



Strategy for regulation of health and safety risks - 4: Level crossings

ORR's strategy for health and safety regulation of level crossings

Railway businesses must manage level crossing risk effectively using their own safety management systems. ORR's role is to check that they are doing so.

ORR's strategy for regulating level crossing safety is based on analysis of the current situation and our judgment of what we think needs to be achieved. In particular, we want to:

- ensure better, more effective **risk management by the railway businesses**, which work together to produce **risk assessments** drawn up by competent people who have a proper knowledge of the risks and of the application of controls associated with crossings, as well as a good understanding of the behaviour of users and their perception of risk;
- **encourage crossing closure** and ensure that all risk assessments consider this first, in line with the principles of prevention, prioritising those crossings that present the highest risk;
- influence **Network Rail's long term strategy** to ensure it includes key principles for improving level crossing safety and that the whole organisation (not just the "level crossing community") takes account of the Strategy in what it does;
- encourage **research, innovation and new technologies** in
 - providing bridges and underpasses;
 - level crossing design, fitment and active warning systems;
 - the effect of infrastructure design on human behaviour;
 - ERTMS signalling technology and the 'digital railway';
 - tailoring specific controls to each location – moving away from one-size-fits-all "types" of crossing;
- oversee **Network Rail's ring-fenced spend in CP5** to achieve the highest risk reduction possible, to support its aim of reducing level crossing risk by 25% by 2019;
- ensure that risks arising from level crossing interfaces are considered, and reduced so far as is reasonably practicable, in the **design stages** of any project that is enhancing or renewing the infrastructure where level crossings are located;
- consider the creation of **new level crossings** (on both the mainline and heritage networks) on a **case-by-case basis and only where exceptional circumstances** can be demonstrated in discussion with us; and
- exploit opportunities to **improve the law on level crossings**, including support for implementing the Law Commissions' proposals.

Index of issues discussed

- Introduction
- Mainline railway
 - Safety risks
- Industry activity
 - Network Rail
 - Heritage railways
 - Tramways
- ORR Activity
- Rail Safety and Standards Board (RSSB)
- Rail Accident Investigation Branch (RAIB) reports
- Glossary of terms

Introduction

1. There are approximately 6200 level crossings in use on the mainline rail network in Great Britain with another estimated 1,500 on heritage and minor railways. There are also a very small number of crossings in depots. Britain's mainline railway is amongst the safest in Europe in terms of the number of unsafe events that have happened, and is out-performing other EU countries in managing risks at level crossings. However, just one major incident could change this and every incident has the potential for significant human and economic loss.

2. Generally, trains are now more frequent and travel at higher speeds than before; there is more road traffic using crossings and bigger farm machinery with better sound-proofing for their operators; people live at a faster pace of life and more pedestrians are using electronic equipment that can distract them.

3. Many level crossings connect communities and people in those communities often want their crossings to remain open even when a case for closure on safety grounds has been made.

4. Network Rail, operators of heritage and light railways and those who control depots have an explicit legal duty under the Health and Safety at Work etc. Act 1974 (HSWA) to minimise risks arising on their networks, so far as is reasonably practicable. ORR's primary interest in level crossings is to promote - and where necessary enforce - their safe design, management and operation in order to reduce the associated risks, to have a positive effect on user behaviour, and so to reduce the number of fatal and serious incidents and 'close calls'.

5. The legal framework governing safety at level crossings is complex, often out-dated (some legal requirements are Victorian in origin), and overly prescriptive in places. In 2008 ORR (in collaboration with DfT) approached the Law Commissions¹ asking them to include level crossing legislation in their tenth programme of law reform. The two Commissions published their joint report and a draft Level Crossing Bill and supporting regulations in autumn 2013. ORR will continue to strive for improvements in the law, and to support the implementation of the Law Commissions' proposals.

¹ There are two: The Law Commission for England and Wales and the Law Commission for Scotland.

