RAIB

Rail Accident Investigation Branch

Rail Accident Report

Pedestrian struck by a train at Pewsey footpath crossing, Pewsey, Wiltshire
26 February 2025

Report 05/2026
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This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC
- the Railways and Transport Safety Act 2003
- 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.

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 RAIB has described a factor as being linked to cause and the term is unqualified, this means that RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident or incident that is being investigated. However, where RAIB is less confident about the existence of a factor, or its role in the causation of the accident or incident, RAIB will qualify its findings by use of words such as 'probable' or 'possible', as appropriate. Where there is more than one potential explanation 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 or incident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, words such as '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 accident or incident 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 RAIB, expressed with the sole purpose of improving railway safety.

Any information about casualties is based on figures provided to RAIB from various sources. Considerations of personal privacy may mean that not all of the actual effects of the event are recorded in the report. RAIB recognises that sudden unexpected events can have both short- and long-term consequences for the physical and/or mental health of people who were involved, both directly and indirectly, in what happened.

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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Pedestrian struck by a train at Pewsey footpath crossing, Pewsey, Wiltshire, 26 February 2025

Contents

Summary

At around 13:56 on 26 February 2025, a pedestrian was struck and fatally injured by a passenger train at Pewsey footpath crossing, in Pewsey, Wiltshire. The train was travelling at about 93 mph (154 km/h) at the time of the accident. Whistle boards were provided to warn pedestrians of trains approaching the crossing. Data from the train showed that the driver sounded the train's warning horn near the whistle board and, upon sighting the pedestrian on the crossing, repeatedly sounded the horn to give an urgent warning.

The accident happened because the pedestrian, who had hearing loss, was probably unaware that the train was approaching when they made the decision to enter the crossing. Evidence suggests that the pedestrian may not have heard the train's warning horn when making this decision because it was not clearly audible to them. This was based on the likely effects of the pedestrian's hearing loss, the reduction in sound level of the warning horn over the distance between the whistle board and the crossing, which was longer than permitted by Network Rail's guidance, and the level of environmental noise near the crossing.

After entering the crossing, and then becoming aware of the immediately approaching train, the pedestrian continued to cross into the train's path. Although it is not possible to say why the pedestrian continued to cross, previous accidents and academic research show that having a limited time to assess the developing situation may have resulted in the pedestrian being unable to decide whether it was safer to continue to cross, to remain stationary, or attempt to move back the way they had come.

RAIB also found that Network Rail had temporarily closed access to an alternative route, normally used by the pedestrian, which would have avoided them having to use the level crossing.

A probable underlying factor was that Network Rail's control framework for footpath crossings fitted with whistle boards did not sufficiently control the risks associated with their use. Other underlying factors were that Network Rail's processes did not effectively mitigate the risks at footpath crossings fitted with whistle boards to users with hearing loss, or who are deaf, and that Network Rail's risk management and assurance processes for footpath crossings with whistle boards did not effectively manage the risk to the wider public using Pewsey crossing.

As a result of this accident, RAIB has made six recommendations to Network Rail. These recommendations are intended to ensure that appropriate risk mitigation measures are identified and implemented where whistle boards may be an unsuitable control measure, that risks to users with hearing loss, or who are deaf, are effectively controlled in the short term, and that the continued use of whistle boards at footpath crossings is reviewed to confirm that their application remains appropriate. Recommendations also seek to ensure that Network Rail aligns its approach to level crossing standards with its wider standards and control management framework, aligns its management assurance of crossing risk assessments with its other assurance activities, and ensures it considers the wider safety impact of closing public rights of way when making decisions around managing its assets.

RAIB has identified three learning points. The first relates to staff responsible for assessing and reviewing risk at level crossings understanding and applying relevant standards and guidance. The second concerns the importance of communicating the nature of incidents to staff responsible for the post-accident testing of rail vehicles and of such tests complying with industry standards. The third relates to ensuring that opportunities are taken to achieve compliance with relevant Network Rail standards when infrastructure modifications are carried out.

Introduction

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 acronyms, which are explained in appendix A. Sources of evidence used in the investigation are listed in appendix B.

The accident

Summary of the accident

3 At around 13:56 on 26 February 2025, an 82-year-old pedestrian with hearing loss was struck and fatally injured by a passenger train at Pewsey footpath crossing, in Pewsey, Wiltshire. The pedestrian was crossing with a dog on a lead, who was also fatally injured. The train was travelling at about 93 mph (150 km/h) at the time of the accident.

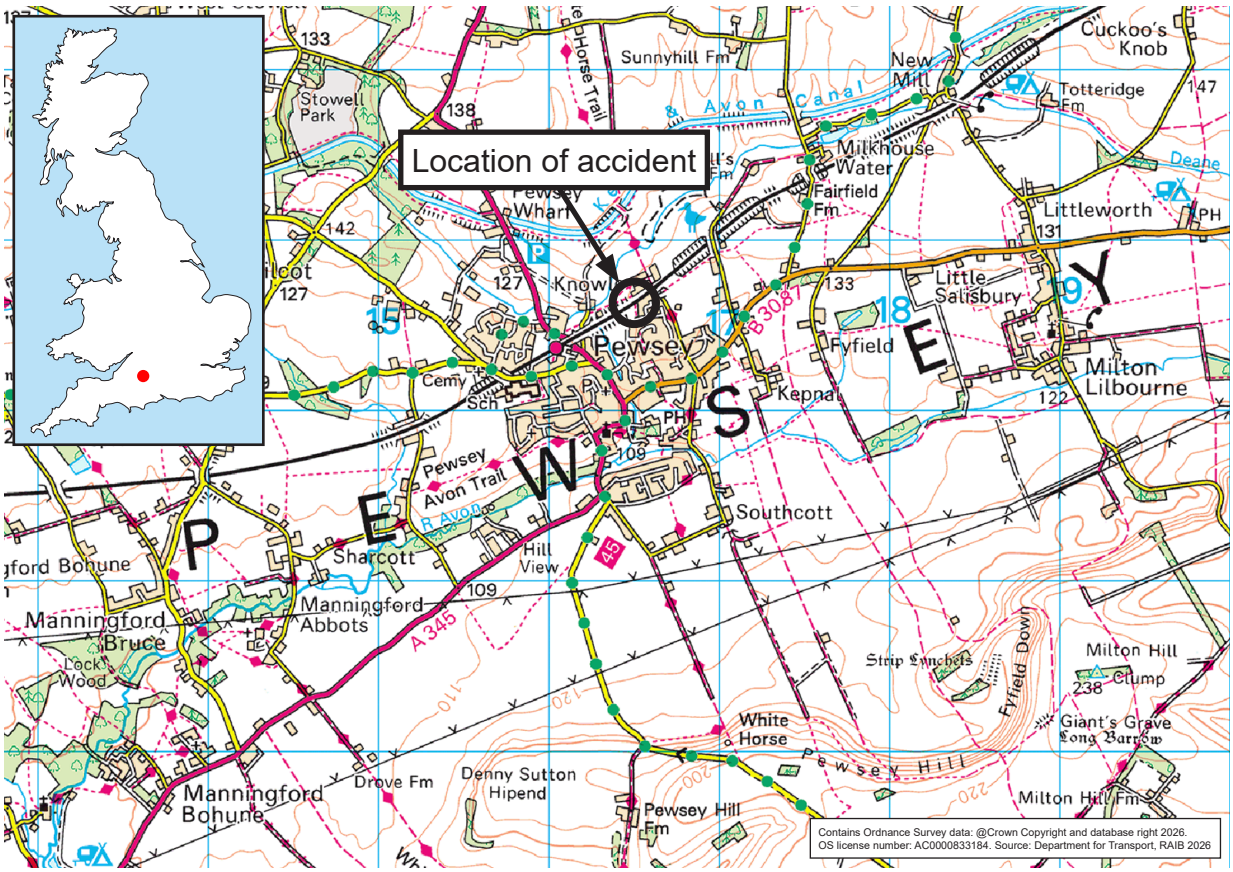

Figure 1: Extract from Ordnance Survey map showing location of accident at Pewsey footpath crossing.

Context

Location

4 Pewsey footpath crossing is located 75 miles from a zero point at Paddington station in London. The railway at this location runs broadly north-east to south-west and comprises two tracks, known as the Up and Down Westbury lines (which run towards and away from London respectively). The maximum permitted speed for trains travelling in either direction over the crossing is 100 mph (161 km/h). The crossing is around 500 metres north-east of Pewsey station. It is part of a public right of way connecting the village of Pewsey to a residential hamlet and to rural areas north of the crossing.

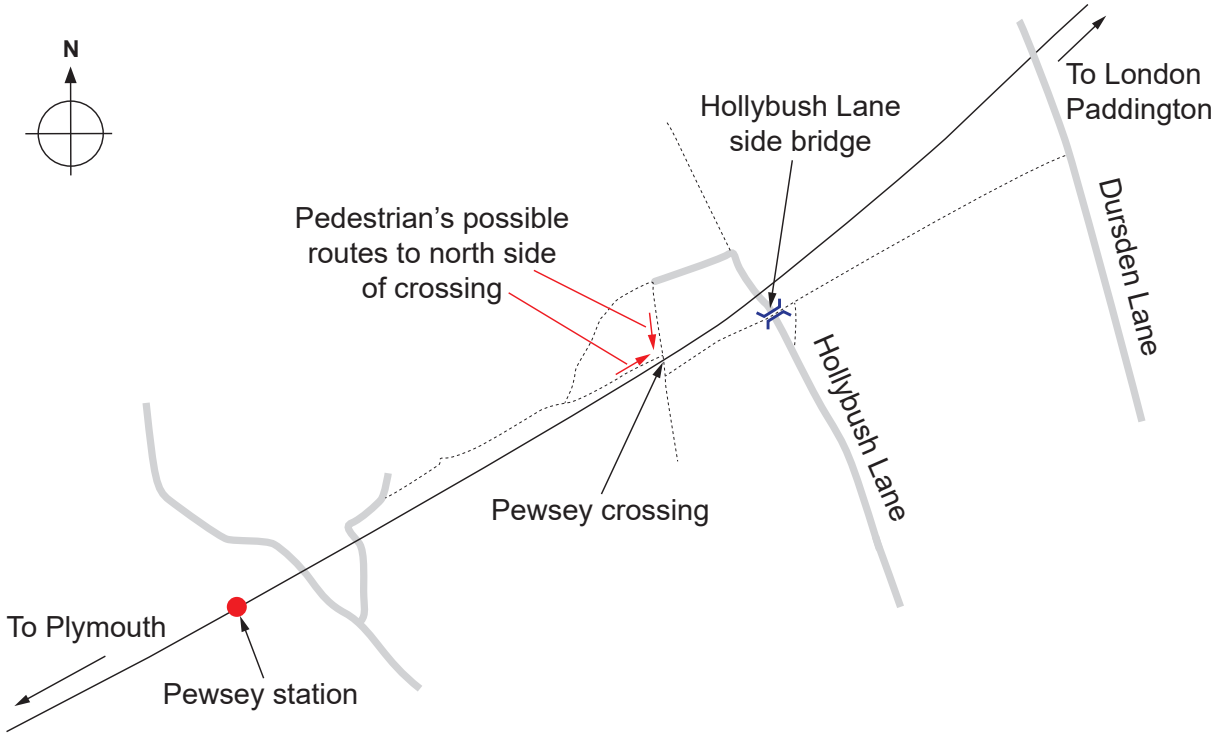

Figure 2: Diagram of the area around the crossing.

5 A public footpath runs along the north side of the railway. This joins a second footpath, which runs approximately north to south, and leads to the north entrance of Pewsey crossing (figure 2). South of the crossing, this second public footpath joins a third footpath which runs along the south side of the railway.

6 This third path leads to Dursden Lane, which is a public road. As it does so, it crosses over Hollybush Lane (also a public road) via a lineside footbridge, known as 'Hollybush Lane side bridge' (figure 3). Just beyond this footbridge, a separate path (which is not a recorded public right of way) branches off from the public footpath and provides pedestrian access to Hollybush Lane.

The crossing

7 A whistle board sign is provided lineside at around 580 metres north-east of the crossing (figure 7). The sign indicates to train drivers that they must sound their train's warning horn as they pass. The purpose of trains sounding their horn at this location is to warn pedestrians using the crossing of trains approaching on the down line. A further whistle board is provided lineside around 400 metres south-west of the crossing to warn pedestrians of trains approaching on the up line.

8 The pedestrian approached the crossing from the north side (figures 4 and 6). When inspected by RAIB on the day after the accident, the path at this location was uneven in places and muddy. Woodchips had been placed on parts of the surface, likely to improve underfoot conditions.

Figure 3: Hollybush Lane side bridge.

Figure 4: Possible approaches used by the pedestrian to reach the north side of the crossing. The approach parallel to the railway is obscured by a building.

9 As pedestrians approach the crossing, a self-closing pedestrian gate leads them through the northern railway boundary onto a path which is enclosed with metal fencing. At the time of the accident, there were signs at the end of this corridor which warned users (figure 5):

- to 'Stop, Look, Listen – Beware of trains'
- not to trespass on the railway
- that oncoming trains can be hidden by other trains.

10 The surface of the corridor from the pedestrian gate to beyond the signs is a compacted crushed-stone surface. Network Rail stated that the crossing deck consists of metal-framed polymer concrete panels. These have a noticeable height difference between the panels on the outer and inner parts of the deck, consistent with the cant (slope) of the track.

Figure 5: Approach to the crossing's north signage via the fenced corridor.

Train involved

11 The train involved in the accident, reporting number 1C82, was the 13:03 Great Western Railway service from Paddington to Plymouth. It was a class 800 train, formed of two 5-car bi-mode multiple units (BMUs), running on diesel power. The class 800 train is based on Hitachi's AT300 platform, which is also the basis of several other train classes operating in Great Britain.

12 The warning horns on class 800 trains produce 'high' and 'low' tone (frequency) warnings and automatically switch between 'loud' and 'soft' sound levels (amplitude), with the loud setting selected above 100 mph (161 km/h) and the soft setting selected at or below this speed.

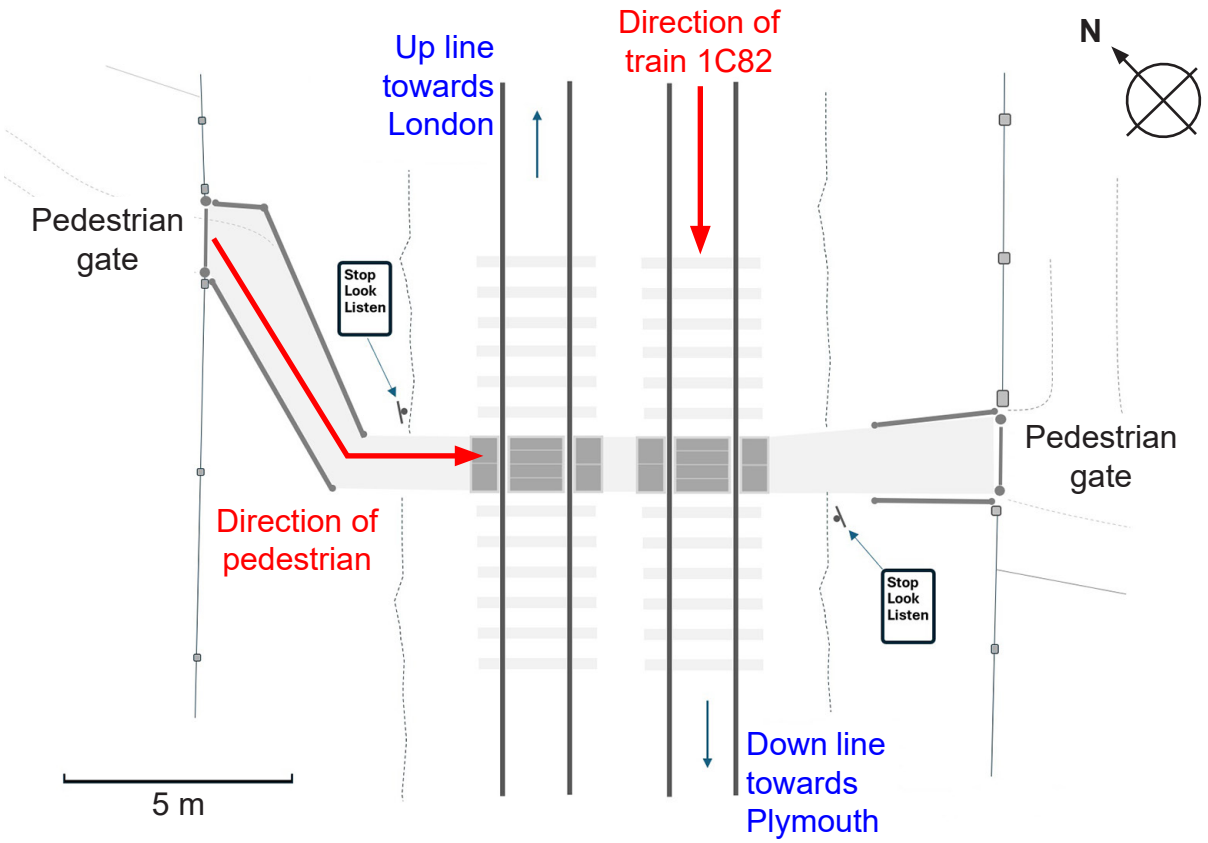

Figure 6: Layout of the crossing.

Figure 7: Forward-facing CCTV showing whistle board sign adjacent to down line near Dursden Lane bridge (courtesy of Great Western Railway).

Organisations involved

13 Network Rail owns and maintains the railway infrastructure at Pewsey crossing, the associated land up to and including the boundary fences, and Hollybush Lane side bridge. It also employs the staff responsible for gathering data about the crossing, and for assessing and managing the risks arising from its use. Pewsey crossing falls within Network Rail's Western route, part of its Wales and Western region. The route contains around 550 level crossings, including approximately 290 footpath crossings.

14 Great Western Railway (GWR) was the operator of the train involved and employs the train driver and the lead driver trainer.

15 Agility Trains contracted Hitachi for the design and manufacture of class 800 trains. A separate contract was placed with Hitachi for the maintenance of the trains.

