hours of 11:00 hrs and 15:30 hrs. There were on average 12 users per hour over this period. In order to understand users' perceptions of what train horns indicated 24 users were asked questions from a prepared questionnaire. 62% of those questioned used the crossing at least once a day during weekdays with a further 13% using it several times a week. Not all of those questioned answered all the questions. The majority used the crossing between 12:00 hrs and 18:00 hrs. The survey showed that:
- all of the respondents thought that both train and tram horns are distinguishable from road vehicle horns (this reduces the possibility that the horn, if heard, was mistaken for a road vehicle);
 - 50% of the respondents expected a train horn to be two tone, 23% didn't know and 18% said it could be either a single tone or two tone, which is what can actually happen;
 - if a horn was heard, 38% would expect it to be a train, 5% would expect it to be a tram and 38% would expect it to be either; and
 - over 80% expected a train, and 50% expected a tram, to sound horns on their approaches to the crossing.
- 96 Only 18% of the sample respondents had a correct perception of how train horns sounded, and 50% had an incorrect perception.

Not realising that the train was approaching while crossing the line

- 97 **The pedestrians, having decided to cross the line, did not realise that there was a train approaching until it was too late to take action to save themselves.**
- 98 The design of any railway crossing should ensure that pedestrians are presented with appropriate information, at a position of safety, to enable a correct decision to be made before crossing. However, once crossing has commenced, additional checks for trains assisted by any audible clues of their approach, can provide a warning after an earlier, incorrect, decision.
- 99 The RAIB has studied two CCTV recordings of previous pedestrian accidents on level crossings where the pedestrian, after deciding to cross the line, continued to cross in front of a clearly visible train or tram without looking around to ensure their safety. The RAIB's observations of pedestrians crossing the highway also shows the same behaviour.

Visibility

100 The luminous intensity measurements indicate that the approaching train would have been more visible than the tram if the grandmother had looked to the north at any time in the seven seconds before the accident. The measurements show that the luminous intensity of the train's night-time headlight exceeded that of the tram's when measured from the position of the pedestrians. The luminous intensity of the train's night-time headlight was increasing and it was also becoming closer, appearing larger against the dark background (Figure 16). The tram would have been less of a visual distraction to any view made directly towards the north as it moved towards the crossing in front of them. Seven seconds before the accident the pedestrians were inside the gate and approaching the disused Calverton line, still effectively in a safe position (Figure 17). This suggests that no further checks were made towards the north while they were crossing.



Figure 16: Reconstructed image of a train and a tram in darkness approximately 7 seconds before the arrival of the train at the crossing. Note: the brightness of the headlights and the scene are approximate because of the limitations of photography and printing in replicating the image perceived by the human eye.

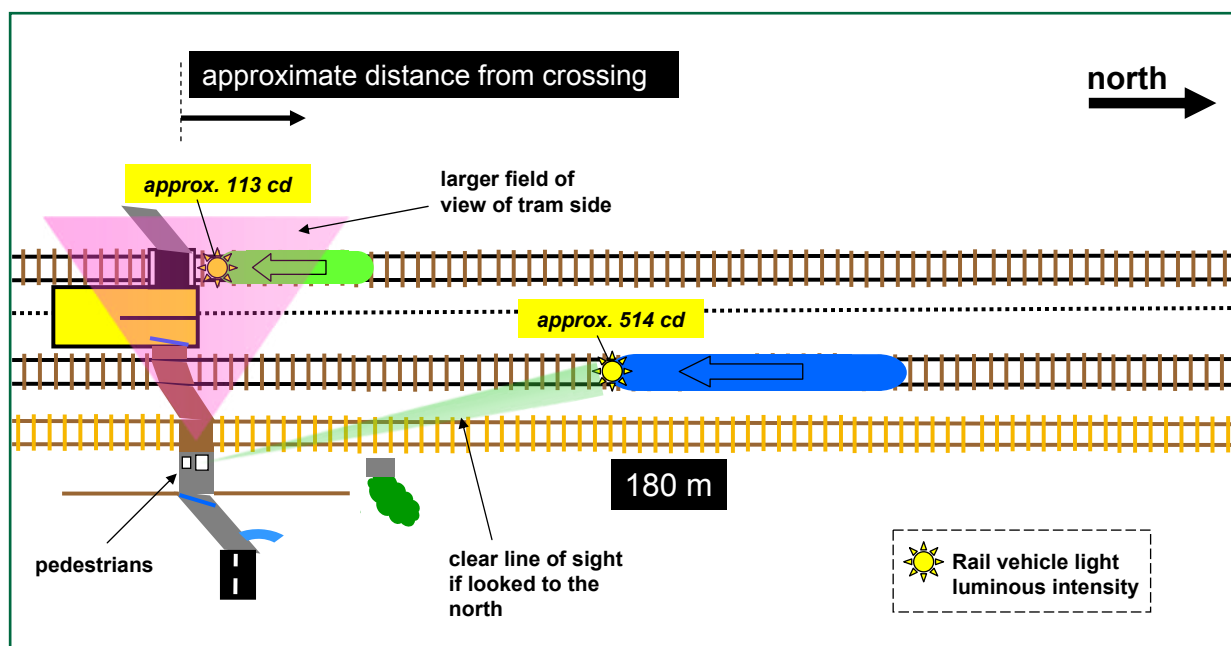


Figure 17: Calculated position of the pedestrians, tram and train 6 seconds before the accident

Audibility

- 101 Unless they had heard the very brief sounding of the horn twelve seconds before the accident, they would not have heard the train until approximately two seconds before it struck them.
- 102 The RAIB's sound pressure level measurements show that, after the horn was initially sounded, the sound levels from the train remained below the background levels until some six seconds before the accident, and below the levels of the tram until two seconds before the accident (Figure 18).