6. The removal of crossings is always the first option to be considered in a risk control strategy by the duty holder, in line with the general principles of prevention² in European and UK law. The closure of level crossings requires attention to many factors, including the practicalities of replacing them with bridges or underpasses, the legal arrangements for closing rights of way, the need to minimise the possible transfer of risk to other crossings, and the possibility of importing new dangers such as increasing the likelihood of trespass.

7. At individual level crossings, users are assisted to cross safely by the layout of the crossing and the presence of equipment such as gates, barriers, warning lights, alarms and signs. These arrangements must be kept under review through a regular re-assessment of risks, and they may need to be changed if the risk profile at the crossing alters: for example, if there are changed traffic levels (either of road vehicles, pedestrians and/or trains), or a different mix of users, or if a new school or housing development is built nearby, or if different user behaviours are observed, such as motorists 'zig-zagging' around barriers, the wearing of headphones or use of mobile phones.

8. This regular re-assessment of risks may indicate that changes are now justified, such as closure of the crossing, or its replacement with some other method of crossing the railway. When crossing risks are re-assessed, new innovatory controls may have become available or existing ones may have become more practical or cheaper to install.

9. ORR has a role in authorising Level Crossing Orders (on behalf of the Secretary of State for Transport), and then in inspecting against them to ensure that the measures that are set out in the Order are actually in place and being complied with. The law does not make Level Crossing Orders mandatory for all crossings. Likely reasons for Orders having been made include a need:

- (a) to clarify the specific safety requirements at a crossing;
- (b) to define what the respective duties of the crossing operator and highway authority are; and
- (c) to formalise any changes made to the crossing.

The Law Commission has proposed that Level Crossing Orders should no longer be used.

² Management of Health and Safety at Work Regulations 1999 Schedule 1

Mainline railway

Safety risks

10. There are several different types of level crossing in use on the mainline network. The table below shows level crossing numbers by type.

	Type (The glossary at the end of the chapter explains the acronyms)	number
Passive level crossings	UWCT/Bridleway T	1717
	Footpath/bridleway/station	2246
	UWC	686
	Open crossing	48
Automatic level crossings	AHB	443
	ABCL/AOCL+B	119
	AOCL/R	39
	MSL	174
Protected level crossings	MCB CCTV	425
	MCB OD	55
	MCB	185
	MCG/Train Crew Operated	154
Total		6291

From Network Rail's document: '*Transforming level crossings: A long-term strategy to improve safety at level crossings*' V8.

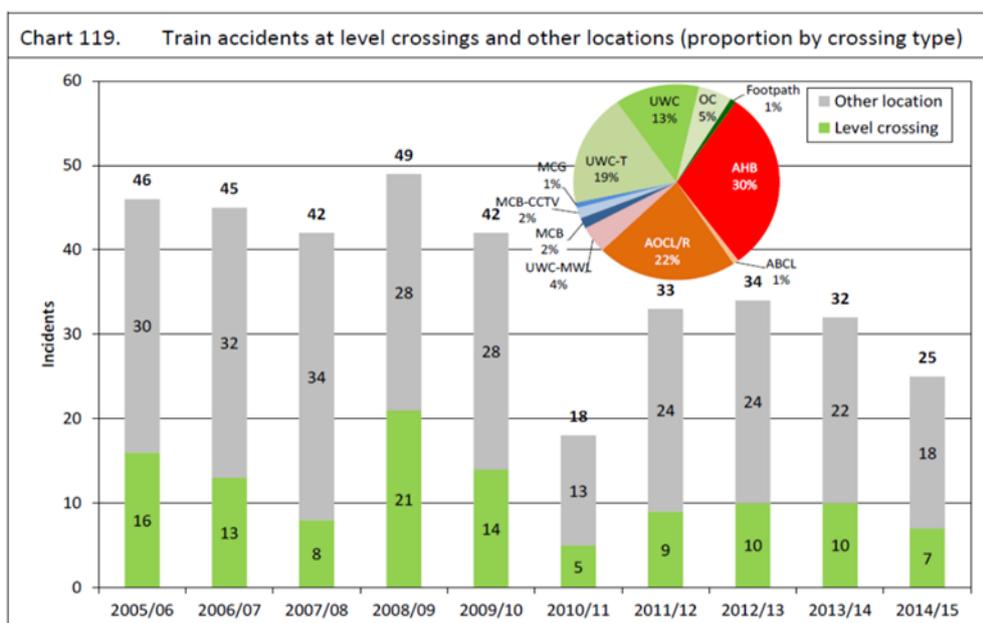
11. The table below documents the **harm** caused by level crossings.