16 All the organisations involved freely co-operated with the investigation.

People involved

The pedestrian

17 The fatally injured pedestrian was 82-year-old Shirley Pope. The pedestrian had used Pewsey crossing between four and five times per week since September 2024 and regularly used the crossing during morning and afternoon walks, which together typically totalled around 1½ to 2 hours per day. Witness evidence indicates that the pedestrian was regarded as independent and capable, with no mobility or cognitive impairment. The pedestrian was walking a dog on a lead at the time of the accident.

18 The pedestrian had hearing loss and was prescribed hearing aids for both ears. At the time of the accident, the pedestrian was wearing a hearing aid in the right ear only. No hearing aid was worn in the pedestrian's left ear (closest to the approaching train). The pedestrian was also wearing a woollen hat which likely covered both of their ears.

Staff

19 The driver qualified in 2019 and became competent to operate class 800 trains in 2023. At the time of the accident, they were undertaking the final assessed drive required to establish their competence in driving the Reading to Taunton route.

20 The lead driver trainer (who was assessing the driver before and during the accident) qualified as a train driver in September 2014 and was appointed as a lead driver in September 2023.

21 The level crossing manager (LCM) joined Network Rail in 2010 and became an LCM in 2020 in Western route. In January 2025 they attended a pilot 3-day refresher course for LCMs. Since 2020, their area of responsibility included around 65 level crossings. Around the time that they completed the narrative risk assessment (NRA) for Pewsey crossing they were also temporarily responsible for a further 22 level crossings. Seventy-five of the crossings they were responsible for were footpath crossings.

22 The route level crossing manager (RLCM) joined Network Rail in 2019 as an LCM. They were temporarily promoted to RLCM in October 2023 and were permanently appointed to the role in January 2024. Upon appointment to the role, they were responsible for overseeing the management of Pewsey footpath crossing, including reviewing any risk assessments. Following organisational changes in August 2024, the RLCM became responsible for the management of level crossings in the eastern part of the Western route, comprising around half the route's 550 level crossings.

External circumstances

23 A weather station located approximately 16 km west of Pewsey recorded a temperature of 8.5°C, relative humidity of 85% and a light westerly breeze of around 3.5 knots (6.5 km/h) at the time of the accident. Earlier in the day, the station recorded 14 mm of rainfall, likely resulting in wet underfoot conditions, although no rain was falling at the time of the accident.

24 The weather conditions at the time of the accident affected the acoustic environment at the crossing, including the level of background noise and the way in which sound from the train's warning horn travelled from the down line whistle board towards the crossing. This may have affected the pedestrian's awareness of the approaching train (see paragraph 59).

The sequence of events

Events preceding the accident

25 Witness evidence shows that, on the morning before the accident, the pedestrian walked with their dog and a friend from around 07:15, for approximately 30 to 40 minutes. The walk was shorter than normal due to rain, and they remained on the south side of the railway, within Pewsey village, without using the crossing. The pedestrian was reported to be in good spirits and spoke about planned activities later in the day, including an afternoon walk.

26 Witness evidence indicates that the pedestrian started their afternoon walk earlier than usual due to a planned engagement later on. Shortly before the train arrived, the pedestrian was approaching the crossing from the north side and moving towards the south side of the crossing with their dog on a lead. Based on this direction of travel, it is likely that they were returning home from their walk.

Events during the accident

27 At around 13:56, data from the train's on-train data recorder (OTDR, sometimes known as the 'black box') shows train 1C82 approached Pewsey crossing on the Down Westbury line at about 97 mph (156 km/h). Around 14.5 seconds before the accident, the driver sounded the train's low tone warning horn with the automatically selected soft setting (see paragraph 37) for 0.9 seconds.

28 By 13:56:02, the train was around 205 metres on approach to the crossing (around 4.8 seconds travel time). Images from the train's forward-facing CCTV system (FFCCTV) show that the pedestrian was on the crossing adjacent to the Up Westbury line and moving at a steady pace from the north to the south side of the crossing (figure 8).

29 Witness evidence is that the train driver saw the pedestrian and sounded the horn to give an urgent warning of the train's approach. The train's OTDR shows the train driver began to sound repeated high/low horn tones at 13:56:03. At this point, the train was around 191 metres on approach to the crossing (around 4.5 seconds travel time). The horn continued to be sounded until the train reached the crossing. Around 170 metres on approach to the crossing (around 4 seconds travel time), the train driver applied the train's service brake. This was followed by an emergency brake application which was made 136 metres on approach to the crossing (around 3.2 seconds travel time).

30 Around 2.1 seconds before the train reached the crossing, the pedestrian reached a point on the Up Westbury line level with the rail closest to the adjacent Down Westbury line on which the train was approaching. They began to enter the space between the two lines and FFCCTV images show the pedestrian continued to increase their pace towards the southern side of the crossing. When struck by the train, they were almost clear of the crossing but within the swept envelope of the approaching train. The train's emergency brakes remained applied until the train came to a stand about 670 metres beyond the crossing.

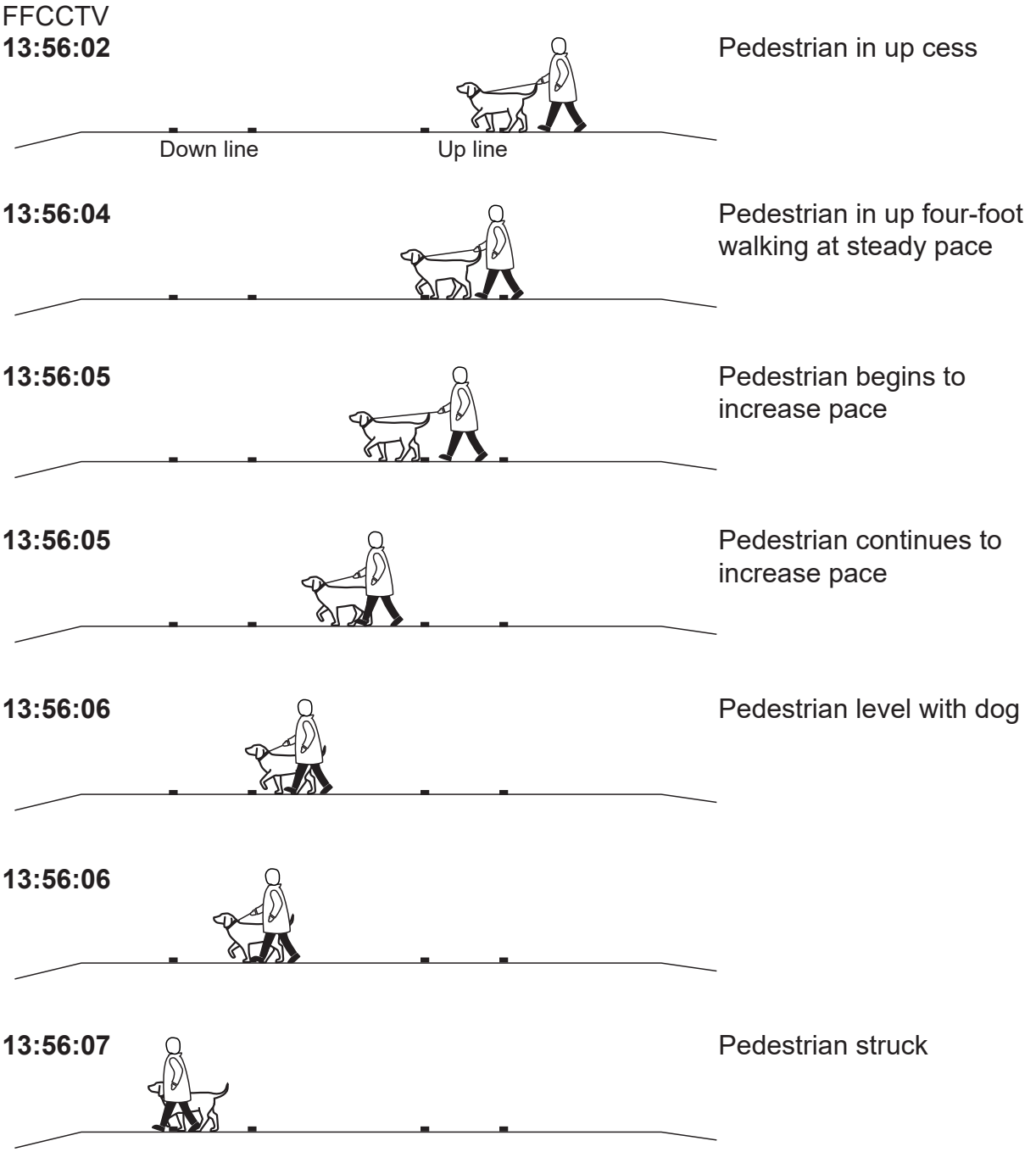

Figure 8: Positions of the pedestrian at the crossing during the accident. The positions shown are indicative only and the diagram is not to scale.

Events following the accident

31 Immediately after the accident, the driver used the GSM-R (Global System for Mobile Communications - Railway) train radio system to report the accident to the signaller. Emergency services and Network Rail staff attended the scene from around 14:28.

Background information

Footpath crossings fitted with whistle boards

32 At footpath crossings, pedestrians are expected to make their own decision about whether or not it is safe to cross. At most footpath crossings, pedestrians are expected to base their decision to cross by looking and listening for approaching trains at the crossing's 'decision point'. This is a notional point situated a minimum of 2 metres from the nearest running line on each side of the crossing.

33 At some footpath crossings, pedestrians have limited sighting of approaching trains at the decision point and cannot make a decision to safely cross solely by looking for approaching trains (see paragraph 62). To address this, Network Rail provides signs, known as whistle boards (figure 7), instructing train drivers to sound their train's warning horn. The audible warning is intended to alert pedestrians to the approach of a train and thereby assist them in deciding whether to enter the crossing.

34 At the time of writing, there were 1,336 footpath crossings on Network Rail managed infrastructure, accounting for around a quarter of all level crossings. Of these, 753 were fitted with whistle boards. Network Rail data shows the following:

- 376 of these crossings had insufficient sighting distance on at least one approach.
- 377 had sufficient sighting on all approaches and therefore do not technically require whistle boards under current standards and guidance.
- Of the crossings fitted with whistle boards, 98 are managed by Network Rail's Western route, 37 of which have insufficient sighting on at least one approach.

35 Network Rail's Technical Authority (which acts as a centre of expertise and sets technical guidance within Network Rail) stated to RAIB that whistle boards installed historically have often been retained because an audible warning may still attract the attention of users who are distracted or may otherwise be less vigilant. It noted that withdrawing a long-established audible warning could introduce unintended risk if not carefully managed, and that environmental noise pollution must be balanced against public safety. Staff working for Network Rail's Western region within level crossing management stated to RAIB that they shared Technical Authority's position on this matter.

Requirements for train horn audibility

36 British Rail listening trials undertaken in the late 1960s established minimum warning horn sound levels for trains of around 120 dB[1] to 125 dB, measured 5 metres in front of the train. This was based on the requirement for horns to be clearly audible at around a quarter of a mile (approximately 400 metres). The maximum speed of trains on the rail network at that time was 100 mph (161 km/h).

[1] A logarithmic measure of the effective sound pressure of a sound relative to a reference value. It is measured in decibels (dB) above a standard reference level.

37 Subsequent standards issued by Railtrack in the late 1990s and early 2000s introduced requirements for maximum warning horn sound levels and for train horns to produce both high and low tones with defined harmonic frequencies. By this time, the maximum speed of trains was 125 mph (200 km/h). These standards also introduced a soft mode for trains with a maximum speed of 100 mph (161 km/h) or less, reducing the required horn sound levels for trains travelling below this speed to between 115 dB(C)[2] (minimum) and 119 dB(C) (maximum), again measured 5 metres in front of the train.

38 Standards issued by the Rail Safety and Standards Board[3] (RSSB) in the early 2000s stated that it was desirable and permissible for trains to automatically change between loud and soft horn settings depending on the train's actual speed. In practice, this resulted in horn sound levels at whistle boards for trains approaching at speeds below 100 mph being reduced.

39 In 2006, RSSB published a research review into the effectiveness of train warning horns at crossings and their impact on residents living near the railway. The review was overseen by the 'train horn steering group' (which included representatives from the rail industry) and the Office of Rail Regulation (ORR, the health and safety regulator for railways in Great Britain, now known as the Office of Rail and Road) which oversaw the research.

40 The review included report T668 'Train horns risk review' which reported that, around the year 2000, new types of rolling stock were being introduced on the railway network which had horns louder than those of older rolling stock.[4] In addition, the louder horns resulted in a significant increase in the number of complaints from residents living near crossings with whistle boards. The research sought to better understand the risk mitigation associated with the use of whistle boards at crossings (including footpath crossings) and explored the possibility of introducing 'quiet periods' when the sounding of the train horn would not be mandatory, and the possibility of reducing the loudness of the newer train horns.

41 The report concluded that the adverse health effects arising in people living adjacent to whistle board locations from the use of train horns exceeded the safety benefits to crossing users from the warning provided. The steering group subsequently recommended the introduction of a quiet period and that only the low tone of the train horn should be sounded at whistle boards for all types of crossings. When RSSB made these recommendations to the steering group, it reported there was only a marginal reduction in the benefit of train horns to level crossing users.

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[2] Sound pressure level weighted to simulate the frequency response of human hearing at high sound pressure levels, written as dB(C).

[3] A not-for-profit company owned by major rail industry stakeholders. It is the independent safety, standards and research body for Great Britain's rail network.

[4] Report T668 notes these new types of rolling stock had to comply with the sound levels specified in the Railway Group Standard GM/RT2484 (dated April 2005). However, report T1205 (subsequently published by RSSB, see paragraph 46) notes that GM/RT2484 decreased the sound levels required in comparison with earlier standards, as part of an overall trend of decreasing sound levels over time. RAIB has not sought to determine the origins of the assertion in T668 but this may relate to differences in tonal characteristics, which can affect perceived loudness and audibility, rather than to higher specified sound levels.

42 In October 2007, the railway Rule Book module GERT8000/TW1, 'Preparation and movement of trains', was updated to issue 6. This instructed drivers to sound only the low tone at whistle boards at all crossing types (including footpath crossings). Previous versions instructed train drivers to sound both high and low tones. The update incorporated requirements of the 'Night Time Quiet Period' (NTQP) running initially[5] between the hours of 23:00 and 07:00. This change extended the requirement for drivers not to sound train horns at whistle boards at all types of level crossings (including footpath crossings) during the NTQP.

43 In April 2007, Railway Group Standard[6] GM/RT2484, 'Audibility Requirements for Trains' was updated to issue 2 to reduce the requirements for minimum sound levels for train horns. For trains with speeds greater than 50 mph (80 km/h) but less than or equal to 100 mph (161 km/h) the minimum and maximum sound level requirements were reduced by 11 dB. The updated requirements for sound levels measured at 5 metres for trains travelling at these speeds were 101 dB(C) minimum (reduced from 112 dB(C) minimum in issue 1) and 106 dB(C) maximum (reduced from 117 dB). The requirement for trains travelling above 100 mph (161 km/h) remained unchanged with a minimum of 115 dB(C) and a maximum of 120 dB(C).

44 In December 2015, Railway Group Standard GM/RT2131, 'Audibility and Visibility of Trains' issue 1 replaced GM/RT2484 issue 2. This specified the sound level requirements for trains with speeds less than or equal to 161 km/h (100 mph) to be 86 dB minimum and 94 dB maximum when measured 25 metres in front of the train (to align the test procedure to that specified in the Technical Specifications for Interoperability (TSI) and British and European standards). RSSB research (see paragraph 46) considered the relative sound level requirements adjusted[7] for distance and found the levels to be only slightly different from GM/RT2484 issue 2. For trains with speeds greater than 50 mph (80 km/h) but less than or equal to 100 mph (161 km/h) requirements for sound levels measured at 5 metres (adjusted for the requirements of GM/RT2131) were a minimum of 100 dB(A[8]) (reduced from 101 dB(A)) and a maximum of 106 dB (reduced from 108 dB(A)).

45 The combined effect of these changes was to reduce the required sound levels for train horns on newly built trains approaching whistle boards by around 20 dB for trains travelling at speeds greater than 50 mph (80 km/h) but less than or equal to 100 mph (161 km/h), and to require drivers to sound only the low tone at whistle boards. Assuming all other factors were equal, this would typically make the warning provided to crossing users less audible and less distinctive.

[5] In December 2016, the timing of the NTQP was reduced to between 23:59 to 06:00.

[6] This report refers to Railway Group Standards, Rail Industry Guidance Notes, and Rail Industry Standards. Copies of these can be obtained from the Rail Safety and Standards Board (RSSB) at www.rssb.co.uk.

[7] Using general acoustic approximations (see paragraph 48), levels at 5 metres will be approximately 14 dB higher than at 25 metres.

[8] Sound pressure level weighted to simulate the frequency response of human hearing at low to moderate sound pressure levels, written as dB(A).

Class 800 train horn audibility

46 In 2019, Network Rail informed RSSB that track workers were reporting incidents where the warning horns on newer types of trains were less audible than on older types. In response, RSSB published research report T1205 'Relationship between train horn test measurements and perceived sound levels on the track' in July 2021. The research included testing of the horn originally fitted to class 800 trains before its subsequent retrofit (see paragraph 51). The testing included trials in operational conditions and assessments of audibility to track workers..

47 The research considered the relationship between horn sound level and distance for the train types tested. It found that older types of trains, constructed between 2002 and 2006, exhibited a strong relationship between horn sound level and distance. However, the class 800 trains, manufactured between 2014 and 2018, exhibited a weaker relationship, with greater variability in the measurements.

48 When considering how sound level reduces with distance, the general principle of 'spherical spreading' is typically applied. This is where the sound energy spreads out over an increasingly large spherical area as it travels further away from the source. Applying this principle shows sound levels will reduce by about 6 dB each time the distance from the source is doubled. However, RSSB's research showed this principle only applied for the first 30 to 50 metres, depending on horn height above the ground. At distances beyond this, the sound level reduced at around 10 to 13 dB per doubling of distance.