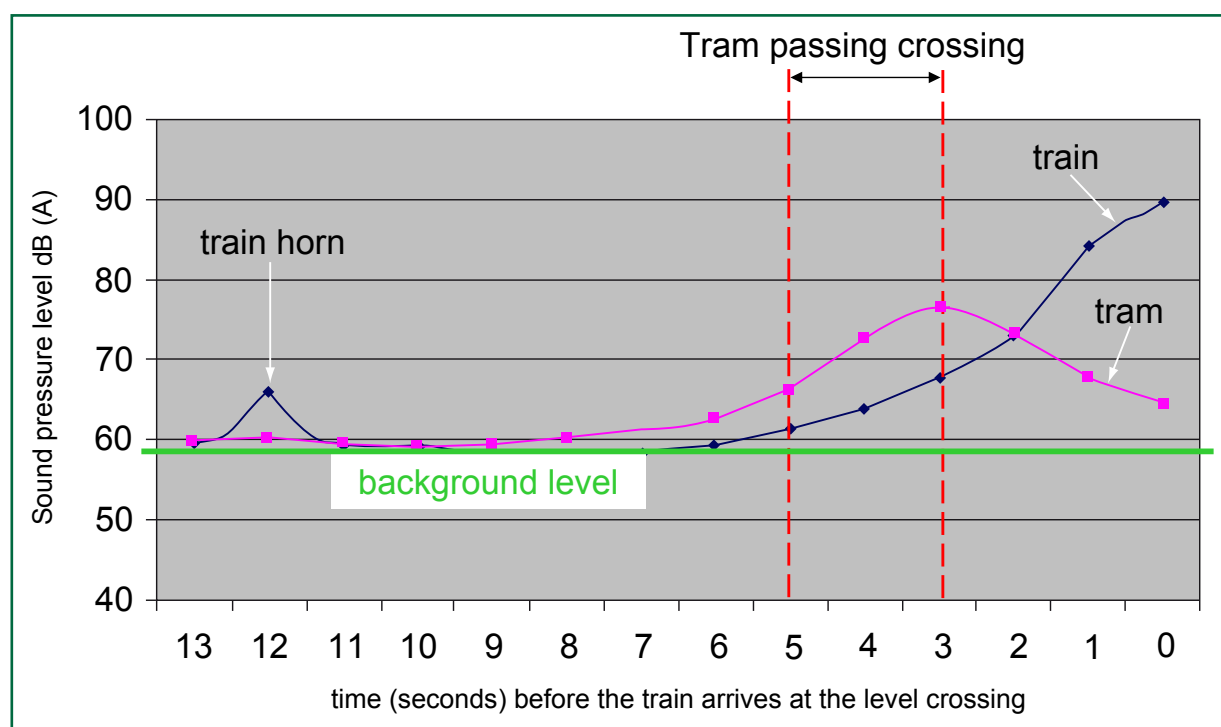


Figure 18: Sound pressure levels as measured at the gate in the period leading up to the accident

- 103 The OTDR data shows that the driver sounded his horn the second time at 50 metres from the crossing, about two seconds before the accident. The reasons for this are explained in paragraph 59.
- 104 The evidence of witnesses is that the grandmother reacted to the approach of the train about two seconds before the accident, but too late to have any effect. This tends to support the hypothesis that she did not hear, or see, the train before that time.

Distraction

- 105 The grandmother may have been focussed on other matters that discouraged her from looking towards the north and seeing the oncoming train.
- 106 As they crossed the lines the tram was moving across their field of vision (Figure 7).
- 107 Witness evidence is that the grandmother was looking down as she walked across the crossing. The layout of the crossing, its surface and the ambient illumination would all encourage a night-time user to focus on where they were walking rather than looking up for possible approaching trains.

108 The Network Rail crossing's western entrance is some 2.25 metres to the south of its eastern one (Figure 12). Since the redesign of the crossing layout to accommodate the Robin Hood line (Appendix E) this offset has been achieved by the crossing:

- going over the Calverton line at right angles, and then;
- diagonally at an angle of some thirty degrees across the interval between the lines, before;
- angling back to cross the Robin Hood line at a flatter angle, to;
- reach the refuge between the railway and the tramway (Figure 19).

The RSPG state that crossings should be perpendicular to the railway.



Figure 19: Bayles and Wylies footpath level crossing, showing offset to south

109 The crossing surface, as described in paragraph 25, was somewhat uneven, and its edges were not defined by white lines.

110 The distance from the crossing to any source of illumination (paragraph 33) meant that the crossing surface and its edges would not be clearly visible in the hours of darkness.

111 As they were walking side by side they would have taken up a large proportion of the 1.8 metre width of the crossing, and this would also have necessitated more attention as to where they were placing their feet.

The crossing layout and awareness of the approaching trains

- 112 The angled section of the crossing would have made them turn some 30 degrees away from the oncoming train as they approached the Robin Hood line, and this also may have reduced their opportunity of seeing it.

Identification of underlying factors⁵

Crossing design and layout

Location of the decision point

- 113 The east-side decision point could have been improved after the closure of the Calverton line in 2007.
- 114 The RSPG⁶ define a decision point as where a decision to cross or wait can be made in safety. For a footpath crossing it should be not less than 2 metres from the nearest running rails where the linespeed is less than 100 mph (160 km/h). The RSPG also state that a sign should be displayed at the decision point facing the user on either side of the crossing explaining the way to proceed safely over it.
- 115 By this definition the decision point for pedestrians crossing Network Rail lines from east to west was the east gate. It was 2.9 metres from the Calverton branch and 6.2 metres from the first rail of the Robin Hood line. Since June 2007, when the Calverton branch was officially closed, it was only the Robin Hood line that presented a risk to pedestrians.
- 116 Moving the decision point from the east gate to a position 2 metres from the Robin Hood line would increase the sighting distance from some 400 metres to approximately 600 metres. It would also decrease the time to cross the Robin Hood line from some ten seconds to about six seconds. There is no evidence that anyone considered moving the decision point closer to the Robin Hood line by adjusting signs, fencing, or boarding over the Calverton line, between the closure of the branch in June 2007 and the accident in November 2008. The RSPG state that an assessment of the suitability of the type of crossing at the location concerned should be made whenever circumstances at the crossing are to change (Appendix D).
- 117 Although the Calverton line was formally disused from June 2007 onwards, and was noted as such in a risk assessment of 21 April 2008, pedestrians would not have known that it did not pose a risk to them. Any checks for trains before or at the gate were therefore earlier than necessary, with an increased crossing time and reduced sighting compared with a decision point two metres from the Robin Hood line.

Crossing layout

- 118 The crossing's variable angles introduced extra risk at the crossing.
- 119 The RSPG state that a crossing should be at right angles to the railway, and should be maintained in a good and even condition.

⁵ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

⁶ Although the RSPG are not retrospective, they do apply to new works, and would have been applied for the re-modelling of the crossing for the opening of the NET.

- 120 The RAIB understands that, when the crossing was re-aligned for the opening of the tramway in 2004, the location of signalling equipment prevented the crossing being placed at right angles across the Network Rail lines, with the offset being accommodated in the refuge between the railways (Figure 19).
- 121 In March 2004 a level crossing risk assessment inspection resulted in a recommendation to straighten the crossing. This recommendation was not followed up due to a change in responsibility for the crossing as a result of a reorganisation within Network Rail (paragraph 138).
- 122 During a risk assessment of the crossing in 2008 the angled deck, and its effect on an increase in crossing time was considered, as the distance over an angled crossing is greater than that over one at a right angle. However, the difference in crossing time due to the greater distance is small. The effect of the angled deck on a pedestrian's vision, or the need to look at the deck to follow the changing angles of the crossing, was not considered.