Crossing category (Ranked by contribution to % total deaths)	Pedestrian deaths (72)	% of peds	Vehicle deaths (21)	% veh	Total deaths (93)	% total deaths
Footpath	38	53%	0	0%	38	41%
AHB	9	12.5%	10	48%	19	20%
UWC-T	9	12.5%	4	19%	13	14%
CCTV	8	11.1%	0	0%	8	8.6%
AOCL	1	1.38%	6	28.5%	7	7.5%
UWC-MSL	2	2.77%	0	0%	2	2.2%
SPC-MSL	2	2.77%	0	0%	2	2.2%
MCB	1	1.38%	1	4.7%	2	2.2%
UWC	1	1.38%	0	0%	1	1.1%
SPC	1	1.38%	0	0%	1	1.1%

Table of fatalities (ORR analysis from raw data gathered for RSSB ASPR).

The Table shows the distribution of fatalities by crossing type, excluding suicides over the last 10 years. The number of pedestrian deaths is 72, the number of road vehicle occupant deaths is 21, giving total level crossing user deaths of 93, over the ten years measured. Footpath crossings are **41%** of all deaths and Automatic Half Barriers are **20%** of all level crossing deaths and nearly half of all road vehicle occupant deaths (10 out of 21) while they are also 12.5% of all pedestrian deaths. The relative fatality rates are: AHBs $19/443 = 0.043$ fatalities per crossing, and footpath $38/2246 = 0.017$ fatalities per crossing. The risk at AHBs is potentially much higher because they have only half barriers and no protecting signal, so the train is always coming regardless of what is happening on the crossing. There is therefore a daily risk of a multiple fatality train crash that does not exist at footpath crossings.

12. The graph below shows the yearly number of train accidents (as defined by RIDDOR) at level crossings and at any other site on running lines. Historically, most collisions between trains and vehicles occurred on AHBs, AOCLs and UWCs. There is some evidence that the underlying rate of collisions has reduced over time. This may partly be as a result of Network Rail fitting overlay half barriers to AOCL crossings and not renewing AHB crossings near stations and schools.



13. The Railway Safety and Standards Board (RSSB) Safety Risk Model, version 8.1³, estimates that 8% of the total mainline railway system risk is at level crossings, which is almost exclusively borne by the road (or path) users.

³ The Safety Risk Model (SRM) is a quantitative representation of the potential accidents resulting from the operation and maintenance of the GB mainline rail network. It comprises a total of 120 individual models, each representing a type of hazardous event. A hazardous event is defined as an event or an incident that has the potential to result in injuries or fatalities.

14. Most of the risk at level crossings (62%) is to pedestrians with members of the public accounting for 57% and passengers on station crossings accounting for the remaining 5%.

15. According to the RSSB's Precursor Indicator Model (PIM)⁴, the most important precursor to train collisions at level crossings is 'public behaviour' but it is important that this is not simply labelled as deliberate 'misuse'⁵ and dismissed. There may be complex reasons for people making errors or not complying with the railway's expectations of their behaviour at level crossings. Risk assessment should seek fully to understand the causes and motivations for errors and deliberate "violations" by the public and to improve crossing design so far as is reasonably practicable.