49 The report also concluded that horns of class 800 trains were less audible than horns of older trains. The report concluded this could be explained by:

- a reduction in the minimum required sound levels of train horns over time (paragraph 36)
- the positioning of that class 800 train's horn equipment was close to the ground which led to increased attenuation (a reduction in sound level over the distance) and resulted in lower sound levels at distances beyond 50 metres

The report also stated that the wide scatter in data for new trains could also indicate some variability in output among horns of these trains.

50 In November 2021, Network Rail issued Level Crossing Guidance (LCG) document LCG22 'Guidance for assessing train horn audibility at passive level crossings'. This stated that Network Rail had received reports from a variety of stakeholders about the audibility of train horns based on the Hitachi AT300 platform, including the class 800 trains. LCG22 provided staff involved with the risk assessment of crossings with practical guidance when assessing for audibility of a train horn at crossings fitted with whistle boards and how this should be incorporated within Network Rail's risk management processes. The application of LCG22 at Pewsey crossing is discussed further in paragraph 107.

AT300 train horn equipment retrofit on class 800 trains

51 Some AT300 type trains (including class 800s) were originally fitted with 311 Hz 'Low Tone Horn' and 370 Hz 'High Tone Horn' (figure 9). Since these trains entered service, Hitachi noted the design was vulnerable to damage from bird and ballast strikes. The valance grille, directly in front of the horn, was also susceptible to obstruction which prevented the horn from functioning correctly. Hitachi identified this was due to a combination of the horn's plastic design and its low mounted position on the vehicle.

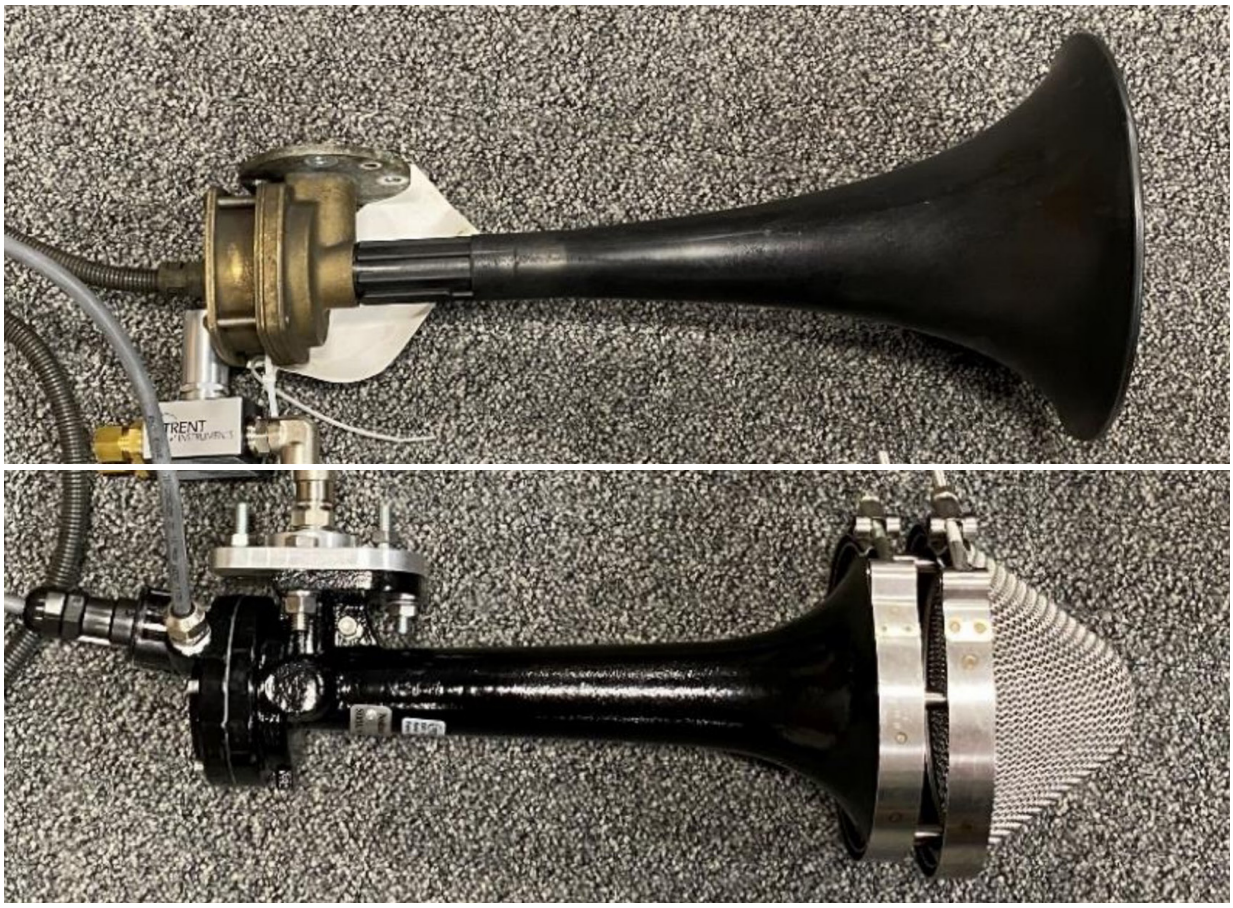

Figure 9: Top image, horn originally fitted to AT300 trains, and, bottom image, retrofitted KSJ horns installed from January 2022 (courtesy of RSSB).

52 In 2021, Hitachi began trials to examine the suitability of an alternative design (referred to as the 'KSJ horn') across the relevant AT300 fleets. Hitachi believed the metal KSJ horns would be more resistant to impact damage and, with additional clearance between the horn and the valance grille, less likely to be affected by external blockages to the grille. Static trials of the KSJ horns, completed in April 2021, noted they had comparable sound levels to the original horns, but the KSJ horns were subjectively more audible due to their '*rich harmonic content*'. An operational trial, involving KSJ horns installed on 3 class 800 and 11 class 801 trains, was completed in October 2021. This trial concluded the installation of KSJ horns had resulted in an improvement in horn reliability.

53 In January 2022, Hitachi approved a programme to retrofit KSJ horns across the majority of the AT300 fleet (including all class 800, 802, 803 and 805 trains). As a result, the train involved in the accident was fitted with KSJ horns.

Analysis

Identification of the immediate cause

54 The pedestrian crossed into the path of train 1C82 as it approached.

55 Unlike road vehicles, trains are not required to be able to stop within the distance that their driver can see to be clear ahead. Therefore, at the vast majority of railway crossings in the United Kingdom, including all footpath crossings, there is no requirement for train drivers to check that a crossing is clear before proceeding over it during normal operation.

56 The train's FFCCTV shows the pedestrian walking with their dog onto the crossing and into the path of the train (paragraph 29).

57 Due to the curvature of the track and partial obscuration by a bridge parapet (figure 10) and vegetation, the train driver was unable to see the pedestrian until the train was about 205 metres from the crossing (paragraph 28).

Identification of causal factors

58 The accident occurred due to a combination of the following causal factors:

a. The pedestrian was probably unaware that the train was approaching when they made the decision to enter the crossing (paragraph 59).

b. After entering the crossing, and then becoming aware of the immediately approaching train, the pedestrian continued to cross (paragraph 76).

c. An alternative route across the railway, normally used by the pedestrian, had been temporarily closed by Network Rail (paragraph 84).

Each of these factors is now considered in turn.

Pedestrian's awareness of the approaching train

59 The pedestrian was probably unaware that the train was approaching when they made the decision to enter the crossing.

60 Based primarily on the available CCTV and witness evidence, RAIB has concluded that the pedestrian had probably neither seen nor heard train 1C82 approach when they started to cross.

61 Analysis of FFCCTV images, OTDR data, site measurements, and timings based on an average walking pace shows it is likely that the train would have already sounded its horn at the whistle board when the pedestrian reached the crossing's decision point and that it was likely to have been sounded while the pedestrian was near to the crossing gate.

Sighting distance and traverse at Pewsey crossing

62 At the northern entrance to Pewsey crossing (used by the pedestrian), crossing users have a restricted view of trains approaching along the down line from the decision point due to track curvature and partial obscuration from a parapet running alongside the railway (associated with the Hollybush Lane underbridge, figure 10). RAIB measured the sighting distance at this location and found that approaching trains could be seen from around 170 metres, with partial sighting extending to around 218 metres.

63 A train travelling at the maximum permitted speed of 100 mph (161 km/h) on approach to Pewsey crossing will travel 170 metres in 3.8 seconds and Network Rail calculated it would take 7.8 seconds for a pedestrian to safely traverse the crossing. Therefore, pedestrians at the north side of Pewsey crossing did not have sufficient sighting distance of trains approaching on the down line to decide whether it was safe to cross by looking for approaching trains alone. The Down Westbury line whistle board sign provided lineside (paragraph 7, figure 7) instructs train drivers to sound the horn to warn pedestrians of trains approaching on the down line to help mitigate the risk of this insufficient sighting.

Figure 10: View from the decision point on the north side of the crossing of trains approaching on the down line. Inset image showing parapet (yellow outline) running alongside the railway, associated with the Hollybush Lane underbridge.

Operation of train 1C82's horn during the accident

64 Rule Book GERT8000/TW1, 'Preparation and movement of trains', issue 20, dated December 2024 was in force at the time of the accident. This requires drivers to sound the horn as they pass a whistle board. Where a low-tone setting is available, the Rule Book instructs drivers to use this tone when passing a whistle board. It also states that if the horn has no soft/loud setting, drivers must use the setting provided, and that if a soft/loud option is available, the loud setting must be used except where otherwise specified. Apart from these requirements, the Rule Book provides no further guidance on the method or duration of horn sounding.

65 GWR's policies and training materials reiterated the requirements within the Rule Book but did not provide additional guidance on how drivers should sound the horn. Witness evidence shows that informal local practices had developed where GWR drivers commonly aimed to sound the horn as close to the whistle board as practicable. Witness and documentary evidence shows there was no consistent approach to the duration of the sounding, although drivers generally regarded a very brief activation (understood to be under 0.25 seconds, colloquially referred to by some drivers as a 'blip') as insufficient.

66 Witness evidence shows the train driver and lead driver heard the train horn sound as train 1C82 approached the crossing, and believed it sounded normal. OTDR data from train 1C82 shows the horn being sounded from 630 metres (50 metres before the whistle board) to 590 metres (10 metres before the whistle board) on the approach to the crossing and that the warning was of about 0.9 seconds duration. The duration was well above what would generally be considered as a blip. Additionally, RAIB's testing of the train's warning horn included determining the relationship between the data recorded by the OTDR, the operation of the horn control in the driver's cab and the sound levels of the horn. The associated data analysis shows the train horn would still have been sounding at the whistle board while on approach to Pewsey crossing, thus meeting the requirements of the Rule Book.

Testing and analysis

67 RAIB undertook testing and analysis to determine if the sound levels produced by train 1C82's warning horn at the whistle board and its likely audibility at Pewsey crossing had any potential effect on the decision of the pedestrian (who had hearing loss) to enter the crossing. Appendix C contains further explanation on the testing involved and how audibility was assessed.

68 RAIB's on-site testing determined that the average sound level produced by the warning horns of class 800 trains, measured at around 25 metres beyond the Down Westbury line whistle board, was 97.8 dB(A). The testing was in accordance with the distance specified in the static test described within the standard and this was well above the minimum requirements of GM/RT 2131.

69 RAIB's on-site testing demonstrated that, although class 800 train horn warnings were consistently above the minimum required sound levels, the sound of the horn attenuated substantially before reaching the crossing. By the time the warnings generated at the Down Westbury line whistle board reached the northern crossing gate and decision point, they were on average only around 3 to 10 dB above background noise at the crossing. In comparison, warnings made at the Up Westbury line whistle board were on average around 20 dB above background noise at the crossing gate.

70 Guidance on assessing the audibility of warning sounds against background noise is given in BS EN ISO 7731:2008 'Ergonomics - Danger signals for public and work areas - Auditory danger signals'. The criterion for the warning sound to be clearly audible to people with either no hearing loss or mild[9] hearing loss is that the sound level of the warning in one or more one-third octave bands shall exceed the masked threshold in that band by 13 dB.

71 Applying this audibility criterion for the conditions observed during RAIB testing at the north (up line) side of Pewsey crossing for class 800 warning horns sounded at the Down Westbury line whistle board showed the following:

- 67% of horn soundings would not have been clearly audible at the gate to people with either no hearing loss or mild hearing loss.
- 33% of horn soundings would not have been clearly audible at the decision point to people with either no hearing loss or mild hearing loss.

72 Applying this audibility criterion for class 800 warning horns sounded at the Up Westbury line whistle board, 25% of horn soundings would not have been clearly audible to people with either no hearing loss or mild hearing loss as they approached the gate.

73 RAIB also considered the pedestrian's aided and unaided hearing abilities (paragraph 18). The British Society of Audiology categorises hearing loss across four levels of severity: mild, moderate, severe and profound. Medical records show that the pedestrian had moderate hearing loss, which is associated with difficulty following conversational speech, particularly when background noise is present. Hearing aids are typically prescribed for this level of hearing loss.

74 Analysis showed the pedestrian would not have been able to hear any of the class 800 warning horns sounded at the Down Westbury line whistle board if they were not wearing their hearing aids at either the gate or the decision point. If the pedestrian had been wearing a hearing aid in their right ear only (as they were during the accident), then analysis determined that 83% of horn soundings would not have been clearly audible at the gate, while 70% of horn soundings would not have been clearly audible at the decision point. This indicates that the pedestrian probably did not hear the train's warning horn when making the decision to enter the crossing.

75 Witness evidence was also gathered from two people who were positioned 125 metres from the crossing on land adjacent to the railway, between the crossing and the whistle board, at the time of the accident. They reported that they did not hear the sound from the train at the whistle board but did hear the subsequent series of short blasts from the train's horn when it was closer to the crossing.

[9] The criterion provided will give an approximate indication of audibility for people without hearing loss or with only a mild hearing loss. The criterion does not give an indication of audibility for people with moderate, severe or profound hearing loss, (as defined by the British Society of Audiology), see paragraph 73.

Pedestrian's actions having entered the crossing

76 After entering the crossing, and then becoming aware of the immediately approaching train, the pedestrian continued to cross.

77 The pedestrian began to cross the railway from the north (Up Westbury line side) to the south (Down Westbury line). After sighting the pedestrian, the train driver began to repeatedly sound a series of short blasts of the train horn from around 4.5 seconds and approximately 190 metres before the crossing and continued to do so until reaching it. The train driver used both low and high tones with the train automatically in the soft setting (paragraph 38).

78 Issue 20 of Rule Book module TW1 (dated September 2024, current at the time of the accident) required train drivers to give a '*long blast*' as an urgent warning of immediate danger. Previous versions of module TW1, including issue 19 dated September 2023, required drivers to give a series of short blasts when giving an urgent warning. Witness evidence and OTDR data indicate that the train driver used this earlier pattern of short horn warnings. RAIB has found no evidence that the difference in horn patterns used had any influence in the outcome of the accident.

79 FFCCTV images show that the pedestrian continued to walk at a steady pace from the north side of the crossing until they reached a position on the Up Westbury line level with the rail closest to the adjacent Down Westbury line on which the train was approaching. They got to this point around 2 seconds before the train reached the crossing. At this moment, the pedestrian's posture changed and they appeared to increase their pace, having almost certainly become aware of the approaching train. The pedestrian continued to cross and reached a position next to the furthest rail on the Down Westbury line around 0.5 seconds before the train arrived at the crossing. The pedestrian was struck by the train as they were adjacent to this rail, or slightly beyond it.

80 FFCCTV images, supported by witness evidence, show the pedestrian likely had between 2 and 4 seconds between first appearing to realise that a train was approaching and the train reaching the crossing. It is not possible to say why the pedestrian continued to cross into the path of the approaching train. However, previous accident reports and academic research[10] show that having a limited time to assess a developing situation may have resulted in the pedestrian being unable to decide whether it was safer to continue to cross, to remain stationary or attempt to move back the way they had come.

81 Rail Industry Standard RIS-0793-CCS, 'Level Crossing Systems', issue 1 dated December 2024, emphasises the importance of providing a warning of an approaching train before users enter the crossing. The standard notes that risk increases if the available warning time is less than the time needed to traverse the crossing. Research[9] shows that preparing to move ones body involves a high level of cognitive processing, and that the direction of movement influences how actions are planned and carried out.

[10] Berchicci M and others, 'Stepping forward, stepping backward: a movement-related cortical potential study unveils distinctive brain activities', Behavioural Brain Research, volume 388 (April 2020).

82 Research[11] into human behaviour also shows that decision-making under time pressure is influenced by a range of factors. These include an individual's rapid perception of threat and the need to quickly plan and execute an action. In such circumstances, stress, urgency, emotional state, motivation, expectation and prior experience can all affect how an individual will interpret the situation and decide on the actions they take.

83 Research[9] also shows the act of stepping backwards requires greater conscious and rational decision-making to change course, whereas stepping forwards is more closely linked to automatic and goal-directed action. Research also shows that, where an individual is already moving towards a perceived place of safety, such as clearing a crossing, continuing to move forwards requires less cognitive effort than stopping or reversing direction, particularly under time pressure. In this case, it is possible that the pedestrian's decision-making was based upon their pre-determined direction of travel and having a clear and visible place of safety directly in front of them.

Closure of Hollybush Lane side bridge

84 An alternative route across the railway, normally used by the pedestrian, had been temporarily closed by Network Rail.

85 Witness evidence shows that before September 2024, when walking north of the railway, the pedestrian normally used a route via Hollybush Lane, which passes under the railway. To access Hollybush Lane from the pedestrian's home, they would walk along the footpath that ran parallel to the railway and use Hollybush Lane side bridge (paragraph 6).

86 In September 2024, Network Rail closed Hollybush Lane side bridge after a structural examination showed significant decay of its timber structure. The closure of the bridge prevented access from the footpath to Hollybush Lane and significantly increased the use of Pewsey crossing, including by the pedestrian involved in the accident (paragraph 17). The closure of Hollybush Lane side bridge and its effect on safety risk at Pewsey crossing is discussed in paragraph 170.