Illumination

- 123 The lack of adequate illumination at the crossing may have contributed to the distraction of the pedestrians, and to the train driver not sounding an earlier warning.
- 124 The RSPG state that illumination of the crossing may be provided to ensure its safe operation, and that any lighting should not cause glare to either road users or train drivers, interfere with the visibility of railway signals nor cause avoidable annoyance to local householders.
- 125 Illumination assists pedestrians crossing in darkness by highlighting the surface and edges of the crossing. The RAIB considers that, if provided, lighting should be sufficiently bright and well positioned to illuminate the crossing deck but not so bright that it prevents users from seeing approaching trains.
- 126 The visibility of a crossing deck is not solely dependant upon the level of illumination present. The edges of a deck can be more easily seen by the use of materials with different reflective properties, such as white lines.
- 127 The level of illumination also affects the ability of train drivers to see pedestrians on level crossings should they be crossing when the train is approaching. However, the crossing design should be such that it allows users to make fully informed decisions without relying on train drivers' observation. In addition, too much illumination can be a distraction to train drivers, who require to see lit signals ahead of them.
- 128 The illumination provided at Bayles and Wylies crossing came from street lighting provided by Nottinghamshire County Council, and there appears to have been no co-ordination between that Council and Network Rail, or any other railway body, about its effect on the safe use of the level crossing.
- 129 It is not possible to say with any certainty whether the level of illumination contributed to the grandmother looking down at the crossing surface, or to the train driver not noticing her and her grandson earlier, but both are possible factors.

Crossing inspection and assessment

Assessment of the crossing

- 130 In assessing the crossing neither Network Rail, NET nor the safety authority considered the risk to pedestrians crossing the railway lines from hazards presented by tram operations, or vice versa.
- 131 In 2004 Bayles and Wylies crossing was redesigned and rebuilt to be treated as two separate crossings; one for the Network Rail lines, and one for the new tramway. The purpose of this was to allow crossing users to assess whether it was safe to cross the railway and the new tramway separately. This is in line with the guidance within the RSPG. However, there is no evidence of assessment of any risks arising from the interaction between the two crossings before the 2004 reconstruction, when the tramway was opened, or during the subsequent inspections and assessments. Moreover, to fully identify the prevalent risks relating to this accident, assessments would have to had been undertaken in darkness.
- 132 The RSPG state that an assessment of the suitability of a level crossing should be carried out if circumstances at the crossing have altered, and after a period of not more than four years. This assessment is to include both normal and abnormal conditions. To address the RSPG guidance for regular assessments, Network Rail has procedures in place for three-yearly assessments as part of a risk assessment and more frequent maintenance inspections.
- 133 Before January 2007 Network Rail carried out its three-yearly crossing risk assessments in accordance with a number of differing standards. However, from 12 January 2007, Network Rail began assessing footpath level crossings using its All Level Crossing Risk Model (ALCRM), in accordance with Network Rail standard NR/SP/OPS/100, 'Provision, Risk Assessment and Review of Level Crossings'. This standard superseded those previously in place, and is described in detail in Appendix F. This specifies the hours during which the census, undertaken as part of an assessment inspection, should take place. In undertaking the most common 'quick' census between the hours of 09:30 hrs and 16:30 hrs on weekdays, it is unlikely that conditions during darkness would be observed.
- 134 The Bayles and Wylies level crossing file contains six inspection and risk assessment records dating back to March 2000. The three most recent assessments, March 2004, April 2005 and April 2008 were conducted by Network Rail following the changes made to the crossing to accommodate the tram.
- 135 The assessment of March 2004 was additional to the regular three-yearly assessments and was associated with the start of the tram services. This followed a recommendation from the previous three-yearly inspection, in September 2002, to reassess the crossing once the crossing construction changes were complete.
- 136 The inspector made recommendations to straighten the crossing deck, reposition the northern whistle board and add a sign informing users that trains run in both directions on either line, as the Calverton line was in use at that time. Although a note was made on the form that the tramway was running adjacent to the train lines, no specific risks from tram operations were identified.

- 137 The then level crossing manager signed off the inspection in March 2004 and held the records at Network Rail's offices in Birmingham, which at that time was the central office responsible for level crossings in the East Midlands area.
- 138 In May 2004 a Network Rail reorganisation led to the responsibility for the level crossing changing from Birmingham to York. Witness evidence indicates that although the level crossing files were transferred, the recommended measures of the March 2004 inspection were not pursued.
- 139 The subsequent three-yearly assessment in April 2005 was managed by the level crossing section based in York. No recommendations for safety improvements were identified by either the inspector or the risk assessor. The previous risk assessment of March 2004 was not reviewed and the April 2005 assessment was signed off in July 2005.
- 140 The most recent three-yearly inspection and risk assessment was on 21 April 2008. This was managed by the level crossing section in Derby, following a further transfer of responsibility within Network Rail. This assessment was conducted in accordance with the ALCRM procedures, which required a census to be done. This can be a full census over a 24 hour period, a quick census lasting half an hour, or an estimate (Appendix F).
- 141 A quick census was done at the time of the inspection, between 12:30 hrs and 13:00 hrs on a weekday. Five pedestrians used the crossing during this time and the subsequent daily estimate from the ALCRM was 135 users. This level of usage is broadly compatible with the twelve users per hour observed in the RAIB's survey after the accident (paragraph 95).
- 142 The Level Crossing Risk Control Coordinator (LCRCC), responsible for completing the risk assessment visited the crossing shortly after the inspection. This was to make arrangements for moving the northern whistle board further from the crossing, which he was aware had been identified during an inspection in September 2002 by *Her Majesty's Railway Inspectorate* (HMRI) in September 2002 (Appendix E).
- 143 The completed risk assessment form identified that the Calverton line was disused, and that the angled deck affected the crossing time of pedestrians. A photograph taken at the time of the inspection showed that the roofing felt was missing from the section of deck on the Robin Hood line. Another photograph showed the clear views to the north and south. However, these were taken at around one metre inside the east gate, two metres or less from the Calverton line.
- 144 The information on the data collection form was entered into ALCRM on 8 August 2008. The ALCRM gave the crossing a risk ranking of 'C3' (Appendix F). This relatively high rating was primarily due to the pedestrian and train usage of the crossing. With a rating of 1, 2 or 3 the procedure required that a further visit was made to the crossing.

- 145 In June 2008 Network Rail had introduced a requirement that any crossing scoring 1, 2 or 3 in an ALCRM assessment had to be visited on site within 12 weeks of the ALCRM score being given. In the case of the April 2008 assessment the data was only checked on 9 October 2008. At the time of data entry there were 100 level crossings in the area awaiting sign off. The further visit did not take place before the accident on 22 November, which was over three months after the ALCRM score had been allocated on 8 August 2008. The RAIB considers that, even if the check had been made within the 12-week period, and mitigation measures identified, it is unlikely that any alterations would have been carried out by 22 November 2008.
- 146 The presence of the tram line was recognised as the data collection form records that 172 trams used the crossing daily, but no specific risks associated with it were identified.
- 147 The only physical change made to the crossing between the April 2005 inspection and the accident was the repositioning of the northern whistle board in August 2008.

