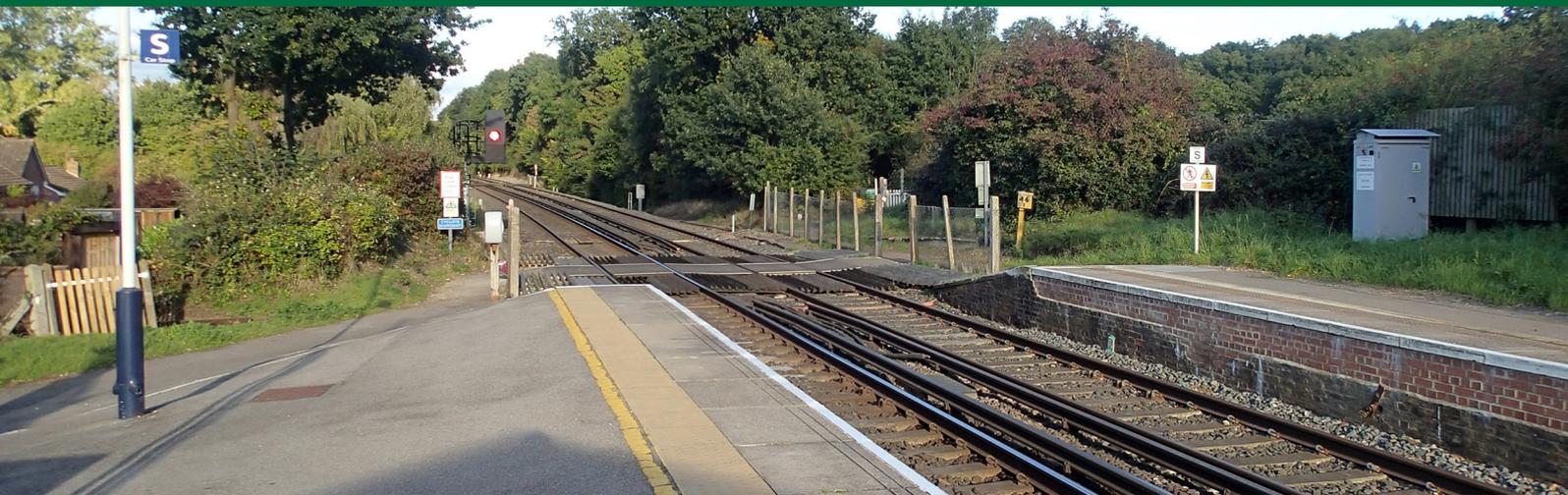




Rail Accident Investigation Branch

Rail Accident Report



**Fatal accident at Alice Holt footpath crossing,
Hampshire
5 October 2016**

Report 14/2017
October 2017

This investigation was carried out in accordance with:

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

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Preface

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

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

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

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

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

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

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

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

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Fatal accident at Alice Holt footpath crossing, Hampshire, 5 October 2016

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Summary

At 16:20 hours on Wednesday 5 October 2016 a mobility scooter was struck by a train, and the scooter user fatally injured, at Alice Holt footpath crossing, Bentley, Hampshire.

Users of Alice Holt footpath crossing are required to look and listen for approaching trains before deciding whether it is safe to cross the line. It is uncertain why the user decided to cross when it was unsafe to do so, as CCTV images suggest that he had previously crossed in a safe manner. It is probable that the user did not see the train or misjudged when it would arrive at the crossing, perhaps due to sun glare, when deciding to cross. The mobility scooter user's opportunity to see the approaching train was limited by the design of Alice Holt crossing, in particular the fencing. The mobility scooter user did not react to the train's horn, possibly because he did not hear it.

The RAIB has found that Network Rail's guidance for level crossing managers did not include any advice concerning use by mobility scooter users and the management of the crossing had not allowed for vulnerable users such as these.

The RAIB has addressed one recommendation to Network Rail. This seeks modification of Network Rail's level crossing management processes so that they consider mobility scooter use at all crossings which rely on users looking and listening for trains.

Introduction

Key definitions

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

The accident

Summary of the accident

- At 16:20 hrs on Wednesday 5 October 2016, passenger train 1A54¹, the 16:15 hrs service from Alton to London Waterloo, struck and fatally injured a mobility scooter user on Alice Holt footpath crossing in Bentley, Hampshire (figure 1).

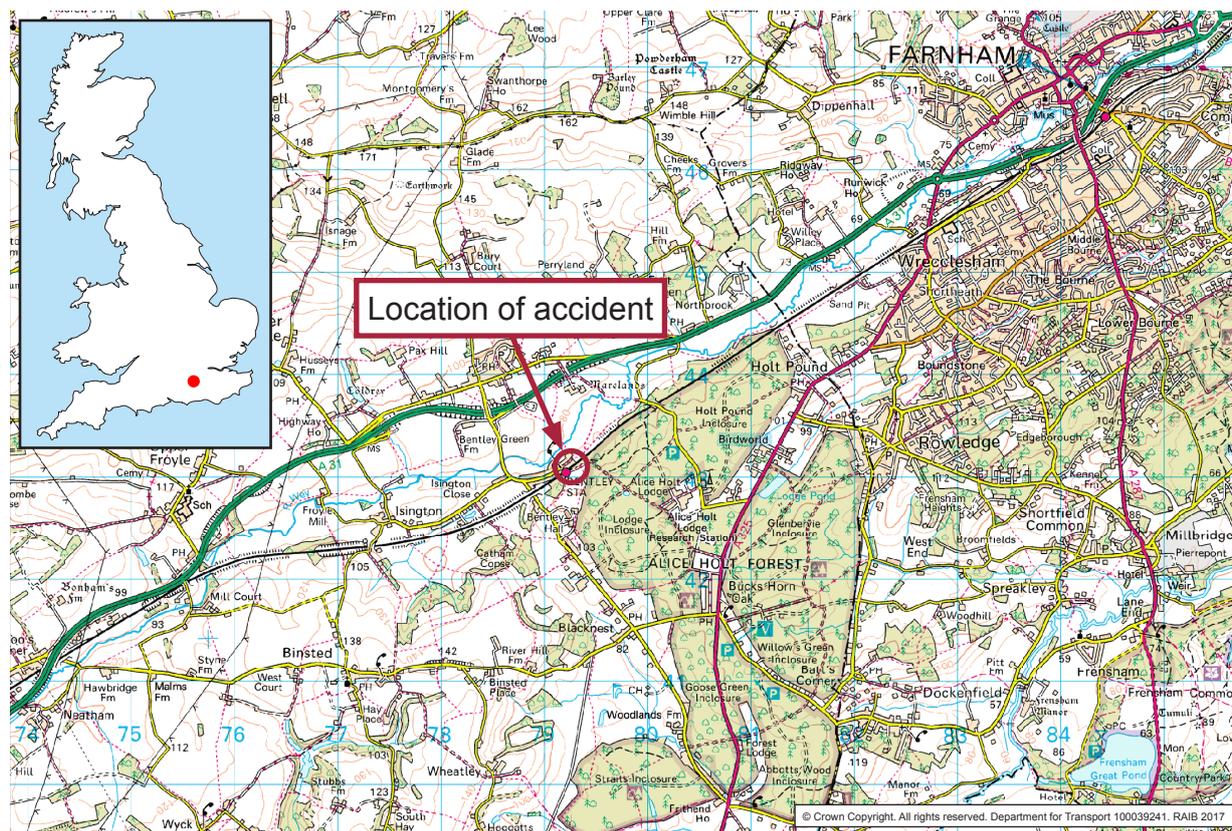


Figure 1: Extract from Ordnance Survey map showing the location of the accident

Context

Location

- Alice Holt footpath crossing is situated at 44 miles 20 chains² on the Alton branch line, at the eastern end of Bentley station. The branch line comprises a single track between Farnham and Alton, designated the 'Alton single' line, with a loop line through Bentley station, designated the 'Down Bentley Loop'. Alice Holt level crossing crosses both the Alton single line and the Down Bentley Loop (figures 2 and 3). Since 2011, the footpath has been part of the Shipwrights Way long distance walking and cycle route between Bentley and Portsmouth.