Identification of underlying factors

87 The following underlying factors are also relevant to the causation of the accident:

a. Network Rail's control framework for footpath crossings fitted with whistle boards did not sufficiently control the risks associated with their use. This is a probable underlying factor (paragraph 89).

[11] Research indicates that people can have difficulty accurately judging the speed of an approaching train, particularly when the train is some distance away, and that this difficulty has been associated with collisions at railway crossings (Meeker F and others, 'Human factors in railroad grade crossing accidents', Transportation Research Record (1997); Mok S and Savage I, 'Why has safety improved at rail-highway grade crossings?', Risk Analysis (2005); Savage I, 'Does public education improve rail-highway crossing safety?', Accident Analysis & Prevention (2006)). Research also indicates that an illusory size–speed bias can cause large objects, such as trains, to be perceived as moving more slowly than smaller objects, even when they are travelling at the same speed (Leibowitz H, 'The role of size and distance in the perception of speed', Perception & Psychophysics (1985)).

b. Network Rail's processes did not effectively mitigate the risks at footpath crossings fitted with whistle boards to users with hearing loss or who are deaf (paragraph 133).

c. Network Rail's risk management and assurance processes for footpath crossings with whistle boards did not effectively manage the risk to the public at Pewsey (paragraph 150).

88 Before examining the risk assessment undertaken at Pewsey, RAIB first considered the effectiveness of Network Rail's control framework and its processes for mitigating risks to users with hearing loss or who are deaf. These two factors, controlled nationally by Network Rail's Technical Authority, framed the local risk management approach by staff in the Wales and Western region. Each of these underlying factors is considered in turn below.

Network Rail's control framework

89 Network Rail's control framework for footpath crossings fitted with whistle boards did not sufficiently control the risks associated with their use. This is a probable underlying factor.

90 A number of railway and Network Rail standards and guidance documents define how Network Rail staff should control risk at footpath crossings fitted with whistle boards.

Background

91 The mainline railway in Great Britain is subject to legal requirements, and a number of different types of standards. These include:

- National Technical Specification Notices set by the Department for Transport for new or upgraded rail infrastructure, rolling stock, and components
- Railway Group Standards and Rail Industry Standards, which are set and maintained by the Railway Safety and Standards Board (RSSB), which provide standards, operating rules, and guidance for use across the rail industry
- internal company standards and guidance, such as those set and maintained by Network Rail.

Network Rail's overarching approach to standard and control management

92 Network Rail standard NR/L2/CSG/STP001 Module 01, 'Principles of standard and control management', issue 9 dated March 2022, outlines how Network Rail's standards and control documents fit within a wider requirements framework including regulatory and domestic legislation and standards. The standard also outlines how safety risk is controlled by documenting requirements and guidance using an approved methodology and hierarchy.

93 STP001/01 defines the types of standards and control documents within a hierarchy (figure 11):

- Level 1: Overarching objectives, goals, strategies and policy requirements.
- Level 2: 'What' is to be done or 'what' criteria designs and products have to meet.
- Level 3: 'How' tasks are to be carried out (including work instructions).

- Other documents: A range of other documents that support level 1, 2 and 3 standards and control documents (including guidance documents).

94 STP001/01 states that *'all requirements and guidance in standards and control documents shall be classified using red, amber, or green indicators'*. These have the following meanings:

- A red requirement is to be complied with/achieved. They are monitored for compliance.
- An amber requirement is required to be complied with/achieved unless an approved variation is in place. They are also monitored for compliance.
- Green guidance should be followed unless an alternative solution produces a better result. Guidance is not monitored for compliance, but alternative solutions should be documented to demonstrate effective control.

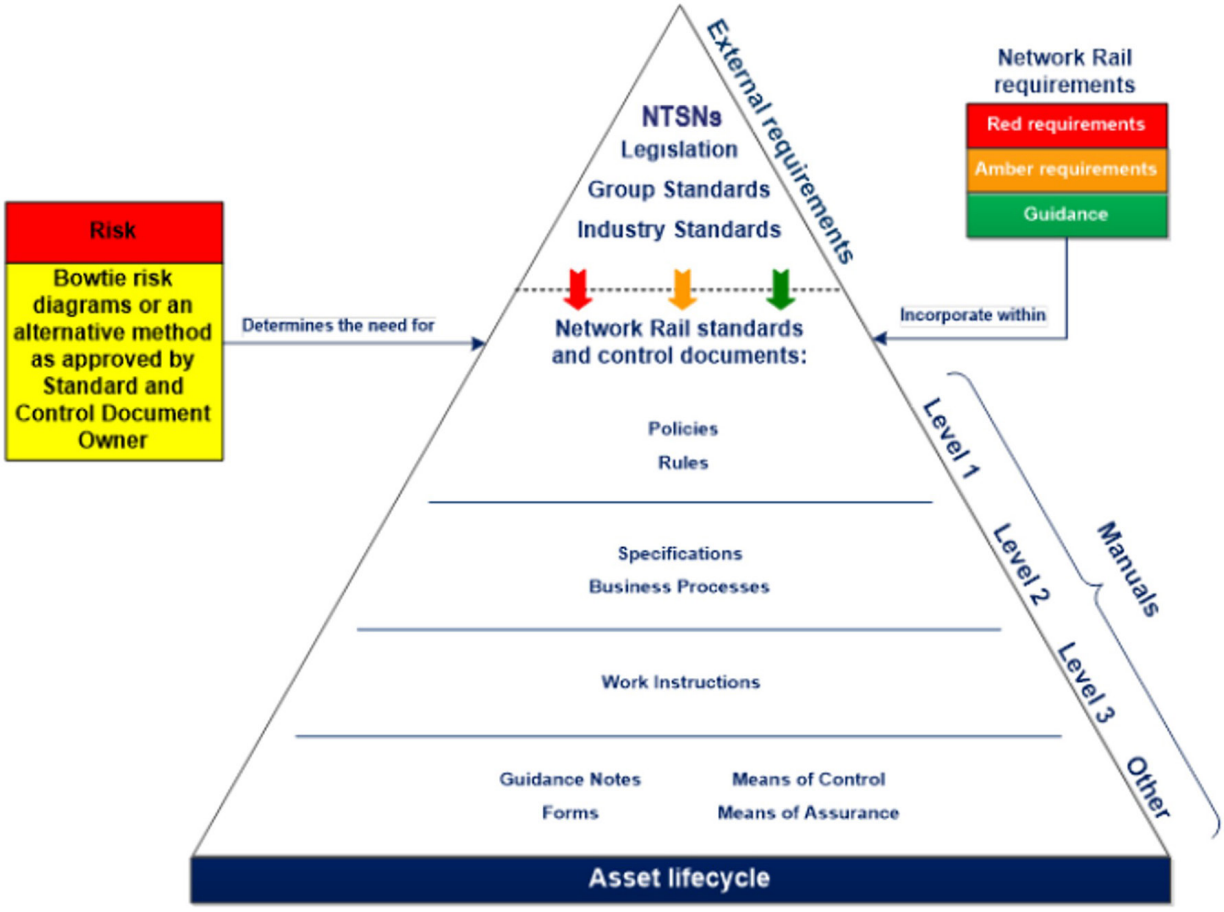

Figure 11: Network Rail's hierarchy of standards and control documents.

Railway standards related to footpath crossings fitted with whistle boards

95 RIS-0793-CCS sets out requirements for level crossing systems to mitigate the risk of collision of a train and a level crossing user. It states that *'The train horn shall be audible at each decision point and throughout the level crossing area'* and that it is '*good practice*' to locate whistle board signage not further than 400 metres from the level crossing, else it may not be audible throughout the crossing.

96 RIS-0793-CCS is designed to be read alongside ORR guidance document 'Principles for managing level crossing safety', dated June 2021, which is intended to inform the assessment and control of risks at all types of level crossings. It sets out principles for identifying and controlling risks and a list of factors to consider to ccompany each principle. Principles of relevance to this accident include:

'User Principle 1: Understand all foreseeable level crossing users. To help you achieve this outcome, you should consider, at least, these factors:

(a) use a variety of quantitative and qualitative methods to gather evidence in order to get a good understanding of who uses the level crossing, how they use it and the frequency and pattern of use …

(b) nearby local facilities, e.g. stations, schools, care homes, national leisure routes, seasonal attractions or event venues and their foreseeable users e.g. people with luggage, children and elderly people;

(c) users with protected characteristics under the Equality Act 2010. You should ensure the specific risks these users encounter are identified and have due regard to eliminating or reducing these risks to promote equality of opportunity for these users;

(d) users with particular characteristics that impact on their safe use of the level crossing, e.g. dog-walkers, users crossing in groups, horse-riders, cyclists, motorcyclists; …

User Principle 6: Provide a suitable warning for users that a train is approaching to enable them to be in a safe place before a train passes. To help you achieve this, you should consider, at least, these factors:

(a) an active warning system in preference to relying on the user to determine whether or not a train is approaching the level crossing;

(b) user behaviours and actions in relation to the operation of the level crossing, e.g. to prevent them from being trapped within a closed crossing or starting to cross when it is unsafe to do so'.

Network Rail's control framework for footpath crossings fitted with whistle boards

97 Under health and safety law, railway companies such as Network Rail are required to reduce risk *'so far as is reasonably practicable'*. Options for controlling the risk should be considered according to the hierarchy of prevention given in schedule 1 of the Management of Health and Safety at Work Regulations 1999. This requires that eliminating the risk (such as through closure of the level crossing) should be the first consideration, followed by engineering controls (for instance, technologies providing an active warning system), and finally administrative controls (such as signage and instructions).

98 Network Rail's process for managing risk at level crossings begins with an assessment by an LCM of the crossing. This includes measuring sighting distances and the traverse length and conducting a census of both users and trains over the crossing. The results of this assessment are entered into Network Rail's computer based All Level Crossing Risk Model (ALCRM), which calculates a quantitative risk score for the crossing.

99 The LCM uses the information from the site visit and the output from ALCRM to produce a written narrative risk assessment (NRA). The NRA documents their findings and explores options to better mitigate the risk. If the risks are deemed not to be as low as reasonably practicable, mitigations options are recommended and assessed for implementation. The quantitative risk score from ALCRM is used to calculate a cost-benefit ratio for each of the proposed risk mitigations. The cost-benefit ratio is a calculation of how much each proposed measure costs and by how much it is expected to reduce the risk, based on the measure's whole-life.

100 The LCM then uses their experience and professional judgement to supplement this calculation and determine whether the options are reasonably practicable to implement, considering qualitative factors associated with risk at the crossing as well as the results of any cost-benefit analysis. The LCM submits the NRA and their risk mitigation option proposals for review to the RCLM who reviews and (as appropriate) countersigns them.

101 Network Rail standard NR/L3/XNG/003, 'Level Crossing Risk Assessment Handbook', issue 1 dated June 2024, is a manual that aims to set out the requirements and process for LCMs to complete a risk assessment of level crossings. An appendix to the standard references 24 LCGs. The text before the table is presented with a dotted green sidebar, denoting the text is to be treated as guidance and states: '*As appropriate, the principles of the level crossing guidance documents shown below should be incorporated within the core level crossing risk assessment process.*'

102 Although presented as guidance in NR/L3/XNG/003, Network Rail's Technical Authority stated to RAIB that LCGs are effectively codes of practice that should be treated as mandatory guidance. Level crossing staff should ensure crossings conform to the guidance unless they can demonstrate that a better or equal solution can be found. In these instances, professional judgement and tolerance (within defined parameters within the broader bounds of the guidance) can be applied provided staff ensure their decisions are evidence-based and documented.

103 LCG05 'Whistle board effectiveness and provision', issue 1 dated October 2013, provides Network Rail staff involved with the risk assessment of footpath crossings with guidance on determining the effectiveness of whistle boards and deciding on their position. It notes that, while whistle boards can provide mitigation for insufficient sighting at level crossings, they are not able to eliminate the risk resulting from insufficient sighting. The guidance states that the effectiveness of whistle boards is limited by factors which should be considered when determining whether they provide an appropriate risk control. These limiting factors include:

- ambient environmental noise
- physical features, including cuttings and line curvature
- train usage, including high numbers of trains or high line speeds
- the use of the crossing by people with hearing loss or who are deaf.

104 LCG05 also states that footpath crossings fitted with whistle boards should conform to the characteristics specified in ORR's Railway Safety Publication 7 (RSP7) 'Level crossings: a guide for managers, designers and operators', December 2011, even though this was superseded by the publication of the 2021 guidance.

105 LCG05 summarises ORR's 2011 guidance as follows:

- *'Whistle boards should only be used on lines with infrequent train services and low line speeds. They should not be positioned further than 400m from the level crossing.* …
- *'The time between a user first hearing a horn and the arrival of the train at the level crossing should be the same for trains travelling in either direction*.'

106 Neither ORR's 2011 guidance nor Network Rail's LCG05 defines what is meant by '*infrequent train services*' or '*low line speeds*' in the context of using whistle boards at footpath crossings. Network Rail's standard NR/L2/XNG/001, issue 3 dated 5 December 2020, reports that footpath crossings should not be provided where the permissible train speed exceeds 125 mph (201 km/h), and that active visible and audible warnings are required where direct observation of trains does not provide sufficient warning time or where the permissible train speed exceeds 100 mph (161 km/h).

107 LCG05 has not been updated by Network Rail to reflect the requirements of RIS-0793-CCS or ORR's 2021 guidance. Network Rail's Technical Authority stated that it considers ORR's 2021 guidance to be less prescriptive than RSP7, which it continues to regard as the benchmark that defines the criteria that it aims to achieve (with equal or better outcomes). It also stated that its recent focus has been on continuous safety improvement initiatives and other priorities.

108 LCG22 (paragraph 50) provides staff with a process to assess train horn audibility at passive level crossings fitted with whistle boards. The guidance reports that it is desirable that information is obtained from engagement with local users and railway staff to provide supplementary information and to help identify whether additional mitigations were needed.

109 The guidance also instructs level crossing staff to stand at the crossing's decision point and listen to a sample of warnings given by 'typical' passenger and freight trains operating in both directions under normal conditions. This assessment should be undertaken in typical weather, including low wind and no heavy rain. Staff are then required to categorise each warning as either 'audible' or 'not audible'. If none of the sampled warnings could be heard, LCG22 states that this observation should be recorded in the risk assessment and that interim mitigations, such as temporary speed restrictions, should be considered. If all sampled warnings were audible, the assessment is regarded as complete, and the outcome must be recorded in the narrative risk assessment document.

110 Where a mixture of audible and non-audible warning horns is noted, LCG22 requires a further assessment using sound equipment to measure background noise. Staff undertaking the assessment were instructed to obtain measurements of the ambient sounds and compare them to the sound levels predicted, based on train speed, distance between the whistle board and the crossing, and the characteristics of railway infrastructure near the crossing (figure 12). If the difference between the predicted train horn sound and the measured ambient sound was more than or equal to 16 dB(A) then the warning was predicted to be audible at the crossing. A measurement of less than or equal to 15 dB(A) was predicted not to be audible.

Risk assessment of Pewsey crossing

111 In October 2021, the LCM visited Pewsey crossing to assess train horn audibility in accordance with LCG22. Of the 10 trains passing the location, 4 were GWR operated AT300 platform Hitachi trains approaching on the down line. A prior assessment of horn audibility at Pewsey crossing had also been undertaken in 2013 following a fatal accident at Mexico footpath crossing, in Cornwall, October 2011 (see paragraph 203). Both assessments found all train horn warnings to be audible in both the up and down directions.

Whistle board distance (m)	Predicted sound pressure level (dBA)				
	Scenario 1 straight track	Scenario 2 curved track	Scenario 3 cutting	Scenario 4 embankment	Scenario 5 road bridge
50	81	75	81	81	81
100	74	69	74	74	75
150	71	65	71	71	71
200	68	61	68	68	68
250	66	58	66	66	66
300	64	56	64	64	64
350	62	54	62	62	62
400	60	52	60	60	61

Figure 12: Predicted horn sound levels in rural cases where train speed is less than or equal to 100 mph from LCG22.

112 The LCM undertook risk assessments for Pewsey crossing in January 2022 and April 2024. The timing of these assessments was consistent with Network Rail's standards for risk assessment (paragraph 101) which required crossings with similar risk and characteristics to Pewsey to be assessed at an interval of 2.25 years. Both risk assessments included consideration of the effectiveness of the whistle boards fitted at the crossing. The template used for Network Rail's NRAs included guidance under the category of '*Pedestrian and train collision risk'*, with the associated hazard *'ineffective whistle boards; warning inaudible, insufficient warning time provided, known high usage between 23:00 and 07:00.'*

113 Witness and documentary evidence shows that during both assessments the LCM considered whether pedestrians were provided with sufficient warning time to traverse the crossing safely and whether the warning horns sounded by trains at the whistle boards fitted at the crossing were audible. The LCM also noted on the risk assessment document that LCG documents were used as references to ensure '*best practice*' and '*standard adherence*'.

114 The LCM recorded the different categories of users at Pewsey crossing in a template table used within Western route. While Western route table included categories for some types of vulnerable users (as defined LCG02) such as dog walkers or people crossing while using headphones, the table did not include categories for users with hearing loss and other types of disabled users.

115 The CCTV census did not identify any users with hearing loss at Pewsey crossing. However, determining if a person has hearing loss would not be typically identifiable through a review of CCTV footage, as it cannot be reliably inferred from a person's appearance or behaviour. In contrast, mobility impairments and use of mobility aids are generally apparent in CCTV observations.

116 The 2024 risk assessment also noted that the LCM had engaged with multiple members of the public during and after the assessment, with no concerns being reported. It also noted that the LCM had held regular engagement days at the crossing. RAIB found evidence of only one such engagement day between the 2022 and 2024 risk assessments, undertaken in August 2023, and no information from this was included in the census section of the 2024 risk assessment.