Maintenance inspections

- 148 Network Rail carried out maintenance inspections of Bayles and Wylies crossing as specified, and there is no link between these inspections and the accident.
- 149 Network Rail requires a maintenance inspection every six months, in accordance with its company procedure, NR/SP/SIG/19608, Level Crossing Infrastructure (Inspection and Maintenance) Handbook. This is to ensure that the crossing is in a suitable condition. The procedure requires the inspector to complete a form with prepared questions, and any defects identified during the inspection are then given a priority for repair.
- 150 The inspection form used for identifying crossing defects asks the inspector to record the sighting distances in all directions, but does not ask the inspector to consider possible distractions to pedestrians. The records of the inspections show differing sighting distances on the east side looking north. These are between 350 and 600 metres, which is indicative that the readings were taken at differing positions between the gate and the railway line.
- 151 Network Rail records indicate that the six-monthly maintenance visits to Bayles and Wylies crossing at various times identified defects. These included missing 'Stop Look Listen' signs which were replaced. A maintenance inspection on 3 April 2008 recorded the condition of the crossing surface as 'satisfactory', even though some roofing felt was missing at the time of the risk assessment inspection less than three weeks later (paragraph 143). This was also identified during the following maintenance inspection on 6 October 2008 and repairs were carried out at the end of that month.

Time of assessments and inspections

152 No-one considered the crossing conditions at Bayles and Wylies crossing in darkness, as all of the inspection and assessment visits were done during daytime hours.

153 Network Rail's inspections and assessments only consider the crossing in the conditions that prevailed at the actual time of the visit. The option (paragraph 140) of Network Rail's assessment procedure to conduct a census between 09:30 hrs and 16:30 hrs on weekdays as part of the risk assessment inspection leads to little opportunity to assess crossings in darkness. These inspections are three-yearly and conditions in darkness will only be seen if conducted towards the end of the day in the winter months. The need to check the other items, such as sighting and maintenance conditions, during an inspection means that visits in darkness are very unlikely.

Previous RAIB investigations involving assessment and inspection at pedestrian level crossings

154 The RAIB has carried out investigations into six previous pedestrian level crossing accidents, and a further relevant preliminary examination. There are issues from three of these investigations, and the preliminary examination, which are relevant to the accident at Bayles and Wylies crossing.

155 The RAIB's previous investigations and its preliminary examination are listed in Appendix G. These accidents involve a total of ten fatalities and one serious injury. The investigations into accidents at Barratt's Lane, Elsenham, and Scate Moor either made no recommendations, or the recommendations were not relevant to the circumstances at Bayles and Wylies crossing.

156 In the accident at West Lodge on 22 January 2008 (RAIB report No 01/2009) a young man was struck and killed by a train during the delivery of coal to a property. The RAIB's investigation found that the visibility from the decision points was sub-standard, that the adjacent highway made it difficult to distinguish approaching trains in darkness, and that actions identified at crossing inspections and assessments had not been carried out. Recommendations 2, 3 and 4 (paragraph 177a) from the West Lodge report are relevant to the accident at Bayles and Wylies crossing. Network Rail has accepted all three recommendations, but the ORR has not yet commented on this response, so the recommendations remain open at the time of publication of this report.

157 In the accident at Tackley on 31 March 2008 a lady was struck and killed by a train approaching a station level crossing at speed. She may have thought that the train was going to stop at the station, but the point from where she would have intuitively taken a decision to cross had considerably worse vision than the point used by Network Rail as the decision point when assessing the crossing. Recommendations 2, 3, 4 and 5 (paragraph 177b) from the Tackley report are relevant to the accident at Bayles and Wylies crossing. Network Rail has accepted all four recommendations, but the ORR has not yet commented on this response, so the recommendations remain open at the time of publication of this report.

- 158 In the accident at Moor Lane on 16 April 2008 a lady slipped on a crossing surface, and was struck and killed by an approaching train, as she tried to avoid it. Recommendation 4 (paragraph 177c) from the Moor Lane report is relevant to the accident at Bayles and Wylies crossing. Network Rail has accepted this recommendation, but the ORR has not yet commented on this response, so it remains open at the time of publication of this report.
- 159 In the accident at Peth Lane on 2 April 2009 a young man was struck and killed by a train at a pedestrian crossing. He was probably wearing earphones at the time, but his vision after the decision point was obstructed by a concrete pillar that served no useful purpose. The RAIB decided not to carry out a full investigation in view of the actions taken by Network Rail and the ORR immediately after the accident to address the issues on the site, and because the recommendations from West Lodge addressed the more general issues from this accident. The RAIB has written to Network Rail to explain its concerns, and why no RAIB investigation has taken place.
- 160 In the accident at Bedwyn on 6 May 2009 a lady was struck and killed by a train on a pedestrian crossing. While the train was in view for longer than the crossing time, there were issues at the crossing concerning the location of the decision point and the visibility from it that led to RAIB to decide to carry out a full investigation. That investigation is ongoing.
- 161 The common points from this series of accidents that are relevant to the accident at Bayles and Wylies crossing are:
- a lack of clarity over the location of the decision point from the point of view of the pedestrian when carrying out assessments and inspections;
 - obstruction of visibility at or beyond the decision point;
 - not identifying key issues at assessments and inspections; and
 - issues that had been identified at assessments and inspections not being carried through to physical action at the crossing.

Observations

Height of crossing warning signs

162 Although not related to the accident, the 2.25 metre height of the warning sign on the east approach to the crossing (paragraph 76) made it difficult to read it at the gate itself, although it was clearly visible on the approach to the crossing. It is possible that the sign was at this height to avoid graffiti being applied to it.

Network Rail assessment procedures

163 Although not relevant to the accident, the various inspections by Network Rail staff identified greatly differing sighting distances (paragraph 150). The RAIB has identified that there is no process for comparing or resolving variations between different level crossing inspections.

Other crossings

164 The RAIB has identified two other pedestrian crossings in the UK over which trains from two different systems are in parallel running. Both involve the Tyne and Wear Metro and Network Rail systems. They are located at South Drive and Benton Square (paragraph 70).

Conclusions

Immediate cause

165 The immediate cause of the accident was the pedestrians being unaware of the oncoming train as they crossed in front of it (paragraph 52).

