OBJ/1002/PJC/2

The Hoad family of Parsonage Farm, and the Trustees and Executors of the Noel de Quincey Estate and Mrs Emma Ainslie of Moat Farm

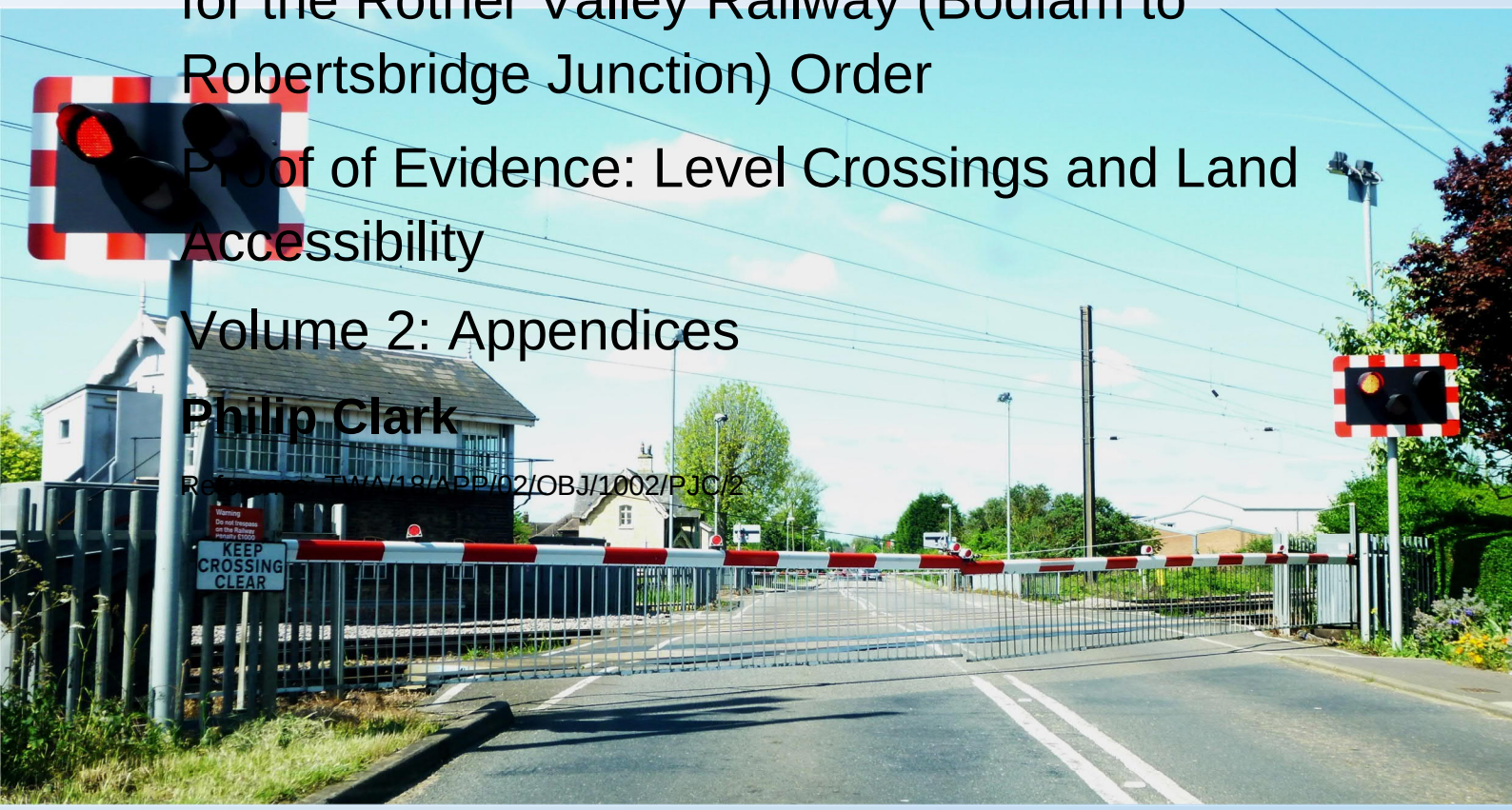
ROTHER VALLEY RAILWAYS

Transport and Works Act 1992 (TWA): Application for the Rother Valley Railway (Bodiam to Robertsbridge Junction) Order

Proof of Evidence: Level Crossings and Land Accessibility

Volume 2: Appendices

Philip Clark



Ref: TWA/18/APP/02/OBJ/1002/PJC/2

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APPENDICES

This document should be read in conjunction with supplementary document **OBJ/1002/PJC/1 – Proof of Evidence: Main Proof** that references the below Appendices.

- Appendix APP-A – ORR Letter response to WSP 25th March 2020 ref ORR/250320
- Appendix APP-B – NR/L2/SIG/11201/ModX21
- Appendix APP-C – Railway Group Standard GK/RT/0075 Lineside Signal Spacing
- Appendix APP-D – Narrative Risk Assessments (updated 2021)
- Appendix APP-E - ORR Strategy for Regulation of Health and Safety Risks 7
- Appendix APP-F – Heritage Rail Association HGR-A0458
- Appendix APP-G – DEFRA Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose, 2008.
- Appendix APP-H – ECML Freedom of Information Request FOI 696

APP-A - ORR LETTER RESPONSE TO WSP 25 MARCH 2020 REF: ORR/250320

Eur Ing Ian Raxton
HM Principal Inspector of Railways

Email: ian.raxton@orr.gov.uk

25 March 2020

WSP
Mountbatten House
Basing View, Basingstoke,
RG21 4HJ

By email to Alex Smith Alex.Smith@wsp.com

For the attention of Richard Hutchings

Dear Richard,

Thank you for the letter sent on 17th March 2020, sorry it has taken a few days to get back to you but I hope you will appreciate that there has been some disruption to working patterns over the last week.

The questions you posed in the letter all seemed fairly clear to us and I hope that the responses below are clear in return.

Q1 – Please would you kindly confirm whether ORR has undertaken its own verification of ORR's cost information?

ORR has not undertaken any verification of the cost information generated by Arup and submitted by RVR.

In terms of the use of 44% or 10% as contingency and bias, it may not be unreasonable to assume a figure lower than 44% when the cost of much of the labour for the scheme could come either as voluntary or as a contribution in kind from a commercial firm.

Similarly the cost of the physical equipment at the crossing is likely to be relatively fixed over the timescale in question and would not necessarily warrant a 44% contingency.

ORR has been clear in our Statement of Case that we have taken the figures on face value. To undertake a comparable costing exercise would require us to effectively repeat the work already done by the consultancy firm which does not appear to represent a useful application of our resources.

Q2 – Please would you confirm whether ORR has any concerns regarding the works being undertaken by volunteers or considered whether the reliance on volunteer workforce will be acceptable to HE and in turn whether it has given consideration to the likely increase in the overall costs of the project in the event that professional contractors are required to be appointed as part of its analysis, given ORR's conclusion that the justification?

ORR expects that all staff, whether employed, contracted or volunteer, should be fit and competent to undertake the tasks they are engaged in. This will include any design, construction and commissioning works.

The construction and maintenance of level crossings is a particular skill set, but that is not to say it cannot be found within volunteers, who may come from day jobs in the mainline railway industry or in highways sector.

The provision of the crossing surface itself is quite likely to require the use of a commercial firm, but such an installation is a well understood process and there several methods of construction that could be used and we believe that the RVR cost estimate included for this.

ORR cannot offer a view of what level of competence Highways England is likely to seek in relation to works to the A21. Highways England has made no representations to ORR on the costs estimated.

Across the wider railway it is normal for heritage railways to construct their extensions using volunteer labour for earthworks, drainage and track construction. Again ORR would expect a suitable level of competence and supervision. Based on experience at other railways we would not expect this to be an issue.

Q3 – Please could kindly you explain why ongoing maintenance/whole life costs have not been taken into account in ORR's analysis?

In this case we took a deliberate decision to exclude maintenance costs, but this was specifically in terms of the calculation of the gross disproportion factors.

We did this to firstly emphasise that ORR was not conducting a far reaching quantified risk analysis on behalf of RVR. Progressively refining the cost elements and including more and more factors in the calculation suggests a degree of accuracy that generally is not relevant when all the calculation is providing is an indication of the degree of disproportion that then is taken on into a wider consideration of issues.

The second reason that they were excluded was that in proportion to the initial capital costs of the works the maintenance costs would have be a fractional increase into a future lifespan cost. It is also not clear that the difference in annual inspection and maintenance costs between bridge and those of a crossing would have been significantly different. A level crossing would likely be inspected and maintained by RVR volunteer staff, with repainting of lines and sign replacement occurring relatively infrequently. A structure such as an overbridge for the railway would still require inspection on a regular basis, but being over

the A21 might require traffic management to be put in place by a Highways England contractor at some cost, and consequent maintenance such as painting would be dependent on structure type and might also need traffic management in place. The differential between the maintenance costs of a bridge or crossing are debatable, but in comparison to the high initial capital costs of the infrastructure are not likely to be so significant as to need considering in the gross disproportion calculation, which in itself is only an indictor and not an absolute matter.

Q4 – Please could you kindly clarify why ORR has not given any consideration to matters of highways safety and convenience and whether in preparing its Statement of Case it has taken into account the strong objection raised by Highways England?

The distinction that the Statement of Case makes between ORR preparing a submission to a TWA Inquiry and ORR's actions when dealing with Level Crossing Orders rests on the powers being applied.

When ORR assesses Level Crossing Order applications we do so on the delegated powers of the Secretary of State. As part of that process we do consider highway safety and convenience matters, but it is not ORR that develops that consideration – we seek the opinion of the relevant highway or roads authority as part of that process. ORR then adds to that the views of other consultees and takes the overarching view on behalf of the Secretary of State.

In this case ORR is not acting in such a role, we are delivering a view on the basis of our direct powers related to railway safety. It is the Inquiry Inspector who acts for the Secretary of State and seeks the views of the relevant parties including Highways England and the Highway Authority to take the overarching view.

Highways England has made no submission or representation to ORR on the most recent RVR documentation and such a submission should be made to the Inquiry Inspector. The Highways England Statement of Case on the Inquiry website has not been sent to ORR directly, and is dated 20 September 2018 which suggests to us that it not based on the most up to date material provided by RVR in the latter part of 2019.

You ask whether ORR's comments being restricted to railway safety matters is somehow contrary to our statement that if a crossing was approved at Inquiry then we would expect further discussions on it. We do not believe so; if the Inquiry considers on balance that a crossing is justified then the current design will inevitably need to be developed in detail, specific equipment suppliers contracted with, and the exact placing of signs, lines, equipment and road surface treatments etc. agreed with relevant authorities. These in turn will then dictate the terms of the Level Crossing Order that will need to be drawn up. As noted above when we conduct that process on behalf of the Secretary of State we will seek the views of the relevant parties, including highway safety and convenience views of Highways England, as part of the Order process. We would regard it as normal process that the principle of a crossing is debated in the TWA and then the detail is debated as part of a Level Crossing Order application.

Q5 – please could you confirm whether ORR have considered the combined impacts of the Northbridge Street level crossing with the A21 crossing?

ORR has considered each crossing in isolation.

In railway operational terms there does not appear to be any intrinsic reason why the two crossings should not operate safely given the distance between them and the likely train speeds.

ORR is not competent to conduct an analysis of the interdependencies between sites in the highway network; we would expect any such issues to be raised by the relevant highway authority to the Inquiry.

Q6 – Please could you clarify whether any discussions have been had with RVR regarding the "most appropriate" crossing control and whether ORR has given any consideration to the possibility that the "most appropriate" solution may result in an increase in costs (both of implementation and ongoing maintenance)?

The description that RVR have provided of the level crossing controls appears to be overly complex and perhaps suggests that the idea that adding more controls increase the acceptability of the arrangements. ORR believes that the arrangements may in fact be more complex than necessary and that the use of a standard mainline style obstacle detector managed crossing may be more appropriate, and in fact this may be cheaper rather than more expensive.

It is also likely to be several years until the crossing is constructed. In that period new technologies may well come to market and be more appropriate to the location. ORR would not want the form of crossing to be tied down in detail as this removes the flexibility to use more appropriate solutions if they arise.

ORR does not consider that this is in any way unusual, we would always seek the most appropriate form of crossing arrangements at the time a railway is constructed.

ORR's reluctance to see the form of crossing defined in detail as part of the TWA Order comes from experience of other railways authorised under various forms of statutory powers. There was a period when it was normal for the exact form of level crossings on railways to be written out in the Private Acts and Light Railway Orders that preceded the TWA process. These statutory instruments continue to cause administrative and regulatory problems to this day because of their inflexibility and the burden of changing them when crossings need to be upgraded or modified to accommodate changes and new and improved technologies. Hence ORR would prefer that the form of crossing is left to be developed as the most appropriate at the time.

Q7 – please could you elaborate on ORR's concerns regarding the proposals for an at grade footpath crossing and clarify whether you have had any discussions with RVR regarding the design, operation and maintenance of such a crossing?

RVR have stated that the footpath will be diverted beneath the railway so this does not appear to be an issue.

However if some complication were to arise and diversion below the railway turned out not to be acceptable and a proposal to cross on the level was returned ORR would have concerns. Principally these are because the footpath is so close to the A21 that train crew would have a significantly increased workload with the need to observe the two crossings in close succession; higher workloads lead to an increased potential for error. In such circumstances we would expect RVR to be able to present a robust case that an overbridge or alternative underpass was not reasonably practicable.

While the risk is tolerable, when there is an easy diversion available and is reasonably practicable then the grade separation is the route to be followed.

Q8 – please could you clarify ORR's position and whether ORR consider that the bridge option should be the preferred design?

If this bridleway were at another part of the country where the land ownership, ground conditions and visual impacts were not so problematic there might not be the same discussion to be had. In cost terms the construction of a bridge over the railway at the lower of the costs suggested by RVR would seem to make it reasonably cost effective to construct. So, based on the evidence presented by RVR we have concluded that it appears reasonably practicable to provide a grade-separated crossing.

We acknowledge however that at this specific site there may be issues with obtaining enough land to construct such an overbridge, that the ground conditions may require substantial foundation structures and also that the AONB may raise issues, so that there may in fact be other issues of cost and practicability at this specific location.

These factors may mean that a bridge is not acceptable in a wider view, or that considerable additional cost is required for land and to create an aesthetically suitable, stable, structure. This in turn could substantially increase the cost estimated by RVR meaning that a bridge may then not be the reasonably practicable option.

Whilst an at-grade bridleway crossing is not desirable it is conceivable that such a crossing could be constructed in a way that it has a tolerable level of safety. Technologies are now available using solar/wind power to support automated warnings at remote sites which could be used, and the location is on a relatively straight section of line which reduces issues around sightlines between users and approaching trains.

Q9 – please could you provide further information on ORR's position should agreement on the alternative methods of access not be possible? Have ORR received information from RVR on reducing the crossing points, or applying appropriate warnings? Furthermore, should it be the case that RVR should cater for the alternative methods of access within their cost and safety analysis?

ORR has little information from RVR on these potential user worked crossing locations or the potential for their consolidation.

RVR have stated that they would expect to fit a form of warning system to the crossings for users, though we would prefer not to tie the railway to a specific product or system at this point. For similar reasons to those noted previously in relation to road crossings we would expect to discuss each location on an individual basis to assess what is the most appropriate solution for the characteristics of the location and usage and the technology on the market at the time.

It should be noted that private user worked crossings giving access between parcels of land would not normally be within the scope of the Level Crossing Order process unless there was some type of public right of way involved, we do not believe that this is the case in this proposal.

It must be emphasised that ORR would prefer the avoidance of user-worked accommodation crossings; and if this is not possible, for the number to be kept to an absolute minimum and that there is still a requirement to demonstrate that alternatives are not reasonably practicable. That said there are many such crossings on heritage railways and the mainline network and these can be constructed and used in a tolerably safe manner. The majority of such crossings have little or no advice for users beyond signage warning them to look both ways before crossing; it is features such as this that lead to the incidents and accidents that do occur.

In the case of the proposed RVR route the alignment of the route is relatively straight making sighting of approaching trains relatively easy for users, and train speeds would be limited to at most 40 kph (25 mph). Similarly the train crew would benefit from the alignment in having good time to see an obstructed crossing and reduce speed on approach.

There is no reason why such a crossing could not have a tolerable level of risk, but it is the variability in user behaviour that then introduces uncertainty. The use of technology to support decision making by crossing users would help to reduce that uncertainty and hence keep risk to a tolerable level. As noted above we would still expect each location to be justified on a site by site basis to demonstrate that an alternative access was not reasonably practicable.

Q10 – please could you kindly clarify whether ORR consider that the provisions set out by RVR do not include the highest level of protection and therefore amendments should be made?

As noted previously we think that the proposals may in fact be overly complex and a technically simpler solution would be more effective. We would also want the case to remain flexible to accommodate the most suitable technology that is available at the time.

Q11 – please could you kindly clarify whether ORR has given any consideration to the need for and potential conclusions of such assessments?

ORR has restricted analysis to railway safety impacts. The assessments that you refer to all related to highway safety issues, we would expect these to be addressed by Highways England and any relevant findings to be made available to the Inquiry Inspector.

Highways England have not raised any concerns with ORR regarding these assessments.

Q12 – Please could you kindly clarify whether ORR has any views on the acceptability of this proposed operational procedure?

The text suggesting that "assistance from the train crew may be necessary to halt road traffic" is not ideal at this location. The conventional technique for crossings such as the type proposed would in reality be to manually trigger the operation of the wig-wag signage which is the signal to road traffic to come to a halt. This avoids the need for staff to go into the road to halt traffic. So staff walking into the road is not a practice that we expect would actually need to be used at the A21. We would however expect the RVR to consider this eventuality as part of their safety management system, and develop suitable arrangements should the crossing completely fail.

Q13 – This conclusion makes two overarching points. First, that it is for the Secretary of State to balance any public interest in the proposals with the "inevitable" and "inherent" risks, and secondly, in effect, to consider whether ORR's exceptional circumstances test has been met.

We appreciate that based on its new SoC, ORR considers that the exceptional circumstances test has been met (albeit not for the proposed bridleway crossing) – we would like to discuss ORR's assessment in light of the points raised above.

However, it will be helpful to understand if ORR's position remains as set out in the first half of the concluding paragraph of its letter of 28 May 2018. In particular whether it remains ORR's position that there is a residual risk that would not exist if there were no at-grade level crossings and that it is for the Secretary of State to carefully consider whether that risk is outweighed by any public benefits of the proposals?

The creation of anything new inevitably creates a risk, the question is always whether that risk is balanced by the benefit the development brings and whether that residual risk is tolerable. ORR's position remains that an at-grade crossing will always present a higher level of risk than a grade separated crossing or not having a crossing at all.

Crossings can be tolerably safe, but there is inevitably still a risk that would not exist if the crossing were not present. This does not mean that a crossing is unacceptable, just that a decision has to be made whether that residual risk is tolerable and acceptable when set against the benefits that arise from the railway being in place.

Yours sincerely

Eur Ing Ian Raxton
HM Principal Inspector of Railways

cc. Ian Skinner, ORR

APP-B – NR/L2/SIG/11201/MODX21

Ref:	**NR/L2/SIG/11201/ Mod X21**
Issue:	3
Date:	02/06/2012
Compliance date:	01/12/2012

Level 2

Signalling Design: Module X21 – Level Crossings: Manually Controlled Barriers With Obstacle Detector

Endorsement and Authorisation

For endorsement and authorisation, please refer to NR/L2/SIG/11201

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Issue record

Issue	Date	Comments
1	September 2011	First Issue
2	December 2011	Update
3	June 2012	Updated for MROT and auto lower strike-ins

Compliance

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1 MANUALLY CONTROLLED BARRIER WITH OBSTACLE DETECTOR (MCB-OD)

1.1 GENERAL DESCRIPTION.

1.1.1 These crossings are protected by colour light signals or motor worked semaphores that are capable of reverting to danger automatically behind a train. These signals shall be interlocked with the barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers and a “Crossing Clear” is confirmed by the obstacle detector.

1.1.2 These crossings normally use four barriers, but on smaller roads where considerable widening would be needed to make four barriers practical, then two barriers may be used.