16. Level crossing risk within the model not caused by the users' actions is relatively low at approximately 6%, but it is significant because signallers and other staff controlling level crossings can make errors from which collisions have resulted. This modelled risk figure also includes pedestrian slips, trips and falls and being struck or trapped by crossing barriers, plus injuries to the workforce. Other risks that can arise at level crossings include contact with railway electrified overhead line (OLE) wires resulting in electrical injuries to vehicle occupants and potential stranding of vehicles on the crossing. Road vehicles can also be struck or trapped by barriers.

17. Based on the reported data⁶, the crossing types at which accidents occurred in 2014/15 were reasonably typical of previous years. Of the 113 collisions in the 10 years from April 2005, 25 (22%) occurred at AOCL crossings, 34 (30%) at AHB crossings and 36 (32%) at UWCs (with or without telephones). The remaining types of crossing each contributed between 1% and 5% of events.

18. Each crossing has a particular risk profile. Risk profiling work using the RSSB Safety Risk Model (SRM) v8.1 shows that:

- (a) the risk of collisions between trains and road vehicles is greatest at automatic half barrier crossings (AHB), automatic open crossings, locally monitored (AOCL), and user worked crossings (UWC);
- (b) the greatest proportion of the risk to pedestrians is at footpath crossings rather than from pedestrian use of any other type of crossing;
- (c) six accidents at level crossings during the past 10 years (i.e. since 2005) have resulted in more than one fatality: three accidents where multiple road vehicle occupants died and three accidents where two pedestrians were struck. The most recent multi-fatality accident occurred on 9 April 2013: two people were killed when a train struck a car on Great Coates level crossing.

⁴ RSSB's PIM measures the underlying risk from train accidents by tracking changes in the occurrence of accident precursors and their potential consequences.

⁵ ORR has been active in encouraging the industry to move away from the term "misuse", in line with the Transport Select Committee's recommendation, and to change its terminology.

⁶ RSSB Annual Safety Performance Report 2014-15.

19. It is rare for level crossing incidents to have significant safety consequences for train crew or passengers, but such cases do occur, and are generally the result of the train derailing after a collision with a road vehicle at a crossing. A level crossing accident resulting in train occupant fatalities occurred at Ufton Nervet in 2004, when a passenger train derailed after striking a car. The train driver and five passengers were killed, as well as the car driver. His death was found at the ensuing inquest to have been suicide, while the train occupants were the victims of homicide.