Causal and contributory factors

166 A possible causal factor was the grandmother did not look to see if a train was approaching (paragraph 63). The following are feasible explanations of why this was:

- a. she was unlikely to have previously experienced a train and a tram arriving simultaneously (paragraph 71, **Recommendation 1**); and
- b. this was because there was no indication to a pedestrian to warn of the possibility of a train and a tram arriving at the same time (paragraph 72, **Recommendation 1**)

167 A possible causal factor was the grandmother did look to see if a train was approaching from the north, but did not register the presence of train 2D22 (paragraph 73). The following are feasible explanations of why this was:

- a. the grandmother took her decision to cross at the east gate, which was not the optimal decision point for the Robin Hood line (paragraph 74 and 171, **No recommendation**);
- b. this was because there was no indication to a pedestrian that the Calverton line was out of use (paragraph 76 and 171, **No recommendation**);
- c. the night-time headlight of train 2D22 was relatively dim in comparison with those of tram 205 (paragraphs 81 and 176, **No recommendation**);
- d. the luminous intensity of the train's night-time headlight was below that required at the time of its construction, and also below that of modern standards (paragraphs 83, 84 and 176, **Recommendation 7**);
- e. there is no requirement to test or measure headlight luminous intensity in service (paragraph 83, **Recommendation 7**);
- f. the interior lights of the tram and the angle that it presented to the pedestrians may have made it more difficult to see train 2D22 (paragraph 82 and 176, **No recommendation**);
- g. the pedestrians may not have heard the various audible prompts, including the very short sounding of train 2D22's horn twelve seconds before the accident, from the approaching train due to the background noise and the noise of the tram (paragraphs 86 and 93, **Recommendation 4**);
- h. drivers have tended to reduce the duration of sounding their horns. As the RSSB's train horns steering group regularly reviews such incidents and the RSSB has stated that it will consider this incident as part of its ongoing reviews, no recommendation is made (paragraph 91, **No recommendation**); and

- i. if the grandmother did hear the horn twelve seconds before the accident she may have associated it with the tram rather than train 2D22 (paragraph 94, **No recommendation**).
- 168 A causal factor was that the grandmother, having decided to cross the line, did not realise that the train was approaching until it was too late to take action (paragraph 97). The following are feasible explanations of why this was:
- a. she may not have checked for approaching traffic after deciding to cross the line (paragraph 99, **No recommendation**); or
 - b. she would not have heard the train between the first sounding of the horn twelve seconds before the accident, and the second sounding of it, two seconds before the accident (paragraph 101, **No recommendation**); or
 - c. she may have been focussed on the approaching tram, the crossing surface or the changes of direction of the crossing, preventing her from looking towards the approaching train (paragraphs 105, 106, 109, 110 and 171, **No recommendation**);
 - d. the angle in the crossing deck turned her body away from the approaching train, reducing the likelihood that she would see it (paragraphs 112, 118 and 171, **No recommendation**);
 - e. the train driver (who was not required to look out for pedestrians) did not see the pedestrians sufficiently early to allow him to sound a warning in time for them to react (paragraph 59, **No recommendation**);
 - f. the train driver's attention was on the west side of the crossing because of the tram ahead of him (paragraph 59, **No recommendation**); and
 - g. the pedestrians were wearing dark clothes (paragraph 59, **No recommendation**).

Underlying causes

169 The underlying causes were:

- Network Rail's subsequent inspections, or processes did not identify that the decision point could be moved closer to the Robin Hood line after the closure of the Calverton branch in 2007, when it could have been (paragraph 113 and 171, **Recommendation 5**);
- the lack of consideration of the effects of illumination of the crossing from the footpath (paragraph 123, **Recommendation 2**);
- no-one considering the risk to pedestrians crossing the railway from hazards presented by tram operations, or vice versa (paragraph 130, **Recommendation 1 and 8**);
- Network Rail not appreciating that crossings in darkness present different risks to users (paragraph 152, **Recommendation 4**); and
- issues identified from previous accident investigations still being present at Bayles and Wylies crossing (paragraphs 161 and 177).

Additional observations⁷

170 Although not linked to the accident on 22 November 2008, the RAIB observes that:

- the height of the warning sign to the east of the crossing made it difficult to read close to, and at the gate (paragraphs 162 and 171, **No recommendation**);
- there is no process for comparing or resolving variations between different level crossing inspections (paragraph 163, **Recommendation 6**); and
- there are two other footpath crossing where two railway lines run in parallel (paragraph 164, **Recommendation 8**).

⁷ 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.

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

- 171 In April 2009 Nottinghamshire County Council replaced the street light on the east footpath approach to the crossing. The existing down-lighter type light was replaced with a lantern type and was moved southwards to the edge of the footpath. Network Rail was not aware of these changes. The RAIB measured the illuminance of the crossing deck following this change and found that the illuminance of the deck was below that recommended in Railway Group Guidance Note GI/GN 7520, Guidance on Lighting on Railway Premises, 1 December 2007. This guidance applies to the illuminance of walkways on railway premises and although not directly applicable to pedestrian level crossings, it does offer a benchmark. It was found that the illuminance levels of the deck were below the guidance values, with lower values measured closer to the refuge ie furthest from the lights. The RAIB informed Nottinghamshire County Council, Network Rail and the ORR of these findings on 22 May 2009.
- 172 The Nottingham Coroner conducted an inquest on 30 June 2009, at which the Jury returned a verdict of Accidental Death. The Jury made the following recommendations to the RAIB:
- **signs** – should indicate ‘To look both ways’;
 - **floodlights** – the possibility of floodlighting ‘should be considered’;
 - **signals** – possibility of audio or visual signals when a train is approaching; and
 - **tram and rail authorities** – should meet to consider the need for extra precautions when both the trams and trains are approaching at the same time.
- The RAIB has considered these in drawing up its recommendations, and in particular Recommendations 1, 2 and 3.
- 173 In June 2009 Network Rail amended a procedure within their Operations Manual to require that crossing assessments are signed-off within six weeks of the inspection site visit.

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

174 In January 2009 Network Rail replaced the plywood deck with a construction made of railway sleepers and renewed all of the roofing felt covering.

175 In May 2009 Network Rail added a second gate on the east side, two metres from the Robin Hood line; this was achieved by fencing and relocating the footpath over the Calverton line (Figure 20), so that the crossing over the Robin Hood line is now perpendicular to it. A 'Stop Look Listen - Beware of trains' sign was added close to the new east gate at a height of around 1.5 metres. These alterations effectively move the decision point to a location two metres from the Robin Hood line, increasing the visibility and reducing the time to cross that line to the refuge. In light of these actions, which address the factors concerning the crossing identified in paragraphs 167, 168 and 169, the RAIB has decided not to issue any specific recommendation relating to the layout of this crossing.



Figure 20: Changes to the crossing undertaken in May 2009

176 East Midlands Trains has let a contract to refurbish its Class 158 trains. This includes fitting new headlights that comply with more modern standards. The RAIB tested one train fitted with the new headlights, and found that the night-time headlight had a luminous intensity of between 4120 and 4300 candelas at a horizontal angle of between 2 and 5 degrees from the geometrical axis passing through the centre of the front of the train. This programme is due for completion June 2010. In view of this action addressing the factor identified in paragraph 167, the RAIB has decided not to issue a further recommendation.