1.1.3 The optimum distance between the crossing and the protecting signals is standard overlap distance, but is often varied as a result of taking into account other factors:-

- If signal spacing is better as a result, the protecting signals may be in the range 50m to 600m without further consideration.
- If the crossing is closed to road a significant time in any hour, then reducing to 50m minimises road closure time.
- Where two crossings are sited in the same signal section, then the distance to the second crossing is often unavoidably more than 600m. This can be minimised by moving the protecting signal at the first crossing to or towards 50m.
- Protecting signals may be within 50m if some appropriate SPAD mitigation is provided.

1.1.4 It shall not be possible to raise the barriers unless the signals are replaced to Red, and are free of approach locking, or the train has passed the signals and traversed the crossing.

1.1.5 The road approaches are protected by road traffic light signals and barriers on both sides of the railway. Audible warnings to pedestrians are provided.

1.1.6 The barriers shall normally be kept raised unless required to be lowered for the passage of trains.

1.1.7 The crossing is normally worked automatically and proved clear of obstructions during the closing phase by an obstacle detector system.

1.1.8 A scaled ground plan shall be produced showing the road and rail layout and all equipment sited at the level crossing.

1.1.9 Where there are four barriers, the entrance barriers shall be arranged to lower before the exit barriers. When the entrance barriers have fully lowered, then if an obstacle detector is reporting the crossing is clear, the exit barriers shall lower. (Details of obstacle detector operation and interaction with the barriers are given later.)

1.1.10 When all barriers have fully lowered, then if the obstacle detector system reports the crossing is clear, (and no other interlocking prevents it), the protecting

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signals shall be allowed to clear.

1.1.11 A minimum of two audible warning devices are provided. They shall be normally sited at the diagonally opposite nearside corners of the crossing facing onto the crossing area. Larger crossings may use more warning devices. See the audible warning section for more details.

1.1.12 Telephones for public use shall be provided.

1.1.13 All crossings shall be provided with a Datalogger that monitors and records the crossing operation.

2 TRAIN DETECTION SYSTEM CONTROLS.

2.1.1 Train detection systems shall be provided between the protecting signals and the crossing for all signalled rail approaches. These systems shall maintain the interlocking once a train has passed the protecting signal until the train is clear of the crossing.

2.1.2 If a train passes a protecting signal at danger (SPAD), the level crossing red road signals shall immediately illuminate (Bypassing the amber phase in doing so.) The barriers shall not automatically lower.

2.1.3 If the protecting signal is less than 50m from the crossing, then the train can be allowed to approach the signal at red if one of the following measures is applied;

- "Stowmarket Controls" - The RTL's shall illuminate automatically in a normal sequence with Amber followed by flashing reds when a train approaches within 125m of the crossing. If the route forward is set, the crossing sequence shall continue with barriers lowering and this shall be the normal method of operating the crossing where there is a station on the approach and stopping trains only pause for say a minute in the station. (There is no requirement for the protecting signal to be a minimum of 25m away where a station is involved.) This function may be achieved by a track circuit joint, Axlecounter or single treadle physically sited at or before the 125m point or be achieved using predictor based equipment. Where the route has not been set beyond the signal, the barriers shall not descend and the RTL's shall automatically extinguish after a time. (default of 30 seconds) Subsequent setting of the route forward during this time shall continue the sequence from the point it has reached. If the time expires than a normal crossing closure sequence is initiated when the route forward is set. Where there are two or more lines, then to ensure MROT the 125m strike-in may be extended and a timer used to delay the amber lights starting until reaching the 125m point for the first train, (default 20 secs). If the barriers are already lowered because another train has already struck-in on another line, then on reaching the initial strike-in, this shall prevent the barriers raising. If the route forward is set, the protecting signal may clear immediately. If the route forward is not set, the barriers shall be held down for a time (default of 30 secs) after the train reaches the 125m point after which they shall rise and the red lights extinguish,

- Where trains are regularly brought to a stand for a time greater than say one minute at the protecting signal, then "SPAD Prediction" shall be considered. In principle this shall detect the speed and braking of the train at some point on the

approach and shall illuminate the road lights automatically when the train approaches within 100m of the crossing and the prediction circuitry expects it to SPAD the protecting signal. In this case the flashing reds lights shall start immediately, bypassing the amber phase. An alarm shall be given at the supervising signalbox.

- Only applicable where because of the particular site arrangements, the move up to the protecting signal is only rarely used, - say less than once a week - in which case there is no requirement to provide any SPAD mitigation under this clause as it would not be cost effective to do so. However a minimum distance to the crossing of 25 Metres shall still be applied where it is practical to do so.
- Only applicable for bay or terminal platforms (Or any other situation where a train cannot arrive at the protecting signal heading towards the crossing): - There shall be a minimum distance to the crossing of 25 Metres except where the length of the platform and the stock using it means this distance would be impractical. In this case the distance between the protecting signal and the crossing may be reduced as necessary below 25 Metres to make the arrangement workable provided a train driver has good sighting of the protecting signal from any position he can start his train. (Provision of 25m or good sighting is considered sufficient mitigation for a “Starting against a Signal SPAD”.)

NOTE The 125m point used in Stowmarket Controls” to activate the RTL’s will give at least 8 secs warning at what has been deemed to be a reasonable worst case SPAD. The eight seconds allows 3 secs Amber then 5 secs Red. The positions used for SPAD prediction are expected to give 5 secs warning of Red lights from asimilar SPAD.

2.1.4 Train detection systems shall be provided beyond the crossing to release the interlocking and to provide an auto raise sequence.

2.1.5 Failure of the train detection systems between the protecting signals and the crossing shall cause the RTL’s to illuminate, (unless the signalbox is closed.) To extinguish the lights (to allow vehicles to pass over the crossing), requires the crossing to be operated in local control until the fault is rectified.

3 METHOD OF OPERATION.

3.1.1 The normal method of working is automatic using the obstacle detector system. Simple manual controls to raise and lower are provided to the signaller as a back-up.

3.1.2 Automatic operation is selected by the signaller setting the switch provided to the “Auto” position.

3.1.3 For automatic mode to take effect when selected, the following conditions must apply and shall also suspend automatic mode should they subsequently change:-

- “Auto” selected;
- Not in local control;
- Not failed
- Obstacle detector system not failed
- Crossing has not been operating an unusual time (See failure modes).
- Signal box not closed

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3.1.4 If auto mode is selected and the above conditions apply, the auto indication shall illuminate with a steady indication. If auto mode is subsequently suspended with the switch still in the auto position, the auto indication shall flash and an alarm shall sound.

3.1.5 If automatic mode is suspended while the obstacle detector is operating, then the interface shall shut it down in a manner that avoids it registering an out of sequence operation that would cause an alarm.

3.1.6 Manual operation is via turning the switch to “RAISE” or “LOWER” as required.

3.1.7 Turning the switch to “LOWER” shall initiate the normal crossing warning and closure sequence and then subsequently maintain the barriers down until the switch is moved.

3.1.8 Turning the switch to “RAISE” shall, subject to the crossing interlocking agreeing it is safe to raise the barriers, initiate a normal barrier raise sequence and then maintain the barriers in the raised position. If the interlocking does not permit the crossing to open to road at the time the switch is turned, then the crossing shall not open to road until the interlocking subsequently does agree it is safe to raise the barriers and the switch has then been re-stroked to the “LOWER” or “AUTO” position and then turned to “RAISE”.

3.1.9 In automatic mode, the crossing warning sequence is initiated by an approaching train. This may be directly initiated locally via track circuits, axle counters, treadles, predictors etc on the approach to the crossing. Or it may be via an indirect command from a train control system such as SSI, IECC, or an information system such as a Train Describer. There is no requirement for the lowering command to be failsafe. For starting from a platform auto lower may be initiated by a TRTS plunger or similar.

3.1.10 Auto requires routes forward to be set at the protecting signals (and where applicable, any other signals within the strike-in area.) Signallers workload is reduced by providing auto working facilities on the signals concerned If an ARS system does not cover the area plus Stopping/Non-stopping controls where there is a station on the approach to the crossing.

3.1.11 Auto operation is inhibited if the crossing is in local control, is failed, or the supervising signal box is closed.

3.1.12 Under auto operation the following rules for auto lower shall apply:

- Initiation shall occur in sufficient time for a train running at permissible speed to receive an unrestricted aspect 10 seconds before passing the AWS of the distant signal protecting the crossing. (The distant signal shall be understood to mean any signal that changes aspect as a result of the level crossing protecting signal changing);
- For a train approaching at maximum permissible speed, the train shall arrive at the crossing within two minutes of the crossing initiating. This time may be extended by 15 seconds where the average gradient to the distant signal is steeper than 1/400 falling, or 30 secs where steeper than 1/200 falling;
- For trains approaching at any constant speed between 45mph (72kph) and the maximum permissible speed, the trains shall arrive at the crossing within a

further minute of the limit set for maximum permissible speed.

- Second or subsequent trains that strike-in after another train has already initiated crossing closure are not required to meet these timings. For these trains arrangements shall allow a default MROT of 20 secs, made up of 10 seconds barrier raise plus 10 seconds road open time.

3.1.13 These rules usually require speed discrimination to adjust the initiation point to match the approaching train speed. The speed discrimination calculations may assume the train is approaching at a constant speed and shall not change its speed significantly. Where a MCB-OD crossing is retrofitted to existing signalling, then the positions of the existing signals may prevent one or more of the bullet points above being achieved. Where this occurs, any proposal to leave the signals in their existing positions shall consider the amount of infringement of the limits and the expected crossing closure times. For small excesses it may not be cost effective to move the signals so that infringements can be accepted. For busy crossings, (in this context, taken as where the road closure time is expected to be above 30 minutes in any one hour through the day), then gaining a few seconds on each crossing operation may make moving the signals cost effective. The project shall consider the merits against costs and in the case of busy crossings shall include discussions with the ORR before a decision is reached.

3.1.14 Where there is a station on the approach then the protecting signal shall always be sited between the station and the crossing.

3.1.15 Where the stopping pattern of trains varies, then where there is an IECC or similar, this can select for a stopping or non-stopping train using the timetable information. Elsewhere a manual stopping/non stopping push button or switch may be provided. If a push button is provided, the default “not operated” condition shall be to set for a stopping train. Pushing the button shall set for a non-stopping train. An indication shall be provided to show what is set.

3.1.16 For non-stopping trains, a computer based system or a predictor based system may be used to derive the speed of the train and provide a continuously variable activation point or equipment including treadles, predictors, track circuits and timers etc may be used to achieve a series of speed band related activation points.

3.1.17 Where the main system used for initiating the crossing is separate from the main signalling system, - or is nominally non-vital, (an example is a train describer), then a back-up arrangement of local train detection that is part of the signalling system shall also be provided. This shall initiate the crossing in the absence of the main system when the train passes the signal in rear of the protecting signal.

NOTE The intention is that if the system that initiates the crossing has failed, but the main signalling system is still available to run trains, that there be an alternate method of initiating the crossing. It will entail delay to the train as it will not receive a green at the distant, but it will remove workload from the signaller. A back-up system is not required if the initiation is part of the main signalling system so that any large scale failure of the system would make it impossible to run trains.

3.1.18 On four aspect signalling where the maximum permitted speed is 90mph (145kph) or more and the train is approaching at less than half the maximum permissible speed, it is permissible for the train to receive a cautionary double yellow aspect at the outer distant, but it shall receive unrestricted aspects at least 10

seconds before reaching the inner distant (single yellow), AWS magnet.

3.1.19 The initiation point shall assume the following times for crossing operation (table 20).

Table 1 – Crossing timings (MCB-OD).

Function	Time
Amber Road Lights	3 Secs
Red Road Lights	5 Secs
Entrance Barriers Lower	10 Secs
Exit Barriers Lower	10 Secs
Down Delay Time	1 Sec
Final Obstacle Detector Check	3 Secs
Interlocking & Aspect Clearing	3 Secs
Total Time	**35 Secs**

3.1.20 Two barrier crossings do not have separate entrance and exit barriers, but the same timings shall be used. (There is a greater chance at a two barrier crossing that a user or vehicle is still occupying the crossing at the time the barriers are due to lower, so would cause a delay to the train if extra time were not built in.)

3.1.21 Where there are two or more lines at the crossing then to allow for MROT between two trains on different lines the strike-in may be extended and a timer used to delay the crossing closure for the first train while using the extension to inhibit auto raise if a second train strikes-in before the first train clears the crossing. The default MROT shall be 20 secs, made up of 10 seconds barrier raise plus 10 seconds road open time.

NOTE As a general rule the first train "strike-in" will be at 35 + 10 = 45 secs running from the AWS of the distant signal. To give a nominal 20 secs of ATC/MROT time, the strike-in point may be positioned at 65 secs and a 20 sec delay timer used to delay crossing closure for the first train. This 20 secs timer is not required to be failsafe.

3.1.22 Where there are two or more lines and one or more have "Stowmarket controls", then since these controls operate for every train on that line they must also be timed and designed to allow MROT to be maintained. However MROT shall not be maintained for SPAD prediction or a SPAD past a protecting signal. For these the RTL's shall operate immediately regardless of infringing MROT.

3.1.23 When the warning sequence is initiated by either the auto mode or the switch in "LOWER" position, the amber road lights shall illuminate and the audible warnings shall start. If not running continuously the obstacle detector is activated and begins its warm up sequence. After three seconds, the amber lights shall extinguish, and be replaced by flashing red RTL's facing towards approaching road traffic. After five seconds (tolerance 4-6 seconds), barriers may be allowed to start lowering.

3.2 Barrier Management At Four Barrier Crossings

3.2.1 At a four barrier crossing then after the five seconds of red lights, the entrance

barriers shall begin to lower taking 6-10 seconds to lower to the down position. All boom lights shall illuminate when the first barrier moves out of the fully raised position. If either of the entrance barriers does not fully lower within a time (default of 12 secs), then the barriers shall immediately raise and when they have fully raised shall immediately try to lower again. The RTL's shall remain illuminated throughout this move. If on the second attempt, the entrance barriers do not lower within the time, then the barriers shall again raise, the RTL's shall extinguish, the audible warnings shall silence and the crossing shall re-open to road. At the same time a failed indication and alarm is given at the supervising signalbox. The crossing shall then await manual intervention.

3.2.2 When down detection of the entrance barriers is gained and the obstacle detector is reporting the crossing is clear, the exit barriers shall begin to lower immediately. If however the obstacle detector reports the crossing is occupied either at the time the barriers are due to descend, or subsequently reports the crossing has become occupied during the period of the descent, then the exit barriers shall be stopped and held at that point or position until the obstacle detector reports the crossing clear again or a time period, (default of 10 seconds), from the barriers becoming due to lower expires, after which the barriers shall fully lower irrespective of the obstacle detector. If the auto mode is suspended during this period before the barriers commence to lower, the full delay time shall run before the barriers commence to lower. If auto mode is suspended during a barrier lowering period when it was reporting the crossing clear, then the barriers shall continue to descend uninterrupted to the fully lowered position.

3.2.3 The use of the obstacle detector system to control the lowering of the barriers is not required to be failsafe. Either the primary obstacle detector or any complementary obstacle detector may be used by itself to determine if the crossing is clear for lowering the barriers. This may be especially appropriate when the XCU is in use because one of the detectors is failed. However any final crossing clear given after all barriers have fully descended must be failsafe and use all the obstacle detector systems.

3.2.4 If however the exit barriers do not achieve the fully lowered position at this first attempt, or if they fully lower but the obstacle detector is still reporting the crossing is obstructed, then the exit barriers shall rise again but the RTL's and audible warnings will continue operating and the barrier lowering sequence will repeat for a second time. Either the obstacle detector system shall report the crossing is clear or a default timer (30 seconds) shall expire after which the exit barriers shall lower. If at the second attempt the barriers fail to fully lower or the obstacle detector is still reporting the crossing is obstructed with the barriers fully lowered, then the exit barriers shall rise, the RTL's shall remain illuminated, the audible warnings shall continue and a failed indication and alarm is given at the supervising signalbox. The crossing shall then await manual intervention

3.3 Barrier Management At Two Barrier Crossings

3.3.1 At a two barrier crossing then after the five seconds of red lights, if the obstacle detector is showing the crossing is clear, the barriers shall lower taking 6-10 seconds to lower to the lower position. If however the obstacle detector reports the crossing is occupied at the time the barriers are due to descend, then the barriers shall be maintained raised until either the obstacle detector reports the crossing clear or a

time expires, (default 30 seconds), after which the barriers shall start to descend and shall take 6-10 seconds to reach the fully lowered position. If however the barriers do not achieve the fully lowered position at this first attempt, then they shall fully rise again but the RTL's and audible warnings will continue operating and the barrier lowering sequence will repeat for a second time. Either the obstacle detector system shall report the crossing is clear or the default timer (30 seconds) shall expire after which the barriers shall lower. If at the second attempt the barriers fail to fully lower or the obstacle detector is still reporting the crossing is obstructed with the barriers fully lowered, then the barriers shall rise, the RTL's shall extinguish, the audible warnings shall silence and a failed indication and alarm is given at the supervising signalbox. The crossing shall then await manual intervention

3.3.2 The audible warnings cease with all barriers fully lowered.

3.4 Conditions For Crossing Clear

3.4.1 When all barriers become fully lowered then providing the following conditions apply, a crossing clear is passed to the interlocking to allow the protecting signals to clear and the audible warnings are silenced:-

- A complete scan with the obstacle detector system that began after the barriers have been detected fully lowered reports the crossing clear of obstructions
- The obstacle detector system is not failed
- All barriers are detected fully lowered
- All barrier booms are proved intact

3.5 Crossing Re-Opening To Road

3.5.1 When the signals clear, the train proceeds over the crossing. Once the rear of the train is clear of the crossing, the barriers shall raise unless another train is already approaching its strike-in point on another line, or there is a second train following the first train which is approaching its strike-in point. If the approaching trains are close enough so that a road open time of 20 seconds (default), cannot be achieved, then auto raise shall be inhibited and the barriers shall remain down for the passage of the approaching train. Any timing calculations may assume trains approach at constant speed.

NOTE The default time of 20 seconds may be reduced to a minimum of 10 seconds where the road traffic is considered sufficiently light that 10 seconds is sufficient to clear most road tail backs.(A high proportion of barriers are knocked off by traffic in tailbacks trying to beat the lights and barriers.) The time of 20 seconds may also be extended if felt necessary to improve the situation provided the extended strike-in arrangements it would require are acceptable. Auto raise inhibit for trains on adjacent lines or second trains on the same line is not required to be failsafe.

3.5.2 Once all trains in the area have cleared the crossing, all barriers shall then rise simultaneously and shall achieve the fully raised position in 4-10 seconds. The intermittent red road lights shall extinguish before the barriers have risen to 45 degrees above horizontal. The boom lights shall extinguish once all barriers have reached the fully raised position.

4 FAILURE MODES.

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4.1.1 If an equipment failure occurs then a failed indication and alarm is given to the supervising signalbox.

4.1.2 If the crossing is closed to road for an unusual time (default of 4 minutes), then an indication shall be given to the supervising signalbox for the signaller to consider taking action. Where there are two or more lines the timer may be reset when a second train strikes-in before the first train clears the crossing, but this is subject to a maximum limit (default of 10 minutes), at which an indication must be given.

4.1.3 If, during the lower sequence, both red road lights on any RTL are failed before the point in the sequence that the barriers are due to start lowering, then the barriers shall remain in the raised position. In this situation, the barriers can only be lowered from the local control unit until the fault is rectified.

4.1.4 Once the barriers have begun to lower a further red light failure shall not stop or prevent them lowering.

4.1.5 If any red lamp in any RTL unit is failed, the red road lights indication given at the operating point shall flash instead of showing a steady indication.

4.1.6 Amber road lights shall be light proved. This function is not used in the crossing controls nor indicated to the operator but is recorded on the level crossing Datalogger to help investigate incidents and allegations.

4.1.7 If after two attempts at lowering the barriers, the barriers are not detected fully down or the obstacle detector system is still reporting the crossing obstructed, then an “obstacle detected” indication and flashing “AUTO” indication is given at the supervising signalbox and auto operation is suspended. (At a two barrier crossing both barriers shall raise, RTL’s shall extinguish, audible warnings cease and the crossing shall reopen to road. At a four barrier crossing the exit barriers shall rise but the RTL’s and audible warnings shall continue. The crossing will await manual intervention.)