117 The completed NRA concluded that the crossing was compliant with Network Rail standards and that the '*crossing is as safe as practicable at this time*'. The risk assessment also concluded that the crossing met Network Rail standards, and the RLCM stated that the crossing had met the red and amber requirements (paragraph 94) of Network Rail standards. The quantitative risk score provided by ALCRM for the crossing was used to inform a cost-benefit analysis for further engineered controls at the crossing, but analysis had shown that the safety benefit of providing these controls was grossly disproportionate to the costs (this is discussed further at paragraph 155).

118 The assessment was then sent for review by the RLCM who believed that the conclusion in the assessment meant the level of safety risk at the crossing had been reduced '*so far as is reasonably practicable*'. The RLCM stated that this was supported by the assessment's optioneering and cost-benefit analysis, which indicated that none of the mitigation options considered was proportionate. The RLCM also believed Pewsey crossing was compliant with standards because the risk assessment had confirmed the warnings provided by trains at the whistle boards were audible and the warning time provided was greater than the time allowance for pedestrians to safely traverse the crossing. The RLCM stated that Network Rail only needed to mitigate the risk to people with hearing loss if they were known to use the crossing (which they had not been at Pewsey).

119 Despite the outcome of the cost-benefit analysis, the April 2024 risk assessment was reviewed again by the RLCM in October 2024 and the crossing was selected for a technical feasibility review for the potential installation of miniature stop lights (MSLs, see paragraph 152) due to be installed before April 2029. The RLCM stated that, while Pewsey crossing was not a particularly unusual crossing on Western route, the combination of the line speed and reliance on whistle boards had led their team to pay closer attention to the site, in conjunction with Network Rail's national strategy to replace whistle boards at footpath crossings.

120 Western route's level crossing team reported that their attempts to introduce engineered controls at the crossing provided evidence that the route had attempted to go beyond Network Rail's legal duties and align to what they considered to be 'best-practice' guidance shown in LCG05.

Acceptable characteristics of footpath crossings fitted with whistle boards

121 Witness evidence shows neither the LCM nor the RLCM considered relocating the Down Westbury line whistle board, which was 580 metres from the crossing, to improve the audibility of horn warning. Witness evidence shows a relocation would only be considered if there was an issue identified, for example with audibility at the crossing, or with train driver visibility (sighting) of the whistle board itself. Neither issue was found during the assessments. The LCM also stated that, on a previous occasion, enquiries they made about relocating a whistle board at another crossing had been rejected because of the associated time and cost implications.

122 Network Rail provided documentary evidence from 1989 which recorded that the Down Westbury line whistle board had been positioned at this location because of signal sighting considerations. However, current Network Rail signal sighting specialists could find no immediate reason as to why the whistle board could not be moved closer to the crossing. The RLCM accepted that the whistle board could technically be moved closer to the crossing as the calculated traverse time (7.8 seconds) was shorter than the warning time provided by the whistle board (11.2 seconds). However, the safety benefit of improved audibility of the warning horn would have needed to be balanced against introducing risks to pedestrians who were familiar with the crossing and accustomed to the existing amount of warning time.

123 Documentary and witness evidence shows that the LCM and RLCM gave no formal consideration to comparing Pewsey crossing to the characteristics defined in LCG05. Such a review may have identified that Pewsey crossing lay significantly outside the guidance in LCG05 and that whistle boards were therefore likely to be less effective at this location (table 1).

Characteristics that whistle boards should conform to as outlined in LCG05	**Conditions at Pewsey crossing**
Low line speeds	100 mph
Infrequent train service	153 trains per day
400 metres from the level crossing	585 metres (on down line)
Equal warning times for approaching trains	Significant variation in warning times between trains travelling in up and down direction due to services stopping at Pewsey station.

Table 1: Characteristics outlined in LCG05 considered against the conditions at Pewsey crossing.

124 The RLCM's conclusion that whistle boards were an effective risk control at Pewsey crossing was based, in part, on the audibility assessment that was conducted by the LCM in 2021 in accordance with LCG22 (paragraph 108), which was Network Rail's primary approach to assessing audibility. The LCM's 2021 audibility assessment at Pewsey crossing found that all sampled train warnings were audible and, in accordance with LCG22, there was therefore no requirement to measure background noise or calculate predicted sound levels.

125 While the 2021 audibility assessment was conducted in accordance with LCG22, RAIB's analysis of the audibility of trains at Pewsey crossing highlighted some important areas where LCG22 may result in an assessor overestimating audibility including:

- An assessment of audibility by an individual is dependent on their hearing ability and other cognitive factors. Individuals may be able to hear sound levels very close to background sound (masked threshold) when expecting to hear the sound. This means they may hear warning horns even where the difference against background noise is less than 15 dB.
- Guidance for staff assessing audibility is to listen for trains at the decision point; however, research has shown most pedestrians will listen for a train while approaching the decision point which may affect the sound levels observed or recorded.
- The criteria applied to determine whether a warning is 'clearly audible' does not account for people with moderate hearing loss (this is considered further at paragraph 133).

126 While there was no requirement to measure background noise or to calculate predictive sound levels, had these been considered the following issues would have been relevant:

- The predictive sound tables outlined in LCG22 broadly assume an attenuation of 6-8 dB per doubling of distance. However, RSSB research project T1205 showed that attenuation in a railway environment is much higher at around 10-13 dB per doubling of distance. This finding is supported by RAIB's testing at Pewsey crossing. Consequently, LCG22 overestimates the predicted sound levels of trains on approach to crossings.
- The predictive sound table considers how a single feature of railway infrastructure could affect the attenuation. However, at Pewsey crossing multiple features were present between the whistle board and the crossing (a curved track, topography (cutting) and a bridge). LCG22 provides no guidance on how to consider such multiple characteristics.
- LCG22 only predicts sound levels within 400 metres. Crossings with whistle boards beyond 400 metres are not considered, even though these types of crossing are more likely to have reduced sound levels.

127 RAIB's testing and analysis (paragraph 67) showed that a significant proportion of horn warnings sounded at the down line whistle board were not clearly audible to pedestrians at Pewsey crossing. This indicated that, despite the audibility assessment undertaken in accordance with LCG22, the whistle board arrangements did not result in a consistently effective audible warning for pedestrians generally. The separate issue of Network Rail's processes for managing risks to users with hearing loss at footpath crossings fitted with whistle boards is discussed at paragraph 133.

128 While not directly relevant to the accident, the risk and audibility assessment conducted at Pewsey did not identify the presence of military helicopter overflights which were observed during RAIB's testing and visits to the crossing. These overflights were shown to greatly increase background noise levels and were occasionally matching or exceeding the sound levels provided by train horn warnings at the crossing.

Risk management at other footpath crossings fitted with whistle boards

129 Network Rail provided RAIB with analysis of its crossings fitted with whistle boards which compared their characteristics with some of the criteria set out in LCG05. In addition to footpath crossings, this analysis also included different crossing types including station barrow, station passenger, and bridleway crossings. Network Rail identified that 376 of its crossings fitted with whistle boards had insufficient sighting. Network Rail was asked to consider line speed and distance between the whistle board and the crossing. For this analysis, Network Rail has assumed the highest line speed at the crossing (which may not reflect any speed restrictions applied) and, where two whistle boards are provided, has considered the whistle board furthest away from the crossing.

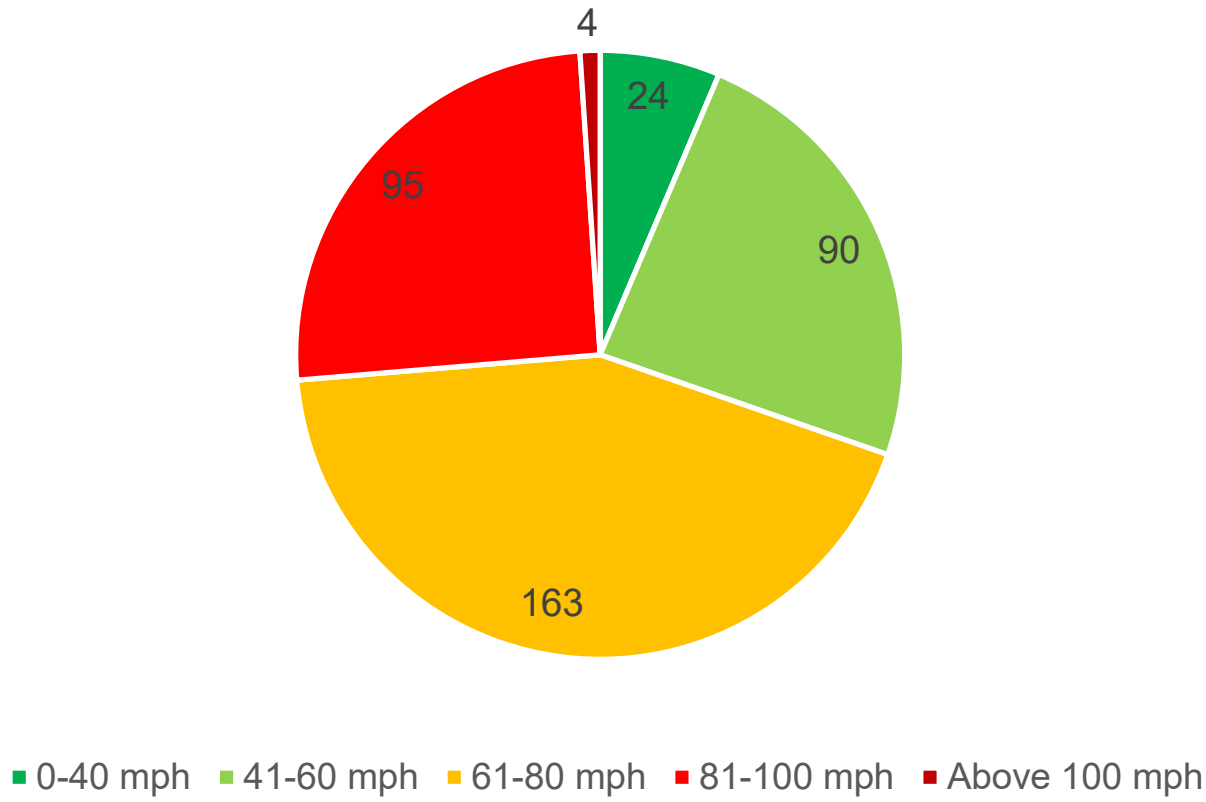

Figure 13: Line speeds at crossings fitted with whistle boards with insufficient sighting.

130 Network Rail's analysis (figure 13) shows that around 70% (262) of the crossings analysed have maximum line speeds greater than 60 mph (97 km/h). LCG05 states that whistle boards should only be used on crossings at locations with low line speeds; the guidance does not define this term (paragraph 106).

131 LCG05 also states that whistle boards should not be positioned further than 400 metres from a level crossing. Network Rail's Technical Authority reported that they generally apply a 10% tolerance (440 metres) to this to allow a pragmatic buffer for real-world constraints, including local noise conditions, sighting and structural limitations, and the practical cost and disruption of relocating infrastructure. Network Rail's analysis (figure 14) shows that 376 crossings fitted with whistle boards with insufficient sighting, and around 7% (25 crossings) had whistle boards that were outside this 440 metre limit. Of these crossings 44% (11 crossings) were in Network Rail's Western route.

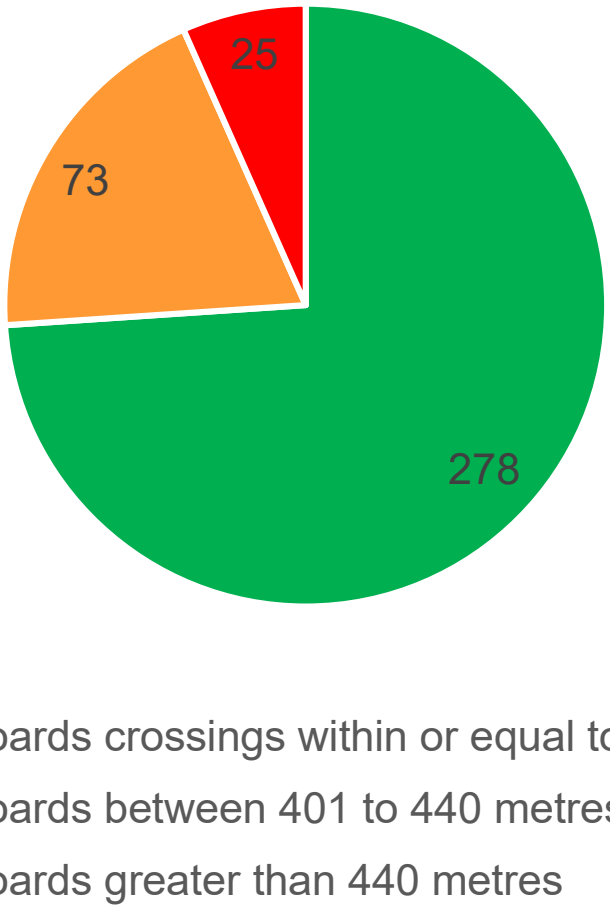

Figure 14: Distance between crossings and whistle boards.

132 RAIB did not ask Network Rail to assess other characteristics referred to in LCG05, such as train service frequency or the consistency of warning time from whistle boards. The factors influencing these characteristics are widespread across the UK mainline network. Many crossings are located on routes with frequent train services. Additionally, sites near stations, speed-restriction changes and mixed passenger and freight operations routinely produce inconsistent warning times at a given whistle board and between boards in opposite directions.

Risk to users with hearing loss

133 Network Rail's processes did not effectively mitigate the risks at footpath crossings fitted with whistle boards to users with hearing loss or who are deaf.

134 The Royal National Institute for Deaf People (RNID, a UK charity) reported that over 18 million people in the UK are deaf, have hearing loss or tinnitus (the perception of hearing noises that do not originate from an external source). An estimated 2.4 million adults in the UK have hearing loss severe enough that they would not be able to hear most conversational speech.

Safety and equality (accessibility) considerations

135 Organisations such as Network Rail have legal duties to control safety risks *'so far as is reasonably practicable'* (paragraph 97). To achieve this, they must demonstrate that the cost (financial or otherwise) of implementing a further safety measure is '*grossly disproportionate*' to the safety benefits it affords. This can be determined by using a cost-benefit analysis as part of the risk management process. Following consideration of their legal duties, organisations may also consider other factors including business reputation and corporate social responsibilities, which may result in the implementation of measures that go beyond their legal duties.

136 These duties exist regardless of whether those exposed to risk have a disability. Under the Equality Act 2010, a disability is a protected characteristic defined as a physical or mental impairment that has a '*substantial*' and '*long-term*' negative effect on a person's ability to do normal daily activities.

137 Cost-benefit analysis is often based on the aggregated risk to all users. While this provides an overview of harm across the general population, it can mask elevated risks experienced by specific groups. Where disabled people (classified by Network Rail as vulnerable users), form part of the foreseeable user group, their risk is likely to be higher than that of the general population. In such circumstances, assessments of reasonable practicability should take account of this increased exposure.

138 Under the Equality Act 2010, organisations providing services or exercising public functions, are required to make '*reasonable adjustments*' for disabled people where a physical feature puts disabled people at a '*substantial disadvantage*' compared with people who are not disabled. Organisations should aim to provide access as close as it is reasonably possible to get to the standard normally offered to the general population. When considering what adjustments are '*reasonable*', organisations are expected to consider the nature and extent of the substantial disadvantage experienced by disabled people, including impacts on their independence and dignity, alongside relevant considerations such as how achievable the adjustment is in practice and the costs involved.

139 ORR's 2021 guidance (paragraph 96) highlights the importance of understanding the nature of crossing users when identifying hazards. It states concerning users with protected characteristics under the Equality Act 2010: you *'should ensure the specific risks these users encounter are identified and have due regard to eliminating or reducing these risks to promote equality of opportunity for these users'*.

140 ORR reported that this clause is intended to instruct those carrying out a risk assessment to consider the safety risk associated with disabled users of crossings, along with other users with protected characteristics, and to take steps to manage those risks.

Network Rail's processes for managing the risks to crossing users with hearing loss

141 The audible warning provided at footpath crossings fitted with whistle boards is reliant on crossing users' ability to detect and interpret the warning to decide whether to enter and use the crossing. For users with hearing loss, or who are deaf, reliance on a warning of this type generally places them at a higher level of risk than users without such impairment.

142 Disabled people are classified by Network Rail as '*vulnerable users*' of level crossings (paragraph 114). LCG02 'Census good practice', issue 3 dated July 2017, provides guidance on identifying vulnerable users. The guidance identifies hearing loss as one of the factors that can result in people being at greater risk when using crossings.

143 LCG02 provides guidance on how to identify vulnerable users at crossings. This includes the use of a CCTV census, review of information from supplementary sources, and engagement with people who live or work in the vicinity of the crossing. The guidance notes that assessors should not rely solely on the CCTV census, because patterns of use by vulnerable or irregular users may fall outside the observation window. It also sets out engagement activity and supplementary information sources, such as rights-of-way mapping, local authority information, social media posts and online community activity, that can provide indications of the different types of user groups. LCG02 further notes that the location and type of crossing will also influence the likelihood of usage by vulnerable users.

144 Local authority census data for Pewsey shows that 28.5% of the local population were aged 65 or older, which is around 50% higher than the national average of 18.6%. RNID states that the percentage of the population with hearing loss increases with age, with over half the population aged 55 and over having partial hearing loss and over 80% of people over the age of 70 having greater hearing loss. This indicates that there could be a comparatively high prevalence of hearing loss among the local population and suggests that the presence of users with hearing loss at crossings such as Pewsey is reasonably foreseeable.

145 LCG05 recognises that train horn warnings sounded at whistle boards may not provide an effective risk control where users with hearing loss, or who are deaf, are present at crossings. However, it provides no guidance on how the presence, or reasonably foreseeable presence, of such users should be identified or how the resulting risk should be assessed or mitigated at these types of crossing.

146 Further guidance on identifying vulnerability is included in the online level crossing risk management toolkit (LXRMTK). This was first introduced by RSSB in 2006 and is intended to outline risks associated with level crossings and to provide guidance on appropriate risk reduction measures. This toolkit, for which Network Rail is now responsible, includes a '*risk influencing factor*' (something that increases the probability of a specific risk occurring or having a negative impact) titled '*disabilities*'. This states that disabilities will influence the behaviour of users at crossings and that users with hearing loss might be unable to hear crossing alarms, train whistles (meaning the train's warning horn), warnings from people or the sound of approaching trains.