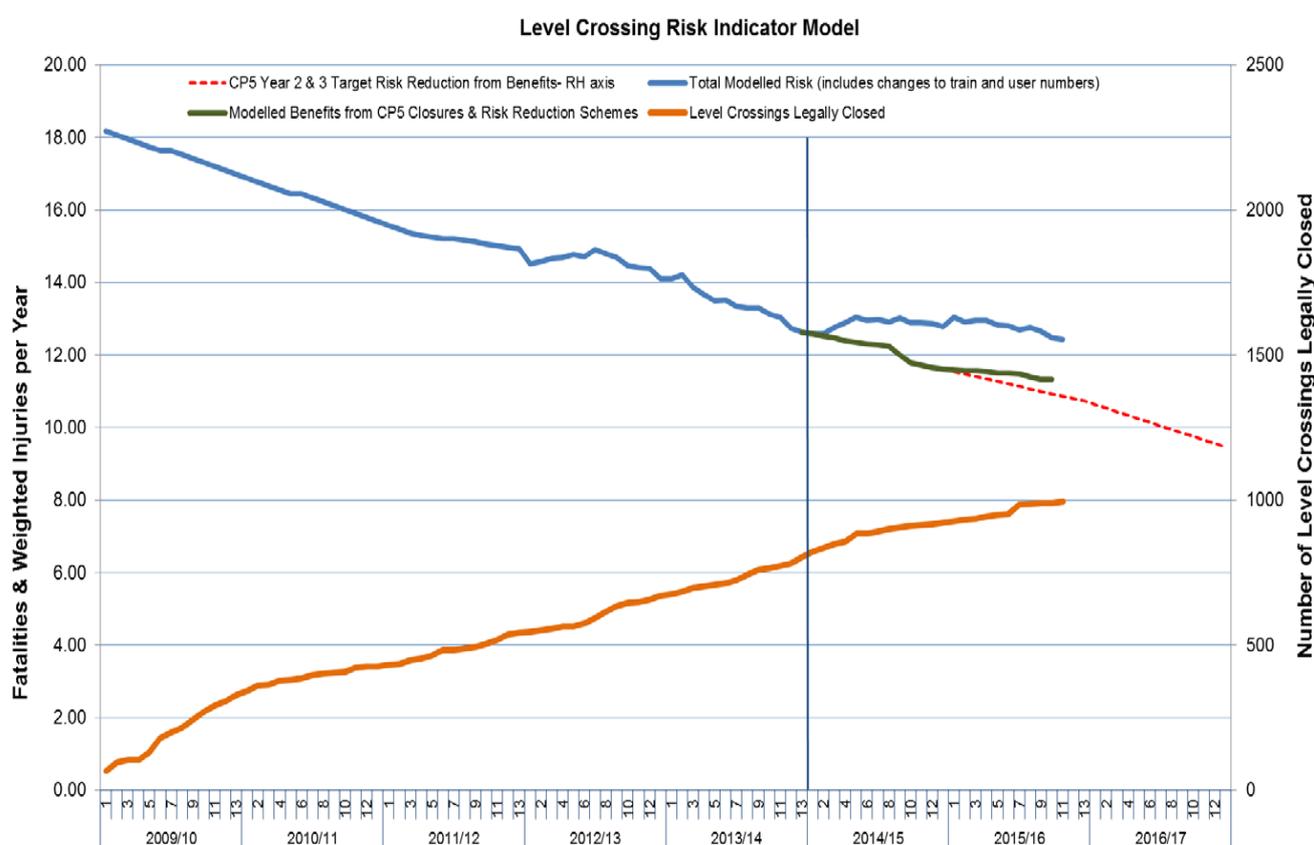
20. Responsibility for controlling level crossing risk is shared between the railway infrastructure manager, the train operating companies, highway authorities and users of the crossing. Effective co-operation and collaboration between these parties is critical and each has a role to play, although the contribution of each party to risk control will vary between crossings, as will their level of understanding.

Industry activity

Network Rail

21. Network Rail's target for risk reduction across the level crossings estate is to reduce risk by 25% in CP5. Risk reduction in CP5 is measured against the FWI⁷ for all crossings that existed at CP4 exit. This was in order to 'peg' the risk reduction achieved, since information about crossing use is changing all the time, and often produces 'increases' in risk as a result of better census data revealing greater crossing use.

22. The graph below shows the trajectory of risk reduction across Network Rail's level crossings, as provided to us by the company.



23. In the graph above, the red dotted line shows the trajectory of risk reduction. The dark line shows how the risk reduction (as measured from ALCRM FWI at CP4 exit) has progressed against that target. It can be seen that, unsurprisingly, this correlates strongly to level crossings closures. The blue line shows the impact of better census information (ie better knowledge about the use of level crossings) since the CP4 exit baseline. This has

⁷ FWI (Fatalities Weighted Index): In this context, these FWI figures are based in the levels of actual harm manifested at each type of level crossing over the previous ten years (as taken from a computer database called SMIS into the ALCRM calculations), and then manipulated with certain weightings which are built into the ALCRM algorithms.

revealed higher levels of use and in turn this pushes up the 'risk', as reflected in the blue line.