4.1.8 If either entrance or exit barriers do not achieve the fully raised position within a time (default of 12 secs), of starting to raise, then the barriers stop in their present positions. The red RTL’s shall re-illuminate and at the supervising signalbox the “UP” indication begins to flash and an alarm is given. If the barriers are stopped during their movement by manual intervention the timer shall be reset and start again when the barriers commence movement again.

4.1.9 If barrier up detection is lost when the barriers ought to be raised, then a failed indication and alarm is given at the supervising signalbox.

4.1.10 A failure indication can only be extinguished when the barriers are either in the fully raised or fully lowered position. In the fully raised position, the failure indication shall only extinguish if the RTL’s are also extinguished. (RTL’s shall be taken to be extinguished if the controls are set for them to be extinguished. No light proving is required.)

4.1.11 All barrier booms shall be fitted with fracture segments (or an equivalent), which include proving contacts. Displacement of a boom resulting in damage to the fracture segment shall initiate an alarm to the operator and cause any protecting signals that are showing proceed aspects to revert to red.

4.1.12 The obstacle detector system shall monitor its own operation. In the event of

an unusual or inappropriate sequence occurring, it will declare a failure and refuse to give “Crossing Clear” until reset.

NOTE For the Honeywell Obstacle Detector; If and when a fault is detected, the crossing control system will attempt to automatically reset the obstacle detector. During the rest attempt a Yellow “OD Failed” indication shall be given to the signaller. If the obstacle detector does not reset, the fault indication given to the signaller becomes a Red “OD Failed” indication and technicians must be called. If the rest procedure is successful, the the sytem returns to normal operation and indications.

5 CONTROLS AND INDICATIONS.

5.1.1 Controls and Indications shall be provided to mitigate in the event of an “obstacle detected” alarm or an equipment failure in the supervising signal box.

5.1.2 The controls and indications shall be incorporated into the main signalling control system.

5.1.3 The following controls and indications shall be provided. (It is assumed below that push buttons are used but switches for push button functions may be provided instead):-

Push button:

- ACKNOWLEDGE (Alarm cancel etc)

Three Position Switch:

- RAISE, AUTO, LOWER.

Two Position Switch:

- SIGNAL BOX, OPEN or CLOSED (If Provided).

Indications:

- Up (Barriers Raised)
- Auto (Automatic mode selected and enabled)
- Working
- Red Road Signals
- Down (Barriers down)
- Detector (Obstacle detected and/or Local Crossing Clear in use)
- OD Fault (Obstacle detector system failed)
- Standby In Use
- Failed

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Audible Alarm

For crossing failures, local control, power supply failure or return, obstacle detected, obstacle detector failure etc cancelled by plunger.

5.2 Absence Switch.

5.2.1 If the controlling signalling centre or gate box is not manned continuously including when there is no booked train service, a 2-way absence switch shall be provided on the operator's panel. One switch may cover all crossings supervised by that operator. The switch positions are marked Signalbox "OPEN" and "CLOSED." A single indication shall be provided with the switch showing that when the switch is turned to the closed position that the system has responded. The indication is labelled "Closed".

5.2.2 To close the signalbox, the protecting signals shall be proved normal, the track sections between the protecting signals and over the crossing be clear, the crossing be in normal operation and the barriers raised. When the signalbox is closed, level crossing indications and alarms are inoperative except the "Closed" indicator lamp. At the level crossing, the train detection systems between the protecting signals and the crossing are inhibited from activating the RTL's.

5.2.3 On re-opening the signalbox, the signals protecting the crossing shall not be permitted to clear until the absence switch has been placed in the "Open" position. Other indications on the panel not directly associated with the level crossing may be cancelled by the absence switch as required.

6 OBSTACLE DETECTOR SYSTEM ARRANGEMENTS

6.1.1 The obstacle detector equipment must meet the following safety performance requirements:

- OD system must detect vehicles and other large objects capable of causing a derailment (e.g. large animals, motorbikes). That part of the OD system that performs this function shall be a SIL3 device, to match or be better than normal signalling interlocking standard equipment and to be orders of magnitude improvement on the human operative safety performance at MCB, MCB-CCTV and MCG.
- OD system must detect people on the crossing surface who may be standing or lying on the crossing surface. The size of people to be detected shall be a 5 percentile person aged 9 or older standing or lying on the crossing surface, and persons bigger than this. This requirement may be met by a system that is equivalent to a human operative performing this task at , MCB, MCB-CCTV and MCG crossings in respect of not detecting a target that should be detected.

6.1.2 The requirments may not be practical for one device or system. In which case the device that detects any large objects capable of causing a derailment shall be a SIL3 device and called the "Primary Obstacle Detector" (POD). If the crossing is sufficiently large that one POD cannot fulfil the derailment requirement, others shall be provided as necessary. Any other devices needed to fulfil the remaining requirement shall be called "Complementary Obstacle Detectors" (COD). There may

as many COD's as necessary to fulfil the requirement.

6.1.3 In order to give crossing clear, the output from all complementary obstacle detector shall be summed with all primary obstacle detectors.

6.1.4 Any failure of any complementary obstacle detector or primary obstacle detector shal be reported via a single failure alarm and indication.

6.1.5 In order to allow or delay the lowering of the barriers during the crossing closure sequence, the complementary obstacle detector system may be used without the primary obstacle detector.

NOTE There is no requirement for the lowering of the barriers to be controlled by a failsafe system, so the complementary detector may be used in isolation to lower the barriers.

7 VIDEO RECORDING ARRANGEMENTS

7.1.1 Video recording shall be provided. It shall operate regardless of the crossing being in automatic, manual, local or hand operation. As a minimum the recording shall include the entire period of crossing operation from the point that the crossing amber light sequence starts until the barriers become fully raised after the passage of a train. It may accept controls from the crossing equipment to tell it when to record. Alternately the recording may run continuously 24/7 or it may take advantage of movement detection technology.

7.1.2 The video recording shall include time stamping in steps of one second..

7.1.3 The recording system shall store any recording for a minimum time of 14 days, after which the oldest records may be overwritten. Facilities shall be available (which may be "off line"), to copy and store the recordings for longer periods.

7.1.4 The cameras and recording system shall be powered from the main level crossing battery via an inverter based power supply or from a separate battery backed supply with similar standby time.

7.1.5 The cameras and recording system shall be colour and offer a minimum horizontal resolution of 450 lines. If infra red illumination is used at night, then under that illumination the system may revert to monochrome. The output from the camera may be analogue video or IP protocol or any similar format as required to match the recorder.

NOTE Generally a colour camera with 700 pixels (or more),on each horizontal line will give more than 450 lines resolution. Many cameras now include IR illumination for night within the camera package.

7.1.6 The cameras shall be fitted with an appropriate lens to view the area required. The area to be viewed is the whole of the crossing surface within the barriers plus sufficient of the road and pedestrian approaches close to the barriers. As a simple rule on an average crossing, - this shall generally mean a view out at least as far as the road stop lines. This view generally requires two cameras and one siteing method that achieves this is to fix cameras to the back of diagonally opposite YO & ZO RTL backboards adjusted to view the crossing area. However other siteing is acceptable if it can achieve a good view of the crossing area. The individual views from cameras may overlap as long as any part of the area can be seen on at least one camera.

NOTE The preference for "nearside" RTL siting is so that each camera sees the rear of cars in the

adjacent lane going away and is not confronted by car headlights approaching in the nearest lane.

7.1.7 The resulting views of the crossing area and close approaches shall take up more than 50% of the picture area seen on each monitor picture.

7.1.8 The cameras shall output to a recognised video standard signal or Ethernet and I/P protocol for video. The recording equipment shall be arranged to deal with whatever signal type is provided.

8 LOCAL CONTROL UNIT.

8.1.1 A local control unit (LCU), shall be provided at the crossing to cover for failure of equipment, engineering work, train failure or single line working.

8.1.2 The LCU shall be contained in a free-standing locked case with door proving and captive lock, mounted on a pedestal. The unit shall be positioned so that the operator has a clear view of the crossing and the road approaches. Switching to local operation shall render the normal controls ineffective. The unit is fitted with a three position switch with functions thus:-

Local	(Left)
Normal	(Centre)
Hand	(Right)

8.1.3 Three push buttons are provided: “RAISE”, “STOP” & LOWER”.

8.1.4 A Telephone to the controlling point is provided next to the local control unit.

8.1.5 Opening the LCU shall sound an alarm and give an indication at the control point. Then:-

- Turning the switch to the LOCAL position shall allow the push buttons in the unit to control the crossing.
- Turning the switch to the HAND position shall enable hand operation

8.1.6 Turning the switch to the NORMAL position from any other shall:-

- Stop and maintain the barriers in their present position. If the barriers are not in the fully raised position the flashing red lights continue.
- If the barriers are fully lowered with the barriers proved intact and then the LCU door is closed and locked, control is transferred back to the normal operating point accompanied by an alarm and indication.

8.1.7 The circuit design shall not allow non-standard road light sequences when switching from one position to the next.

9 LOCAL CROSSING CLEAR UNIT (XCU)

9.1.1 The Local Crossing Clear Unit (XCU) provides facilities for a local operator to input a “Crossing Clear” to the interlocking in the event of the obstacle detector being failed or under maintenance. This allows signals to be cleared and avoids delays to trains.

9.1.2 The XCU shall be contained in a free-standing locked case with door proving and captive lock, mounted on a pedestal. The unit shall be positioned so that the operator has a clear view of the crossing and the road approaches.

9.1.3 A Telephone to the controlling point is provided next to the local crossing clear unit.

NOTE where the XCU is positioned adjacent to the LCU, which already has a telephone, a separate telephone is not required.

9.1.4 The unit contains a three position switch together with two push buttons and an indication.

NOTE The indication is used with the crossing clear push buttons. A separate indication may be used or it may be incorporated in "illuminated" push buttons.

9.1.5 The three position switch has the following functions:-

Signals On	(Left)
Normal	(Centre)
Local Crossing Clear	(Right)

9.1.6 Opening the XCU and turning the switch to the "Local Crossing Clear" position shall prevent the Obstacle detector system from giving "Crossing Clear" and instead enable the push buttons to give "Crossing Clear".

9.1.7 When a train strikes-in, the crossing sequence shall start as normal. When all barriers become fully lowered, the "Crossing Clear" indication in the XCU shall flash. The local operator shall confirm the crossing is clear by pressing both "Crossing Clear" buttons together. This is passed to the interlocking to allow signals to clear and trains to proceed over the crossing.

9.1.8 Turning the switch to the Signals On position shall place and maintain all protecting signals at red.

9.1.9 Turning the switch to the NORMAL position shall enable the Obstacle Detector system to give "Crossing Clear" accompanied by an alarm and indication at the control point.

10 HAND OPERATION.

10.1.1 While the local control unit allows for most simple failure situations, internal circuitry faults, physical damage or power failures may prevent powered operation in local control. To mitigate these situations, it shall be possible to operate the barriers individually by hand.

10.1.2 Hand operation shall be taken and carried out as follows:

- Take local control by opening the LCU. Turn the switch to the hand position;
- Unlock and open the barrier machine doors or access panels to access the hand controls. Opening the doors or panels shall prevent power operation.
- Raise and lower the barriers with the hand controls provided.

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10.1.3 To return to normal operation from the signalbox:

- The hand controls shall be re stowed and the barrier machine doors or access panels closed and locked. This shall return the barriers to local control and allow operation under power;
- The arrangements above for returning to normal operation from local control shall be followed.

APP-C – RAILWAY GROUP STANDARD GK/RT/0075

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Lineside Signal Spacing and Speed Signage

Synopsis
This document specifies the minimum distances that must be provided between the first cautionary aspect and the stop signal to which it applies. In addition, it addresses the signing for permissible speeds and speed restrictions.

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Lineside Signal Spacing and Speed Signage

Issue record

Issue	Date	Comments
One	March 2011	Original document. Superseded GK/RT0034 issue four, Lineside Signal Spacing, and GK/RT0038, issue two, Signing of Permissible Speeds and Speed Restrictions.
Two	September 2011	Small scale change to correct inconsistencies between GK/RT0075 issue one, Lineside Signal Spacing and Speed Signage, and its associated guidance note GK/GN0675.
Three	September 2014	Revision to E.2.1 to remove requirement for a risk assessment before an emergency speed restriction is applied. Other changes delivered by project 12/033 include: • Revisions to clauses 2.1.3b), 3.3.2.4, 3.4.1.4a), D.1.1.2, D.2.5.1a), D.2.5.2, D.4.2.1 and E.2. • New clause at D.2.5.3. • Updates to Figures D-21 and D-27. • The removal of clause D.4.2.3. • Changes made to address typographical errors in Table B.1 and Table X-3. • Clause number 3.3.1.5 corrected to 3.4.1.5. • Updates to the definitions section. • Clause 4.1.1.3 deleted from application section.
Four	September 2015	New issue to modify the requirements in 3.4.1.4 for the provision and position of warning boards for temporary speed restrictions (TSRs) with additional changes which include: • Minor clarification in clause 1.1.1. • Reinstatement of reference in clause 2.1.3 to excess signal braking distances. • Easement in clause D.2.1.2 for the non-standard positioning of warning boards (and associated AWS) for TSRs. • Amendment of Tables X-1, X-2 and X-3. • Correction of errors in Appendix X-3 relating to inconsistencies in deceleration distances for braking from speeds of 45, 50 and 55 mph. (These changes have not been made to the associated guidance note GK/GN0675, as this was already correct.)

Amended or additional parts and / or sections of revised pages have been marked by a vertical black line in the adjacent margin.

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Superseded documents

The following Railway Group Standard is superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GK/RT0075, issue three Lineside Signal Spacing and Speed Signage	All	05 December 2015

GK/RT0075 issue three Lineside Signal Spacing and Speed Signage, ceases to be in force and is withdrawn as of 05 December 2015.

Supply

The authoritative version of this document is available at www.rgsonline.co.uk. Enquiries on this document can be forwarded to enquirydesk@rssb.co.uk.

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Part 1 Purpose and Introduction

1.1 Purpose

1.1.1 This document mandates requirements for lineside signal spacing, permissible speeds and temporary and emergency speed restrictions. The scope of this document does not include compatibility of lineside signalling and speed signage with train driving processes when an in-cab signalling system is in use.

1.2 Introduction

1.2.1 Background

1.2.1.1 Lineside signals are provided by the infrastructure manager at locations where it is necessary to provide information about the movement authority to drivers.

1.2.1.2 The movement authority displayed by each lineside signal provides the driver with information about:

a) The distance to go, depicted by the signal aspect.

b) The route that is set and the destination, depicted by the combination of the signal aspect and route indication.

1.2.1.3 Lineside operational signs are provided by the infrastructure manager at locations where it is necessary to display information about permissible speeds and temporary speed restrictions to drivers.

1.2.1.4 Driver competence incorporates:

a) Correct interpretation of lineside signal aspects and route indications.

b) Route knowledge, including knowledge of the signalling layout and permissible speeds.

c) Traction knowledge, including braking performance.

1.2.1.5 The safety of train operations depends on compatibility between the movement authority system, the driver and the train braking system.

1.2.1.6 The minimum signalling braking distances in this document are compatible with the braking performance data for traction and rolling stock, as set out in the following Railway Group Standards:

GM/RT2041 Braking System Requirements and Performance for Trailer Coaching Stock

GM/RT2042 Braking System Requirements and Performance for Traction Units

GM/RT2043 Braking System and Performance for Freight Trains

GM/RT2044 Braking System Requirements and Performance for Multiple Units

GM/RT2045 Braking Principles for Rail Vehicles.

1.2.1.7 With respect to lineside signal spacing, the interface between the infrastructure manager and railway undertakings is concerned with:

a) Compatibility with train braking performance, so that when the driver observes a normal sequence of signal aspects (that is, the expected aspect sequence compliant with the requirements of GK/RT0045) leading up to a signal displaying a stop aspect, the train can decelerate from the permissible speed and stop within the distance available from the first cautionary aspect to the stop signal.

b) The driver's ability to perceive and remember information about the movement authority as part of the overall driving task.

1.2.1.8 Loss of compatibility in either of these areas is a causal factor of a signal passed at danger (SPAD).

1.2.2 Principles

1.2.2.1 The meaning of lineside signal aspects and the responsibility that train drivers have to control the speed of the train with respect to permissible speeds and the aspects displayed by signals is set out in Handbook RS521.

1.2.2.2 Compatibility between train braking performance and lineside signal spacing is essential so that drivers consistently have sufficient distance to bring the train to a stand at the associated stop signal when a caution signal aspect is displayed.

1.2.2.3 Consistency of signal spacing assists drivers by enabling them readily to interpret the information presented by the signal aspect sequences in terms of the required stopping position of the train, thus reducing the potential for misleading drivers.

1.2.2.4 Permissible speeds applicable to each type of train over each section of line are specified in the Sectional Appendix. Speed signs are provided and positioned consistently to provide drivers with clear information on permissible speeds, and to provide adequate warnings of significant speed reductions and temporary and emergency speed restrictions.

1.2.3 Related requirements in other documents

1.2.3.1 The following Railway Group Standards contain requirements that are relevant to the scope of this document:

GE/RT8000	Rule Book
GE/RT8012	Controlling the Speed of Tilting Trains Through Curves
GE/RT8075	AWS and TPWS Interface Requirements
GE/RT8037	Signal Positioning and Visibility
GI/RT7033	Lineside Operational Safety Signs
GK/RT0045	Lineside Signals, Indicators, and Layout of Signals
GK/RT0192	Level Crossing Interface Requirements
GM/RT2041	Braking System Requirements and Performance for Trailer Coaching Stock
GM/RT2042	Braking System Requirements and Performance for Traction Units
GM/RT2043	Braking System and Performance for Freight Trains

GM/RT2044 Braking System Requirements and Performance for Multiple Units

GM/RT2045 Braking Principles for Rail Vehicles.

1.2.4 Supporting documents

1.2.4.1 GK/GN0675 Guidance on Lineside Signal Spacing and Speed Signage.

1.3 Approval and authorisation of this document

1.3.1 The content of this document was approved by Control Command and Signalling (CCS) Standards Committee on 09 July 2015.

1.3.2 This document was authorised by RSSB on 31 July 2015.

Part 2 Requirements for Lineside Signal Spacing

2.1 Compatibility requirements for lineside signal spacing

2.1.1 GE/RT8270 sets out the process for the assessment of compatibility that is required whenever a material change is to be made that affects the interface between the signalling system and railway undertakings or any infrastructure managers that operate stations.

2.1.2 The assessment of compatibility shall check that the signalling spacing data used to determine minimum signalling braking distances (further requirements are set out in 2.3) is compatible with all of the following:

a) The types of rolling stock that will be operated on the route.

b) The maximum speeds that the rolling stock will be authorised to operate on the route.

c) The maximum attainable speeds of the rolling stock, where this is used to determine minimum signalling braking distances.

2.1.3 The assessment of compatibility shall check that the actual signalling braking distance is compatible with the SPAD risk mitigation measures that will be put in place by the railway undertakings, where any of the following apply:

a) There is more than 50% excess signalling braking distance, except where an exemption applies (see Table 1).

b) A variation in excess signalling braking distances means that the distance between the signals displaying the first cautionary aspect and the stop aspect is reduced by 34% or more, compared with the excess signalling braking distance for the preceding sequence of signals on the same line.

c) In four-aspect signalling areas, where the distance between the signals displaying the single yellow aspect and the red aspect is less than one third of the distance between the signals displaying the double yellow aspect and the red aspect.

Situation		Scope of compatibility check where actual signal spacing exceeds the minimum signalling braking distance by more than 50%
a	Where signals control movements in the same direction on parallel lines that have different permissible speeds, and signals are positioned adjacent to each other to minimise the risk of driver misread or disregard	The compatibility check is only required for signalling braking distances on the higher speed line. Signal braking distances on the lower speed line are exempt from the compatibility check
b	Where trains join a higher speed line at a converging junction from a lower speed line or start from a siding, loop or another platform line	The compatibility check is only required for signalling braking distances on the higher speed line. Signal braking distances for train movements from the lower speed line are exempt from the compatibility check

Situation		Scope of compatibility check where actual signal spacing exceeds the minimum signalling braking distance by more than 50%
c	Where trains start from a platform on a through line	The compatibility check is only required for signalling braking distances associated with non-stopping trains. Signal braking distances for train movements that start from rest are exempt from the compatibility check
d	Where the signal spacing is designed using particular signalling braking distance data (for example, Appendix A for a mixed traffic line)	The compatibility check is only required for signalling braking distances associated with the appendix to which the line is signalled
e	Where the signal spacing is designed to Appendices B or C, and a differential speed restriction is applied to enable traffic with an inferior braking characteristic to operate	The compatibility check is only required for signalling braking distances associated with the appendix to which the line is signalled
f	At the approach to buffer stops at terminal stations or at bay platforms	The compatibility check does not apply to the spacing distance between the approach signals and the buffer stops

Table 1 Exemptions from compatibility check

2.2 Requirement for signal spacing

2.2.1 The position of lineside signals shall be compatible with the braking performance of rolling stock so that trains moving at the permissible speed (or attainable speed in the circumstances set out in 2.7) can stop within the actual signalling braking distance.