147 The toolkit provides 26 potential mitigation measures to help improve the safety of disabled people at footpath crossings. The suggested mitigation measures do not identify which measures would specifically improve the risk for people with hearing loss, but the mitigations identified include repositioning of whistle boards and the installation of equipment to generate audible warnings at the crossing itself.

148 While initial training on the toolkit was provided to LCMs, the toolkit has not been updated since May 2015. Witness evidence is that the LCM did not refer to this toolkit during the 2022 and 2024 risk assessments of Pewsey crossing and that most LCMs reportedly rarely use it.

149 Although Network Rail guidance recognises that train horn warnings at whistle boards may be ineffective for users with hearing loss, its processes require the positive identification of vulnerable users, principally through census activity including review of CCTV, before additional mitigation measures are considered. A person with hearing loss, or who is deaf, is unlikely to be apparent through CCTV observation alone, and demographic data strongly indicates that the use of the crossing by such users was reasonably foreseeable at Pewsey. However, no users with hearing loss were identified during the census activity and, consequently, no consideration was given to managing the risks associated with their use of the crossing.

The risk assessment of the crossing

150 Network Rail's risk management and assurance processes for footpath crossings with whistle boards did not effectively manage the risk to the public at Pewsey.

151 As part of the 2024 risk assessment, the LCM considered a range of options to reduce the risk at the crossing. These options included the installation of MSLs and the provision of new crossing gates. The LCM also considered options to close the level crossing, through diversion of the public right of way and provision of alternative means of crossing the railway via a footbridge or underpass.

Consideration of miniature stop lights

152 MSLs consist of red and green lights. The green light indicates that no trains are approaching. When an approaching train reaches the strike-in point, the light automatically changes to red, and an audible alarm sounds to indicate that users must not cross. The strike-in point is set at a distance calculated to allow users a safe amount of time to cross.

153 Typically, an MSL's strike-in point is determined by calculating the required safe amount of time to cross when trains are travelling at the maximum speed permitted on the line. However, at level crossings with features that would require a train to stop (such as a station) this becomes more complex. There are different types of MSL system, each of which is appropriate for different crossing configurations. 'Integrated MSLs' are the original design of MSL and are built into the railway signalling system. Network Rail staff have advised this type of MSL could not be installed at Pewsey crossing due to the configuration of the signalling system at this location and hence was not considered in the 2022 or 2024 risk assessments.

154 The 2022 risk assessment did consider the installation of Interfaced Overlay Miniature Stop Lights (IOMSLs, sometimes referred to as 'Flex' MSLs, the brand name of an approved type of equipment). These systems are separate from the railway signalling system and can receive inputs from an electronic signal on each approach to a crossing. IOMSLs were initially accepted for use by Network Rail in April 2021. However, while this variant could be positioned where there are signals within the strike-in area of a crossing, it was not suitable for installation at crossings near a station. In 2022, Network Rail started a trial (at Globe Inn crossing, on Network Rail's Western route) to introduce a variant of IOMSLs which would measure the speed of approaching trains and enable its use at crossings near stations.

155 The 2022 risk assessment of Pewsey considered the safety benefits and costs associated with fitting the speed-monitoring variant of IOMSLs. Following this assessment, the type of system was funded for installation at the crossing for installation by March 2024 with the assumption that this technology would be available for installation before this date. Witness evidence shows that the level crossing team intended to install this system following completion of the trials and approval of the use of the technology by Network Rail's Technical Authority. Documentary evidence shows that, in June 2023, Western route's level crossing team decided not to progress the installation of speed-monitoring IOMSLs due to resource pressures affecting the wider programme of level crossing improvements in Western route.

156 The 2024 risk assessment repeated the recommendation for the installation of the speed-monitoring variant of IOMSL and funding was approved for installation by April 2029. At the time of writing, the IOMSL (speed-measuring variant) is currently not authorised for general deployment, but Network Rail's Technical Authority has indicated they expect this to be achieved shortly.

157 The April 2024 risk assessment and cost-benefit analysis determined that there was a 0.10 ratio between the safety benefits of installing IOMSLs versus the cost of their installation. This meant that the cost of installing IOMSLs was ten times the cost of the potential safety benefit. To support safety decision-making, Network Rail also applies a gross disproportion factor to the output of the cost-benefit analysis. This scales up the benefits side of the cost-benfit analysis to account for local factors such as culpability, vulnerable users, potential for mass-casualty events and uncertainty about how the crossing is used. In the case of Pewsey, the gross disproportion factor was determined to be 2.5 and the revised cost-benefit analysis (gross disproportion factor included) was 0.25. This meant the cost of installing IOMSLs was calculated to be four times the cost of the potential safety benefit.

158 The RLCM stated that the cost-benefit analysis had shown the cost of installing IOMSLs at Pewsey crossing was "grossly disproportionate" to the risk and the installation was not needed for Network Rail to demonstrate it had met its legal duties to control risk (paragraph 97). Despite this, IOMSLs were approved for installation at Pewsey crossing in October 2024. The RLCM stated that this decision was made to better align with '*best practice*' guidance, including LCG05. The RLCM had also considered the higher line speed at the crossing and Network Rail's broader strategy to replace passive crossings (see paragraph 207).

159 Network Rail's ALCRM and cost-benefit analysis processes are dependent on the information provided by staff responsible for gathering data about the crossing and making judgements around its safe use. For the 2024 assessment at Pewsey, several inputs and assumptions that were relevant to the circumstances of the accident influenced the quantified risk. Evidence gathered during the RAIB investigation shows that some of these inputs did not reflect the actual conditions at the crossing and some judgements were not consistent with relevant Network Rail guidance. Examples of this include:

- Network Rail's 2024 risk assessment recorded that the whistle boards and associated train horn warnings were effective. Witness evidence shows that the formal evaluation of whistle board effectiveness was primarily based on confirming that an adequate warning time was available for pedestrians to traverse the crossing and that the warnings were audible. However, formal application of LCG05 may have shown that whistle boards were unlikely to provide an adequate mitigation at this location (paragraph 122).
- The sighting distance available for trains approaching in the down direction at the decision point on the north (Up Westbury line) side of the crossing had been recorded as 265 metres. RAIB measured the sighting distance at this location and found that sighting was partially obstructed at 170 metres due to the bridge parapet where the railway travels over the road at Hollybush Lane and that partially obstructed sighting ended at around 218 metres (figure 10). The sighting distance at this location had also been incorrectly inputted into ALCRM.
- The LCM had conducted a 9-day census and had recorded the average number of daily users per day as 24. However, a review of the supporting census table showed the average users had been miscalculated and the correct average was 35 users per day.

160 Usage of the crossing had also changed substantially between the April 2024 risk assessment and the accident in February 2025. This was because an alternative route across the railway had been closed in July 2024 (see paragraph 170). A further 9-day census starting 3 days after the accident showed that the usage of the crossing was an average of 71 users per day.

161 RAIB asked Network Rail to recalculate the risk levels at Pewsey crossing correcting these inconsistencies. This showed that each traverse of the crossing was calculated to be 80% higher risk than calculated in the 2024 risk assessment. Additionally, the overall risk was shown to be around four times higher than the risk previously calculated.

Consideration of Supplementary Audible Warning Device (SAWD) technology

162 Supplementary Audible Warning Device (SAWD) technology (also known under its brand name of 'Covtec') was developed to provide an automated audible warning at crossings. SAWD is a train-detection system that emits a warning sound intended to replicate a train horn at footpath and bridleway crossings when a train is approaching. The system operates as a standalone installation, with no physical connection to the rail infrastructure, and is powered by a solar charged battery, enabling continued operation during extended periods of adverse weather.

163 Network Rail's 2015 strategy 'Transforming Level Crossings 2015 – 2040, a vision-led long-term strategy to improve safety at level crossings on Great Britain's railways' (see paragraph 206) stated that crossings fitted with whistle boards with known use during the NTQP would be equipped with train detection warning systems (which would include SAWD technology). Witness evidence shows that the RLCM had not considered the application of SAWD technology at Pewsey crossing because there was no viable technical solution available for installation.

164 SAWDs were trialled in April 2014 and received full certification of acceptance in May 2015. However, in November 2016, special instructions were issued nationally that stated that no new SAWDs systems would be installed. This reflected Network Rail's intention to replace them with a more cost-effective MSL warning system known as 'project Meerkat'.

165 Further instructions, published in October 2020, prohibited the purchase of new SAWDs systems and permitted existing installations to remain in service until October 2025, when they were required to be withdrawn. However, in 2023, Network Rail decided to cease development of the Meerkat project after it encountered ongoing technical difficulties and increasing costs that prevented it from progressing to an operationally viable system.

166 The delay in delivering operational technical solutions should have prompted a review of Network Rail Technical Authority's approach and the continued suitability of guidance documents such as LCG05 and LCG22. This is particularly relevant given Network Rail's wider objective to significantly reduce the number of passive crossings and applying a risk-based approach to its management of safety these types of crossing.

Consideration of closure of crossing via alternative route

167 The 2024 risk assessment considered constructing either a footbridge or an underpass to enable closure of the level crossing while maintaining the public right of way. These options were rejected on the grounds of cost and the proximity of nearby housing. The risk assessment also considered the potential availability of other routes where pedestrians could cross the railway in the vicinity of the level crossing. Identification of a suitable alternative route would allow Network Rail to approach the local authority (Wiltshire Council) to seek closure of the public right of way across the railway, enabling Pewsey crossing to be closed.

168 The risk assessment noted an alternative route at Dursden Lane, a minor public road, that passes over the railway around 560 metres north-east from the crossing (figure 2). Dursden Lane was connected to the crossing to the south of the railway via a public footpath running adjacent to the railway and to the north via footpaths within an adjacent nature reserve. This option was considered via cost-benefit analysis and resulted in a 3.02 ratio (7.5 with the gross disproportionate factor applied). This meant the safety benefit of closing the crossing via the alternative route was between 3 to 7.5 times greater than the cost of doing so. However, this option was marked as '*discounted*' in the conclusions section of the assessment without any documented reasoning as to why this was the case.

169 Witness evidence shows that there had been no attempt to consider this option further or to contact Wiltshire Council. The RLCM also reported that applications to local authorities to close public rights of way at crossings is rarely straightforward and can 'be lengthy to progress', with potential statutory consultation and a public planning inquiry. In comparison, the RLCM believed installing MSLs at Pewsey would maintain the public right of way and had the benefit of previous agreement and funding.

170 The 2024 risk assessment did not consider an alternative route at Hollybush Lane, a minor road that passes under the railway approximately 170 metres north-east of the level crossing (paragraph 6). At this location, Hollybush Lane forms part of a recreational route promoted by Wiltshire Council and other public organisations for leisure use. Witness evidence indicates that, because Hollybush Lane is an established recreational route located close to the level crossing, diverting pedestrians via this route was expected to attract less local objection than the alternative diversion via Dursden Lane.

171 RAIB found no evidence that an alternative route via Hollybush Lane was considered during the 2024 assessment, and witness evidence shows the LCM was not aware that Hollybush Lane was accessible to pedestrians via the public footpath to the south of the level crossing (figure 2).

Consideration of changes to the usage of the crossing due to lineside footbridge closure

172 Network Rail records show that detailed examinations of Hollybush Lane side bridge had been conducted annually since at least 2018 due to the bridge's timber construction. Condition reports from 2018 to 2021 show consideration of decay of the timber structure and in 2022 Network Rail decided to replace the bridge with a new structure. This replacement was expected to be completed in 2023 or 2024. However with insufficient funding being available, and other locations being deemed a higher priority, Network Rail delayed the replacement of the bridge.

173 A further detailed examination of the bridge in 2023 showed no further deterioration of the structure. In September 2024, a detailed examination noted worsening deterioration and recommended the bridge for immediate closure. Initially, in September 2024, Network Rail decided not to replace the bridge but to progress a repair of the timber elements which was planned for January 2025. However, in October 2024 the repair of the bridge was delayed until beyond 2028 due to budget constraints.

174 In February 2025, Network Rail was contacted by Wiltshire Council after it had received complaints from local residents about the closure. The council noted that Network Rail had not applied for a Temporary Traffic Regulation Order when it closed the bridge. The Temporary Traffic Regulation Order process, which applies to emergency and urgent closures, sets out requirements for applicants to consider and notify affected parties, and to define alternative pedestrian routes during the closure.

175 Documentary and witness evidence shows that when considering the maintenance of bridges, including the prioritisation and funding of bridge repair and replacement, Network Rail primarily considers the risks associated with the structure and potential risk to safe passage of trains in its decision-making. There is no requirement in Network Rail standards or guidance for staff to consider the impact the closure of a bridge may have on the potential transfer of risk to other functions (such as increased usage at crossings).

176 In February 2025, Network Rail also received a telephone complaint from a member of the public regarding the closure of the bridge. Network Rail's internal communications to the RLCM summarised the complaint which highlighted that closure of the bridge had resulted in increased use of Pewsey crossing, and that there had been an incident where a member of the public had fallen on the crossing. It also noted a generally older population at Pewsey.

177 In response, the RLCM stated that the LCM was due to check the crossing on 17 February 2025 and planned for the installation of IOMSLs. The RLCM stated that the LCM's check of the crossing had already been scheduled due to a complaint from a member of the public regarding trains not sounding their horns at the whistle boards. The LCM's visit to the location was not a formal inspection (as defined in Network Rail standards) but rather to determine that the whistle board signage was visible to train drivers (for example not obscured by vegetation) and that the crossing was in generally good condition (for example signage in place and crossing deck not damaged). At the time of the accident, this check of the crossing had been completed and the RLCM was not considering any further action regarding these issues.

178 Witness evidence shows that the RLCM assumed the footbridge was located further from the crossing and did not consider that the closure would substantially change the usage at the crossing. As a result, the RLCM did not brief or instruct the LCM to determine if these factors could increase the risk during the check of the Pewsey crossing or instigate a review of the current risk assessment or user census.

The role of the safety authority

179 ORR regulates the railway industry's health and safety performance in Great Britain. Its role includes the monitoring of health and safety performance, carrying out assessments and taking action to enforce compliance with health and safety law. ORR is also tasked with ensuring that appropriate action is taken in response to RAIB recommendations.

180 ORR generally plans its routine inspection work on the basis of risk and its analysis of where it can secure the most significant improvements in safety management. Its inspections and assessments aim to draw systemic conclusions which will promote improved safety arrangements across a wide range of activities, rather than only identifying specific shortcomings. However, if any shortcomings were to be identified during inspections and assessments, then these would be raised by ORR with the duty holder concerned.

181 Before 2019, ORR had concentrated proactive inspections on footpath crossings fitted with whistle boards with deficient sighting. Witness evidence shows this focus was, in part, a response to RAIB's investigation into the fatal accident at Mexico footpath crossing in 2011 (RAIB report 10/2012, see paragraph 203).

182 In March 2024, a trainee ORR inspector, as part of their training, inspected Pewsey crossing as part of an inspection of six footpath crossings fitted with whistle boards on Western route. The inspection included visiting the crossings, reviewing the crossings' risk assessments, and engaging with the LCM and RLCM. ORR reported that new inspectors may visit a range of crossing types, including footpath crossings fitted with whistle boards, to gain experience in the inspection process, as part of their competence development.

183 The remit of the whistle board crossings inspection for Pewsey crossing stated the purpose of the inspection was to '*ensure Network Rail is providing adequate warning of approaching trains at crossings with whistle boards to ensure users can cross safely*'. The main objectives of the visit were to ensure that Network Rail was achieving legal compliance and to assess whether Network Rail had carried out a '*suitable and sufficient*' risk assessment.

184 Of particular relevance to the circumstances of the accident at Pewsey crossing, the ORR inspection remit required the inspector to:

- assess that whistle boards were in the correct position and, if placed beyond 400 metres from the crossing, if train warning horns were audible
- observe any environmental (or local factors) that may affect users' ability to hear train horn warnings in daytime and night-time
- observe any vulnerable users (including users with hearing loss or who are deaf).

185 Witness and documentary evidence shows that the ORR inspector observed three horn warnings from trains approaching on the down line, including two freight services and one passenger service. Additionally, one passenger service on the up line was observed. The inspector noted that in their opinion the warnings were audible at the crossing and gave pedestrians sufficient time to cross safely. Additionally, the inspector observed users of the crossing and noted the local surrounding area meant vulnerable users were likely to include unaccompanied children, dog walkers and the elderly.

186 In July 2024, the ORR inspector wrote to the RLCM highlighting issues they had identified at Pewsey crossing. Actions were raised and agreed which included the following:

- that the risk assessment did not clearly record how users crossing during the night-time quiet period had been considered when prioritising additional control measures
- that some potentially vulnerable users, including dog walkers, had not been classified as vulnerable
- that some warning signage was secured using temporary fixings which could allow signs to move out of position and reduce their visibility to users.

Observations

Industry post-accident testing

187 RAIB observes that industry post-accident testing did not result in technical testing of the train's warning horn as required by railway standards.

188 On 28 February, 2 days after the accident, a local resident reported to GWR that they did not hear train 1C82 sound its horn at the whistle board during the accident. GWR reviewed the train's OTDR, which showed that the horn had been sounded at the appropriate location.

189 Rail industry standard RIS-2273-RST, 'Post Incident and Post Accident Testing of Rail Vehicles', issue 2 dated 2017, outlines the tests to be conducted on a rail vehicle following an accident. The standard reports that, in circumstances where initial investigations indicate that the sounding of the train's warning horn could be a factor, the audibility of the warning horn must be tested. As a minimum, checks should determine that the horn is operational and then where suspected, further investigations could include:

- correct fundamental frequencies of the warning horns
- sound pressure levels are within original design limits
- assessment of the condition of the horns (damaged/blocked).

190 GWR did not inform Hitachi about the allegation that the horn did not sound during the accident. In the days following the accident, Hitachi undertook the inspections and checks normally carried out when a unit has been involved in a fatality, but where the performance of the unit was not believed to be a contributing factor. As part of this process, Hitachi conducted a functional check of the horn system and an external inspection of the area around it. However, Hitachi did not measure the sound pressure levels or fundamental frequencies of the horn, and no assessment was made of the internal condition of the horn system to determine whether the equipment was damaged or obstructed.