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

² There are 80 chains to a mile, 22 yards to a chain. All mileages in the report are measured from a datum at Waterloo station, along a former route through Tongham.

- 5 The line is mainly used by passenger trains. In the vicinity of Alice Holt crossing there is a maximum permitted speed of 70 mph (113 km/h) for passenger trains in both directions on the Alton single line and 40 mph (64 km/h) on the Down Bentley Loop. There are lower permitted speeds for freight trains. Signalling on the branch line is by *track circuit block*, controlled from Woking Area Signalling Centre.



Figure 2: Features surrounding Alice Holt footpath crossing

Organisations involved

- 6 Network Rail owns, operates and maintains the railway infrastructure where the accident occurred as part of its Wessex Route. It also employed the staff responsible for gathering data about the footpath crossing, and for assessing and managing its safe use.
- 7 South West Trains operated train 1A54 and employed its driver.
- 8 Hampshire County Council created and promoted the Shipwrights Way.
- 9 Network Rail, South West Trains and Hampshire County Council freely co-operated with the investigation.

Train involved

- 10 Train 1A54 was formed of three 4-car Class 450 *electric multiple units*. The RAIB found no evidence that the condition of the train, or the way it was driven, contributed to the accident.

The level crossing

- 11 The railway at this location runs approximately east to west. Self-closing wooden wicket gates at the railway boundary provide access to tarmac footpaths leading to a level timber *crossing deck*. The paths run parallel to the railway line as they approach the crossing decking which is 8.7 metres long, 2.4 metres wide and runs perpendicular to the rails (figure 3). Lineside signs (*whistle boards*) located 305 metres on the Alton side of the crossing and 415 metres on the London side of the crossing instruct train drivers to sound their train's warning horn.



Figure 3: Layout of Alice Holt footpath crossing

- 12 Fencing separates the footpath from the adjacent railway on the southern side of the railway, with a gap at the end of the crossing. A fence separates the footpath from the adjacent railway on the Alton side of the northern end of the crossing (there is no path in the other direction at the northern end). White lines on the ground, around 2 metres from the nearest rails, mark the ends of the decking (figure 4). A sign near each end of the crossing instructs users to 'Stop Look Listen' and 'Beware of trains' (figure 5). The white lines are at the position described as the decision point within Network Rail and Office of Rail and Road (ORR) level crossing documentation. Level crossing management processes assume users look and listen for trains, and decide whether to cross the line while at the decision point. The practical limitations of a mobility scooter user's position are discussed in paragraphs 68 to 70.

- 13 Network Rail assesses the risk at each of its level crossings using the *All Level Crossing Risk Model* (ALCRM) which classifies the risk to an individual user (decreasing from A to M) and the collective risk, which is the risk to all users, including those on trains (risk decreasing from 1 to 13). Alice Holt level crossing was assessed as category C3. Based on this classification system, relative to Alice Holt, about 10% of Network Rail's 6500 level crossings have greater risk to individuals, about 40% have a similar risk to individuals and 50% have a lower risk. In terms of collective risk, 4% have a higher risk, 4% a similar risk and 90% a lower risk.

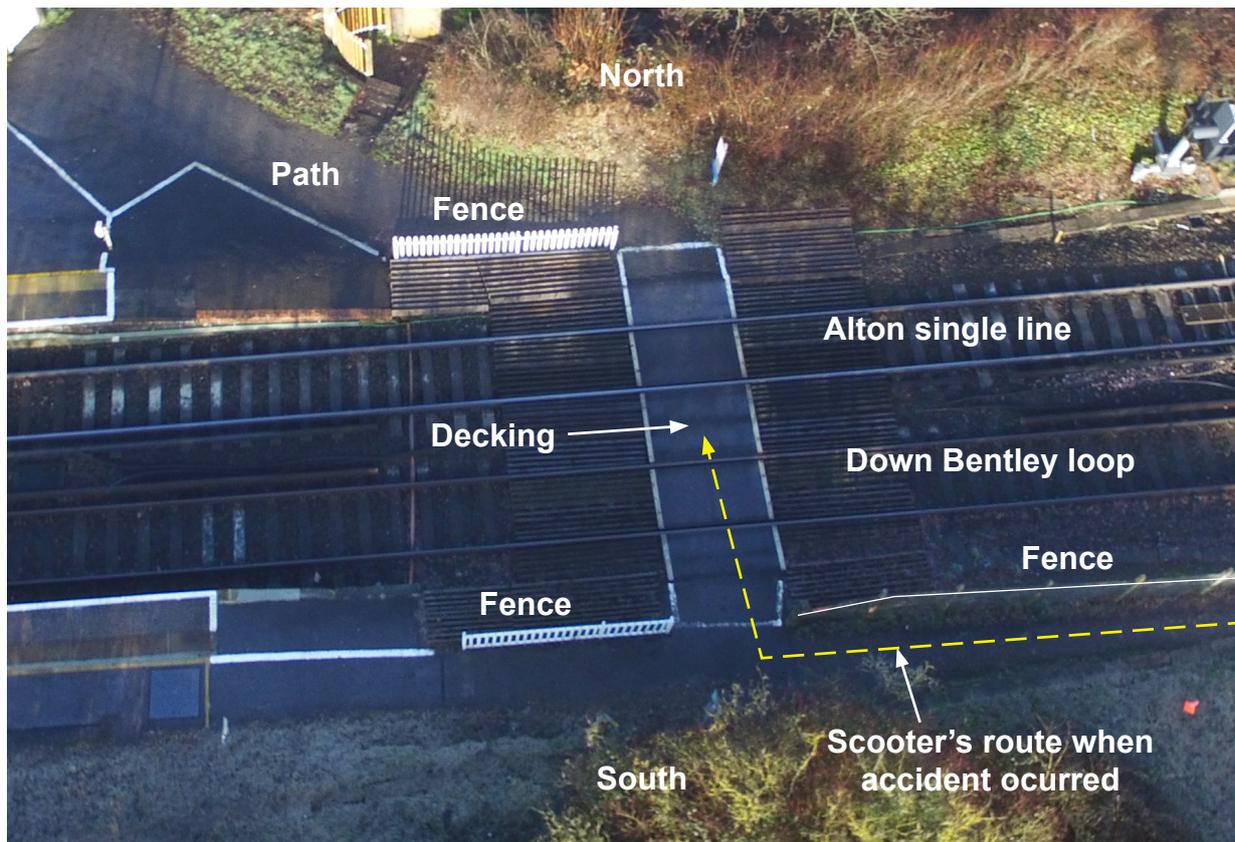


Figure 4: Arrangement of fences, white lines and decking at Alice Holt footpath crossing

- 14 The footpath over the level crossing is recorded as a public right of way on the local *definitive map* and is designated as Binsted Footpath 44.

The mobility scooter

- 15 The mobility scooter involved in the accident was around six months old at the time of the accident. It was a SupaScoota Sport XL with twin 180 Watt motors (figure 6) and was fitted with lithium batteries which, according to the manufacturer's data, gave the scooter a range of around 11 miles (18 km).
- 16 The scooter was fitted with a device to limit its maximum speed to 4 mph (1.8 m/s) in order to comply with UK regulations for 'class 2 invalid carriages'. This class of mobility carriage should not be used on public roads except to cross them or where there is no pavement³. The scooter manufacturer's data for other markets indicates that, without the speed limiting device, the maximum speed of this model of scooter would be 5.6 mph (2.5 m/s).

³ <https://www.gov.uk/mobility-scooters-and-powered-wheelchairs-rules/overview>.



Figure 5: Key features of Alice Holt footpath crossing when approaching from the south

- 17 This model of scooter is also fitted with a device limiting cornering speed in order to reduce the likelihood of the scooter overturning. This slowed the scooter in proportion to how far the handlebars were turned.
- 18 *Forward facing closed circuit television (FFCCTV)* from train 1A54 shows that, in the moments before the accident, the scooter was travelling at approximately its maximum speed (paragraph 30). The station CCTV shows the scooter turning normally when using the crossing about 38 minutes before the accident (paragraph 26). There is therefore no evidence of any scooter defect relevant to the accident.