Recommendations

Previous Recommendations

177 The following recommendations were made by the RAIB as a result of previous investigations, which address factors identified in paragraphs 167 and 169. They are therefore not remade so as to avoid duplication:

a) Accident at West Lodge Crossing, near Haltwhistle, Northumberland, 22 January 2008 – published 21 January 2009

Recommendation 2: Network Rail should identify any footpath crossings that do not provide adequate arrangements to protect users, and draw up and implement a programme to improve them. The programme should prioritise the order in which the crossings are improved, with crossings presenting the highest risk improved ahead of those of lower risk.

Recommendation 3: Network Rail should revise its management systems so that the findings of level crossing inspections and assessments are acknowledged, prioritised and acted upon to provide arrangements that adequately protect users.

Recommendation 4: Network Rail should revise its methods of crossing inspection and assessment so that they confirm that arrangements to protect users and safeguard the railway:

- (a) remain adequate in all normal and foreseeable operating conditions; and
- (b) make allowance for the mobility of likely users.

b) Fatal Accident at Tackley Station level crossing, Oxfordshire, 31 March 2008 – published 30 March 2009

Recommendation 2: Network Rail should issue an updated policy or standard to improve the control of fencing at unprotected crossings, such that decision points are not forced to the minimum dimension or sighting distances unnecessarily compromised.

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.

Recommendation 4: Network Rail should incorporate in their procedures:

- (a) arrangements to routinely pass the findings of level crossing assessments and inspections between operations and maintenance departments, so that the organisation achieves a co-ordinated view of the condition of those assets; and
- (b) an audit process to identify errors, inconsistencies or the application of inappropriate mitigation measures in crossing inspection reports.

Recommendation 5: Network Rail should review their methods for assessing warning times, as the current arrangements which rely on calculations and the measurement of distances using optical equipment have been shown to be unreliable, particularly on curved track. This should include consideration of permanently identifying the sighting distances to be achieved, so that visibility can be positively verified from each decision point when crossings are inspected to improve the objectivity of these assessments.

c) Accident at Moor Lane footpath level crossing in Staines, Surrey, 16 April 2008 – published 23 December 2008

Recommendation 4: Network Rail should revise the guidance it gives to staff inspecting level crossings, ensuring that the importance of the correct position and layout of the warning signs is adequately emphasised.

178 The following recommendations are made⁸ following the accident at Bayles and Wylies crossing.

Recommendations to address causal and contributory factors

- 1 *The purpose of this recommendation is to address the unique risks of Bayles and Wylies crossing.*

Network Rail and NET should install signs at the outer extremes of the Bayles and Wylies level crossing, and at the exits from the central refuge, warning pedestrians who are about to cross the lines that trains and trams can approach in either direction at any time on both the railway and the tramway (paragraph 169).

- 2 *The purpose of this recommendation is to improve the safety of Bayles and Wylies crossing by adjusting the illumination to optimise:*

- *the visibility of the crossing deck for pedestrians, including discerning the edges of the crossing surface;*
- *the visibility of pedestrians for train drivers;*
- *the visibility of train headlights for pedestrians; and*
- *the minimisation of dazzle in the vision of train drivers.*

Network Rail and Nottinghamshire County Council should jointly assess the lighting of Bayles and Wylies level crossing, and if necessary alter it so that it is adequate for pedestrians to clearly see where they are walking when crossing the line (paragraph 169).

- 3 *The purpose of this recommendation is to reduce the unique risks of Bayles and Wylies crossing to as low as reasonably practicable:*

Network Rail, together with NET, should re-assess Bayles and Wylies crossing and establish if the installation of additional protective measures, such as a miniature warning light system, are required (paragraph 169).

continued

⁸ Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations into account in ensuring the safety of their employees and others.

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

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

Recommendation 2 is also addressed to Nottinghamshire County Council, in accordance with regulation 12(1)b, who accordingly have similar duties under regulation 12(2)

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

- 4 *The purpose of this recommendation is to allow for differing conditions at level crossings in hours of darkness.*

Network Rail should revise their procedures for assessing and inspecting level crossings so that they allow for differing conditions in hours of darkness, allowing for the variable levels of luminous intensity from train night-time headlights, the variable duration of train horns and their sound levels relative to ambient noise and for the period when drivers do not sound their horns (paragraph 169).

- 5 *The purpose of this recommendation is to ensure crossings are reviewed to maintain their risk as low as is reasonably practicable.*

Network Rail should amend their processes to re-assess crossings when circumstances at the location have changed to include instances when lines have, or are planned to be, closed (paragraph 169).

Recommendations to address other matters observed during the investigation

- 6 *The purpose of this recommendation is to prevent different sighting distances or other key dimensions being recorded for the same level crossing.*

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 (paragraph 170).

- 7 *The purpose of this recommendation is to establish consistent and adequate levels of luminous intensity from night-time headlights of trains using the Network Rail system.*

The Rail Safety and Standards Board should evaluate the risk from the operation of trains with less luminous intensity from night-time headlights than that required from current railway group standards. If the risk is considered unacceptable the RSSB should propose, in accordance with the group standards code, changes to railway group standards to require all trains operating on the Network Rail system to be brought up to, and maintained at, an acceptable standard of luminous intensity within a defined timescale (paragraph 167).

- 8 *The purpose of this recommendation is to apply the lessons of this accident to other similar crossings.*

Nexus⁹ and Network Rail should review the pedestrian level crossings at South Drive and Benton Square jointly and apply any relevant learning points from this investigation to them (paragraph 170).

⁹ The operator of the Tyne and Wear Metro

Appendices

Appendix A - Glossary of abbreviations and acronyms

ALCRM	All Level Crossing Risk Model
BR	British Rail
dB(a)	Decibel (A)
HMRI	Her Majesty's Railway Inspectorate
NET	Nottingham Express Transit
ORR	Office of Rail Regulation
OTDR	On Train Data Recorder
RSPG	Railway Safety Principles and Guidance