191 Documentary evidence showed that, even had the allegation concerning the horn been passed to Hitachi, its procedures would still not have required any further testing to verify the horn's acoustic performance, such as measuring sound pressure levels or frequencies, or an examination of the internal condition of the horn system. Hitachi was subsequently asked to undertake this work by RAIB, and it was carried out in April 2025 (paragraph 67).

The crossing surface and decision point

192 RAIB observes that surface works undertaken at Pewsey footpath crossing did not result in the decision points being marked or the crossing surface being coloured as required by Network Rail standards.

193 Network Rail standard NR/L2/XNG/30020 Module R03, 'Requirements for station, footpath, bridleway and user-worked level crossings', issue 1 dated June 2022, outlines surface and marking requirements at footpath crossings. This requires that, where reasonably practicable, the surface between decision points should be coloured yellow and the surface of the crossing at the decision points should be marked with a white line.

194 The north approach to Pewsey crossing along a public footpath was uneven and muddy in places (paragraph 8). The path in between the gate and the edge of the metal-framed decking panels near the running line was constructed from compacted crushed stone.

195 Following the 2022 risk assessment, Network Rail took steps to remove the skew at the crossing, so that users no longer needed to cross at an oblique angle, and to improve the crossing's surface. This work provided an opportunity to create a crossing surface that was compliant with the requirements of NR/L2/XNG/30020. However, the work undertaken was not compliant with the standard, as the surface between the decision points was not coloured yellow and the decision points were not marked with white lines.

196 The LCM stated that they were not involved in writing the specification for the work and was not aware of any standards relating to these requirements. As such, the non-compliances were not identified in the 2024 risk assessment or before the accident.

197 RIS-0793-CCS, published in December 2024, provided further direction and guidance on the provision of these surface markings (paragraph 81).

Summary of conclusions

Immediate cause

198 The pedestrian crossed into the path of train 1C82 as it approached (paragraph 54).

Causal factors

199 The causal factors were:

a. The pedestrian was probably unaware that the train was approaching when they made the decision to enter the crossing (paragraph 59), **Recommendations 1, 2 and 3**.

b. After entering the crossing, and then becoming aware of the immediately approaching train, the pedestrian continued to cross (paragraph 76).

c. An alternative route across the railway, normally used by the pedestrian, had been temporarily closed by Network Rail (paragraph 84), **Recommendation 6**.

Underlying factors

200 The underlying factors were:

a. Network Rail's control framework for footpath crossings fitted with whistle boards did not sufficiently control the risk associated with their use. This is a probable underlying factor (paragraph 89), **Recommendations 1, 3 and 4, Learning point 1**.

b. Network Rail's processes did not effectively mitigate the risks at footpath crossings fitted with whistle boards to users with hearing loss or who are deaf (paragraph 133), **Recommendation 2 and 3**.

c. Network Rail's risk management and assurance processes for footpath crossings with whistle boards did not effectively manage the risk to the public at Pewsey (paragraph 150), **Recommendations 5 and 6**.

Additional observations

201 Although not linked to the accident on 26 February 2025, RAIB observes that industry post-accident testing did not result in technical testing of the train's warning horn as required by railway standards (paragraph 187), **Learning point 2.**

202 RAIB observes that surface works undertaken at Pewsey footpath crossing did not result in the decision points being marked or the crossing surface being coloured as required by Network Rail standards (paragraph 192), **Learning point 3**.

Previous RAIB recommendation relevant to this investigation

203 The following recommendation, which was made by RAIB as a result of its previous investigations, has relevance to this investigation.

Fatal accident at Mexico footpath crossing (near Penzance), 3 October 2011, RAIB report 10/2012, Recommendation 5

204 The recommendation reads as follows:

Recommendation

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

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

- *the costs and benefits at each crossing of providing audible or visual warnings at the crossing itself rather than by approaching trains (taking account of the possibility of the significantly reduced costs of visual warnings; and*
- *at crossings where whistle boards will remain, whether the position of the board at each crossing has been optimised taking account of all relevant local factors including (but not limited to) prevailing wind, local topography, sources of noise and the traverse time for crossing users and the positive and negative effects on railway neighbours.*

205 In December 2016, Network Rail reported to ORR that it had undertaken an extensive review of all crossings fitted with whistle boards on the network and had developed LCG05 and that this guidance and its associated template provided a consistent standard of assessment. In May 2017, Network Rail reported that whistle boards across its network had been assessed as either:

- *'effective and compliant; or*
- *have interim solutions in place pending either optimisation of whistle boards or delivery of long-term measures; or*
- *have had long-term measures implemented as support to or replacement for whistle boards.'*

206 In October 2017, Network Rail reported that its 2015 level crossing strategy (paragraph 163) placed increased emphasis on the safety of passive crossings and described how it intended to manage the use of whistle boards. This included:

- *'By 2019 all whistle boarded crossings with known use during the night-time quiet period will be equipped with train detection warning systems.*
- *By 2025 all whistle boards will have either been replaced or will be supported by automatic user-based warning systems.'*

207 In December 2019, Network Rail published its '*Enhancing Level Crossing Safety 2019 – 2029, A long-term strategy targeting improved safety on Great Britain's railway*'. In this strategy, Network Rail committed to meeting its legal duties by managing level crossing risk so far as is reasonably practicable and ensuring safety investment decisions are informed by cost-benefit analysis. Network Rail stated that technology is a central element of the strategy and it would work with suppliers to seek out innovative technology and reduce costs. The strategy also contained the following statement:

'In targeting technology at passive crossings, we will prioritise in equal measure:

- *Locations of high risk, high line speeds and high traffic volumes*
- *Footpath and bridleway crossings with sighting deficiencies protected by whistle boards; targeting those with known usage during the night-time quiet period and working to eradicate whistle boards from the network.'*

208 In August 2020, ORR reported to RAIB that it was satisfied with Network Rail's actions in response to this recommendation and that it considered that the recommendation was implemented.

209 Network Rail's 2015 strategy meant that Pewsey crossing should have been considered for the fitment of a train detection-based warning system before 2019. Although Network Rail's current strategy, published in 2019, softened earlier commitments for the installation of technology at all footpath crossings fitted with whistle boards, the characteristics of Pewsey crossing suggest that it should have been a priority candidate for such intervention. However, the withdrawal of SAWDs in November 2016 and the lack of progress in developing other technical solutions resulted in a continued reliance on whistle boards at higher risk crossings (such as Pewsey crossing) over an extended period.

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

210 Shortly after the accident, Network Rail installed an additional whistle board sign on the Down and Up Westbury lines. This second sign instructed train drivers to sound both high and low tone warnings on approach to Pewsey crossing. Witness evidence shows that, before the accident, some GWR drivers were not consistently using the horn at whistle boards in accordance with the requirements of the Rule Book. Some drivers were also advised during route learning (where they develop the knowledge needed to safely drive trains over specific sections of track) to use both the high and low tones at whistle boards. Following the accident, RAIB also observed this practice among a proportion of drivers approaching Pewsey crossing (before the second whistle board was installed) and has been observed separately at other locations by RAIB.

211 The signage at the crossing decision points was also replaced to comply with current standards. However, the decision point was not marked on the crossing surface.

212 In May 2025, a further safety incident involving a member of the public occurred at the crossing, and during its investigation Network Rail identified that a user with hearing loss was using the crossing. For this reason, Network Rail imposed an emergency speed restriction on the Down Westbury line which reduced the maximum permitted speed for trains from 100 mph (161 km/h) to 40 mph (64 km/h).

213 In July 2025, Network Rail removed the requirement to withdraw existing SAWD systems from use by October 2025. At the time of writing, the installation of new SAWD systems remains prohibited, although Network Rail's Technical Authority has stated that this restriction is expected to be lifted shortly.

Recommendations and learning points

Recommendations

214 The following recommendations are made:[12]

1 *The intent of this recommendation is to ensure that appropriate risk mitigations are identified and implemented at footpath crossings fitted with whistle boards where the characteristics result in such signs being an unsuitable risk control measure.*

Network Rail should review its assessment of risk at footpath crossings fitted with whistle boards that fall outside the characteristics defined in LCG05 'Whistle board effectiveness and provision' issue 1.

Network Rail should specifically consider what actions should be adopted to control risk during the period in which longer term mitigation measures are being implemented, and to review the situation if, and when, timescales change.

This should include considering the implementation of reductions in maximum permitted line speeds and/or the provision of potentially more effective means of providing warnings (such as miniature stop lights or supplementary audible warning devices) or other engineered safeguards (paragraphs 199a and 200a).

2 *The intent of this recommendation is to ensure that the risk to people with hearing loss or who are deaf using footpath crossings with whistle boards is effectively controlled in the short term.*

Network Rail should ensure that level crossing managers are aware of the foreseeable use by people with hearing loss or who are deaf of all footpath crossings fitted with whistle boards.

Network Rail should provide clear guidance to level crossing managers and other staff involved in the management of such crossings on appropriate risk mitigations to manage the risks of crossing usage by people with hearing loss or who are deaf pending the outcome of recommendation 3 (paragraphs 199a and 200b).

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

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

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

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

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

3 *The intent of this recommendation is to ensure that the use of whistle boards as a risk mitigation at footpath crossings is reviewed to ensure that it is appropriate.*

Network Rail should undertake a review of its existing standards, procedures and guidance relating to footpath crossings fitted with whistle boards to ensure that these are consistent and meet relevant legal duties and good practice for safety and accessibility.

This review should specifically consider:

- The applicable legal requirements with respect to the safety and accessibility for a foreseeable range of crossing users, including those who may have hearing loss or who are deaf.
- Guidance on the principles of managing level crossing safety issued by the Office of Rail and Road.
- Network Rail's wider approach to passive level crossings and crossings fitted with whistle boards outlined in 'Enhancing Level Crossing Safety 2019 - 2029'.
- Whether whistle boards remain an effective risk mitigation for the foreseeable range of crossing users, including those who have hearing loss or who are deaf, particularly given the findings of this investigation with respect to the audibility of train warning horns in different operating environments.
- The availability of alternatives to whistle boards such as reducing maximum permitted line speeds and/or the provision of potentially more effective means of providing warnings to users (such as miniature stop lights or supplementary audible warning devices) or other engineered safeguards.

Network Rail should develop a timebound programme to update as necessary the relevant standards, procedures and guidance (paragraphs 199a, 200a and 200b).

This recommendation may apply to other infrastructure managers whose networks include footpath level crossings fitted with whistle boards.

4 *The intent of this recommendation is to ensure that Network Rail's approach to providing level crossing standards and guidance documents aligns with its wider standards and control management framework.*

Network Rail should review the contents of its level crossing guidance documents (such as LCG05 'Whistle board effectiveness and provision') to ensure its approach is consistent with Network Rail's development and implementation of control documents 'NR/L2/CSG/STP001 - Standards and Controls Management'.

Following this review, Network Rail should develop a timebound programme to update as necessary the relevant standards, procedures and guidance (paragraph 200a).

5 *The intent of this recommendation is to ensure that Network Rail improves its management assurance of narrative risk assessments to ensure it aligns with its wider assurance activities relating to the control of risks.*

Network Rail should review the process by which it reviews and checks narrative risk assessments to ensure that they are correct and meet the requirements of standards and guidance related to level crossings.

This review should also consider if Network Rail's review of narrative risk assessments is aligned with Network Rail's processes for assurance activities relating to the control of risks including Network Rail standard 'NR/L2/ASR/036 - Network Rail Assurance Framework' and the Network Rail Assurance Manual.

Following the review, Network Rail should develop a timebound programme to update as necessary the relevant standards, procedures and guidance (paragraph 199c).

6 *The intent of this recommendation is to ensure that Network Rail understands and considers the wider implications for safety of closing a public right of way.*

Network Rail should review its arrangements for carrying out impact assessments in circumstances where closing a public right of way is required to facilitate repair or renewal of an asset (such as a footbridge) where this action may affect the risk associated with assets managed by other Network Rail disciplines (such as level crossings) or usage of infrastructure managed by other organisations.

Following this review, Network Rail should implement any improvements identified (paragraphs 199c and 200c).

Learning points

215 RAIB has identified the following important learning points:[13]

1 This accident highlights the importance of staff responsible for assessing and reviewing risk at level crossings understanding and applying relevant standards and guidance. Where guidance indicates that a control may not be effective in the circumstances at a particular crossing, this should be recognised and clearly recorded in the risk assessment. This finding should inform judgements around whether risk levels have been reduced to '*so far as reasonably practicable*' and consideration of the provision of alternative risk controls (paragraph 200a).

2 The inspection and testing of the train involved in this accident highlights the importance of effective communication of the circumstances of an accident to those responsible for post-accident testing, and of the organisations responsible for such testing having procedures that align with relevant industry standards (paragraph 201).

3 The work undertaken before the accident to remove the skew at Pewsey crossing demonstrates the importance of ensuring that, when infrastructure modifications are carried out, opportunities are taken to achieve compliance with relevant standards, including those concerning surface colouring and the marking of decision points (paragraph 202).

[13] 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

Appendices

Appendix A - Glossary of abbreviations and acronyms

Abbreviation / acronym	Term in full
ALCRM	All Level Crossing Risk Model
FFCCTV	Forward-facing CCTV
GSM-R	Global System for Mobile Communications - Railway
IOMSL	Interfaced Overlay Miniature Stop Lights
LCM	Level crossing manager
MSLs	Miniature stop lights
NRA	Narrative risk assessment
ORR	Office of Rail and Road
OTDR	On-train data recorder
RAIB	Rail Accident Investigation Branch
RLCM	Route level crossing manager
RNID	Royal National Institute for Deaf People
RSSB	Rail Safety and Standards Board
SAWD	Supplementary audible warning device
TSI	Technical Specifications for Interoperability

Appendix B - Investigation details

RAIB used the following sources of evidence in this investigation:

- information provided by witnesses
- information taken from the train's OTDR
- CCTV recordings taken from the train involved
- site photographs and measurements
- weather reports and observations at the site
- analysis of signalling data
- Railway standards, rules and instructions
- Network Rail company standards and guidance
- staff competence records and training records
- medical records
- analysis of mobile phone download data
- information relating to the train's warning horn and OTDR systems
- testing data collected at Pewsey crossing and from the unit involved in the accident as well as expert reports commissioned by RAIB

Appendix C - RAIB's sound testing and acoustic analysis

C1 RAIB undertook testing with the train involved in the accident during August 2025. The main objectives of this testing and analysis were:

a. To understand the sound made by the warning horn fitted to 1C82 at the whistle board. This looked at:

- the relationship between the OTDR, the operation of the horn control in the driver's cab and the sound levels of the horn
- how horn sound levels vary with the duration of a horn activation
- the sound levels and frequencies of the horn from the unit involved in the accident and determine if these were compliant with current standards.

b. To determine the sound levels that would have reached Pewsey crossing after train 1C82 sounded its horn at the whistle board. RAIB undertook 2 days of testing at Pewsey crossing in August 2025. The primary objectives of these tests were to:

- measure horn sound levels and frequency close to the whistle board to estimate the source level.
- measure variability in background sound levels and frequency at the crossing
- measure horn sound levels and frequency at the position where the pedestrian would likely have been standing when train 1C82 sounded its horn
- determine the attenuation (the reduction in sound level as sound travels away from its source) between where train 1C82 sounded its horn and the crossing.

c. To determine how audible the sound from train 1C82's warning horn was at Pewsey crossing for users with hearing loss, and for the pedestrian involved in this accident, both when they were wearing hearing aids and when they were unaided.

C2 RAIB's testing found that there was relatively close alignment between the horn lever being applied by the driver and the recorded duration on the OTDR (figure C1). There was also a close correlation between the duration of the horn sounding as recorded by the OTDR and the sound output of the horn but with the horn continuing to sound for a short duration after the OTDR had stopped recording.

C3 RAIB also found that the duration of the sounding of the horn affected sound levels, with a longer application/duration delivering a greater sound level. This marginal increase diminished for longer applications over the range measured (up to around 1 second, figure C2). RAIB's testing also determined that the condition of the horn grille, extent of the horn control lever being moved by the driver and the choice of the low tone or high tone horn being used did not have an effect on the sound levels produced.

C4 Analysis of data collected during testing also determined the sound level of the horn at 25 metres during the accident was in the range of 93.7 dB to 98.5 dB. This means that the train's horn likely exceeded the minimum and maximum sound levels required by GM/RT 2131 (paragraph 44) of 86 dB and 94 dB and met the frequency requirements specified in BS EN 15153 'Railway applications - external visible and audible warning devices', issued in 2020, of 291 to 331 Hz.