2.3 Determining minimum signalling braking distances

2.3.1 Minimum signalling braking distances shall be determined using the data set out in Appendices A to C, as set out in 2.3.3 to 2.3.5. The associated guidance note (GK/GN0675) contains signalling braking distance data in imperial (yards) as well as metric units. Additionally, in respect of Appendices A, B and C, these data are included in graphical form.

2.3.2 Additional requirements for assessing compatibility of the data used and rolling stock performance are set out in 2.1.2.

2.3.3 The minimum signalling braking distance shall be established from Appendix A, based on the maximum permissible speed for freight trains (taking account of standard differential speeds and speed limits imposed by special instructions).

2.3.4 Where passenger trains (including those with enhanced braking where specific non-standard differentials are not provided) are authorised to travel at speeds greater than the permissible freight train speed (by means of standard or non-standard differential speeds), the signalling braking distance shall be equal to or exceed the distance derived from Appendix B, for the maximum permissible speed of those trains.

2.3.5 Where passenger trains with enhanced braking are authorised to travel at speeds greater than the permissible freight train speed (by means of non-standard differential speeds), the signalling braking distance shall be equal to or exceed the distance derived from Appendix C, for the maximum permissible speed of passenger trains with enhanced braking.

2.3.6 The minimum signalling braking distance shall be determined using:

a) The permissible speed at the signal displaying the first cautionary aspect, and

b) The average gradient of the line between the signals displaying the first cautionary aspect and the stop aspect.

2.3.7 For gradients between two values shown in the tables, the signalling braking distance for that gradient shall be calculated by linear interpolation between the signalling braking distances for the two adjacent gradient values.

2.3.8 Where a falling gradient varies and the mean gradient is 1 in 200 or steeper, the minimum signalling braking distance to be used shall be the shorter of either:

a) The distance for the mean gradient plus 10% of that distance, or

b) The distance for the steepest falling gradient.

2.4 Acceptable variations in signal spacing

2.4.1 The position of signals shall be designed so that the actual signalling braking distance is no less than the minimum signalling braking distance.

2.4.2 Wherever practicable, the position of signals shall be designed so that excess signalling braking distance does not exceed 50%.

2.4.3 Additional requirements for assessing compatibility of actual signalling braking distances and train operations, where there is more than 50% excess signalling braking distance, are set out in 2.1.3.

2.5 Consistency of signalling braking distances

2.5.1 Variation in the excess signalling braking distances between successive signals shall be kept to a minimum in order to control the risk associated with signals passed at danger (SPAD).

2.5.2 Additional requirements for assessing compatibility of variation of excess signalling braking distances and train operations are set out in 2.1.3.

2.6 Four-aspect signalling

2.6.1 In areas of 4-aspect signalling, the distance between the single yellow aspect and the red aspect shall be no less than one-third of the actual signalling braking distance between the double yellow aspect and the red aspect, unless the criteria set out in either 2.6.2 or 2.6.3 apply.

2.6.2 It is permissible for the distance between the single yellow aspect and the red aspect to be reduced to no less than one-third of the required minimum signalling braking distance between the double yellow aspect and red aspect.

2.6.3 It is permissible for mid-platform signals to be located so that the distance from the single yellow aspect at the mid-platform signal to the red aspect at the platform starting signal is less than one-third of the required minimum signalling braking distance between the double yellow aspect and the red aspect. In this case the permissible speed and the location of the mid-platform signal shall be configured to comply with all of the following requirements:

a) The distance between the running-in platform ramp and the platform starting signal is greater than the minimum signalling braking distance at the permissible speed.

b) The mid-platform signal is sighted so that it is visible to the driver from the running-in platform ramp, as set out in GE/RT8037.

c) The platform starting signal is sighted so that it is visible to the driver from the mid-platform signal, as set out in GE/RT8037.

2.6.4 Additional requirements for assessing compatibility of four-aspect signal spacing and train operations are set out in 2.1.2.

2.7 Use of attainable speed to determine minimum signal spacing

2.7.1 Where attainable speed is used to determine minimum signalling braking distances, the maximum attainable speed shall be derived using current acceleration data for the appropriate types of rolling stock. Additional requirements for assessing compatibility of minimum signalling braking distances and rolling stock performance are set out in 2.1.2.

2.7.2 On a 4-aspect signalled line, at a converging junction, the distance between the first signal beyond the junction and the next stop signal shall be compatible with both of the following:

a) The permissible speed and aspect sequence through the junction on the straight route , and

b) The permissible speed and aspect sequence on the converging route.

2.7.3 Where the converging route is a 3-aspect signalled line and the permissible speed through the convergence is lower than the permissible speed on the straight route, one of the following shall apply:

a) The attainable speed at the first (4-aspect) signal beyond the junction (taking account of any permissible speed restriction through the junction) shall be compatible with the actual signalling braking distance to the next signal so that the train can stop when the signal is displaying a single yellow aspect, or

b) The last signal on the converging route shall be a 4-aspect signal.

2.7.4 Where there is signalling braking distance from the commencement of an existing reduction of permissible speed and the stop signal, it is permissible to use the attainable speed at the first caution.

2.8 Requirements at infrastructure manager boundaries

2.8.1 The requirements for signal spacing set out in this document shall apply also to the transitions between different signalling systems that are part of Network Rail managed infrastructure.

2.8.2 Where a signalling braking distance crosses a boundary between infrastructure managers, the minimum distance between a caution signal and the associated stop signal (or equivalent end of movement authority) shall be determined using the signalling braking criteria specified by the infrastructure manager controlling the stop signal (or responsible for end of movement authority*).*

Part 3 Requirements for Signing of Permissible Speeds and Speed Restrictions

3.1 Compatibility requirements for signing of permissible speeds and speed restrictions

3.1.1 GE/RT8270 sets out the process for the assessment of compatibility that is required whenever a material change is to be made that affects the interface between the signalling system and railway undertakings or any infrastructure managers that operate stations.

3.1.2 The assessment of compatibility shall check that permissible speeds and temporary speed restrictions are compatible with existing and planned train operations on each route, including a check of all of the following:

a) The permissible speed profile.

b) The configuration and position of permissible speed indicators and permissible speed warning indicators.

c) The provision of additional speed signs, where this is a permitted option to manage operational risk, including:

i) Additional permissible speed warning indicators (see 3.3.1).

ii) Repeater permissible speed indicators at converging junctions (see 3.3.3).

d) Where the nature of engineering work results in complex signage arrangements. The proposed configuration and position of temporary speed indicators and warning boards and the arrangements for their implementation and withdrawal.

e) The configuration and position of signs that display standard and non-standard differential speeds, where trains compatible with the signalling braking distances set out in Appendices B and C are authorised to operate at higher permissible speeds (see 3.3.2).

f) The omission of differential speed signs, where differential speeds are implemented by instruction (see 3.3.1).

g) The display of metric speed information, where this is required (see 3.2.1).

h) The overall presentation of information to the driver (further requirements are set out in 3.2.2).

3.1.3 The assessment of compatibility shall check that the deceleration distances (see 3.2.3) used, which are the minimum spacing distances between the warning indicator and the speed indicator, are compatible with all of the following:

a) The types of rolling stock that will be operated on the route.

b) The maximum speeds that the rolling stock will be authorised to operate on the route.

c) The maximum attainable speeds of rolling stock, where these are used to determine the signal spacing.

d) The permissible speed(s) on every signalled approach to the speed reduction, including differential speeds which are authorised for different types of rolling stock.

e) The speed reduction(s) required on every signalled approach.

f) The applicable speed restriction, including differential speeds.

g) The average gradient on the approach to the speed indicator/board.

3.2 Requirements for permissible speeds and temporary speed restrictions

3.2.1 Display of speed information

3.2.1.1 The infrastructure manager shall provide lineside operational safety signs to display permissible speeds and temporary speed restriction information, applicable to each running line, for each direction that trains can be operated under signalled movement authorities for main running movements.

3.2.1.2 Speed signs shall display speed information in units of miles per hour.

3.2.1.3 Where trains are operated using speedometers calibrated in kilometres per hour, speed signs shall also display speed information in units of kilometres per hour.

3.2.1.4 Speed signs that display differential speeds shall display the lower (or lowest) speed above the higher speed(s).

3.2.1.5 Speed signs shall be positioned on the left-hand side of the line in the direction of travel, unless they cannot be accommodated there.

3.2.1.6 Speed signs shall be configured so that all of the applicable speeds (including differential speeds) over the same section of track are displayed together at the same position and location. It is permitted for nominally co-located signs to be separated by a short distance where readability would not be impaired.

3.2.2 Overall presentation of information to the driver

3.2.2.1 Speed signs and associated automatic warning system (AWS) equipment shall be positioned so that the totality of information (including lineside signs, signal aspects, indications and lineside equipment) displayed to the train driver is not liable to cause confusion.

3.2.2.2 Where train protection systems are in use, the position of speed signs shall be compatible with the warning and intervention functionality of these systems so that a driver obeying the lineside signs does not receive unwarranted warnings or interventions.

3.2.3 Deceleration distances

3.2.3.1 Where attainable speed is used to determine the deceleration distance (only permitted for temporary speed restrictions), the maximum attainable speed shall be derived using current acceleration data for the appropriate types of rolling stock. Additional requirements for assessing compatibility of deceleration distances and rolling stock performance are set out in 3.1.3.

3.2.3.2 Where differential speeds are associated with a speed reduction to a lower permissible speed or a temporary speed restriction (whether they are applicable to the permissible speed on the approach, the lower permissible speed or temporary speed restriction, or both), the deceleration distance shall be determined for each type of train, taking account of:

a) The applicable speeds for that train, and

b) The longest deceleration distance required.

3.2.3.3 Deceleration distances shall be determined using one of the following:

a) The deceleration data set out in Appendix X which is compatible with Appendix A (composite data for all trains).

b) The signalling braking distance, where minimum signalling braking distances have been determined using Appendix B (composite data for passenger trains), and the deceleration distance derived from Appendix X is greater than the minimum signalling braking distance.

c) The signalling braking distance, where minimum signalling braking distances have been determined using Appendix C (data for trains with enhanced braking), and the deceleration distance derived from Appendix X is greater than the minimum signalling braking distance.

3.2.3.4 Appendices B or C shall only be used to determine deceleration distances for permissible speeds and temporary speed restrictions where all of the trains that operate over the route have a braking performance that is compatible with the required reduction in speed, taking account of the following factors:

a) The permissible speeds, including any enhanced permissible speeds and differential speeds, and

b) The authorised speed limits applicable to each category and type of train.

3.3 Signs for permissible speeds

3.3.1 Position and sighting of signs

3.3.1.1 A signal sighting committee (as set out in GE/RT8037) shall agree the position and sighting of:

a) Permissible speed indicators.

b) Permissible speed warning indicators.

3.3.1.2 Permissible speed indicator(s) shall:

a) Display the relevant permissible speed(s).

b) Be provided for every increase or decrease of permissible speed, except where differential speeds applying to certain types of train are implemented by instruction. This applies where speed is required to be restricted for particular types of train that do not constitute a recognised category for which differential speed signs are specified in the Rule Book.

c) Be positioned where the change of permissible speed occurs (see Figure 1).

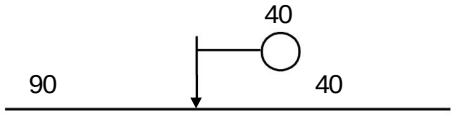


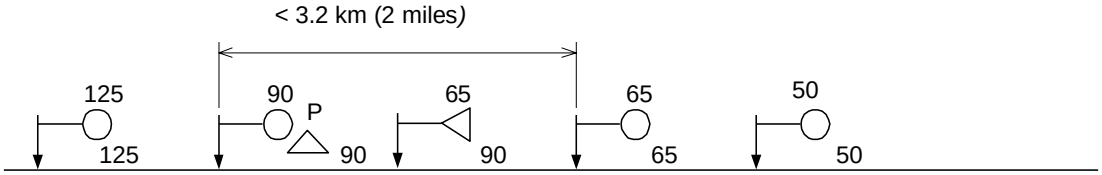
Figure 1 Example of a permissible speed indicator

3.3.1.3 Permissible speed indicators shall be provided at converging and diverging junctions in accordance with 3.3.3 and 3.3.4.

3.3.1.4 Except where the criteria in 3.3.1.5 apply, a permissible speed warning indicator shall be provided on all signalled approaches to each permissible speed reduction, where either:

a) The permissible speed on the approach, including any differential speed, is 60 mph or greater and the required speed reduction is one-third or more, taking account of any differential permissible speeds that apply, or

b) There are two or more successive reductions in permissible speed within a distance of 3.2 km (2 miles), none of which individually represents a reduction of one-third, but which together require a speed reduction of one-third or more from an approach speed of 60 mph or greater (see Figure 2).



Note: Depending on spacing of speed reductions and relevant deceleration distances, the warning indicator for the second speed reduction could fall before the speed indicator for the first speed reduction

Figure 2 Example of two or more successive reductions in speed

3.3.1.5 Permissible speed warning indicators shall not be provided for:

a) A speed reduction over a diverging route where the signalling system is configured to display signal aspects that provide for the required speed reduction (see 3.3.7).

b) A speed reduction over a level crossing where a Level Crossing Warning Sign (St Georges Cross) is provided.

3.3.1.6 Where provided, permissible speed warning indicators shall be positioned in accordance with 3.3.5, 3.3.6, 3.3.7 using the appropriate deceleration distance set out in 3.2.3.3.

3.3.1.7 Only one permissible speed warning indicator shall be provided on each approach to a permissible speed indicator, unless an additional indicator is required to mitigate safety risk and will not cause confusion to drivers. Further requirements are set out in 3.1.2.

3.3.2 Display of differential permissible speeds

3.3.2.1 Permissible speed indicators and permissible speed warning indicators shall display a maximum of three differential speeds (applicable to different categories of trains), including standard and non-standard differential speeds. For the purposes of this section, an enhanced permissible speed as defined in GE/RT8012 shall be considered as a non-standard differential speed. The only permitted combinations are:

a) Two displayed speeds, each for one of two standard categories of train, where standard differential speeds apply.

b) One displayed speed for a standard category of train and either one or two displayed non-standard speeds applicable to the train categories set out in GE/RT8000 Rule Book module SP.

c) Two displayed speeds for the two standard categories of train (standard differential speeds), together with one displayed non-standard differential speed applicable to a train category set out in GE/RT8000 Rule Book module SP.

3.3.2.2 Further requirements applicable to differential speeds are set out in 3.1.2.

3.3.2.3 Where standard differential speeds apply, the two speeds shall be displayed on a single permissible speed indicator (see Figure 3) and, where a warning indicator is provided, on a single permissible speed warning indicator (see Figure 4).

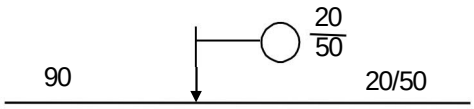


Figure 3 Example of a standard differential permissible speed indicator

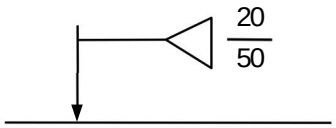


Figure 4 Example of a standard differential permissible speed warning indicator

3.3.2.4 Non-standard differential permissible speeds shall be displayed by a separate speed sign, which shall incorporate an indication of the applicable train category. The meanings of letter abbreviations for non-standard speeds are set out in Rule Book Module SP. The classes of train that apply in a given situation are set out in the Sectional Appendices.

3.3.2.5 A non-standard permissible speed indicator shall be mounted on the same post as the associated standard permissible speed indicator (see Figure 5) and:

a) Where the non-standard speed is higher than the standard speed(s), it shall be displayed below the standard speed(s).

b) Where the non-standard speed is lower than the standard speed(s), it shall be displayed above the standard speed(s).

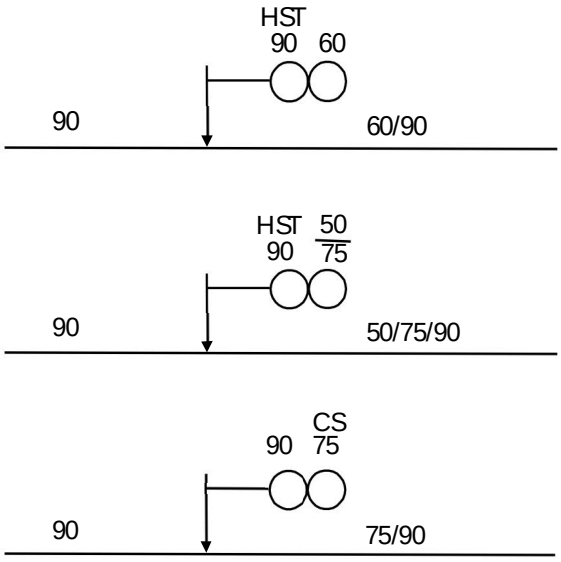


Figure 5 Examples of a non-standard differential permissible speed indicator

3.3.2.6 Where a permissible speed warning indicator is required, non-standard differential speeds shall be displayed by a separate speed sign, which shall incorporate an indication of the applicable train category. Further requirements about train categories are set out in GE/RT8000 Rule Book.

3.3.2.7 A non-standard permissible speed warning indicator shall be mounted on the same post as the standard permissible speed warning indicator (see Figure 6) and:

a) Where the non-standard speed is higher than the standard speed(s), it shall be displayed below the standard speed(s).

b) Where the non-standard speed is lower than the standard speed(s), it shall be displayed above the standard speed(s).

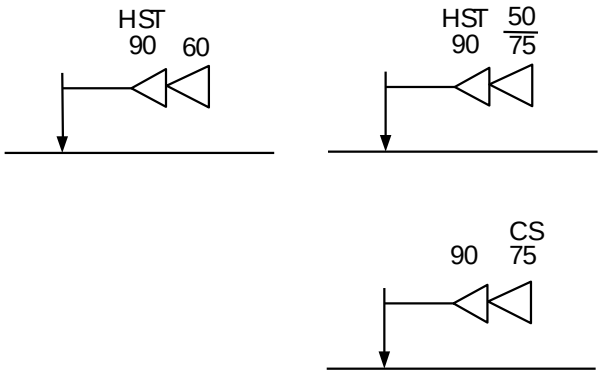


Figure 6 Examples of a non-standard differential permissible speed warning indicator

3.3.3 Permissible speed indicators at converging junctions

3.3.3.1 A permissible speed indicator shall be provided at converging junctions if the permissible speed beyond the converging junction is different from the permissible speed on the higher speed route (see Figure 7).

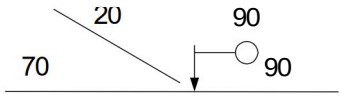


Figure 7 Example of permissible speed indicator at converging junction

3.3.3.2 It is permissible to provide a miniature permissible speed indicator as a repeating sign immediately after a converging junction, where all of the following apply:

a) The permissible speed beyond the junction is the same as the permissible speed of the approach on the higher speed route, and

b) The permissible speed beyond the junction is higher than that on the converging route, and

c) The junction is not located within the deceleration distance approaching a lower speed for which warning has already been given.

3.3.4 Permissible speed indicators at diverging junctions

3.3.4.1 A permissible speed indicator with an arrow indicating the direction of the diverging (lower speed) route shall be provided immediately before a diverging junction (including a facing crossover) over which there is a reduction in permissible speed (see Figure 8). Where the permissible speed of the straight route does not change at the junction, a speed indicator shall not be provided for the straight route.

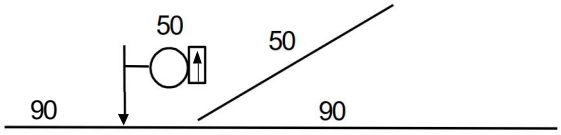


Figure 8 Example of permissible speed indicator at diverging junction with speed reduction on diverging route only

3.3.4.2 Where a lower permissible speed applies equally to both routes, a single permissible speed indicator shall be provided without directional arrows (see Figure 9).