Figure 6: A mobility scooter of the type, but not the colour, involved in the accident

The mobility scooter user

- 19 The mobility scooter user, Mr Derek Thomas, was an 83 year-old local resident, who was accustomed to crossing the railway at this location, both with and without a scooter. He had used a mobility scooter for around the previous 6 months as hip pain prevented him from taking the long walks he enjoyed. His family stated that he was active and capable of leaving the scooter and walking unassisted. They also reported that he had good hearing, and good eyesight, when corrected with glasses (a pair of glasses was found at the scene of the accident).

Other people involved

- 20 The Network Rail *Level Crossing Manager* (LCM) was responsible for Alice Holt footpath crossing and around 60 other level crossings on the 'inner' area of the Wessex Route. The LCM was appointed to the role in 2013 when LCMs were introduced on the Wessex route.
- 21 Network Rail's *Wessex Route Level Crossing Manager* (RLCM) at the time of the accident was acting in the role and has since returned to the role of LCM on the 'outer' area of the Wessex route.
- 22 The substantive RLCM was seconded to another post at the time of the accident. He was the Operational Risk Control Coordinator (ORCC) for the area including the crossing at the time when the Shipwrights Way was created. He has since returned to the role of Wessex RLCM.

External circumstances

- 23 At the time of the accident there was a bright low sun with a strong breeze blowing from the east. The wind speed was recorded at RAF Odiham, about 8.5 km from Bentley, as 29 km/h with gusts of up to 46 km/h.
- 24 The RAIB has found no evidence supporting media reports of forestry work causing local noise at the time of the accident. The Forestry Commission has stated that contractors working for it were cutting trees on a site around 400 metres from the crossing during the days leading up to the accident, but not on 5 October. Network Rail stated that it was not undertaking any maintenance work locally on the day of the accident.

The sequence of events

Events before the accident

- 25 The mobility scooter user's family have stated that, on most days when at home, he took his dog for a walk from his home on the north side of the crossing into Alice Holt Forest on the south side of the crossing. He used Alice Holt crossing twice on each walk, travelling from north to south on the outward journey and from south to north on his return journey.
- 26 Station CCTV recordings show that, on the outward journey, the mobility scooter user travelled through the station car park and along the path leading to the north side of the crossing around 38 minutes before the accident (figure 7). Just before reaching the north side of the crossing, the user stopped for 6 seconds, with his dog at his side. The scooter then moved forward and turned slowly onto the crossing before accelerating towards the southern side of the crossing and out of the CCTV coverage. The framing of the CCTV image is such that the user's head cannot be seen, so the RAIB is unable to tell which directions he looked before moving forward. The CCTV shows that the user's dog started to move forward at the same time as the mobility scooter but, because the dog moved faster, it crossed the railway ahead of the scooter.
- 27 There is no direct evidence relating to the mobility scooter user's actions when he completed his crossing of the railway, and no evidence of his subsequent actions until, about 38 minutes later, he reached the crossing on his return journey. This is because the station CCTV does not cover the central or southern part of the crossing and there is no other witness evidence. It is highly likely that the user took his dog into Alice Holt Forest during this time.

Events during the accident

- 28 The first evidence of the mobility scooter user returning over the crossing from the south side is shown by station CCTV footage which shows his dog completing its crossing of the railway and arriving at the north side of the crossing around five seconds before the scooter is struck by the train. The dog then stands at the end of Bentley station platform.
- 29 There is no evidence of the mobility scooter user's actions until the scooter is visible in the train's FFCCTV about four seconds before impact. During these four seconds, the FFCCTV shows that the scooter is travelling at about its maximum speed of 4 mph (1.8 m/sec). There is no evidence of the user turning to look at the train during this period. At the point of impact the scooter had just passed over the northern rail of the Alton Single line.



Figure 7: The mobility scooter user crossing from the north side, 38 minutes before the accident

- 30 The train driver sounded the train horn at the whistle board (paragraph 11), around ten seconds before reaching the crossing, while travelling at close to 70 mph (113 km/h)⁴. The train's FFCCTV shows that the scooter was not visible to the train driver until about four seconds before the impact. Upon seeing the mobility scooter crossing the line, the driver applied the train's full service brake, followed by sounding the train's horn and applying the emergency brake just before impact. From the initial brake application until the train came to rest 327 metres past the crossing, its average deceleration rate was 14%g, compared to the 12%g minimum specified for emergency brakes on this type of train⁵.



Figure 8: View from the train's forward facing CCTV at the moment brakes were applied, when the scooter was about to complete crossing the Down Bentley Loop

Events after the accident

- 31 The driver made a priority call to the signaller using his in cab *GSM-R radio* to report the accident and to request emergency services. The emergency services arrived and found that the mobility scooter user had suffered fatal injuries.

⁴ A train speed of 71 mph (114 km/h) was recorded by the *on-train data recorder*, which operates to an accuracy of +/-2 mph (3 km/h).

⁵ Braking System Requirements and Performance for Multiple Units, GM/RT2044.

Key facts and analysis

Background information

Footpath crossings

- 32 Footpath crossings, a type of level crossing, are found where the railway crosses a path on which pedestrians have a right of way. On this type of level crossing, guidance provided by the Office of Rail and Road (ORR)⁶ states that ‘users are expected to use reasonable vigilance to satisfy themselves that no trains are approaching before they start to cross the line. They should cross quickly and remain alert whilst crossing.’
- 33 Level crossings such as Alice Holt, where users are required to look and listen for trains before they start to cross, are commonly referred to as passive crossings (that is, the crossing is not provided with equipment such as *miniature stop lights* to warn users of approaching trains).
- 34 Safe use of passive crossings depends on users having sufficient warning of an approaching train. Therefore, the time from when the user first becomes aware of an approaching train until the time it arrives at the level crossing (the warning time) needs to be greater than the time required by users to cross (the traverse time⁷).
- 35 The warning time needs to account for the maximum permitted speed of trains approaching the crossing. The location at which a train is first visible to a crossing user is known as the sighting point. Where the warning time provided by looking for trains at the sighting point is insufficient, additional means of warning must be provided. This can be, as at Alice Holt crossing, an audible warning provided when the train driver sounds the train horn in response to a whistle board, or a telephone to contact the signaller for permission to cross.
- 36 It is not a fundamental requirement for the safe operation of most level crossings, including Alice Holt footpath crossing, that train drivers should be aware of, and react to, the presence of crossing users. However, drivers are required to sound a warning and apply the brakes if they observe a person, vehicle or other obstruction on the crossing.

⁶ Level Crossings: A guide for managers, designers and operators. Railway Safety Publication 7, December 2011.

⁷ Also referred to as the crossing time.

- 37 Mobility scooters have a legal right⁸ to use any level crossing that is a public right of way. However, Network Rail is only required to make any additional provision for mobility scooters where it is reasonably practicable to do so, and mobility scooter users therefore have a responsibility to decide whether a crossing is suitable for them to use. Network Rail also has a duty under the Health and Safety at Work Act to ensure, so far as is reasonably practicable, the safety of all those using or affected by a level crossing. This means that Network Rail needs to regularly monitor the suitability of arrangements at a crossing and make improvements when it is reasonably practicable to do so.