Appendix B - Glossary of terms

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

Bi-directional	A track on which trains may be worked in either direction under normal signalling arrangements.*
Chains	A unit of length equal to 22 yards. There are 80 chains in one standard mile.
Crossing time	The time taken for a user to cross from one side of the railway to the other between decision points.
Decibel (A)	<p>decibels (A) or dB(A) is a unit of sound pressure level.</p> <p>Sound pressure level is a measurement of the pressures caused by sound waves. A sound meter is fitted with a filter (known as an A-weighted filter) which gives an approximate allowance for the response of the human ear to different sound frequencies.</p>
Decision Point	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 m from the nearest running rails or 3 m where the line speeds are higher than 160 km/h.
Diesel multiple unit	A multiple unit train whose source of power is a diesel engine.*
Her Majesty's Railway Inspectorate	The name of safety regulator for the rail industry in Great Britain prior to its incorporation within the ORR in 2006.
Luminous intensity	<p>Luminous intensity is the power emitted by a light in a particular direction. It is measured in candelas (cd), and it allows for the response of the human eye to different colours (wavelengths) of light within the visible spectrum.</p> <p>The ability to discern a light source is not solely dependant upon its intensity. Other factors such as contrast with its background and other light sources, the size of, and distance from the light, its speed of movement and the angle at which it is viewed all affect how conspicuous it is.</p>
Office of Rail Regulation	The safety regulator for the rail industry in Great Britain since April 2006.
On Train Data Recorder	<p>A data recorder fitted to traction units collecting information recorder about the performance of the train, including:</p> <ul style="list-style-type: none"> ● speed; ● regulator and brake control positions; ● activations of horn, DSD and AWS cancel button, etc.*

Preliminary examination	An initial examination of a railway accident or incident by the RAIB, to enable the Branch to decide whether or not to carry out a full investigation.
Railway Group Standards	Mandatory technical or operational document which sets out what is required to meet system safety responsibilities on Network Rail's infrastructure.
Sleepers	A beam made of wood, pre- or post-tensioned reinforced concrete or steel placed at regular intervals at right angles to and under the rails.*
Warning time	The shortest possible time for trains to travel the sighting distance or, where whistle boards are provided, the shortest time between the sound being heard at the crossing and the train arriving at the crossing. In calculations of warning time the highest attainable train speed should be used.
Whistle board	A white circular sign with a grey edge and black ' W ' in the centre that indicates to a driver that they must sound the horn or whistle.*

Appendix C - Key standards current at the time

GE/RT8000	Rule Book
GI/GN 7520	Guidance on Lighting on Railway Premises, 1 December 2007
GM/RT2483	Visibility Requirements for Trains, Issue One, June 2004.
NR/SP/SIG/19608	Level Crossing Infrastructure (Inspection and Maintenance) Handbook
NR/L3/OCS/041	Operations Manual - Contents and responsibilities Matrix. Issue 15, December 2007
TEE/C/85/R/76	Technical Specification for Headlights for Traction Units, March 1988

Appendix D - Safety principles and guidance for pedestrian level crossings

The following paragraphs are copied from Railway Safety Principles and Guidance (RSPG), part 2, Section E, as published by the Health and Safety Executive in 1996, which remains the current guidance for level crossings. The paragraphs are those the RAIB considers to be relevant to the accident at Bayles and Wylies crossing on 22 November 2008.

Application of the guidance

- 3 Application of this guidance should provide a sufficient level of safety for approval to be given by the Inspectorate, provided that it has been demonstrated that the use of the guidance is wholly applicable to the level crossing.
- 4 If this is not the case, then the Inspectorate will wish to be satisfied that due consideration has been given to implementing the safety principles in the Part 1 document Railway Safety Principles and Guidance in a way that ensures that all intolerable risks have been eliminated and that all remaining risks have been reduced to be as low as reasonably practicable (known as ALARP).

General description

Definition of a decision point:

‘Decision point’ applies to user-worked crossings, footpath crossings and bridleway crossings. It 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 m from the nearest running rails or 3 m where the line speeds are higher than 160 km/h. For bridleway crossings and user worked crossings this should not be less than 3 m from the nearest running rail.

- 11 An assessment of the suitability of the type of crossing at the location concerned should be made whenever:
 - (a) circumstances at the crossing are to change (eg rolling stock, signalling, electrification, speed etc);
 - (b) circumstances at the crossing are found to have altered (eg housing or industrial developments etc); or
 - (c) after a period of not less than two or more than four years, as specified in the last assessment to ensure that the level of protection afforded by the crossing is adequate and appropriate.
- 12 In assessing the suitability of any proposed safety measures or arrangements, it is important to take into account:
 - (a) normal operating conditions;
 - (b) degraded conditions where any component or part of the railway system has failed;
 - (c) foreseeable abnormal conditions to which the system may be subjected; and;
 - (d) emergency situations.

- 29 Where trains run after dark, illumination of the crossing may be provided to ensure its safe operation. If the road approaches to a crossing are lit, the crossing should be illuminated to at least the same standard. Any lighting should not cause glare to either road users or train drivers, interfere with the visibility of railway signals nor cause avoidable annoyance to local householders.
- 138 Users are expected to use reasonable vigilance to satisfy themselves that no trains are approaching the crossing before they start to cross the line, and to cross as quickly as possible. Users should have sufficient time from first seeing or being warned of an approaching train to cross safely.
- 139 Footpath crossings should be protected by a stile or self-closing wicket gate on both sides of the railway. They should not have a gate on one side and a stile on the other, nor different widths or types of gates.
- 142 A sign should be displayed at the decision point facing the user on either side of each type of crossing explaining the way to proceed safely over the crossing.
- 143 Where the type of crossing passes over multiple railway lines and an interval between lines exists so that a fenced, safe waiting place can be created for users, the crossing on each side of the interval should be treated as a separate crossing. A chicane may be provided on the crossing to make the position of the safe waiting place clear.

Method of Operation

- 147 The warning time should be greater than the time required by users to traverse the crossing surface between the decision points at either end of a crossing. In assessing the speed at which users will traverse the crossing, allowance should be made for the mobility of the likely users and the type of crossing surface.
- 148 A speed of 1.2 metres per second (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.
- 149 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;
 - (b) telephones (only applicable at bridleway crossings); or
 - (c) miniature stop lights as described in Chapter 17.
- 150 Where whistle boards are provided, the following factors should be considered in deciding their location:
- (a) the speed of sound (330 m/s) and the speed of the train;
 - (b) the sound may be inaudible at the crossing because of ambient noise; and
 - (c) there may be objections to the noise of train horns in residential or built-up areas.
- 151 Where whistle boards are provided, they are required on all railway approaches. The difference in warning times should be 3 seconds or less.

- 194 At footpath crossings and bridleway crossings, the surface provided between the decision points should be unobstructed. There should be no movable signalling or track equipment on the surface (such as sets of points) or close by, that might create a hazard. The surface should be maintained in a good and even condition. The rails are not considered to constitute an obstruction or uneven surface.
- 207 At footpath crossings, the width of the surface should not be less than 1 m.
- 210 Footpath crossings and bridleway crossings should be at right angles to the railway line.
- 286 At user-worked crossings, footpath crossings and bridleway crossings, a sign explaining to the user how to proceed safely over the crossing e.g. 'Stop, Look, Listen' or 'Cross only if green light shows' or 'Stop, always telephone before crossing' should be provided facing the user at the decision point.