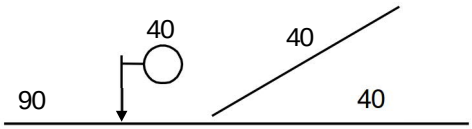


Figure 9 Example of permissible speed indicator at diverging junction with speed reduction (equal speed) on both routes

3.3.4.3 Where different permissible speeds commence for each route at a diverging junction or crossover, two permissible speed indicators shall be positioned side-by-side. Arrow(s) shall be incorporated into the sign to indicate any divergence (see Figures 10 and 11).

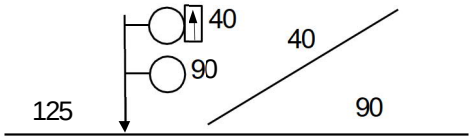


Figure 10 Example of permissible speed indicator at diverging junction with speed reduction on both routes (different speeds)

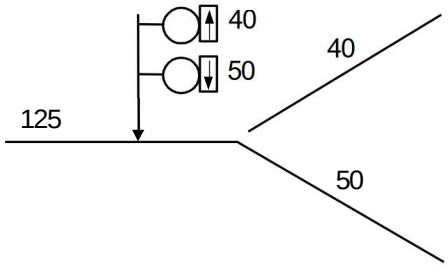


Figure 11 Example of permissible speed indicator at diverging junction with no straight route

3.3.5 Positioning of permissible speed warning indicators

3.3.5.1 Where provided, permissible speed warning indicators shall:

a) Be positioned as close as practicable to (but not less than) the deceleration distance from the permissible speed indicator, taking account of the longest deceleration distance required (see Figure 12), and

b) Not be positioned between a signal or other sign applicable in the same direction of travel and the AWS equipment associated with that signal or sign.

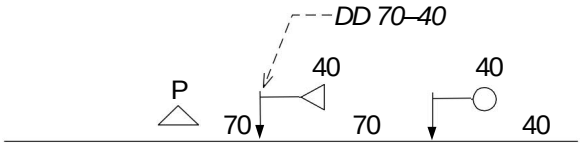


Figure 12 Example of permissible speed warning indicator (simple case)

3.3.5.2 Where two permissible speed indicators are located at the same position (for example, at a diverging junction) and permissible speed warning indicators are required for both, the position of the permissible speed warning indicators shall be determined using the greatest deceleration distance required.

3.3.5.3 Where the circumstances set out in 3.3.1.4b) apply, the deceleration distance used to position the permissible speed warning indicator shall be determined using the permissible speed applicable prior to the commencement of the series of reductions in speed (see Figure 13).

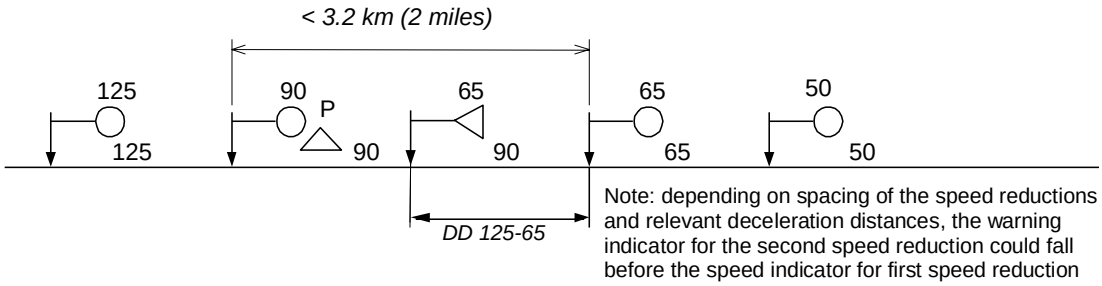


Figure 13 Example of permissible speed warning indicator for successive reductions in speed

3.3.5.4 Where further permissible speed reductions occur beyond a reduction for which a permissible speed warning indicator and associated AWS magnet is provided, these shall be assessed separately. A further permissible speed warning indicator shall be provided if the criteria set out in 3.3.1.4 are met (see Figure 14).

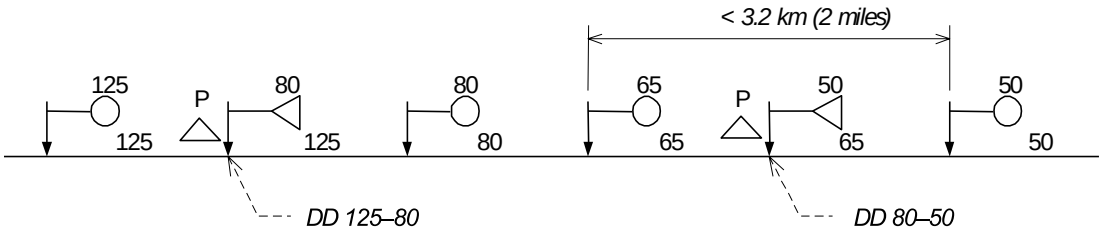


Figure 14 Example of successive reductions in speed where a further permissible speed warning indicator is required

3.3.5.5 Where exceptionally the speed profile is such that that the deceleration distance would either:

a) Position a permissible speed warning indicator within a section of line with a lower permissible speed than that immediately preceding the speed reduction (see Figure 15), or

b) Encompass a section of line with a lower permissible speed (see Figure 16), and this lower speed is equal to or less than the speed displayed on the permissible speed warning indicator, one of the following arrangements shall be used:

c) The permissible speeds shall be adjusted to avoid this arrangement (preferred), or

d) The permissible speed warning indicator shall be positioned at the end of the lower speed section, beneath the permissible speed indicator for the higher speed (non-preferred).

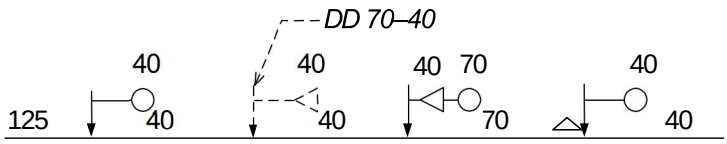


Figure 15 Example of positioning of permissible speed warning indicator where deceleration distance falls within lower speed section

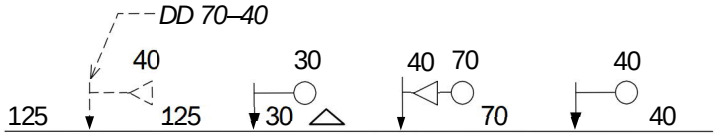


Figure 16 Example of positioning of permissible speed warning indicator where deceleration distance encompasses lower speed section

Note: The arrangements shown in Figures 15 and 16 are non-preferred. Where practicable, permissible speeds should be specified to obviate such arrangements.

3.3.5.6 If the permissible speed on the preceding lower speed section is higher than the permissible speed displayed on the permissible speed warning indicator and there is an intermediate higher permissible speed, the permissible speed warning indicator shall be positioned either:

a) At not less than the deceleration distance, or

b) At the end of the lower speed section, beneath the permissible speed indicator for the higher speed

whichever is the greater distance. In this case the intermediate higher permissible speed shall be disregarded when determining the position of the permissible speed warning indicator.

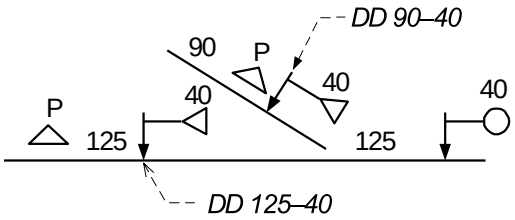
3.3.5.7 Further requirements for checking the provision, position and configuration of permissible speed warning indicators are set out in 3.1.2.

3.3.6 Permissible speed warning indicators at converging junctions

3.3.6.1 Where the criteria set out in 3.3.1.4 apply at converging junctions, permissible speed warning indicators shall be provided:

a) On each signalled approach to a permissible speed indicator (see Figure 17).

b) So that all approaching trains receive one warning for each permissible speed reduction.



Note: 125 repeater sign omitted intentionally (3.3.3.2 refers)

Figure 17 Example of permissible speed warning indicators at converging junction

3.3.7 Permissible speed warning indicators at diverging junctions

3.3.7.1 A permissible speed warning indicator incorporating a directional arrow shall be provided to indicate a permissible speed on a diverging route over or beyond a diverging route ahead, where:

a) The junction signal is not approach controlled from red (see GK/RT0045), and

b) The required speed reduction meets the criteria set out in 3.3.1.4.

3.3.7.2 Where a permissible speed warning indicator incorporating a directional indication is positioned at a signal that displays a cautionary aspect for the diverging route to which the warning indicator applies:

a) The caution indication given by the AWS magnet associated with the signal shall also apply to the warning indicator.

b) A separate AWS magnet shall not be provided for the warning indicator (see Figure 18).

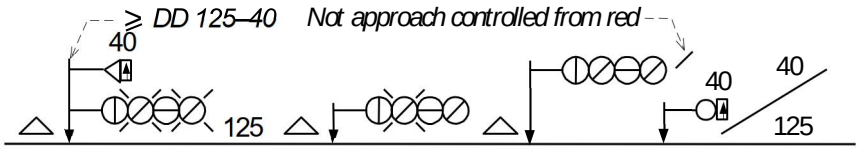


Figure 18 Example of permissible speed warning indicator for diverging junction positioned at a signal that displays a cautionary aspect

3.3.7.3 Where a permissible speed warning indicator incorporating a directional indication is not positioned at a signal that displays only a cautionary aspect for the diverging route to which the warning indicator applies:

a) A separate AWS magnet shall be provided for the permissible speed warning indicator, and

b) The AWS magnet shall be suppressed when the junction signal and any intervening signals between the permissible speed warning indicator and the junction signal have been cleared for a route for which the warning indicator does not apply.

3.3.7.4 A permissible speed warning indicator, incorporating a directional arrow, shall be positioned adjacent to the permissible speed indicator (with directional arrow) at a diverging junction, or crossover (see Figure 19) where:

a) A reduction in permissible speed on the diverging route beyond the diverging junction (or crossover) requires a permissible speed warning indicator, or

b) The deceleration distance would position the permissible speed warning indicator in the vicinity of the diverging junction or crossover, or

c) Either it is not practicable to locate the warning indicator within the diverging junction or crossover, or it is necessary to make it clear to which line the warning indicator applies.

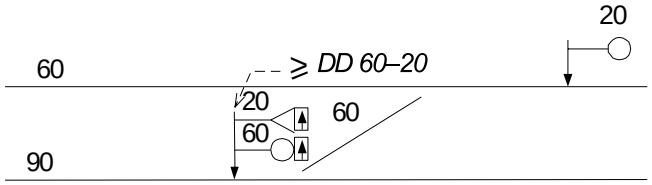


Figure 19 Example of permissible speed warning indicator for speed reduction on a diverging route

3.3.8 Provision of AWS magnets for permissible speed warning indicators

3.3.8.1 An AWS magnet shall be provided on the approach to all permissible speed warning indicators provided to satisfy the criteria set out in 3.3.1.4, except

a) Where the AWS magnet associated with a signal displaying a cautionary aspect is configured to provide an equivalent warning (see 3.3.7.2).

b) On lines not fitted with AWS.

c) In AWS gap areas.

d) In respect of additional warning indicators.

3.3.8.2 The AWS magnet shall:

a) Be positioned 180 m on the approach to the permissible speed warning indicator.

b) Be positioned not less than 4 seconds running time from any other AWS equipment.

c) Not be positioned between any other AWS equipment and its associated signal, board or indicator.

The constraints in b) and c) do not apply to other AWS equipment which is provided for movements in the opposite direction and which is suppressed for movements in the direction to which the permissible speed warning indicator applies.

3.3.8.3 The AWS magnet shall be configured to generate an AWS caution indication in the driving cab.

3.3.8.4 The AWS magnet shall be suppressed for signalled running movements for which it does not apply, unless AWS cancelling indicators are provided (see GE/RT8075: AWS and TPWS Interface Requirements).

3.3.9 Publication of alterations of permissible speeds

3.3.9.1 Details of alterations to permissible speeds shall be published in:

a) The Weekly Operating Notice (WON), prior to implementation, and

b) The next available Periodical Operating Notice (PON), pending re-issue of the appropriate Table A entry in the Sectional Appendix.

3.4 Provision of signs for temporary and emergency speed restrictions

3.4.1 Commencement and termination indicators and warning boards

3.4.1.1 The commencement of each temporary speed restriction shall be indicated by a speed indicator displaying the required speed(s) for all signalled movements entering the speed restriction (see Figure 21), except where:

a) Movements cross over a temporary speed restriction, via a ladder or diamond crossing, and

b) The permissible speed for the movement via a ladder or diamond crossing is less than or equal to that of the temporary speed restriction (see Figure 20).

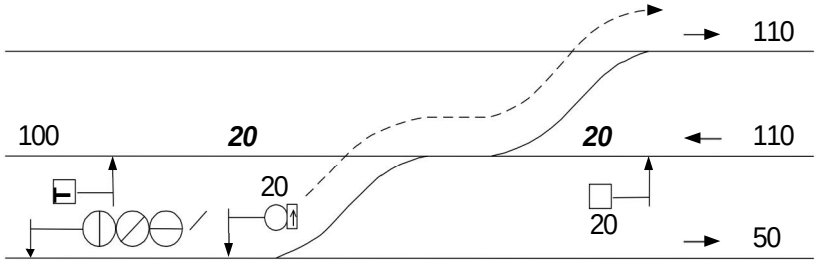


Figure 20 Example of movement via crossing not requiring temporary speed restriction signs

3.4.1.2 Except in the case of abutting restrictions (see Appendix D, D.3), a termination indicator, displaying the letter 'T', shall be positioned at the end of each temporary speed restriction (see Figure 21).

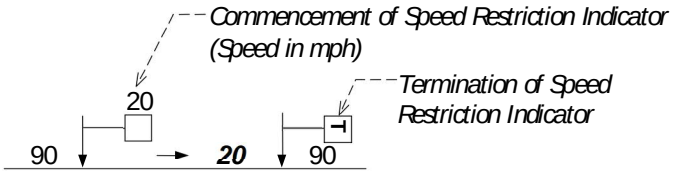


Figure 21 Example of a commencement and termination indicator

3.4.1.3 Speed indicators shall be positioned in accordance with Appendix D.

3.4.1.4 Warning boards shall be provided for all signalled running movements towards temporary and emergency speed restrictions, except where trains always start from rest (for example, a siding or terminal station platform line) and the commencement of the speed restriction is less than 300 m ahead.

In these cases the WON shall specify:

'A warning board is not provided on the ___ line for trains proceeding to the ___ line for the temporary speed restriction at ___ miles ___ chains.'

3.4.1.5 Warning boards shall be positioned in accordance with Appendix D, using the deceleration distance criteria in Appendix X.

3.4.1.6 Only one warning board shall be provided on each approach to a temporary speed restriction, except where repeater warning boards are provided in accordance with Appendix D, D.2.5.

3.4.1.7 Where an emergency speed restriction is to be imposed, an emergency indicator shall be provided in addition to the warning board (see Figure 22), and positioned in accordance with Appendix E.

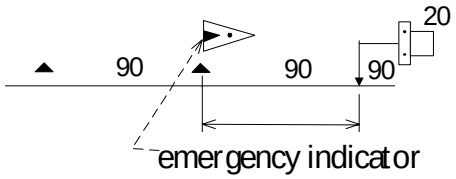


Figure 22 Example of an emergency indicator

3.4.1.8 Speed signs provided for temporary and emergency speed restrictions shall be positioned on the left-hand side of the line in the direction of travel, except where:

a) It is not practicable to accommodate a speed sign on the left-hand side of the line, and

b) The applicability of a sign positioned on the right-hand side of the line is unambiguous.

3.4.1.9 Where temporary speed restriction speed indicators or warning boards are positioned to the right of the track in the direction of travel, the WON shall specify either:

'The temporary speed restriction equipment for trains travelling in the up/down direction on ___ line between ___ miles ___ chains and ___ miles ___ chains is situated to the right of the track,' or

'The warning board _____ (for example, IN THE TUNNEL) on the ___ line at ___ miles ___ chains is situated to the right of the track.'

3.4.2 Display of differential speeds at temporary speed restrictions

3.4.2.1 Speed indicators and warning boards shall only display the two standard differential speeds.

3.4.2.2 The two standard differential speeds shall be displayed (see Figure 23) using:

a) A speed indicator displaying both speeds.

b) A warning board displaying both speeds.

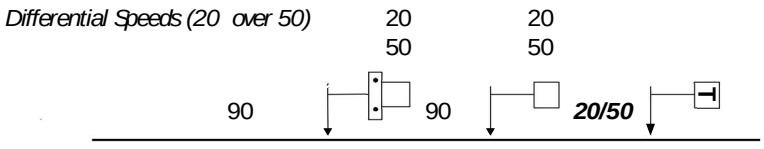


Figure 23 Example of differential speed indicators

3.4.3 Provision of AWS permanent magnets for temporary speed restriction warning boards

3.4.3.1 An AWS magnet shall be provided on the approach to:

a) All warning boards, in accordance with Appendix D.

b) All emergency indicators, in accordance with Appendix E.

3.4.3.2 Except where the criteria in Appendix D, D.2.4 apply, the AWS magnet shall:

a) Be positioned 180 m on the approach to the warning board or emergency indicator.

b) Be positioned not less than 4 seconds running time from any other AWS equipment.

c) Not be positioned between any other AWS equipment and its associated signal, board or indicator.

The constraints in b) and c) do not apply to other AWS equipment which is provided for movements in the opposite direction and which is suppressed for movements in the direction to which the permissible speed warning indicator applies.

3.4.3.3 AWS magnet(s) shall be configured to generate an AWS caution indication in the driving cab.

3.4.4 Publication of temporary speed restrictions

3.4.4.1 Details of temporary speed restrictions shall be published in the WON prior to implementation.

3.4.4.2 Where this is not practicable, the speed restriction shall be implemented as an emergency speed restriction, as set out in Appendix E.

Part 4 Application of this Document

4.1 Application - infrastructure managers

4.1.1 Scope

4.1.1.1 The requirements in Part 2 of this document apply to all work that affects the design of new or altered lineside signalling arrangements relating to signal spacing. Where it is known, or becomes known, that existing lineside signal spacing does not comply with the requirements of this document, action to bring it into compliance is required when the signalling is renewed, the signal spacing is modified or permissible speeds are amended.

4.1.1.2 The requirements in Part 3 of this document apply to alterations to the speed profile, including the speed signage for temporary and emergency speed restrictions. Where it is known, or becomes known, that existing lineside speed signage does not comply with the requirements of this document, action to bring it into compliance is required when the speed signage is modified or renewed.

4.1.2 Exclusions from scope

4.1.2.1 There are no exclusions from the scope specified in 4.1.1 for infrastructure managers.

4.1.3 General compliance date for infrastructure managers

4.1.3.1 This Railway Group Standard comes into force and Parts 2 and 3 are to be complied with from 05 December 2015.

4.1.3.2 After the compliance dates or the date by which compliance is achieved if earlier, infrastructure managers are to maintain compliance with the requirements set out in this Railway Group Standard. Where it is considered not reasonably practicable to comply with the requirements, authorisation not to comply should be sought in accordance with the Railway Group Standards Code.

4.1.4 Exceptions to general compliance date

4.1.4.1 There are no exceptions to the general compliance date specified in 4.1.3 for infrastructure managers.

4.2 Application - railway undertakings

4.2.1 There are no requirements applicable to railway undertakings.

4.3 Health and safety responsibilities

4.3.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

Appendix A Signalling Braking Distance Data for all Trains

The content of this appendix is mandatory.