24. Since the introduction of level crossings managers (LCMs) and route LCMs, ORR has found evidence of the better understanding by Network Rail of risks at level crossings. LCMs are carrying out "narrative risk assessments" as well as "All Level Crossing Risk Model (ALCRM)⁸ assessments" which have helped them to identify better controls that can reduce risk further. However, in some cases, such as straightening "skewed" pedestrian crossings⁹, the design of the ALCRM means that there is no risk reduction shown, so LCMs are having difficulty in securing resources for such work. So a challenge for Network Rail in the future will be to incorporate the narrative risk assessment in this process better, to ensure such controls are put in place and that the risk reductions are acknowledged and accounted for.

25. Network Rail continues to develop new technologies that will provide an active warning to users of approaching trains, which have included the development of warning systems activated by treadles, and radars which can be powered by wind and solar energy. They are commissioning POGOs (power operated gates) to remove the need for vehicle drivers to walk over the crossing four times just to open and close gates. However, Network Rail's own approval process has not always been fit for purpose and takes too long to complete, with the result that some of the new technology is still not in use on the network. We will continue to challenge on this aspect through our regular meetings with Network Rail.

26. Network Rail is also developing 'red light enforcement' technology for use at high risk AHB and AOCL crossings to capture users who deliberately pass the road traffic lights at danger.

27. In Control Period 4 (CP4, 2009 -2014) Network Rail closed over 800 crossings and reduced modelled risk at crossings by over 30%. As part of ORR's final determination for Control Period 5 (CP5, 2014 - 2019) – published on 31 October 2013 - ring-fenced funding of £99 million has been made available for Network Rail to make further reductions in risk beyond what might be considered minimum legal compliance. Another £10 million has been made available specifically to fund closures in Scotland. Network Rail's routes continue to have a programme of closures which is over and above that provided through the ring fence-funded closure programme.

28. Network Rail is producing a level crossings strategy which will demonstrate how it intends to reduce risk in this and future control periods by (amongst other things):

- (a) continuing to focus on closure of targeted high risk level crossings;
- (b) working to a time-bound plan for making all passive crossings "active", which means providing clear warning of approaching trains, and replacing telephones and whistle-boards to reduce the likelihood of human error by users of the crossing;
- (c) prioritising the elimination of passive crossings on high speed lines or at stations;
- (d) prioritising the removal of AHBs near stations or schools;

⁸ ALCRM = "All level crossings risk model", which is a tool for risk ranking level crossings. The output is not a risk assessment: it is a risk ranking

⁹ "Skewed" means pedestrian crossings which are not aligned at a right angle to the track(s). Straightening them means that users are better able to traverse the crossing safely.

- (e) improving conditions underfoot and signage, including the marking of danger zones to raise user knowledge and situational awareness;
- (f) developing and rolling out a full barrier automatic crossing with obstacle detection; and
- (g) ensuring the whole organisation takes account of the strategy in what it does and not just the 'level crossing community'.

Heritage railways

29. Since heritage train speeds are lower the risks associated with level crossings on heritage railways are different - but they are still significant and therefore our strategy is also applicable to this sector of the industry. Indeed, heritage railways need to manage crossings to the same legal standard as their mainline counterparts, as the risk faced by individual users of crossings is akin to that run by users on the main line network.

30. In 2012-13 ORR Inspectors visited all AOCL crossings to check compliance with the applicable Orders and to ensure they were being maintained and remained fit for purpose. Work has been undertaken with the Heritage Railway Association (HRA) which as a result has issued straightforward guidance to minor railways on minimum sighting distances at footpath and road crossings, and on vegetation maintenance to improve sighting.

31. On heritage lines ORR will continue to use the consultation process provided by the Transport and Works Act to pursue its policy of requiring risk assessments which consider closure as the first option, as part of the principles of prevention¹⁰.

32. ORR continues to raise level crossing safety in the course of inspection visits and from 2013-14 it has been promoting the replacement of filament lamp signal heads with LED versions where risk assessment by the Railway indicates that it is right to do so.