Routine level crossing management

- 38 Network Rail manages its responsibilities for the safety of footpath crossings in accordance with wider arrangements for the routine management of level crossings. Two key processes are involved:
- Level crossing risk assessment: regularly assessing the potential for collisions (and other incidents) to identify risks and to arrange implementation of any necessary control measures.
 - Level crossing asset inspection and defect rectification: regularly inspecting level crossings, identifying defective assets and managing their rectification.
- 39 Until 2013, the risk assessments were carried out by ORCCs using data collected on level crossing visits by *mobile operations managers*. Level crossing asset inspections were carried out by the local *off-track maintenance* teams.
- 40 In 2013, Network Rail introduced the new role of LCM on its Wessex Route as part of a nationwide initiative. The LCMs carry out data collection, risk assessments and level crossing asset inspections. They then liaise with the relevant maintenance team and investment authority regarding rectification and improvement work. There are currently five LCMs on the route, each with a number of allocated level crossings. The LCM responsible for the Alice Holt footpath crossing reports to the RLCM for Wessex.
- 41 Since the introduction of new guidance for risk assessment of level crossings in March 2015⁹, routine risk assessments are required to be carried out every two and a quarter years at Alice Holt level crossing. The frequency of risk assessments varies from crossing to crossing according to the crossing's ALCRM risk score (paragraph 13) with higher risk crossings receiving more frequent assessments. Risk assessment visits are also required following an accident, following a near miss and before a proposed operating or design change is agreed. The risk assessments include evaluation of warning times, evaluation of traverse time (including whether any additional crossing time allowance is required for *vulnerable users* such as those with limited mobility), and initiating action if the warning time is less than the traverse time.

⁸ Section 20 of the Chronically Sick and Disabled Persons Act 1970 exempts invalid carriages (whether mechanically propelled or not) from any 'statutory provision prohibiting or restricting the use of footways'. A footway is defined as a 'way which is a footway, footpath or bridleway within the meaning of the Highways Act 1980'. If the carriages are mechanically propelled, they are not treated as a motor vehicle for the purposes of the Road Traffic Acts (except for a specific instance that is not relevant).

⁹ Network Rail Operations Manual procedure 5-16 issue 3, compliance date 07 March 2015, part of NR/L3/OPS/041

- 42 The last risk assessment at Alice Holt before the accident is dated 1 September 2015 and was carried out as a consequence of a near miss incident. Previous risk assessments had been carried out in December 2007, January 2011 (relating to a site inspection in December 2010) and June 2013.
- 43 The September 2015 risk assessment calculated a traverse time of 7.57 seconds¹⁰ for Alice Holt crossing and found that the warning time exceeded the traverse time for users crossing in both directions and trains travelling in both directions (table 1). This conclusion relied on users crossing from the north hearing train horns being sounded at a whistle board and made no allowance for vulnerable users. Sun glare was among the risks identified at this crossing.

User approaching from	Train approaching from	Train visible for	Sighting time, at 70 mph	Whistle board	Warning time, at 70 mph
North	Alton	221 m	7.1 s	305 m	9.7 s
North	London	288 m	9.2 s	415 m	13.3 s
South	Alton	405 m	12.9 s	305 m	9.7 s
South	London	438 m	14.0 s	415 m	13.3 s

Table 1: Warning and sighting times for each approach to the crossing. Based on Network Rail's September 2015 risk assessment and similar to observations on site by RAIB. Network Rail calculated the traverse time as 7.57 seconds. Data directly relevant to accident is shaded.

- 44 Network Rail's asset inspection records show that, at the time of the accident, there was an outstanding maintenance issue concerning the pedestrian gate on the south side of the crossing, which had two rotten pickets. However, the condition of the gate is not considered to have been a factor in the accident.

Identification of the immediate cause

- 45 **The mobility scooter user started to cross the railway when it was not safe to do so.**
- 46 The FFCCTV on train 1A54 shows that the mobility scooter user was using the crossing as the train approached (paragraph 29). The reasons why the mobility scooter user decided that it was safe to cross at this time cannot be established but possible reasons are considered below.

¹⁰ Network Rail used a traverse speed of 1.189 metres/second, slightly slower (more conservative) than the Office of Rail and Road guidance value of 1.2 metres/second.

Identification of causal factors

- 47 There is no direct evidence showing the mobility scooter user's actions as he approached the southern side of the crossing and then began to cross. Direct evidence is only available for the few seconds immediately before the accident when the mobility scooter is visible on the recordings of the train's FFCCTV. Before this time the train is too far from the crossing for the scooter to be seen in the recorded images. The southern side of the crossing was not covered by the station CCTV which only showed the northern side of the crossing. When the driver first saw the scooter it was already on the crossing.
- 48 Despite the absence of direct evidence of the mobility scooter user's actions on the southern approach to the crossing, it has been possible to derive an indicative timeline of events leading up to the accident. This is based on the reasonable assumption that the actions of the mobility scooter user on his return journey would have been similar to those observed on the northern side of the crossing as he made his outward journey (the layout of the north and south sides of the crossing are similar). Other inputs to this indicative timeline have included;
- timings recorded during a reconstruction of the likely crossing sequence; and
 - positions and speed of the scooter when first recorded by the train's FFCCTV.
- 49 Figure 9 shows the timeline that has been derived on the basis of the above inputs. Although only indicative, it represents the most likely sequence of events. It shows the user stopping just before the white line at the southern end of the crossing for 6 seconds with the scooter parallel to the railway and facing towards Alton (as seen on the station CCTV for the outward journey). It is inferred that this stop was so that he could look along the railway towards Alton, the direction from which train 1A54 was approaching (figure 10). He possibly also looked for trains in the opposite direction but this would have been more difficult as it meant looking over his shoulder. Towards the end of this period he may have started to concentrate on the route he was about to take with his scooter.
- 50 The scooter then moved off (designated $t=0$ seconds in this description and figure 12) and began to turn towards the decking. The user then could not see trains approaching from Alton because the view from his scooter was obscured by the fence separating the path from the railway. When visiting the site after the accident, the RAIB noted that the fence height was sufficient to obstruct the view of a mobility scooter user. An adult of average height could see over it.
- 51 The limitation on scooter speed during turning meant that the fence then prevented the user seeing trains approaching from Alton for about 6 seconds until, at $t=6$ seconds, his head passed through the gap. It is uncertain whether he looked towards Alton at, or shortly after, this point (figure 11). It is possible he did not do so because he was concentrating on controlling his scooter and/or he was looking for trains approaching from the opposite direction.
- 52 The scooter then accelerated to its maximum speed of 4 mph (1.8 m/sec) as it continued over the crossing. About 3.5 seconds later ($t=9.5$ seconds) the train collided with the rear of the scooter.