Appendix E - History of Bayles and Wylies crossing

The crossing was originally a user worked crossing, giving access to road vehicles across the railway. There had been a double line passenger line to Mansfield and Worksop, and the single line branch to Calverton colliery, but after passenger services to Mansfield ceased in the 1960s, and following a reduction of freight traffic, British Rail (BR), the then infrastructure owner, reduced the main line to a single line.

BR closed the crossing to road vehicles in 1988, and it became a public footpath.

The original crossing did not cross the lines at right angles to the railway as the west-side access point was offset to the south from the east-side access point.

By the early 1990s the Calverton colliery branch was no longer used for regular traffic, but it continued to be used irregularly for track maintenance training purposes.

In 1993 BR re-opened the Robin Hood line for passenger services between Nottingham and Newstead. At this time the level crossing crossed only two lines; the disused Calverton colliery branch on the east and the Robin Hood line, which at this time was on the west of the site. A fenced walkway in the wide space between the two lines was provided. This was angled to accommodate the offset between the west and east access points.

By 1998, Railtrack, who had taken over the infrastructure from BR, had upgraded the signalling on the line, including the provision of the signal gantry post installed to the north of the crossing. This was done as part of extending the Robin Hood line services to Worksop.

During the crossing modifications related to both the re-signalling and provision of the tram line there were several visits made by Her Majesty's Railway Inspectorate (HMRI). Although the purpose was principally to assess the road level crossings, Bayles and Wylies footpath crossing was also reviewed. Following a visit in August 2001, Railtrack supplied HMRI with a drawing of the layout of the crossing proposed by the tram construction contractor. This included fitting a straight deck over the train lines.

An HMRI visit in September 2002 identified that the northern whistle board was too close to give adequate warning time for the new increased linespeed of the Robin Hood line and Railtrack were asked to move it.

By 2003 a final design proposal for the crossing had been completed. This involved the creation of a refuge so that crossing over the train and tram lines could be separated, akin to having two crossings. Railtrack asked the construction contractor whether the work could include for straightening the deck over their lines and moving the whistle board. This did not involve HMRI and no agreement was reached between the parties.

The construction of the refuge took place without this modification. This was possibly complicated by some signalling equipment which earlier had been located directly opposite the east gate when the Robin Hood line was resignalled. A further HMRI inspection in March 2004, to inspect the completed crossing at the start of tram services, did not identify any issues other than one of the gates not closing properly.

In June 2007 the Calverton colliery branch was formally withdrawn from service and became disused.

The northern whistle board was finally moved by Network Rail to a position further from the crossing in August 2008.

Appendix F - The All Level Crossing Risk Model

In January 2007, Network Rail launched an 'all level crossing risk model' (ALCRM), a computer modelling tool. This tool was designed to standardise the assessment of risks for all types of crossings across the network and its purpose is to support and inform decision making on level crossings in accordance with standard NR/SP/OPS/100 'Provision, Risk Assessment and Review of Level Crossings'.

The relevant section of the Network Rail operations manual, procedure 5-24 'Use of the all level crossings risk model', requires that each level crossing shall be subject to a risk assessment at not more than three-yearly intervals. Additional assessments are required following changes in traffic patterns or after an accident or serious incident. The assessment regime is supplemented by six-monthly inspections by Network Rail maintenance staff (paragraph 83).

The ALCRM requires the type of crossing to be identified and data from a site survey to be input. This includes sighting distances, line speeds and a census of crossing users. Procedure 5-23 lists three types of census: a 'full census' covering a 24-hour period, for which special arrangements need to be made; a 'quick' census covering a 30 minute period between 09:30 hrs and 16:30 hrs on a weekday, for which the results are multiplied by 27 to give a total estimated usage per day; and an estimate. Procedure 5-23 states that a quick census is the standard requirement for public vehicular crossings and the first preference for other crossings unless use is very light.

The risks associated with a particular crossing are divided into collective and individual risk categories. A collective risk is defined as the risk posed to groups, such as on-board staff, train passengers, or vehicle occupants, whereas an individual risk is that posed to a regular crossing user.

The model gives the crossing a risk score for each risk category, and identifies the factors contributing to this. It is intended to support and inform an assessor, but the output does not highlight unacceptably short sighting times, take account of the provision of whistle boards or the possible effects to crossing users in darkness. The assessor is required to exercise judgement in reviewing the output.

The Level Crossing Risk Control Co-ordinator is required to visit the site and consider risk mitigation if a crossing is assessed as having a collective risk score of 1 to 3 on a range of 1 to 13, where 1 represents the highest risk, at sites where the contribution of the train accident risk comprises more than 50% of the total risk at the level crossing.

The model calculates an equivalent fatalities value, which is a statistical measure, before and after any mitigation is applied. The result is a numeric value which can be used for the purposes of cost-benefit analysis. Network Rail have developed a risk mitigation 'toolkit' to assist Level Crossing Risk Control Coordinators in identifying appropriate risk mitigation measures.

The initial programme of ALCRM assessments was required to include public vehicular crossings and station foot crossings within the first 12-month cycle commencing in January 2007, with all crossings being incorporated into a 3-year rolling programme. Assessments are normally undertaken by the Level Crossing Risk Control Co-ordinator supported by local mobile operations managers.

Appendix G - RAIB investigations into other accidents at pedestrian level crossings

The reports on the following completed investigations can be found at the RAIB's web site, www.raib.gov.uk

Date	Location	RAIB report No.	Date Report published	No. of recs	Consequences
21 November 2005	Barratt's Lane, near Nottingham	13/2006	21 July 2006	0	1 fatality
3 December 2005	Elsenham, Essex	23/2006	11 December 2006	10	2 fatalities
8 January 2006	Scate Moor, near Harrogate	06/2006	16 June 2006	0	1 serious injury
22 January 2008	West Lodge, Haltwhistle	01/2009	20 January 2009	4	1 fatality
31 March 2008	Tackley, Oxfordshire	09/2009	30 April 2009	6	1 fatality
16 April 2008	Moor Lane, near Staines	27/2008	23 December 2008	4	1 fatality

The RAIB has carried out a preliminary examination of the following accident, but decided not to carry out a full investigation into it.

Date	Location	Consequences
2 April 2009	Peth Lane, near Newcastle	1 fatality

The RAIB has commenced an investigation into the following accident, which is ongoing:

Date	Location	Consequences
6 May 2009	Fairfield crossing, near Bedwyn	1 fatality

This report is published by the Rail Accident Investigation Branch,
Department for Transport.

© Crown copyright 2009

Any enquiries about this publication should be sent to:

RAIB	Telephone: 01332 253300
The Wharf	Fax: 01332 253301
Stores Road	Email: enquiries@raib.gov.uk
Derby UK	Website: www.raib.gov.uk
DE21 4BA	