Tramways

33. The junctions between tramways and roads are almost exclusively treated as the junction between two roads, and the management of such junctions in the same way as level crossings is rare in Great Britain¹¹.

34. Junctions where roads cross tramways are different from level crossings in that they are designed as road crossings with the usual highway traffic controls rather than the specialised flashing lights, audible warnings and barriers seen on mainline railways. The crossings and traffic lights are the responsibility of highway authorities and the police are responsible for investigating incidents.

¹⁰ Management of Health and Safety at Work Regulations 1999, schedule 1.

¹¹ For example, Seaton Tramway at Colyford, Nottingham Tramway at St Alban's Rd & Brickyard Drive; Manchester Metro-link at Navigation Road are managed as level crossings rather than as road junctions.

ORR activity

35. Level crossings on both the main line and heritage railways remain a high priority for ORR. We have been active for many years, using relevant legal mechanisms to pursue our strategy and so improve the risk profile of level crossings. Our key activities and the outcomes we seek from them are in the table that follows:

ORR activity (in broad priority order)	..the outcome we seek from this activity
<p>Adopting a policy of not authorising any new level crossings other than in exceptional circumstances and requiring risk assessments to consider closure first as part of the principles of prevention. Our policy is on our website at: http://orr.gov.uk/data/assets/pdf_file/0003/16527/rgd-2014-06.pdf</p>	<p>No substantial increase in the number of level crossings, and a reduction in the number if reasonably practicable.</p>
<p>Targeting inspection activity on particular aspects of risk management. In CP5 we are concentrating our proactive inspection on crossings with whistle boards, in long signal sections or with deficient sighting.</p>	<p>Proportionate, risk-based supervision of management of level crossings, targeting areas where we anticipate that improvements may be needed.</p> <p>Checking that rail infrastructure managers are protecting the safety of level crossing users and train occupants.</p>
<p>Encouraging Network Rail to develop a level crossing strategy which (amongst other things) should identify how it can make passive crossings active.</p> <p>For consistency, discussing the creation of a level crossing strategy for its sector with the Heritage Railway Association.</p>	<p>Long-term safety improvements for users and train occupants, to be achieved by Network Rail and heritage railways adopting a clear, coherent strategy and then implementing it over time.</p> <p>(The outcome from making passive crossings active is to add an extra layer of engineering control to crossings that rely mostly on the vigilance of users to protect their own lives when crossing.)</p>

<p>Encouraging Network Rail to carry out narrative risk assessment and not rely solely on ALCRM assessments.</p> <p>Narrative risk assessments encourage 'optioneering' where Network Rail can decide on what controls should be fitted to crossings, over what is there already, if a crossing must remain.</p>	<p>Improved safety for crossing users and train occupants arising from better understanding of the risks and how to control them at every individual crossing on the network.</p>
<p>Encouraging Network Rail to explore ways in which the European Rail Traffic Management System (ERTMS) can be exploited to improve the safety and convenience of all crossing types</p>	<p>Network Rail taking the opportunity, when re-signalling parts of the network to ERTMS standard, to remove crossings where possible and, at any that remain, exploiting ERTMS to improve safety relative to the former signalling system.</p>
<p>Encouraging the industry, particularly Network Rail and heritage, to develop new technologies that will reduce risks at (for example) footpath and UWCs and crossings with restricted sighting.</p>	<p>Improved safety for users and train occupants at crossings that rely presently on the users' vigilance alone, by adding a layer of engineered protection from new technologies.</p>
<p>Processing submissions for the authorisation of level crossings and significant change to existing crossings in line with Level Crossing Orders.</p>	<p>We agree with the Law Commissions' conclusion that this work should no longer be done by law, but at present it is mandatory. Given that we have to perform it, we will seek to use the process to ensure that proper risk assessments and implementation of controls have been carried out by Network Rail or the heritage railway concerned.</p>
<p>Inspecting level crossings to ensure compliance with the law, and any Level Crossing Order.</p>	<p>Checking (by sample inspections) that Network Rail or the heritage railway is implementing proper risk controls at particular crossings, and taking enforcement action if appropriate to secure the safety of crossing users and train occupants</p>

Investigating complaints and incidents at level crossings that meet our criteria for investigation

Holding organisations to account for any harm they have inflicted on crossing users or train occupants - but this is low in our priorities because we target our resources on activities that avoid harm happening in the first place, rather than on holding others to account after people have been hurt.