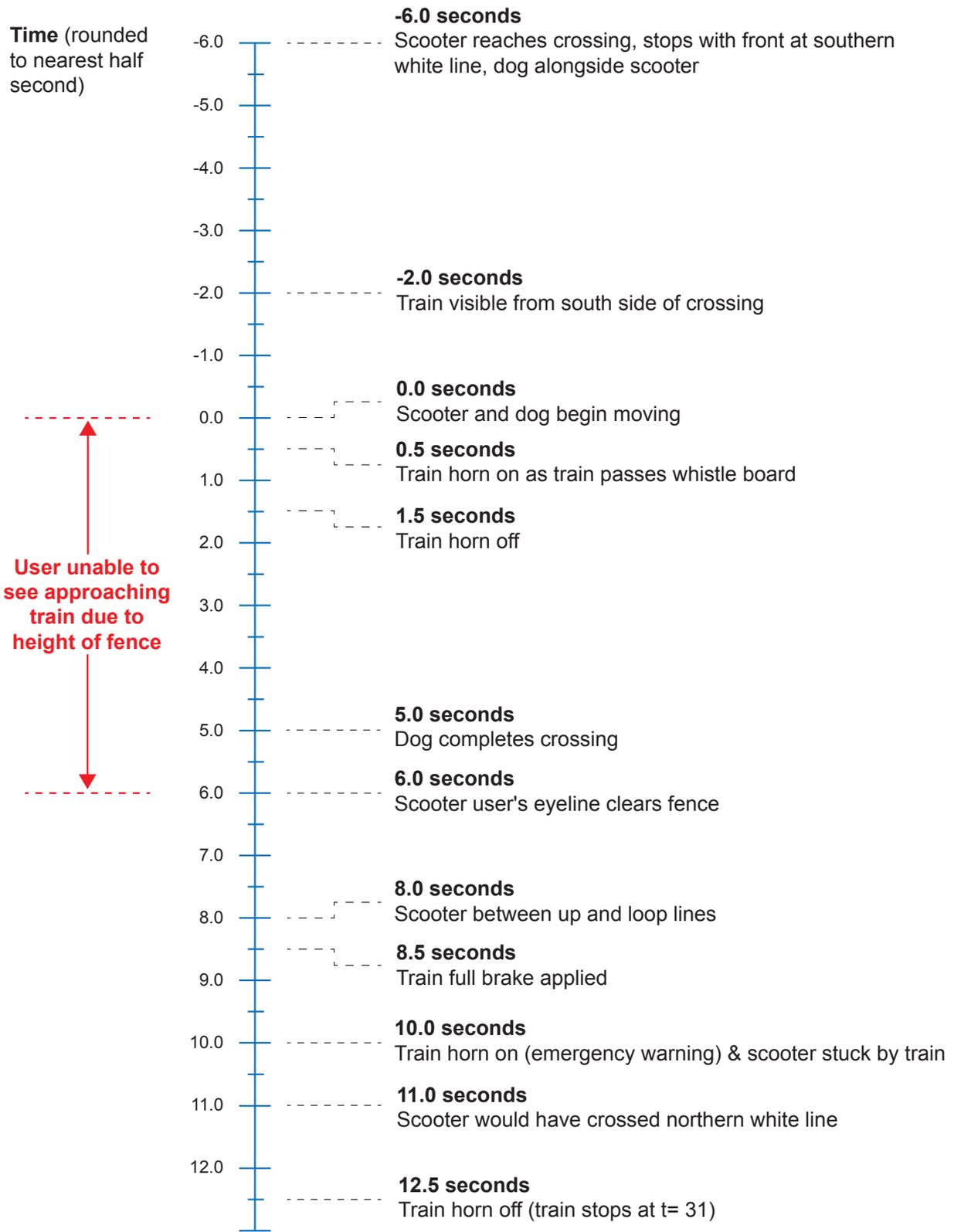


Figure 9: A timeline of the accident, derived from the available CCTV recordings



Figures 10 and 11: View of approaching trains before and after the white line, from the height of the mobility scooter user

- 53 The possible scenario described above, and likely variants, were a result of the following factors:
- The mobility scooter user was probably unaware (at $t=0$ seconds in the scenario) that it was unsafe to cross when the front of his scooter was at the white line. This cannot be stated with certainty because there is no direct evidence that he stopped just before the white line.
 - The user was probably unaware that it was unsafe to cross when deciding to continue crossing the railway after his head emerged from the gap in the fence (at $t=6$ seconds or later in the scenario). It is unclear whether he made a deliberate decision or relied on an earlier decision at this time. It is possible that the user became aware of the train when he was at a position where he believed the train was too close for him to avoid an accident by returning towards the south side of the crossing.
 - The user's actions were probably influenced by arrangements at the crossing which restricted when the mobility scooter user could decide whether it was safe to cross.
- 54 It is unlikely that the user omitted to look as he was an experienced user of the crossing and the pause on the outward journey (paragraph 26) was almost certainly him doing this.
- 55 **The user was probably unaware that it was unsafe to cross when the front of the scooter was at the white line.**
- 56 It is probable that the user made his initial decision to start to cross when the front of the scooter was at the white line. The train would have passed the sighting point approximately two seconds before the scooter started moving.

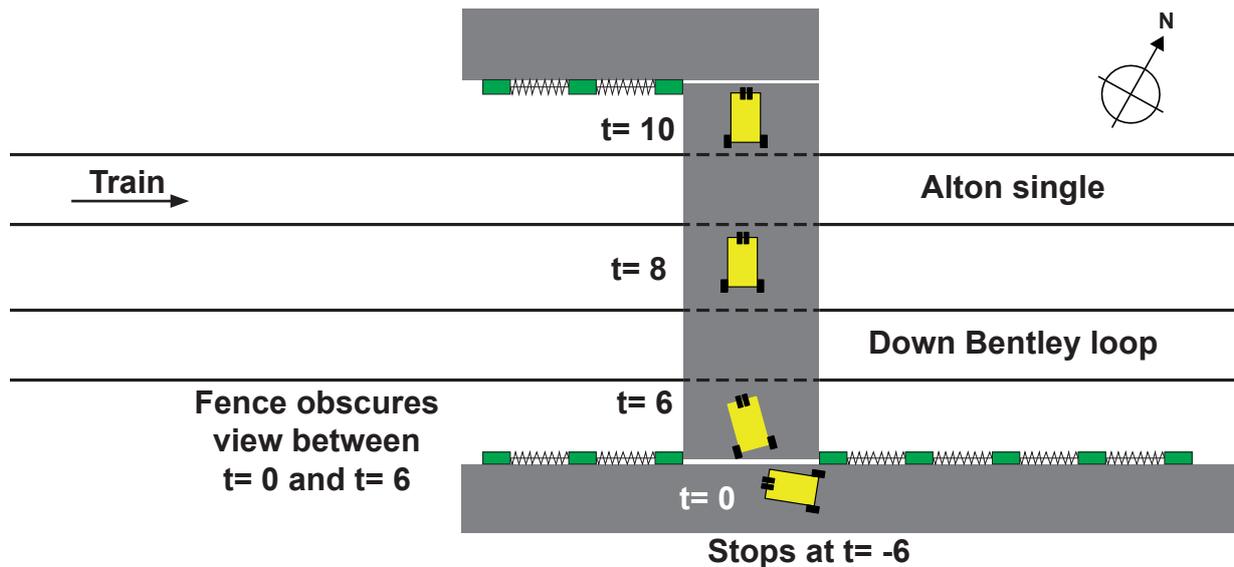


Figure 12: positions of the mobility scooter at key times during the crossing

- 57 If deciding to cross when the front of the mobility scooter was at the white line, it is possible that the user did not look towards the approaching train during the last two seconds before the mobility scooter started moving (it is unlikely that the mobility scooter user would have moved off if he was aware that a train was rapidly approaching at the time). This would mean he looked towards the train just before it reached the sighting point. It is possible that he did this because, in the short time after looking in this direction, and before moving off, the user looked at the fence posts and/or crossing surface in order to control his mobility scooter properly. He may also have been looking for trains approaching from the opposite direction at that time.
- 58 If the user looked towards the train after it had passed the sighting point it is probable that he either did not see the train, saw the train but misjudged its speed, or incorrectly believed it would stop at Bentley station (ie just before reaching the footpath crossing).
- 59 If the user looked but did not see the train, or saw the train but misjudged its speed, it is possible that this was because of sun glare (figure 13). The sun was approximately 17 degrees above the sighting point of the train. Research¹¹ into the effects of sun glare on road users suggests that, for 60 year-old drivers, problems of glare occur when the sun is within 25 degrees of the subject. The mobility scooter user was 83 years old and therefore likely to be subject to around three times more disability glare (glare that hampers a person's vision of an object) than a person of up to 35 years of age¹².

¹¹ Jurado-Piña, R. & Pardillo-Mayora, J.M., 2009. A methodology to predict driver vision impairment situations caused by sun glare, *Transportation Research Record* 2120, pp. 12–17.

¹² Vos, J.J., 2003, On the cause of disability glare and its dependence on glare angle, age and ocular pigmentation, *Clinical and Experimental Optometry*, vol. 86(6), pp. 363-370.

- 60 It is also possible that the user saw the train but incorrectly believed that it would stop at Bentley station. He may have been predisposed to this belief because only about 20 of the approximately 80 trains which use the crossing each day (about 12 of the approximately 40 trains from Alton) do not stop at Bentley station. The non-stopping trains from Alton generally approach the crossing at about 70 mph (113 km/h).



Figure 13: view from the southern end of the crossing decking, taken at the same time of day as the accident, showing the effect of sun glare

- 61 The mobility scooter user did not stop in response to the warning horn sounded as the train passed the whistle board, possibly because he was unaware of the sound.**

- 62 The mobility scooter user did not stop in response to the train's horn which was sounded for around one second as the train reached the whistle board¹³, about 9.5 seconds before the train struck the mobility scooter. In the most likely scenario (paragraphs 50 and 51), this was while the scooter was passing through the gap in the fence. It is not possible to know whether the mobility scooter user heard the sound of the horn. If he did not, this could have been because he was concentrating on negotiating the turn onto the deck. It is also possible that he heard the horn without realising it was a fast train approaching the crossing.