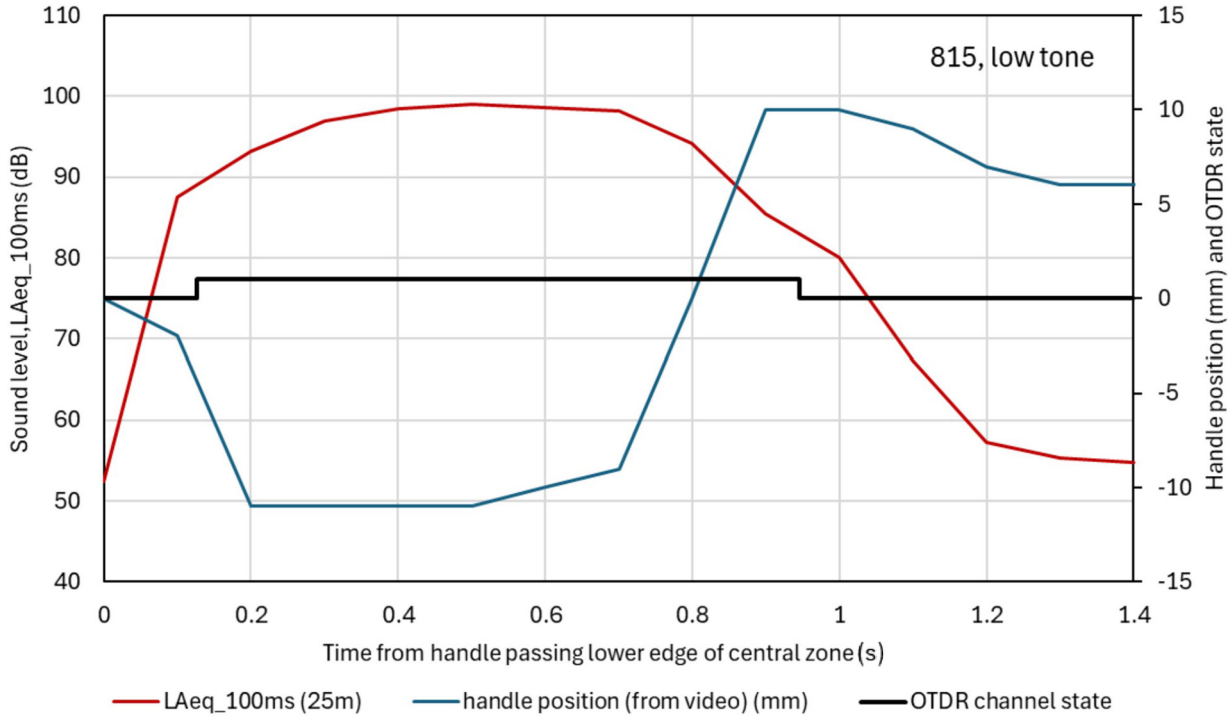

Figure C1: Sound level (left-hand axis) and horn handle position (right-hand axis) as a function of time (bottom axis). OTDR is 0 when the horn is not activated, and has a value of 1 throughout the duration that the OTDR detects that the horn is activated.

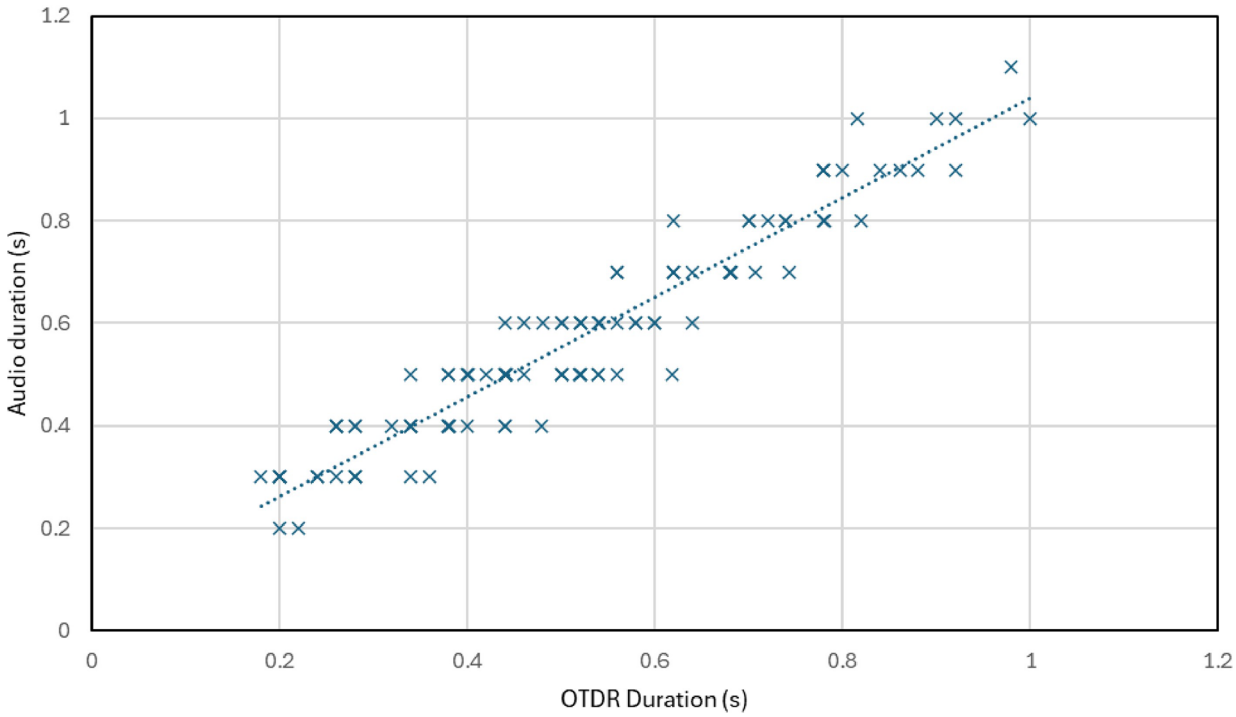

Figure C2: Duration of horn sounding recorded by OTDR and actual duration of sound recorded.

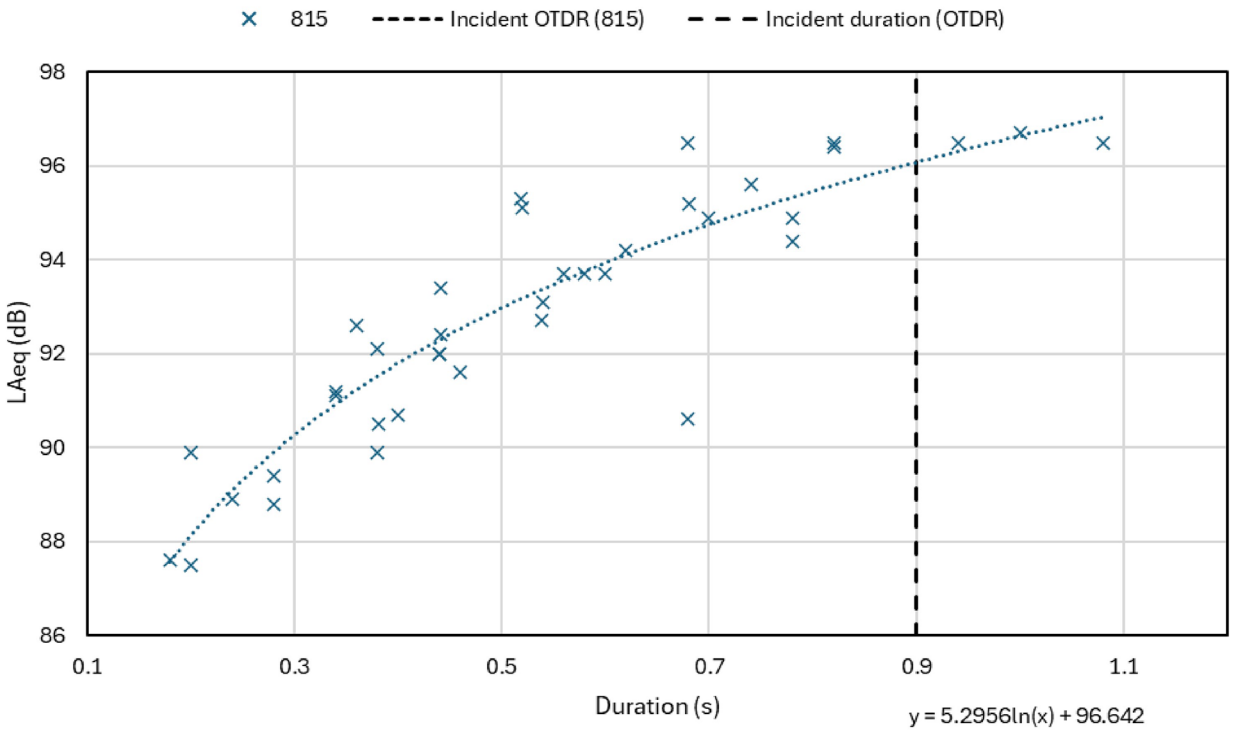

Figure C3: Sound level of horn at 25 m as a function of horn duration.

C5 Weather conditions such as wind, temperature and humidity can affect sound propagation and background noise levels. The weather during RAIB's testing at Pewsey crossing was warmer and drier than at the time of the accident, although in both cases there was no rain and only light wind. RAIB has no reason to believe that these differences in conditions between the time of the accident and testing materially affected the results of the audibility analysis.

C6 RAIB testing identified that the environmental background sounds at the crossing gate were an average of 39.3 dB(A) and at the decision point were an average of 38.4 dB(A) at the time measurements of the train horn were taken. The background sounds included noises from:

- nearby animals
- aircraft, including low flying from military helicopters (from a nearby base)
- road vehicle noises
- sounds associated with operating the crossing's gates.

C7 Table C1 gives the average sound levels of the train horns and background sounds measured and the range of measurements.

C8 Figure C4 provides the relative sounds from the train horn and background at the crossing gate and figure C5 the same information at the decision point.

		Background sound, dB(A)	Horn sound, dB(A)
Noth crossing gate	Mean average	39.3	42.6
	Standard deviation	7.3	4.3
Crossing decision point	Mean average	38.4	48.1
	Standard deviation	4.9	5.0

Table C1: Background and train horn sounds measured at Pewsey crossing.

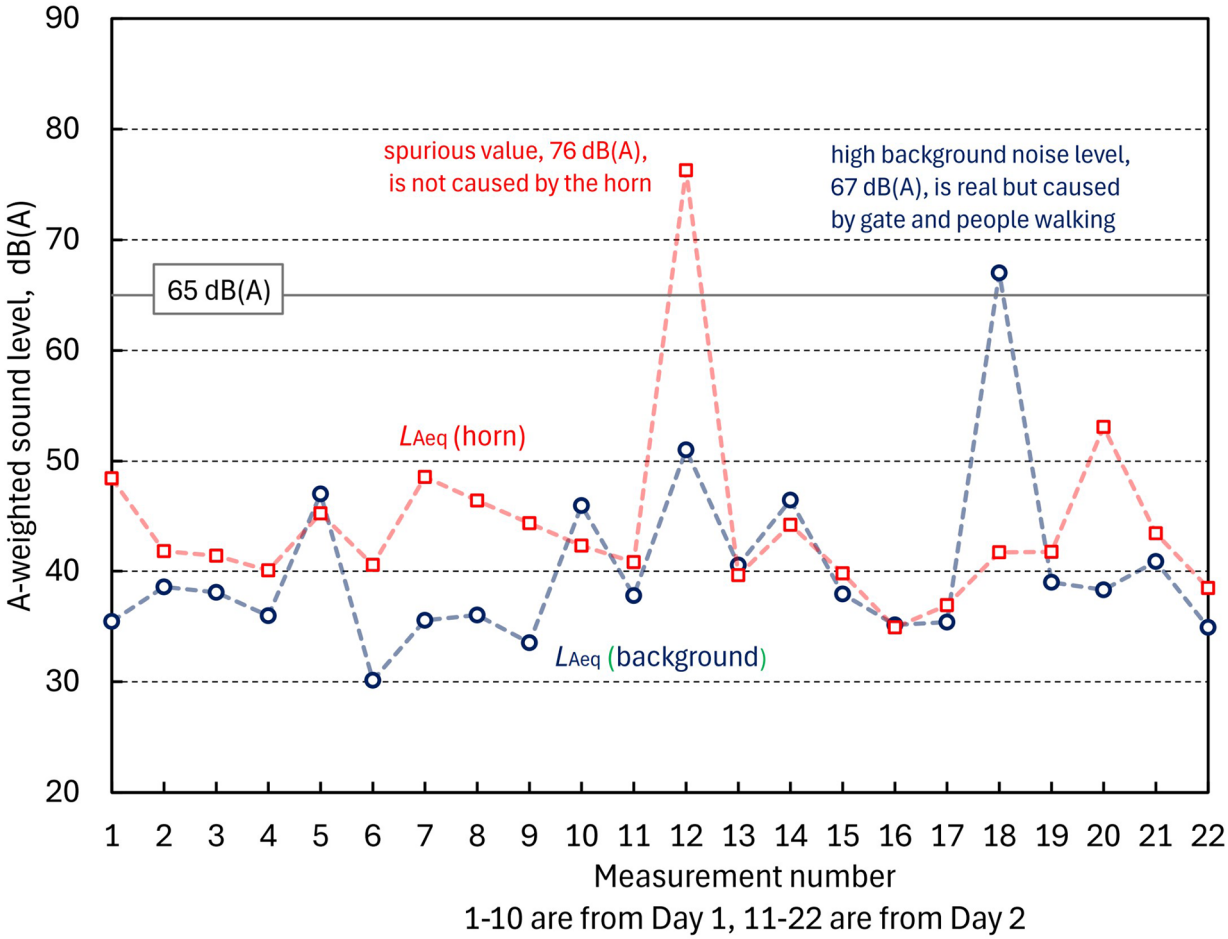

Figure C4: The sound levels measured at the north crossing gate, blue circles are background sound and red squares are horn sounds. The value recorded for measurement 12 reflected the sound of the creaking crossing gate, which masked the sound of the train horn.

C9 RAIB testing also determined the average sound of class 800 train warnings at the up line whistle board at around 400 metres from the crossing. At the north crossing gate this was 59.2 dB(A) with a standard deviation (a measure of the dispersion of values about their mean) of 9.5. As such, approximately 68% of values recorded were within a range of 49.7 to 68.7 dB(A).

C10 An individual's ability to detect a sound is dependent on their hearing ability and their perceptual attention when the sound is being made. The audibility of warning sounds is dependent on the background noise that the sound must be heard against. Acoustic specialists use the term 'masked threshold' to define the minimum sound level that can be heard greater than 50% of the time above background noise. A warning sound must be loud enough to attract attention and be recognised above this threshold and so needs to exceed the background sound by an appropriate margin. The warning sound must also exceed the background sound at the same frequency.

C11 At the crossing, the sound level had reduced to an average of 48.1 dB(A) at the decision point and 42.6 dB(A) at the crossing gate (figure 6). The attenuation of sound during the testing was measured to be 9 dB to 13 dB per doubling of distance (9 to 13 dB/dd) with the median rate of approximately 12.0 dB/dd. The rates of attenuation due to distance were similar to the data that had been collected during previous research in the railway environment (paragraph 46).

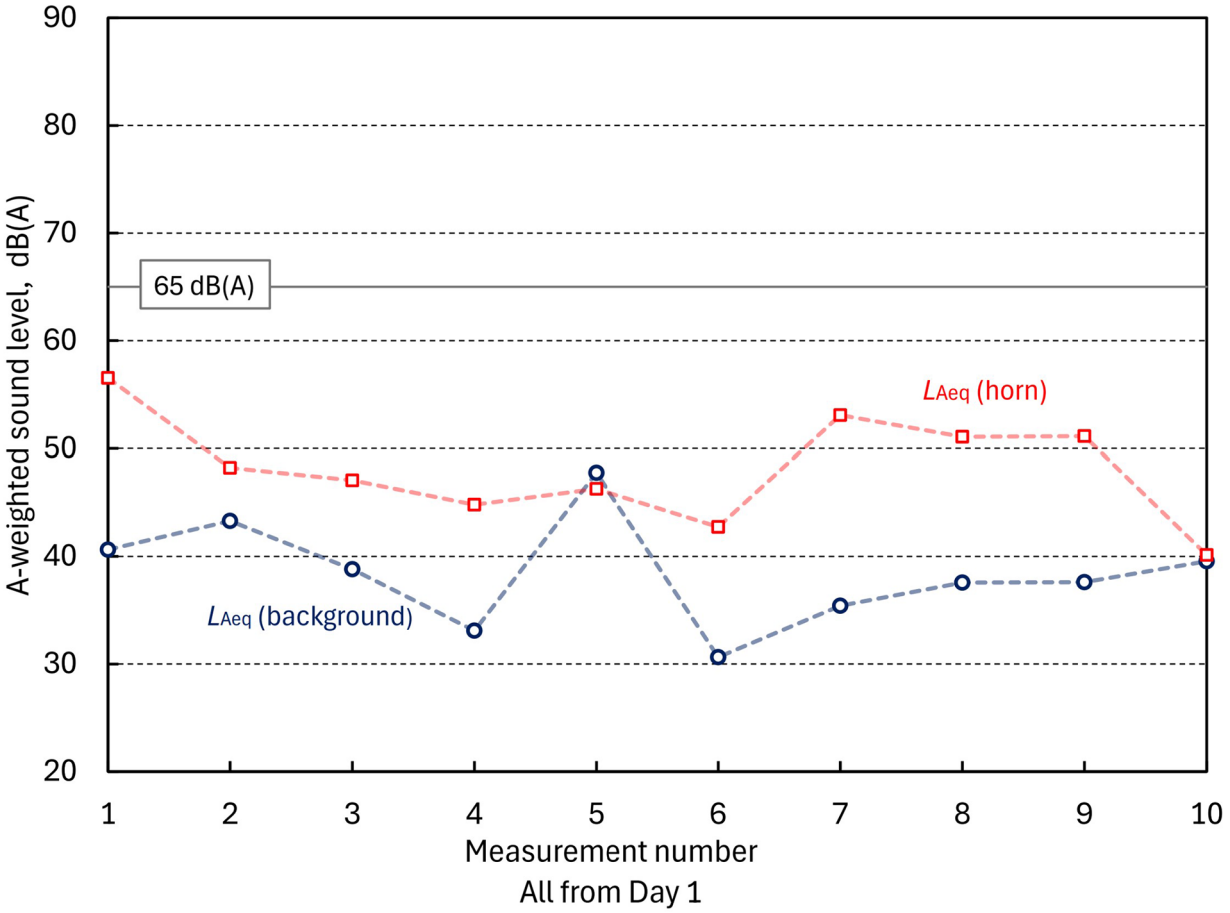

Figure C5: The sound levels measured at the decision point, blue circles are background sound and red squares are horn sounds.

C12 Attenuation between the Down Westbury line whistle board and the crossing at Pewsey may have also been influenced by a number of other environmental factors such as the presence of a road bridge close to the whistle board, the curvature of the track between the crossing and whistle board and the location of the whistle board within a cutting. Although these factors may have affected the sound attenuation, they are difficult to quantify in terms of their effect on the sound levels at the crossing.

C13 While the crossing gate and decision point are relatively close to each other, the lower sound levels at the crossing gate probably occurred because the location was more sheltered and an earth mound partially obstructed the sound levels between the train and the gate.

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