A.1 Composite table for all trains (metres)

DISTANCE (METRES)

GRADIENT (mm/m)

	Rising						**Falling**				
INITIAL SPEED (mph)	20 (1 in 50)	15 (1 in 67)	10 (1 in 100)	5 (1 in 200)	2.5 (1 in 400)	Level Level	2.5 (1 in 400)	5 (1 in 200)	10 (1 in 100)	15 (1 in 67)	20 (1 in 50)
10	62	65	69	75	78	82	89	97	118	146	190
15	100	107	117	128	136	144	156	168	200	244	311
20	155	165	180	200	210	220	238	255	295	365	480
25	220	235	260	290	303	325	345	375	445	575	770
30	295	315	350	390	418	445	485	530	645	820	1305
35	375	405	445	505	540	585	640	715	925	1265	2046
40	455	505	570	660	730	795	895	990	1300	1740	2046
45	580	650	740	855	945	1035	1185	1315	1520	1740	2046
50	629	684	747	855	945	1035	1185	1315	1520	1740	2046
55	704	760	824	899	955	1035	1185	1315	1520	1740	2046
60	776	833	896	970	1020	1070	1190	1315	1520	1740	2046
65	810	870	938	1019	1066	1116	1220	1315	1520	1740	2046
70	897	961	1033	1117	1165	1218	1280	1353	1520	1740	2046
75	953	1015	1084	1164	1215	1258	1320	1382	1534	1740	2046
80	953	1015	1084	1164	1215	1258	1320	1382	1534	1740	2046
85	1047	1110	1180	1261	1310	1354	1415	1471	1614	1788	2046
90	1181	1254	1334	1428	1485	1537	1610	1674	1842	2049	2330
95	1333	1418	1511	1621	1680	1750	1835	1913	2113	2366	2713
100	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312
105	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312
110	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312
115	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312
120	1585	1655	1745	1880	1960	2041	2143	2245	2503	2835	3312
125	1714	1789	1869	1957	2000	2054	2143	2245	2503	2835	3312

For gradients greater than 1 in 50 rising – use distances for 1 in 50 rising.
For gradients greater than 1 in 50 falling – seek derogation.

Lineside Signal Spacing and Speed Signage

Railway Group Standard
GK/RT0075
Issue Four
Date September 2015

Appendix B Signalling Braking Distances for Passenger Trains

The content of this appendix is mandatory

B.1 Composite table for passenger trains (metres)

DISTANCE (METRES)

	GRADIENT (mm/m)														
	Rising								**Falling**						
INITIAL SPEED (mph)	30 (1 in 33)	25 (1 in 40)	20 (1 in 50)	15 (1 in 67)	10 (1 in 100)	5 (1 in 200)	2.5 (1 in 400)	Level Level	2.5 (1 in 400)	5 (1 in 200)	10 (1 in 100)	15 (1 in 67)	20 (1 in 50)	25 (1 in 40)	30 (1 in 33)
10	27	28	29	30	31	32	32	33	33	34	36	38	40	43	46
15	42	44	45	47	49	51	52	53	54	56	59	63	67	72	78
20	62	65	67	70	73	76	78	80	82	84	89	95	101	109	118
25	86	89	93	97	101	106	109	112	115	118	127	136	147	159	174
30	114	120	125	132	138	146	150	154	159	164	175	187	201	218	239
35	150	157	165	173	182	192	197	203	209	215	230	246	265	287	314
40	198	207	215	225	235	246	252	258	266	274	292	312	336	364	399
45	251	263	274	287	300	315	323	332	342	353	377	404	437	476	525
50	313	327	342	359	377	396	407	418	433	447	479	516	561	615	686
55	381	399	418	439	461	487	500	515	533	551	593	642	702	774	871
60	460	483	506	533	562	595	614	632	660	679	734	799	879	979	1117
65	537	564	592	624	658	698	720	742	770	798	864	942	1040	1162	1333
70	624	656	689	728	769	816	843	870	904	938	1018	1113	1234	1387	1607
75	727	766	807	853	904	963	995	1030	1075	1115	1216	1338	1496	1700	2007
80	832	877	925	980	1040	1110	1150	1190	1245	1291	1413	1561	1755	2013	2412
85	940	992	1047	1110	1180	1261	1310	1354	1410	1471	1614	1788	2021	2334	2834
90	1058	1118	1181	1254	1334	1428	1485	1537	1605	1674	1842	2049	2330	2715	3361
95	1190	1260	1333	1418	1511	1621	1680	1750	1835	1913	2113	2366	2713	3207	4100
100	1357	1440	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312	4044	5668
105	1357	1440	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312	4044	5668
110	1357	1440	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312	4044	5668
115	1357	1440	1528	1630	1745	1880	1960	2041	2143	2245	2503	2835	3312	4044	5668
120	1461	1522	1585	1655	1745	1880	1960	2041	2143	2245	2503	2835	3312	4044	5668
125	1579	1646	1714	1789	1869	1957	2000	2054	2143	2245	2503	2835	3312	4044	5668

Appendix C Signalling Braking Distances for Trains with Enhanced Braking (9%g mean)

The content of this appendix is mandatory

C.1 Table for trains with enhanced braking (9%g mean) in metres

DISTANCE (METRES)

GRADIENT (mm/m)

	Rising								**Falling**						
INITIAL SPEED (mph)	30 (1 in 33)	25 (1 in 40)	20 (1 in 50)	15 (1 in 67)	10 (1 in 100)	5 (1 in 200)	2.5 (1 in 400)	Level Level	2.5 (1 in 400)	5 (1 in 200)	10 (1 in 100)	15 (1 in 67)	20 (1 in 50)	25 (1 in 40)	30 (1 in 33)
10	23	24	25	25	26	27	27	28	29	30	31	33	34	37	40
15	37	38	40	41	43	45	46	47	48	49	52	55	59	64	70
20	55	57	60	62	65	68	72	72	74	76	81	86	92	100	110
25	78	81	85	89	93	98	100	103	106	109	117	126	136	149	164
30	105	110	115	121	128	135	139	143	148	153	164	176	191	208	230
35	139	146	153	162	170	180	185	191	197	204	218	235	254	277	306
40	188	196	205	214	224	234	240	246	254	262	279	298	321	347	380
45	232	243	253	264	276	289	296	304	313	322	343	366	393	425	464
50	282	294	306	320	334	351	359	368	379	390	415	442	475	511	557
55	336	350	365	381	399	418	428	438	451	464	493	525	563	606	660
60	395	411	429	448	468	490	502	514	529	544	578	615	659	709	770
65	458	478	497	519	543	568	582	597	614	631	670	712	762	819	890
70	526	548	571	596	623	652	668	684	703	723	767	816	873	937	1017
75	598	624	650	678	708	742	762	779	801	823	872	927	991	1064	1153
80	676	704	734	766	800	838	860	879	904	929	984	1046	1118	1199	1299
85	758	790	823	859	897	940	963	986	1014	1042	1103	1172	1252	1343	1455
90	846	882	919	959	1002	1049	1075	1101	1132	1163	1232	1309	1398	1499	1623
95	939	979	1020	1065	1112	1165	1193	1223	1257	1291	1368	1453	1552	1664	1802
100	1031	1075	1119	1168	1220	1278	1309	1341	1377	1415	1498	1590	1698	1819	1968
105	1132	1179	1228	1282	1339	1402	1437	1472	1514	1553	1644	1745	1862	1994	2157
110	1237	1289	1342	1401	1463	1532	1570	1608	1653	1697	1796	1905	2033	2177	2354
115	1346	1403	1461	1525	1593	1668	1709	1751	1799	1847	1955	2074	2212	2369	2561
120	1461	1522	1585	1655	1728	1810	1855	1900	1952	2004	2121	2250	2400	2569	2777
125	1579	1646	1714	1789	1869	1957	2005	2054	2111	2167	2293	2432	2594	2777	3001

Appendix D Temporary Speed Restrictions

The content of this appendix is mandatory

D.1 Position of speed indicators and termination indicators

D.1.1 General requirements

D.1.1.1 Where temporary speed restriction speed indicators are required (see 3.4.1.1), they shall be positioned:

a) On the approach to the temporary speed restriction, and

b) As close as practicable to the location where the temporary speed limit commences.

D.1.1.2 Additional speed indicator(s) shall be provided within a temporary speed restriction in the following circumstances:

a) At a position where trains are permitted to reverse direction (for example, at the signal at which the train may reverse direction). In this case the WON shall specify:

'The speed indicator on the ___ line at ___ miles ___ chains is provided for trains turning back at this location.'

b) Where there is an operational requirement to change drivers (for example, at stations). In this case the WON shall specify:

'The speed indicator on the ___ line at ___ miles ___ chains applies to changing crews at this location.'

D.1.1.3 Where differential speeds apply, all the required speed indicators and directional indicators shall be positioned together.

D.1.1.4 It is permitted for nominally co-located signs to be separated by a short distance where this would not impair readability.

D.1.2 Position of speed indicators at converging junctions

D.1.2.1 Where lines converge within a temporary speed restriction, a speed indicator shall be provided at each entry to the speed restriction before the convergence, so that trains pass only one speed indicator applicable to the restriction (see Figure D-1).

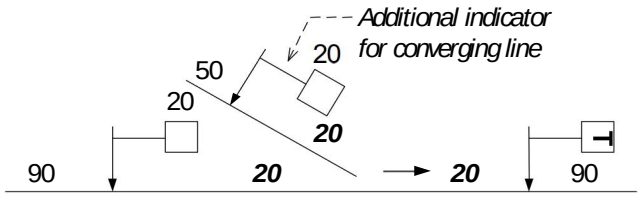


Figure D-1 Example of speed indicators at converging junction (D.1.2.1)

D.1.3 Position of speed and termination indicators at diverging junctions

D.1.3.1 A speed indicator, with an arrow indicating the direction of divergence, shall be provided on the approach to any diverging junction or facing crossover on or over which there is a temporary speed restriction.

D.1.3.2 Where a temporary speed restriction only applies to the trailing point end of a crossover and the speed indicator cannot be placed at a position within the crossover, the speed indicator (with directional arrow) shall be placed before the facing point end (see Figure D-2). In this case the WON shall specify:

'The speed indicator on ___ line at ___ miles ___ chains applies only to trains using the crossover to ___ line.'

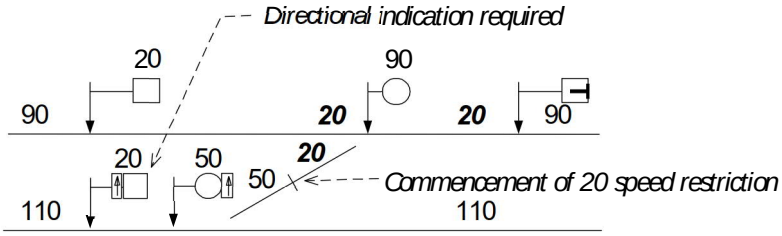


Figure D-2 Example of TSR over trailing end of crossover (D.1.3.2)

D.1.3.3 Where a temporary speed restriction applies only over the facing point end of a crossover, a termination indicator (or, if entering another adjoining temporary speed restriction, a speed indicator displaying the value of that speed restriction) shall be placed adjacent to the trailing point end (see Figure D-3). In this case the WON shall specify:

'The termination indicator on ___ line at ___ miles ___ chains applies only to trains using the crossover from ___ line.'

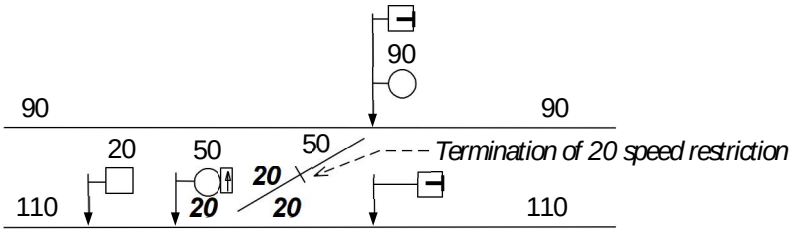


Figure D-3 Example of TSR over facing end of crossover (D.1.3.3)

D.2 Temporary speed restriction warning boards and AWS equipment

D.2.1 General requirements for warning boards

D.2.1.1 Warning board(s) shall be positioned as close as practicable to (but not less than) the deceleration distance from the associated speed indicator.

D.2.1.2 Where the temporary speed restriction commences at an increase of permissible speed, and the speed of the TSR is the same as, or higher than, the speed on the approach, the warning board(s) shall be positioned at a minimum distance from the associated speed indicator equivalent to a running time of four seconds at the permissible speed.

D.2.1.3 The distance from the warning board to the speed indicator shall be extended:

a) Where this is necessary to avoid AWS conflicts (see D.2.4).

b) So that a warning board is not positioned between existing AWS equipment and the equipment to which the AWS applies.

D.2.1.4 Where the required deceleration distance from the permissible speed on the immediate approach to the temporary speed restriction would result in the warning board being positioned in a section of line with a higher permissible speed, the

deceleration distance shall be determined using that higher permissible speed (see Figure D-4).

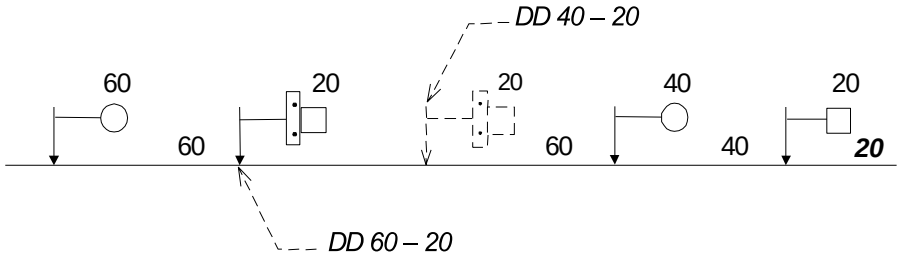


Figure D-4 Example of TSR with a higher permissible speed on approach (D.2.1.4)

D.2.1.5 Where the required deceleration distance from the permissible speed on the immediate approach to the temporary speed restriction would result in the warning board being positioned in a section of line with a lower permissible speed, the deceleration distance required for this lower permissible speed shall be determined. If the revised position of the warning board still falls within that lower permissible speed section, it shall be positioned at that distance (see Figure D-5).

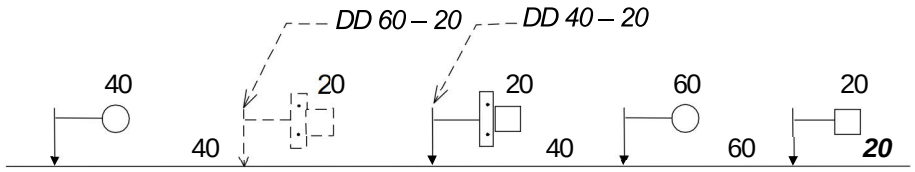


Figure D-5 Example of TSR with a lower permissible speed on approach (D.2.1.5)

D.2.1.6 If the revised position of the warning board as set out in D.2.1.5 lies between the permissible speed indicator at the commencement of the higher permissible speed section and the temporary speed restriction speed indicator, the warning board shall be positioned at the permissible speed indicator for the higher speed section to prevent acceleration (see Figure D.6).

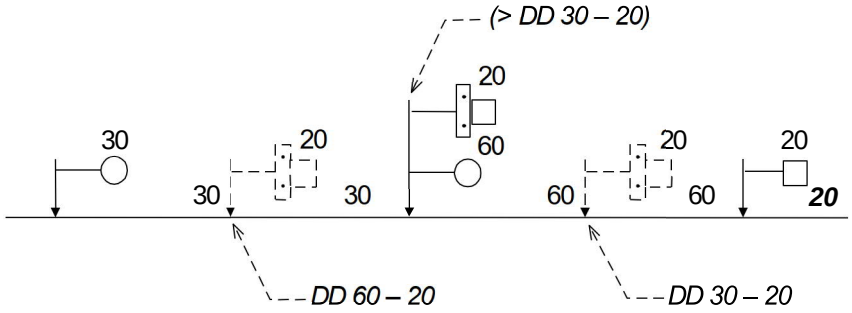


Figure D-6 Example of TSR with warning board at commencement of higher permissible speed (D.2.1.6)

D.2.2 Requirements for warning boards at converging junctions

D.2.2.1 Where the deceleration distance requires a warning to be given on the approach to a converging junction, a warning board shall be positioned at the appropriate deceleration distance on each line approaching the speed indicator (see Figure D-7).

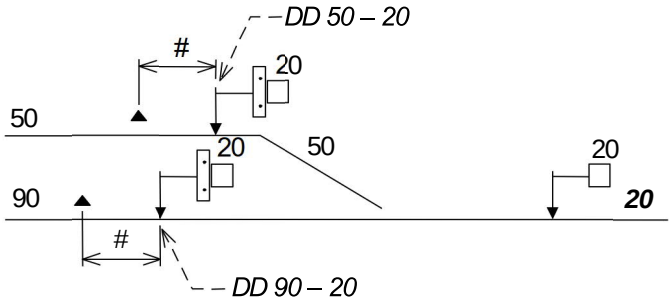


Figure D-7 Example of warning board positioning at a converging junction (D.2.2.1)

D.2.2.2 Where the required deceleration distances would position one of the warning boards on the approach to a convergence, then all warning boards shall be positioned before the convergence so that a train passes only one warning board on any approach to the temporary speed restriction.

D.2.3 Requirements for warning boards at diverging junctions

D.2.3.1 Where a temporary speed restriction applies over or beyond a diverging junction, and the required deceleration distance places the warning board before the junction (see Figure D-8), the warning board shall incorporate an arrow indicating the direction of divergence. In this case the WON shall specify:

'The warning board situated on the ___ line at ___ miles ___ chains applies to trains proceeding to the ___ line.'

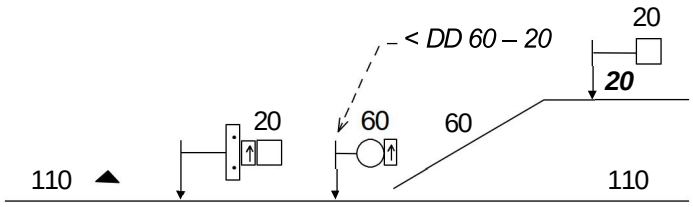


Figure D-8 Example of warning board positioning at a diverging junction (D.2.3.1)

D.2.3.2 Where the deceleration distance would provide a warning board on a diverging line at a position that would cause the associated AWS permanent magnet to be located at or before the facing points, all of the following arrangements shall apply (see Figure D-9):

a) The warning board shall incorporate a directional arrow.

b) The warning board shall be positioned at the facing points.

c) The AWS magnet shall be positioned at the required distance on the approach to the warning board.

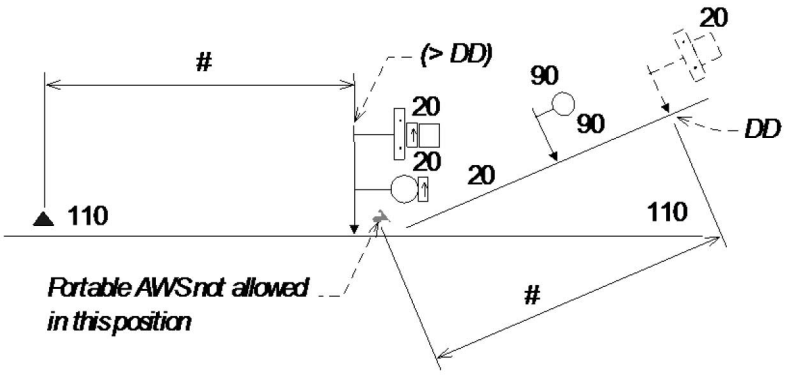


Figure D-9 Example of a diverging junction with warning board located at the facing points (D.2.3.2)

D.2.3.3 Where the deceleration distance would provide the warning board on the approach to a junction signal that is approach controlled from red (permanent or temporary approach control), all of the following arrangements shall apply:

a) The deceleration distance shall be determined using the junction speed.

b) The warning board shall be positioned at or after the sighting point of the signal (including the route indicator), or of the splitting banner repeating signal, where provided (see Figure D-10).

c) The WON shall specify:

'The warning board situated on the ___ line at ___ miles ___ chains applies to trains proceeding to the ___ line.'