¹³ The on-train data recorder analysis shows that the warning horn was sounded as the train passed the whistle board. A report from a local resident suggests that other trains on this line sound their horn at significantly different distances from the crossing. The RAIB has written to South Western Railway (SWR, successor to SWT) reminding it that train horns should be sounded at the whistle board to provide a consistent warning time to level crossing users.

63 RAIB site observations showed that in still conditions a train horn sounded at the whistle board is clearly audible at the crossing. However, on the day of the accident there was a fresh breeze, gusting to a strong breeze blowing from the east, against the direction of the train (paragraph 23). This may have muted the sound of the horn enough for the user to miss it. Noise from the mobility scooter was unlikely to have masked the sound of the horn as RAIB testing has shown that this type of scooter is silent when stationary and very quiet in motion.

64 It is probable that the user was unaware that it was unsafe to cross when he continued to cross the railway after passing through the gap in the fence.

65 It is not known whether the mobility scooter user reassessed, or made his, decision to cross the line after passing through the gap in the fence at $t = 6$ seconds. The train would normally have been visible from the crossing at this time. It is possible that he did not look for trains after passing through the gap because he was concentrating on controlling his scooter over the crossing and/or looked only for trains travelling from London, perhaps because it had been difficult for him to look in this direction when the front of the scooter was at the white line (paragraph 49).

66 It is probable that the user was unaware that it was unsafe to continue crossing when he continued to cross the railway immediately after passing through the gap in the fence because:

- a. he relied on the judgement he made when the front of the scooter was at the white line (paragraph 55); and/or
- b. he misjudged the train speed, perhaps due to sun glare, or believed the train would stop at Bentley station (as in paragraphs 56 to 60).

67 It is possible that the user became aware of the approaching train after the scooter had passed through the gap in the fence, and the user's head passed through the gap. In this position he could not have accelerated to reach the north side of the crossing more quickly because the scooter was already travelling at its maximum speed. It is therefore possible that he decided the likelihood of being struck by the train would be minimised if he continued over the crossing. It is possible that this decision was based on one or more of the following:

- a. Reversing would have been time consuming. To reverse the scooter would have required the user to release the speed control with his right hand, move this hand to a handlebar mounted switch and then return it to the speed control. Testing determined that it would take a minimum of just over a second to stop and select reverse. The scooter would then have been limited to half speed while travelling in reverse.
- b. He believed that he would be at risk of being struck by a train on the Down Bentley Loop line. The front of his scooter was only 1.1 metres from the nearest rail of the Down Bentley Loop when his head first emerged from the fence gap and, although just clear of a passing train, this is closer than railway staff are permitted to stand when a train passes at 70 mph (113 km/h). It is not known whether he knew which line would be used by the approaching train.

- c. Performing a U-turn, although possible within the width of the crossing deck, would have taken longer than reversing due to the cornering speed limiter (paragraph 17).
- d. Reluctance to return to the south side (it is the RAIB's experience that people on level crossings tend to try to reach their destination when they are uncertain whether to proceed).
- e. The user may not have wanted to be separated from his dog which crossed in front of the train and, as recorded by the station CCTV, arrived at the north side of the crossing about five seconds before the accident. It then waited on the north side of the crossing until after the accident. Any influence of the dog on the user's decision was probably subconscious as witnesses understood from conversations with the user before the accident that he would not deliberately put his life at risk for the dog.

68 It is probable that the user's actions were influenced by arrangements at the crossing which restricted the opportunity for the mobility scooter user to see approaching trains.

- 69 The RAIB considers that the arrangement of the crossing is a probable factor in the accident because the fence extending above the mobility scooter user's eye level prevented him from seeing the approaching train for a period of several seconds while the scooter was turning slowly onto the crossing (t= 0 seconds to t= 6 seconds in the possible scenario). If the user had looked towards the train in this period, the train would have been closer to the crossing than before the scooter crossed the white line at the fence gap. In these circumstances, the danger from the train may have been seen by the user despite the sun glare (paragraph 59). It is then possible that the user would have waited for the train as he would have been less affected by the issues which could have caused him to continue moving over the crossing after his head passed through the fence gap (paragraph 6). The path approaching the south end of the decking was too narrow for the mobility scooter user to position his scooter at right angles to the railway before beginning to cross the white line (paragraph 85)
- 70 A crossing layout resulting in a significant time period when a user cannot see an approaching train after deciding to cross is inconsistent with the ORR's expectation that users will remain alert for approaching trains while using this type of crossing (paragraph 32). A typical adult would not be affected by this problem as they could see over the fence. Other pedestrians would be past the fence immediately after they started to cross, a time when they could easily return to a place of safety. However this was not the case for a mobility scooter user.

Identification of probable underlying factor

71 Network Rail's level crossing management process did not take full account of use by mobility scooters.

72 Network Rail's level crossing management process did not contain explicit provisions for mobility scooter users and the vulnerable user allowance in this process was not applied at Alice Holt footpath crossing, and did not give consideration to safe use by mobility scooter users. It is possible that the accident would have been avoided by providing the standard Network Rail allowance for vulnerable users (paragraph 73 to 81). It is probable that the accident would have been avoided if measures had been implemented to facilitate safe use by mobility scooters (paragraphs 82 to 85).

Use by vulnerable users

73 Network Rail's guidance to LCM staff current at the time of the September 2015 risk assessment, required LCMs to consider the needs of vulnerable users by allowing an extended traverse time at some level crossings. The guidance stated that '*vulnerable users can include...people with physical and/or mental disabilities or other impairments, ...dog walkers, ... [and] cyclists*'. The guidance made no specific reference to mobility scooter users.

74 The guidance required a 50% increase to the standard traverse time if an allowance was required for vulnerable users. It stated that:

'the number of variables and constraints involved make it impossible to define a single, absolute national threshold for applying the 50% safeguard to the traverse time...[the decision whether to apply the 50% allowance] should always be based on structured expert judgement and local knowledge...It is reasonable to consider if, for every five users/traverses:

- *only one in five is made by a vulnerable user, the 50% safeguard would not typically be applied*
- *two in five is made by a vulnerable user, it is especially important that a risk based decision is made*
- *three to five are made by vulnerable users, the 50% safeguard would always be applied*'.

75 The September 2015 risk assessment did not make provision for the additional 50% traverse time applicable to vulnerable users (paragraph 80). It calculated the standard traverse time as 7.57 seconds, close to the 7.25 seconds calculated by the RAIB after the accident. Adding the 50% allowance would have given a traverse time of 11.35 seconds. This is less than the 12.9 seconds warning time available to users looking towards Alton from the south side of the crossing (the accident situation). As a result, consideration of vulnerable users crossing only from the south side of the railway would not have resulted in a change in crossing arrangements.