Investigating complaints may reveal poor management of crossings that can be remedied to the benefit of users and train occupants.

36. We have investigated level crossings incidents and taken enforcement action as a result of our findings, including prosecution. Our enforcement notices are published on our website.¹²

Rail Safety and Standards Board (RSSB)

37. RSSB undertakes level crossing research and a significant amount of activity has been completed over the past decade. This has included research into human factors, assessment of new control measures and development of risk management tools including the All Level Crossing Risk Model (ALCRM), and the Level Crossing Risk Management Tool Kit (LXRMTK).

38. RSSB has undertaken research into the causes of pedestrian accidents at level crossings and identifying potential solutions. This work has also examined the effectiveness of decision points (at which users decide whether it is safe to cross at user-worked crossings). Research has also been carried out into level crossing signage and warning systems, and has been centred on gaining an accurate understanding of user perceptions and common errors.

39. We will continue to press RSSB to conduct research that supports our strategy and check that the industry acts upon research results to improve safety at crossings. In particular, ORR will support research that gives better understanding, and then improves the impact, of infrastructure design on human behaviour, in view of the evidence of the importance of this element in the total risk associated with crossings.

Rail Accident Investigation Branch (RAIB) Reports

40. By autumn 2015, RAIB had published a total of 48 reports into incidents at level crossings (40 Network Rail and 8 heritage and light rail crossings) and made 218 recommendations. This includes three class investigation reports on station pedestrian crossings (2006), UWCs (2009) and AOCLs (2011).

¹² <http://orr.gov.uk/>

41. RAIB makes recommendations which we consider and pass on to relevant bodies which are then required to take them into consideration and act upon them appropriately. ORR also has an obligation to report to RAIB the progress made by the industry on each recommendation within its reports, within 12 months of the report being published. Our responses to RAIB are published on our website. In addition ORR reviews all reports to identify new or emerging risks and takes account of this intelligence when planning what action it should take to encourage the industry to manage its risks better.

Glossary of terms	
Acronym	Definition
ABCL	Automatic barrier crossings, locally monitored
AHB	Automatic half-barrier crossings
ALCRM	All level crossing risk model
AOCL	Automatic open crossings, locally monitored
AOCL+B	Automatic open crossings, locally monitored + barrier
AOCL/R	Automatic open crossings, locally monitored /remotely monitored
ASPR	Annual Safety Performance Report
CP	Control periods
DfT	Department for Transport
ERTMS	European Rail Traffic Management System
EU	European Union
FWI	Fatalities and weighted injuries
HRA	Heritage Railway Association
HSWA	Health and Safety at Work etc. Act 1974
LED	Light Emitting Diode
LX	Level crossing
LXRMTK	Level Crossing Risk Management Tool Kit
MCB	Manually controlled barrier crossing
MCB- CCTV	Manually controlled barrier crossing with closed circuit television
MCB OD	Manually controlled barrier – obstacle detection
MCG	Manually controlled gate
MSL	Miniature stop lights
OLE	Overhead Line Equipment
ORR	Office of Rail and Road
PIM	Precursor Indicator Model
RAIB	Rail Accident Investigation Branch
RSSB	Rail Safety and Standards Board
SPC	Station Passenger Crossings
SRM	Safety Risk Model
UWC	User worked crossing
UWCT	User worked crossing with telephone