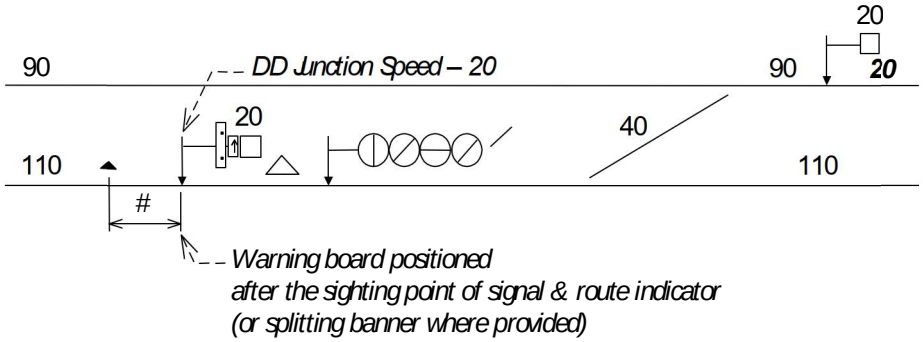


Figure D-10 Example of a diverging junction where signal is approach released from red (D.2.3.3)

D.2.3.4 Where the deceleration distance would provide the warning board on the approach to a junction signal and the signalling aspect sequence provides information to the driver on which route has been set (for example, the junction signal is approach controlled from yellow with flashing yellows or splitting distant in rear), all of the following arrangements shall apply:

a) The warning board shall be positioned at the deceleration distance calculated using the permissible speed of the line (see Figure D-11).

b) The WON shall specify:

'The warning board situated on the ___ line at ___ miles ___ chains applies to trains proceeding to the ___ line.'

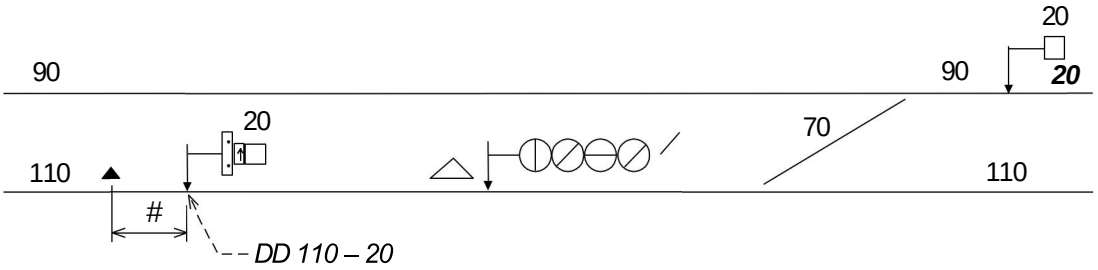


Figure D-11 Example of a diverging junction where signal is approach released from a higher aspect (D.2.3.4)

D.2.3.5 Where the deceleration distance would provide the warning board on the approach to a junction signal that is not approach controlled or that displays a free single yellow with a standard 4-aspect sequence on the approach, all of the following arrangements shall apply:

a) Temporary approach control from red shall be applied to the signal for the applicable diverging route or straight route (see Figure D-12, which sets out an example of a temporary speed restriction on the straight route).

b) The signal aspect release point shall be at or after the sighting point of the signal (including the route indicator, where applicable), or of the splitting banner repeating signal, where provided.

c) The warning board shall be positioned so that it is visible to the driver when the signal aspect is released from red to display a proceed aspect.

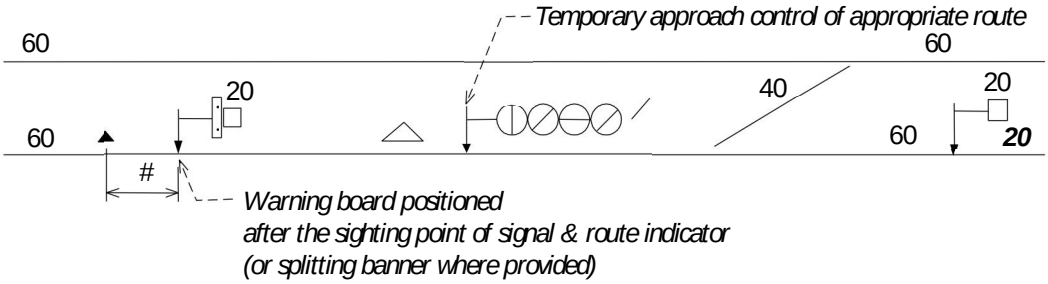


Figure D-12 Example of a diverging junction where no previous routing advice is given (D.2.3.5)

D.2.4 Requirements for AWS permanent magnets and AWS cancelling indicators

D.2.4.1 Except where D.2.4.2 applies, an AWS permanent magnet shall be positioned:

a) On all lines that signalled running moves approach the warning board, whether or not the line is fitted with AWS (see Figure D-13).

b) 180 m (200 yd) on the approach to the temporary speed restriction warning board, unless the criteria in D.2.4.3 apply.

c) Where the criteria in D.2.4.3 apply, between 45 m (50 yd) and 180 m (200 yd) from the warning board, subject to a minimum of 4 seconds running time at permitted speed (see Figure D-14).

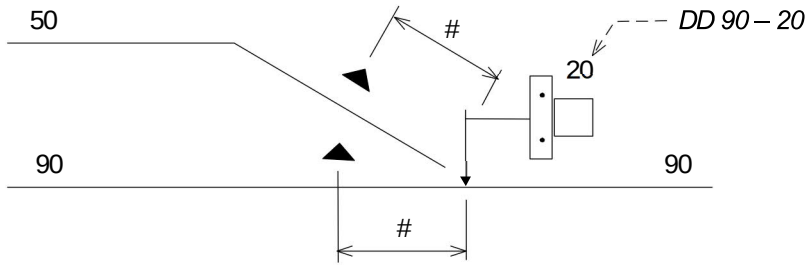


Figure D-13 Example of usual positioning of AWS magnets (D.2.4.1a)

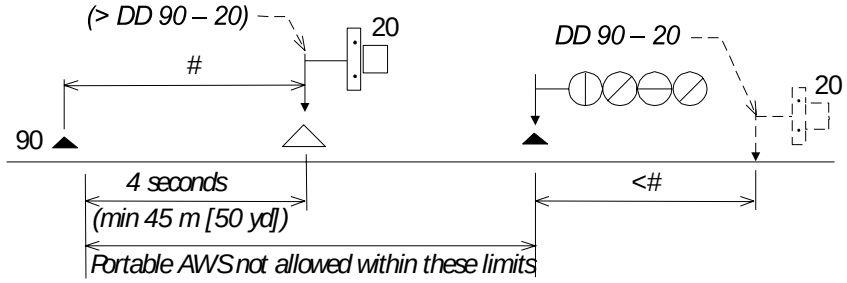


Figure D-14 Example of critical positioning of AWS magnets (D.2.4.1c)

D.2.4.2 The AWS permanent magnet shall not be provided, either:

a) In an AWS gap area (see GE/RT8075), or

b) On lines from which trains always start from rest, for example, bay or terminal platforms. In this case the WON shall specify:

'No AWS at warning board on ___ line at ___ miles ___ chains.'

D.2.4.3 The AWS permanent magnet shall not be positioned within 4 seconds running time of the AWS equipment associated with any of the following, which apply in the same direction:

a) A signal (including fixed distant boards and SPAD indicators).

b) A permissible speed warning indicator.

c) A level crossing advanced warning sign (St. Georges Cross).

D.2.4.4 By exception, where no other configuration of warning board and AWS position is practicable:

a) The warning board shall be positioned at a signal.

b) The AWS equipment associated with the signal shall be re-configured to generate an AWS caution indication in the driving cab, regardless of the aspect displayed by the signal (see Figure D-15). In this case the infrastructure manager shall assess the SPAD risk arising from disconnection of the AWS, and ensure that the correct AWS functionality for the signal is restored at the earliest opportunity.

c) The WON shall specify:

'Warning Board positioned at signal no. ___ on ___ line, an AWS warning indication will be given irrespective of the aspect exhibited by the signal.'

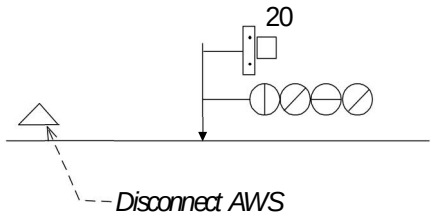


Figure D-15 Example of warning board at signal with signal AWS electromagnet disconnected (D.2.4.4)

D.2.4.5 On single or bi-directional lines, where it is possible to utilise existing AWS equipment associated with a signal or sign for the opposing direction, which is normally suppressed for movements in the direction towards the warning board (see Figure D-16):

a) The warning board shall be positioned to utilise the existing AWS equipment for the opposing direction.

b) The warning board shall be positioned at the required distance beyond the existing AWS equipment (see D.2.4.1).

c) The suppression shall be disconnected.

d) An AWS cancelling indicator shall not be provided.

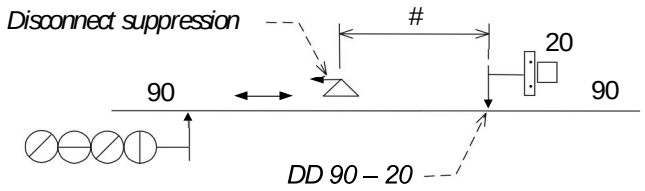


Figure D-16 Example of disconnection of suppressor on existing magnet (D.2.4.5)

D.2.4.6 On single and bi-directional lines, except where the arrangement in D.2.4.5 is used, an AWS cancelling indicator shall:

a) Be provided.

b) Be positioned 180 m (200 yd) beyond the portable AWS equipment when travelling in the direction for which the warning is not applicable (see Figures D-17 and D-18). This distance shall be adjusted to avoid conflict with other equipment so that the AWS cancelling indicator is positioned between 4 and 7 seconds running time from the AWS equipment, subject to a minimum of 45 m (50 yd).

D.2.4.7 On single or bi-directional lines:

a) The AWS permanent magnet and its AWS cancelling indicator shall not be positioned between a signal or a sign (that apply to movements in the same direction as the AWS cancelling indicator), and the AWS equipment associated with that signal or sign.

b) The warning board shall be positioned accordingly (see Figures D-17 and D-18).

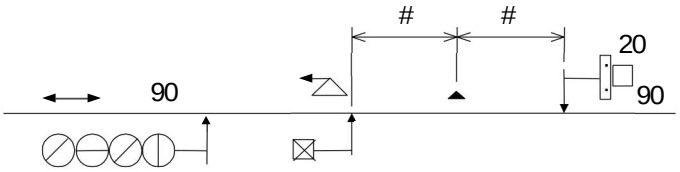


Figure D-17 Example showing use of AWS cancelling indicator (D.2.4.6 / D.2.4.7)

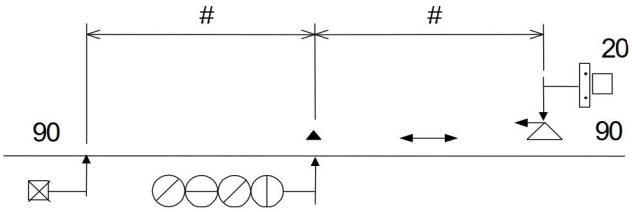


Figure D-18 Another example showing use of AWS cancelling indicator (D.2.4.6 / D.2.4.7)

D.2.4.8 Where the deceleration distance means that a warning board is to be positioned on a line not fitted with AWS, between a junction leading onto an AWS fitted line and the protecting signal, the warning board shall be positioned at the signal and provided with its own portable AWS equipment (see Figure D-19). In this case the WON shall specify:

'Warning Board positioned at signal no. ___ on ___ line applies to trains proceeding towards the ___ line. An AWS warning indication will be given irrespective of the aspect exhibited by the signal.'

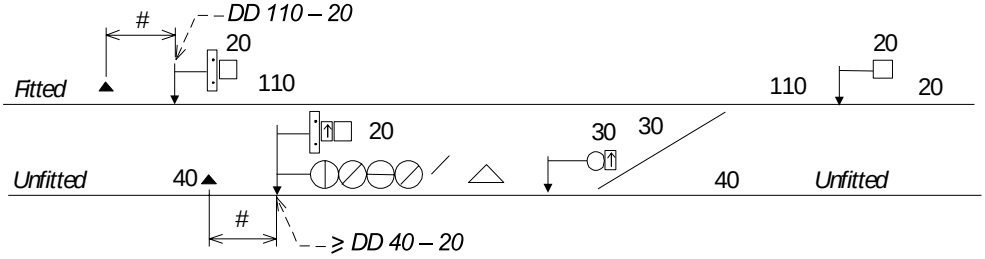


Figure D-19 Example showing provision of a warning board on an unfitted line leading to a fitted line (D.2.4.8)

D.2.4.9 Where the deceleration distance means that a warning board is required on an AWS fitted line 4 to 7 seconds running time beyond a crossover from an unfitted line, where AWS equipment is provided ahead of the signal for trains proceeding onto the fitted line, all the following arrangements shall apply (see Figure D-20):

a) The existing AWS equipment shall be re-configured so that a caution indication is provided in the driving cab.

b) A permanent magnet shall not be provided.

c) The WON shall specify:

'The AWS magnet for signal no. ___ on ___ line will give an AWS warning indication for trains proceeding towards the warning board on ___ line at ___ miles ___ chains irrespective of the aspect exhibited by the signal.'

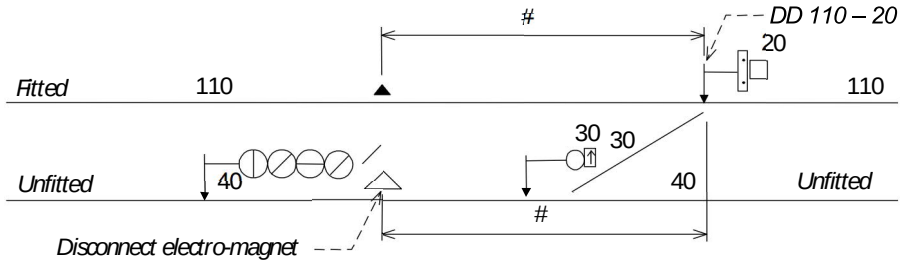


Figure D-20 Example showing disconnection of AWS in advance of protecting signal leading to a fitted line (D.2.4.9)

D.2.5 Repeater warning boards

D.2.5.1 A repeater warning board, showing the restricted speed, shall be provided where:

a) The deceleration distance means that the warning board is positioned on the approach to a passenger station, or on a bay platform line or siding, and

b) The associated speed indicator is positioned at least 300 m beyond the station or siding connection.

D.2.5.2 Each repeater warning board shall be configured as shown in Figure D-21 and positioned so that it is visible to drivers before trains start from rest.

D.2.5.3 Repeater warning boards shall be provided from any other line where trains always start from rest.

D.2.5.4 AWS permanent magnets shall not be provided for repeater warning boards.

D.2.5.5 Where repeater warning boards are provided, the WON shall specify either:

'Repeater warning board positioned ahead of ___ station, for temporary speed restriction on the___ line commencing at ___ miles ___ chains.' or

'Repeater warning board positioned at signal no. ___, for temporary speed restriction on the ___ line commencing at ___ miles ___ chains.'

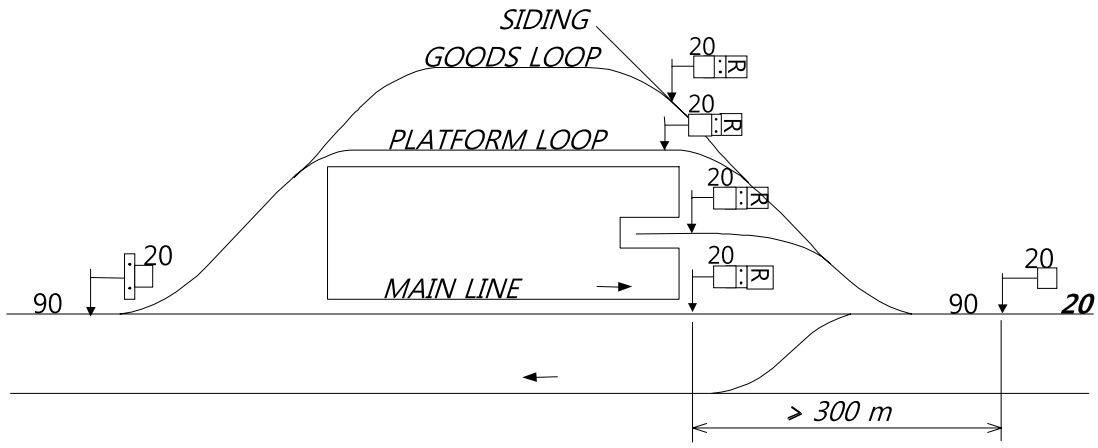


Figure D-21 Example showing use of repeater warning boards (D.2.5.2)

D.3 Requirements for adjacent temporary speed restrictions

D.3.1 Where a lower speed is followed by a higher speed

D.3.1.1 Where a temporary speed restriction is immediately followed by another temporary speed restriction with a higher speed all of the following arrangements shall apply (see Figure D-22):

a) A speed indicator for the higher temporary speed restriction shall be positioned at the end of the lower speed restriction.

b) A termination indicator shall not be provided for the lower temporary speed restriction.

c) A warning board shall not be provided for the higher temporary speed restriction.

d) The WON shall specify:

'No warning board for ___ mph speed restriction on ___ line commencing at ___ miles ___ chains.'

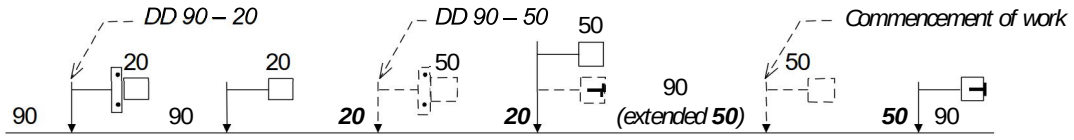


Figure D-22 Example of a lower TSR followed by a higher TSR (D.3.1.1)

D.3.2 Where a higher speed is followed by a lower speed

D.3.2.1 Where the deceleration distance means that the warning board for a temporary speed restriction falls within or before a higher temporary speed restriction all of the following arrangements shall apply (see Figures D-23 and D-24):

a) The higher temporary speed restriction shall be extended to terminate at the commencement of the lower temporary speed restriction.

b) A termination indicator for the first temporary speed restriction shall not be provided.

c) The warning board for the second restriction, if this is within the higher temporary speed restriction, shall be positioned at the deceleration distance calculated using the speed of the first temporary speed restriction (rather than the permissible speed of the line).

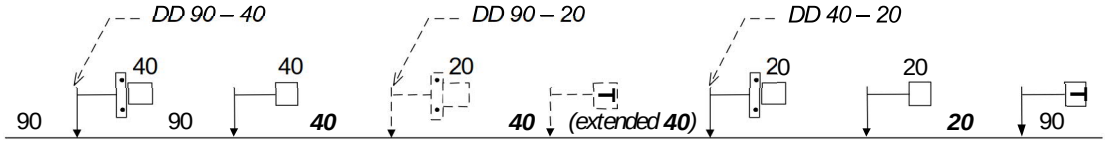


Figure D-23 Example of a higher TSR followed by a lower TSR (D.3.2.1)

Figure D-24 Another example of a higher TSR followed by a lower TSR (D.3.2.1)

D.3.3 Where warning boards coincide

D.3.3.1 Where two or more warning boards, for separate diverging routes or successive speed restrictions on the same line, are calculated to fall within 4 seconds running time of each other:

a) The warning boards shall be positioned so that the AWS magnet for the second warning board is positioned immediately after the first warning board in the direction of travel.

b) A separate AWS magnet shall be provided for each warning board.

c) The AWS magnet for each warning board shall be positioned in accordance with D.2.4.

D.3.3.2 Where the conditions of D.3.3.1 apply to speed restrictions on diverging routes (see Figure D-25):

a) The warning board for the straight route shall be positioned so that the driver passes it first.

b) In the case of the divergence the WON shall specify:

'The second warning board and associated AWS warning indication on ___ line at ___ miles ___ chains apply only to trains proceeding to ___ line.'

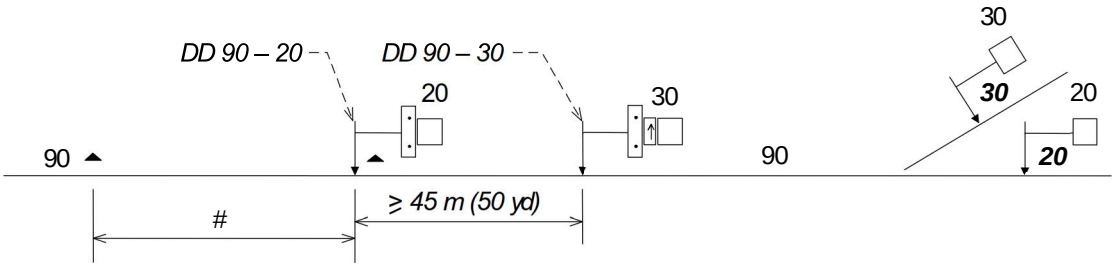


Figure D-25 Example of co-incident warning boards for diverging routes (D.3.3.2)

D.3.3.3 Where the conditions of D.3.3.1 apply to successive speed restrictions on the same line, the warning boards shall be positioned in the order in which the speed restrictions are approached (see Figure D-26).