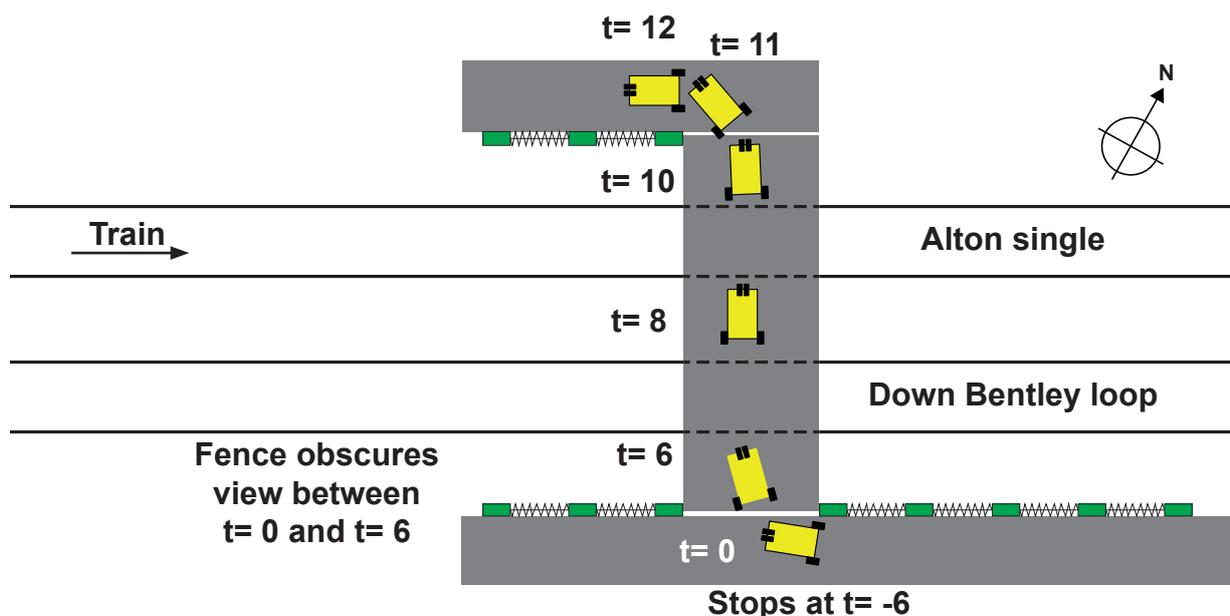


Figure 14: the scooter's trajectory at Alice Holt footpath crossing, had the accident not occurred

- 76 However, consideration of vulnerable users crossing from the north side could have resulted in changes to arrangements at the crossing. The traverse time of 11.35 seconds required for vulnerable users is longer than the 9.7 seconds warning time available to users at the north side of the crossing (table 1). If changes had been made to accommodate vulnerable users on the north side of the crossing, it is possible that these would have altered the circumstances of the accident.
- 77 The 11.35 seconds traverse time exceeds the time taken for the scooter to be clear of the train's path if the most likely scenario is extended until the scooter would have been clear of the railway. The scooter would have been just clear of the tracks 10 seconds after starting moving ($t = 10$), although very close to a train passing on the Alton single line. It would have been completely over the northern white line at $t = 11$ seconds and have completed its turn at $t = 12$ seconds¹⁴.
- 78 An RAIB survey for two hours during the weekend after the accident found that all of the users were in groups including dogs or cyclists. Around 35% of the users were in groups that included dogs, all of which were on leads. Cyclists made up the remainder, with around three quarters of these dismounting as instructed by signs at the crossing. All were included in the list of users that can be considered as vulnerable according to the guidance applicable in September 2015¹⁵ (paragraph 74).

¹⁴ The turn off the crossing is faster than onto it as the scooter is decelerating rather than accelerating. This characteristic was confirmed by RAIB testing of a similar mobility scooter.

¹⁵ A subsequent revision of this guidance suggests that dismounted cyclists could be excluded from the vulnerable users category in some circumstances and that dog walkers are only considered vulnerable if their dogs are off the lead or not under control.

- 79 Evidence that the crossing could be used by mobility scooters was available from Hampshire County Council who had designated the footpath over the crossing as part of the Shipwrights Way. The county council's website describes this part of the Shipwrights Way as suitable for mobility scooters. The county council discussed use of Alice Holt crossing with Network Rail in 2011 as part of the process for creating the Shipwrights Way. This led to modified gate arrangements mainly intended to aid cyclists, but described in a funding application to South Downs National Park Authority as: 'to facilitate access for cyclists, pushchairs and mobility vehicle users'. This application was copied to Network Rail for information.
- 80 The LCM who undertook the September 2015 risk assessment used the results of a 14 day camera survey, undertaken in late summer 2015, to determine whether an allowance for vulnerable users was required. The LCM recorded an average of 86 pedestrians and 29 cyclists per day but did not keep a record of any other user categories identified during this survey. The survey images were not retained after viewing by the LCM. This was in compliance with Network Rail's image retention policy for level crossing surveys and means that the RAIB are unable to assess the number of vulnerable users among the pedestrians recorded during this period.
- 81 The LCM used her own judgement to decide that the recorded usage was not sufficient to require the vulnerable user allowance. This was because she was using the process which applied until December 2013. Until this date, Network Rail had not quantified the proportion of vulnerable users required to trigger the allowance. ALCRM guidance stated only a 'higher than usual' number of vulnerable users. The LCM was unaware of updated guidance issued in December 2013 giving the proportion of vulnerable users required to trigger the allowance (paragraph 74). Managers from Network Rail headquarters level crossing team circulated the updated guidance to RLCMs in December 2013 for them to brief to their LCMs. The circulation list is no longer available. The Wessex RLCM had no record of receiving this information and does not recall briefing this information. Some group meetings of LCMs discussed the updated guidance at Network Rail's June 2014 level crossing manager forum. The LCM attended the forum but there is no evidence that the vulnerable user guidance was discussed in the group meeting she attended. All Wessex LCMs have subsequently been briefed on updated versions of the guidance.
- 82 If the vulnerable users allowance had been provided at Alice Holt crossing following the September 2015 risk assessment, additional mitigation is most likely to have been achieved by adjusting whistle board positions or by reducing the speed of trains approaching the crossing. A change to the position of the whistle board would have been unlikely to have affected the accident as the user did not react to the sound of the horn (paragraph 61); a reduction of the maximum speed for approaching trains might have done so, as more time would have been available to cross.

Specific consideration of mobility scooters

- 83 It is probable that specific consideration of mobility scooter requirements would have reduced the issues imposed by the fence and the turn onto the crossing (paragraph 68). An improvement could have been achieved by lowering the fences so that the users could see over the fence, work which has now been completed (paragraph 95).
- 84 As an alternative or complementary action, the approach to the crossing could have been modified so that mobility scooter users could position themselves at right angles to the railway before making their decision to cross. Network Rail's Access & Inclusion Manager stated after the accident at Alice Holt that this is the position which mobility scooter users should try to reach before making their decision to cross. The approach path on the south side of the decking at Alice Holt crossing was too narrow (figures 16 and 17) to achieve this without partially passing over the white line at the gap in the fence and then reversing. It is possible that making this manoeuvre would appear more dangerous to the mobility scooter user than making a decision from a position at an angle to the line.
- 85 A modification allowing a decision with the scooter at right angles to the railway would have reduced the traverse time to 6 seconds on the RAIB possible timeline (figure 15). If the fences had not been lowered, it would also have resulted in a substantial reduction in the period of time when the fence obscured the user's view of trains approaching from Alton.

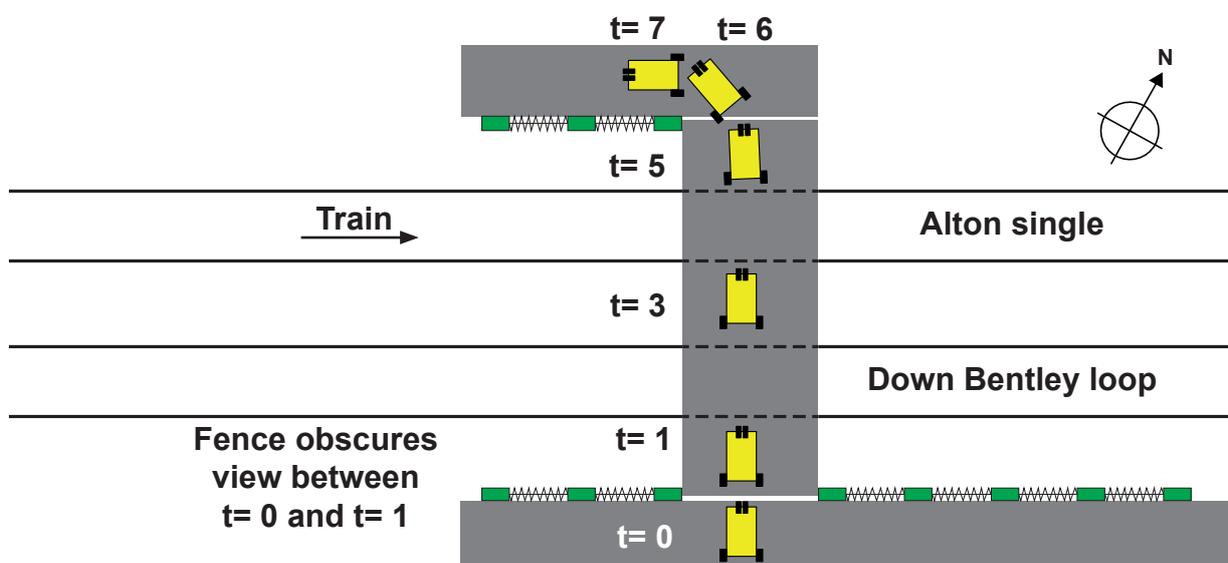


Figure 15: positions of the mobility scooter at key times during the crossing, if the scooter did not have to turn after starting moving



Figure 16 and 17: dimensions of the scooter and the approach to Alice Holt crossing

Previous occurrences of a similar character

- 86 RSSB publishes an annual report on the safety performance of the mainline railway. In its 2016/17 publication¹⁶ it reported that, excluding suicide, the overall risk of injury at level crossings is 11.4 *fatalities and weighted injuries* (FWI) per year. Charts in the 2016/17 report record that the number of public pedestrian fatalities at level crossings varies significantly from year to year. There were four in 2016/17, three in 2015/16, nine in 2014/15, seven in 2013/14 and four in 2012/13.
- 87 RSSB provided RAIB with details of incidents involving mobility scooters and motorised wheelchairs at level crossings since 2002. There were a total of 95 recorded incidents, 12 of which resulted in injury, including the accident at Alice Holt.
- 88 RSSB records show seven reported incidents at Alice Holt crossing between 2006 and the date of the accident, including five near misses where people crossed in front of a train. The majority of these near misses involved London bound stopping trains.

¹⁶ [Annual Safety Performance Report 2015/16](#). RSSB, July 2016.

Summary of conclusions

Immediate cause

89 The mobility scooter user started to cross the railway when it was not safe to do so.

Causal factors

90 The following causal factors have been identified:

- the user was probably unaware that it was unsafe to cross when the front of his scooter was at the white line;
- the mobility scooter user did not stop in response to the warning horn sounded as the train passed the whistle board, possibly because he was unaware of the sound;
- the user continued to cross the railway after passing through the gap in the fence; and
- the arrangements at the crossing restricted the opportunity for the mobility scooter user to see approaching trains.

Probable underlying factor

91 Network Rail's level crossing management process did not take full account of use by mobility scooters.

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

- 92 Dissemination of vulnerable user definitions and proportions, has now been included in an update of Network Rail's Level Crossing Guidance 'census good practice' (LCG02, version 2) published in October 2016. Network Rail has reported that this was distributed to level crossing managers by email on 26 October 2016 to be briefed at the next available team meeting. This document was further updated to version 3 in July 2017, with the same distribution and briefing methods.
- 93 Version 2 of this guidance has been readily accessible by LCMs on the 'Level Crossing Hub', Network Rail's online resource for level crossing managers, since November 2016. Version 3 has been available since July 2017. These versions both include mobility scooter users as vulnerable users for whom LCMs may consider adding 50% extra crossing time. Neither version gives any guidance specific to this type of user.
- 94 Network Rail has a significant and continuing education programme, targeted at various level crossing users, including those with sight, hearing and mobility restrictions.

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

- 95 Network Rail has lowered all three fences at Alice Holt level crossing and has widened the path on approach to the south side of the crossing. Resurfacing of the crossing is included as a recommendation in the November 2016 risk assessment of the crossing.

Recommendation

96 The following recommendation is made¹⁷:

- 1 *The intent of this recommendation is to ensure that appropriate action is taken where necessary to take account of mobility scooter use of passive level crossings. Modification of all crossings is not required as Network Rail's legal duty to make modifications is limited to circumstances when it is reasonably practicable to do so. It is expected that Network Rail will take account of principles identified by recent research when modifying crossings. It may be possible to achieve the first four bullet points by providing level crossing managers with guidance to be applied during the crossing visits and narrative risk assessment which already form part of Network Rail's existing level crossing management process.*

Using the modifications already implemented at Alice Holt footpath crossing as an example, Network Rail should review and, where necessary, modify its management processes for passive level crossings to take account of use by people on mobility scooters in addition to other users. The review should include consideration of the following:

- The size, speed and turning characteristics of mobility scooters.
- The position of users' heads relative to ground level and relative to the front, back and sides of mobility scooters.
- The increasing use of mobility scooters.
- How risk assessments at individual level crossings consider:
 - the likelihood of use by people on mobility scooters; and
 - whether it is both necessary and reasonably practicable to improve crossing arrangements (eg providing areas where scooter users can safely decide when to cross, improving sight lines and providing visual/tactile prompts encouraging safe use).

continued

¹⁷ Those identified in the recommendation have a general and ongoing obligation to comply with health and safety legislation, and need to take this recommendation 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, this recommendation is addressed to the Office of Rail and Road to enable it to carry out its duties under regulation 12(2) to:

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

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

- Educating mobility scooter users about how to cross the railway safely. Methods to be considered should include targeted advertising, working with appropriate interest groups and use of both social media and websites. Content should be compatible with risk assessment output (eg advertising any need to turn perpendicular to the railway before deciding whether to cross).

Appendices

Appendix A - Glossary of abbreviations and acronyms

ALCRM	All level crossings risk model
FWI	Fatalities and weighted injuries
FFCCTV	Forward facing closed circuit television
LCM	Level crossing manager
ORCC	Operational Risk Control Coordinator
ORR	Office of Rail and Road
RLCM	Route level crossing manager
SWT	South West Trains

Appendix B - Glossary of terms

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

All level crossings risk model	A model used by Network Rail to evaluate the risk at level crossings.*
Crossing deck	That part of a level crossing that is walked on, ridden on or driven on by pedestrians, cyclists, equestrians or motorists.*
Definitive map	A map prepared by a surveying authority which is a legal record of the public rights of way.
Electric multiple unit	A multiple unit train whose source of power is an electric motor.*
Fatalities and weighted injuries	A concept used by the railway industry when recording safety performance or comparing risk: one fatality is deemed equivalent to ten major injuries, or to 200 minor injuries.*
Forward facing closed circuit television	A CCTV camera mounted on the front of a train, recording a view similar to that which the driver could see.
GSM-R radio	A secure railway telephone system based on the global system for mobile communications.
Level Crossing Manager	A Network Rail manager who carries out risk assessments and asset inspections at level crossings.
Miniature stop lights	Small red and green lights, used as the warning at some level crossings.*
Mobile operations managers	A Network Rail manager who provides first response to incidents.
Off-track maintenance	The part of Network Rail's maintenance organisation that deals with the part of the railway corridor in between the track and the boundary fence.
On-train data recorder	A data recorder fitted to a train that collects information about its performance and the status of systems on board, such as speed and brake control.
Route Level Crossing Manager	The manager responsible for all of the level crossings on each of Network Rail's routes, they also have line management responsibility for the level crossing managers.

RSSB	A not-for-profit company owned and funded by major stakeholders in the rail industry, and which provides support and facilitation for a wide range of cross-industry initiatives. The company is registered as 'Rail Safety and Standards Board' but trades as 'RSSB'.
Track circuit block	The system of signalling the railway where safe operation of trains is achieved by allowing only one train at a time to occupy a section of track fitted with a track circuit (a track circuit is a device to detect the absence of a train).
Whistle Board	A lineside sign depicting the letter 'W' instructing train drivers to sound the train horn as they pass the sign.
Vulnerable users	People who are likely to take an extended time to traverse a crossing or might be at greater risk of harm compared to typical users.

Appendix C - Investigation details

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

- information provided by witnesses;
- information about the deceased;
- information taken from the on-train data recorder on train 1A54;
- CCTV images from Bentley Station and the front of train 1A54;
- site photographs, measurements and video recordings;
- information and documents provided by Network Rail, Hampshire County Council and South West Trains;
- local weather reports and observations;
- industry research reports relating to the use of level crossings;
- scientific journals, and research reports and reviews; and
- a review of related incidents and accidents that the RAIB has been notified of.

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