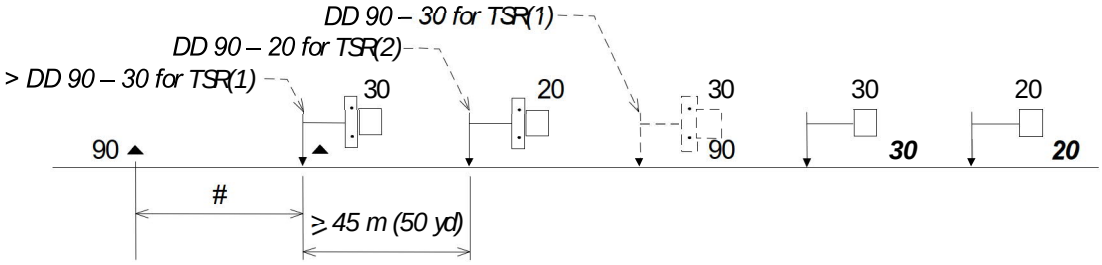


Figure D-26 Example of successive speed restrictions on the same line (D.3.3.3)

D.4 Altering temporary speed restrictions

D.4.1 Moving temporary speed restriction limits

D.4.1.1 It is permissible for the limits of a temporary speed restriction to be moved progressively along a line, provided that the commencement is not moved towards drivers in the direction of travel. Both of the following arrangements shall apply:

a) The speed indicator and termination indicator shall be repositioned as the worksite is moved, and the warning board shall be repositioned at deceleration distance from the repositioned speed indicator.

b) The WON shall specify:

'Moving temporary speed restriction.'

D.4.1.2 If it is not practicable to reposition the warning board (see Figure D-27):

a) The speed indicator and associated warning indicator shall remain in the original position.

b) The termination indicator shall be repositioned so that it indicates the end of the temporary speed restriction at all times.

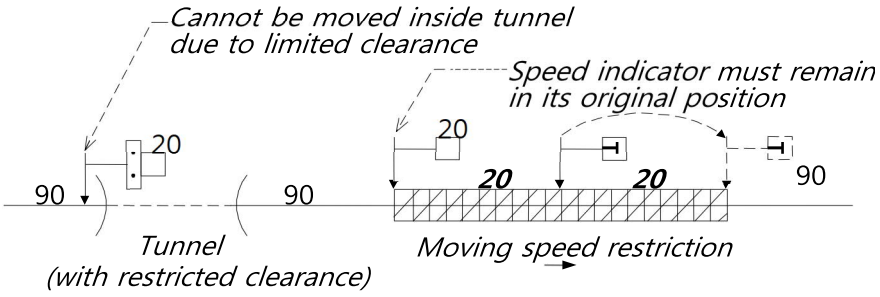


Figure D-27 Example showing a moving TSR where the warning board cannot be moved (D.4.1.2)

D.4.2 Withdrawing and increasing speeds of temporary speed restrictions

D.4.2.1 If the implementation of a temporary speed restriction is published or notified, and then its speed is raised earlier than planned, the speed indicators, warning boards and repeater warning boards shall:

a) Remain in the same position until the published time and date for their removal, and

b) Be altered to show the higher speed.

D.4.2.2 If a temporary speed restriction is published or notified but then does not need to be imposed, or if it is withdrawn earlier than shown in the WON, the speed indicators, warning boards and repeater warning boards, where required, shall:

a) Be erected or retained in the published position, unless a Special Notice cancelling the restriction is issued at least 24 hours before the temporary speed restriction is planned to commence.

b) Where erected or retained, be altered to show the permissible speed of the line or 'Spate' indications (see Figure D-28).

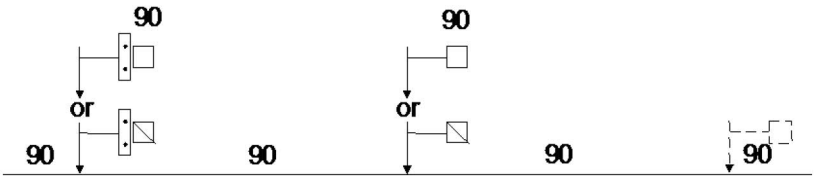


Figure D-28 Example of a TSR not imposed or withdrawn early (D.4.2.2)

D.4.2.3 Where temporary speed restrictions adjoin (see D.3), the first temporary speed restriction shall only be relaxed or removed, which will leave an adjoining restriction in place, when:

a) The warning boards for the remaining temporary speed restriction have been repositioned to take account of the change, and

b) Amended details have been published in the WON.

Appendix E Emergency Speed Restrictions

The content of this appendix is mandatory

E.1 Management of emergency speed restrictions

E.1.1 A temporary speed restriction shall be implemented as an emergency speed restriction if:

a) It has not been published in the WON.

b) It has only been published in an amendment to the WON.

c) The actual speed restriction is slower than the speed details published in the WON, or

d) The speed restriction applies at a time that is different to the details published in the WON.

E.1.2 The infrastructure manager shall consistently communicate details of all emergency speed restrictions to the drivers of all railway undertakings that operate over the route.

E.1.3 An emergency speed restriction shall be managed as a temporary speed restriction only after the correct details have been published in the WON.

E.2 Provision of speed indicators, warning boards and AWS equipment

E.2.1 Emergency speed restrictions shall be implemented as temporary speed restrictions, in accordance with the requirements of this standard, except that a risk assessment is not required for the disconnection of an AWS electromagnet at a signal.

E.2.2 In addition, an emergency indicator shall be positioned:

a) On the approach to the AWS permanent magnet for the warning board.

b) Not less than 180 m (200 yd) before the warning board.

c) Not further than 400 m (440 yd) before the warning board.

E.2.3 An AWS permanent magnet shall be positioned on the approach to the emergency indicator (see Figure E-1).

E.2.4 The emergency indicator and associated permanent magnet shall remain in place until either:

a) The relevant details have been published in the WON, or

b) The speed restriction has been withdrawn.

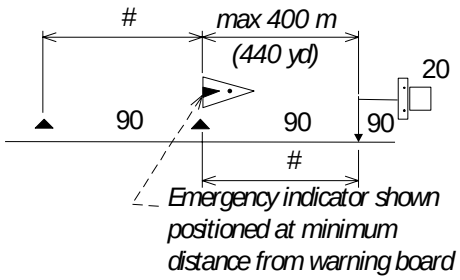


Figure E-1 Example of arrangements for emergency speed restriction (E.2.2)

Appendix X Deceleration Distances

The content of this appendix is mandatory

X.1 Deceleration distance to speed restriction of 10 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5R	Level	1 in 400 2.5F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
10											
20	155	165	180	200	210	220	238	255	295	365	402
25	220	235	260	290	303	325	345	375	402	422	523
30	295	315	350	390	402	402	412	422	523	644	770
35	375	402	402	443	473	503	553	604	744	986	1305
40	402	443	503	583	643	704	784	865	1066	1408	2012
45	523	604	664	785	845	905	995	1086	1267	1569	2046
50	523	604	664	785	845	905	995	1086	1267	1569	2046
55	602	652	710	785	845	905	995	1086	1267	1569	2046
60	716	776	845	929	980	1032	1097	1162	1329	1569	2046
65	775	838	910	996	1049	1102	1168	1234	1428	1730	2046
70	862	929	1004	1096	1150	1205	1276	1348	1520	1740	2046
75	945	984	1084	1164	1215	1258	1320	1382	1534	1740	2046
80	945	984	1084	1164	1215	1258	1320	1382	1534	1740	2046
85	1040	1102	1171	1251	1309	1354	1415	1471	1614	1788	2046
90	1173	1246	1325	1419	1484	1537	1610	1674	1842	2049	2330
95	1325	1409	1502	1612	1680	1750	1835	1913	2113	2366	2713
100	1520	1621	1735	1870	1960	2041	2143	2245	2503	2835	3312
105	1520	1621	1735	1870	1960	2041	2143	2245	2503	2835	3312
110	1520	1621	1735	1870	1960	2041	2143	2245	2503	2835	3312
115	1520	1621	1735	1870	1960	2041	2143	2245	2503	2835	3312
120	1574	1643	1735	1870	1960	2041	2143	2245	2503	2835	3312
125	1702	1777	1856	1944	1998	2052	2143	2245	2503	2835	3312

Gradients are shown in mm/m as ‘R’ for rising and ‘F’ for falling

Table X-1 Deceleration distance in metres to speed restriction of 10 mph

Lineside Signal Spacing and Speed Signage

X.2 Deceleration distance to speed restriction of 20 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5R	Level	1 in 400 2.5F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
20											
25	220	235	260	290	303	325	345	375	402	402	402
30	295	315	350	390	402	402	402	402	443	543	805
35	375	402	402	402	422	443	483	523	664	885	1267
40	402	402	463	523	573	624	694	764	986	1287	1811
45	483	543	604	704	764	825	925	1026	1207	1489	1971
50	483	543	604	704	764	825	925	1026	1207	1489	1971
55	560	607	662	729	777	825	925	1026	1207	1489	1971
60	674	733	799	880	929	979	1042	1105	1268	1489	1971
65	736	796	866	950	1001	1052	1116	1180	1345	1650	2046
70	826	890	964	1053	1106	1160	1225	1291	1489	1740	2046
75	886	966	1046	1147	1207	1258	1320	1382	1534	1740	2046
80	891	966	1046	1147	1207	1258	1320	1382	1534	1740	2046
85	1013	1075	1143	1222	1275	1328	1398	1469	1609	1788	2046
90	1147	1218	1297	1389	1449	1509	1589	1670	1842	2049	2330
95	1298	1382	1473	1582	1656	1730	1820	1911	2113	2366	2713
100	1492	1593	1705	1838	1925	2012	2112	2213	2503	2835	3299
105	1492	1593	1705	1838	1925	2012	2112	2213	2503	2835	3299
110	1492	1593	1705	1838	1925	2012	2112	2213	2503	2835	3299
115	1492	1593	1705	1838	1925	2012	2112	2213	2503	2835	3299
120	1540	1608	1705	1838	1925	2012	2112	2213	2503	2835	3299
125	1670	1750	1831	1911	1971	2032	2122	2213	2503	2835	3299

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-2 Deceleration distance in metres to speed restriction of 20 mph

X.3 Deceleration distance to speed restriction of 30 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5R	Level	1 in 400 2.5F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
30											
35	375	402	402	402	402	402	402	402	523	704	1066
40	402	402	402	422	472	523	593	664	825	1106	1609
45	402	443	523	624	694	765	845	925	1086	1348	1851
50	402	443	523	624	694	765	845	925	1086	1348	1851
55	480	522	570	630	700	770	847	925	1086	1348	1851
60	596	648	709	783	794	805	898	991	1142	1348	1851
65	661	717	781	860	892	925	1000	1075	1230	1529	1971
70	757	817	887	970	1008	1046	1121	1196	1408	1740	1971
75	845	905	986	1066	1126	1187	1285	1358	1534	1740	1971
80	845	905	986	1066	1126	1187	1285	1358	1534	1740	1971
85	964	1023	1089	1165	1216	1267	1312	1358	1549	1750	1971
90	1098	1166	1243	1331	1389	1448	1528	1609	1790	2012	2293
95	1248	1329	1418	1529	1589	1650	1740	1831	2052	2313	2655
100	1440	1538	1647	1777	1864	1951	2051	2152	2434	2796	3219
105	1440	1538	1647	1777	1864	1951	2051	2152	2434	2796	3219
110	1440	1538	1647	1777	1864	1951	2051	2152	2434	2796	3219
115	1440	1538	1647	1777	1864	1951	2051	2152	2434	2796	3219
120	1485	1550	1647	1777	1864	1951	2051	2152	2434	2796	3219
125	1613	1690	1770	1871	1921	1971	2061	2152	2434	2796	3219

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-3 Deceleration distance in metres to speed restriction of 30 mph

X.4 Deceleration distance to speed restriction of 40 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	(1 in 400) 2.5R	Level	(1 in 400) 2.5F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
40											
45	402	402	402	463	523	583	663	744	885	1106	1569
50	402	402	402	463	523	583	663	744	885	1106	1569
55	402	402	426	473	528	583	663	744	885	1106	1569
60	475	518	568	630	668	706	754	803	932	1107	1569
65	545	593	648	714	759	805	865	925	1086	1328	1811
70	648	702	763	845	886	927	996	1066	1247	1529	1831
75	744	805	885	966	1016	1066	1146	1227	1428	1609	1831
80	766	812	885	966	1016	1066	1146	1227	1428	1609	1831
85	887	943	1004	1086	1126	1167	1227	1287	1428	1609	1831
90	1021	1085	1158	1247	1307	1368	1438	1509	1670	1891	2152
95	1171	1247	1332	1431	1500	1569	1649	1730	1931	2193	2515
100	1359	1453	1556	1690	1770	1851	1961	2072	2334	2676	3098
105	1359	1453	1556	1690	1770	1851	1961	2072	2334	2676	3098
110	1359	1453	1556	1690	1770	1851	1961	2072	2334	2676	3098
115	1359	1453	1556	1690	1770	1851	1961	2072	2334	2676	3098
120	1428	1509	1569	1690	1770	1851	1961	2072	2334	2676	3098
125	1569	1629	1710	1811	1851	1891	1982	2072	2334	2676	3098

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-4 Deceleration distance in metres to speed restriction of 40 mph

X.5 Deceleration distance to speed restriction of 50 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5 R	Level	1 in 400 2.5 F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
50											
55	402	402	402	402	402	402	402	402	402	422	664
60	402	402	402	409	435	461	494	528	617	740	1046
65	402	422	463	506	544	583	623	664	785	986	1428
70	523	563	604	664	704	744	804	865	1006	1247	1609
75	624	664	744	825	865	905	975	1046	1227	1428	1609
80	658	699	744	825	865	905	975	1046	1227	1428	1609
85	780	830	884	947	986	1026	1086	1147	1267	1428	1609
90	914	972	1046	1127	1177	1227	1287	1348	1509	1710	1931
95	1062	1133	1210	1308	1368	1428	1498	1569	1770	2012	2293
100	1246	1333	1448	1569	1639	1710	1810	1911	2152	2454	2877
105	1246	1333	1448	1569	1639	1710	1810	1911	2152	2454	2877
110	1246	1333	1448	1569	1639	1710	1810	1911	2152	2454	2877
115	1246	1333	1448	1569	1639	1710	1810	1911	2152	2454	2877
120	1368	1428	1489	1569	1639	1710	1810	1911	2152	2454	2877
125	1489	1549	1629	1710	1760	1811	1861	1911	2152	2454	2877

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-5 Deceleration distance in metres to speed restriction of 50 mph

X.6 Deceleration distance to speed restriction of 60 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5R	Level	1 in 400 2.5F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
60											
65	402	402	402	402	402	402	402	402	402	483	724
70	402	402	402	422	442	463	503	543	644	825	1267
75	463	503	543	583	613	644	704	764	905	1147	1267
80	523	551	586	628	653	678	721	764	905	1147	1267
85	640	682	728	780	810	841	877	914	1026	1147	1267
90	774	824	880	945	985	1026	1076	1127	1267	1428	1650
95	921	983	1050	1130	1178	1227	1297	1368	1529	1730	2012
100	1106	1187	1287	1388	1458	1529	1619	1710	1911	2213	2575
105	1106	1187	1287	1388	1458	1529	1619	1710	1911	2213	2575
110	1106	1187	1287	1388	1458	1529	1619	1710	1911	2213	2575
115	1127	1187	1287	1388	1458	1529	1619	1710	1911	2213	2575
120	1267	1308	1368	1428	1478	1529	1619	1710	1911	2213	2575
125	1388	1448	1509	1589	1629	1670	1720	1770	1911	2213	2575

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-6 Deceleration distance in metres to speed restriction of 60 mph

X.7 Deceleration distance to speed restriction of 70 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5R	Level	1 in 400 2.5F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
70											
75	402	402	402	402	402	402	402	402	443	583	925
80	402	402	402	418	434	450	469	489	536	590	925
85	483	503	530	570	597	624	646	668	732	808	925
90	600	644	682	744	774	805	834	863	966	1086	1247
95	745	805	851	925	965	1006	1056	1106	1247	1408	1609
100	945	1006	1086	1187	1237	1287	1367	1448	1629	1871	2193
105	945	1006	1086	1187	1237	1287	1367	1448	1629	1871	2193
110	945	1006	1086	1187	1237	1287	1367	1448	1629	1871	2193
115	1006	1046	1086	1187	1237	1287	1367	1448	1629	1871	2193
120	1147	1187	1247	1308	1338	1368	1408	1448	1629	1871	2193
125	1267	1328	1388	1448	1488	1529	1569	1609	1690	1871	2193

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-7 Deceleration distance in metres to speed restriction of 70 mph

X.8 Deceleration distance to speed restriction of 80 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5R	Level	1 in 400 2.5F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
80											
85	402	402	402	402	402	402	402	402	402	402	422
90	402	422	445	478	497	517	540	564	619	685	770
95	563	583	624	664	688	712	748	785	865	966	1106
100	744	785	845	905	955	1006	1056	1106	1247	1428	1650
105	744	785	845	905	955	1006	1056	1106	1247	1428	1650
110	764	785	845	905	955	1006	1056	1106	1247	1428	1650
115	865	905	945	986	1006	1026	1056	1106	1247	1428	1650
120	1006	1046	1086	1127	1157	1187	1217	1247	1308	1428	1650
125	1127	1167	1227	1287	1317	1348	1378	1408	1489	1569	1670

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-8 Deceleration distance in metres to speed restriction of 80 mph

X.9 Deceleration distance to speed restriction of 90 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5 R	Level	1 in 400 2.5 F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
90											
95	402	402	402	402	402	402	402	402	422	463	523
100	503	523	563	604	634	664	694	724	825	925	1086
105	503	523	563	604	634	664	694	724	825	925	1086
110	604	624	644	664	674	684	704	724	825	925	1086
115	704	744	764	805	815	825	845	865	905	966	1086
120	845	865	905	945	965	986	1006	1026	1086	1147	1207
125	966	1006	1046	1106	1126	1147	1177	1207	1267	1328	1408

Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-9 Deceleration distance in metres to speed restriction of 90 mph

X.10 Deceleration distance to speed restriction of 100 mph

Initial Speed (mph)	GRADIENT (mm/m)										
	1 in 50 20R	1 in 67 15R	1 in 100 10R	1 in 200 5R	1 in 400 2.5 R	Level	1 in 400 2.5 F	1 in 200 5F	1 in 100 10F	1 in 67 15F	1 in 50 20F
100											
105											
110	402	412	422	443	453	463	468	473	493	513	533
115	523	543	563	583	593	604	614	624	654	684	724
120	644	664	694	724	739	754	774	795	825	865	905
125	785	805	835	865	885	905	930	956	1006	1056	1106

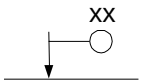
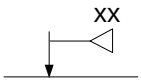
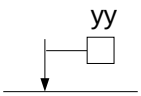
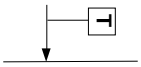
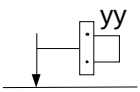
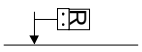
Gradients are shown as ‘R’ for rising and ‘F’ for falling

Table X-10 Deceleration distance in metres to speed restriction of 100 mph

Lineside Signal Spacing and Speed Signage

Railway Group Standard
GK/RT0075
Issue Four
Date September 2015

Appendix Y Key to Symbols Used in this Standard

xx	Section of line showing permissible speed (xx mph)
	Section of line with differential permissible speeds (yy mph and zz mph)
P	AWS magnet for permissible speed warning indicator ("P" indicates permanent magnet only)
xx ***yy***	Section of line showing (in upright type) permissible speed (xx mph) *(in italics)* temporary speed restriction (yy mph)
yy/zz	Section of line with differential temporary speed restriction (yy mph and zz mph)
	Permissible speed indicator (xx indicates speed displayed)
	Permissible speed warning indicator (xx indicates speed displayed)
	Speed indicator marking commencement of temporary speed restriction (yy indicates speed displayed)
	Termination indicator for temporary speed restriction
	Warning board for temporary speed restriction (yy indicates speed displayed)
DD yy–xx	Position of warning board at deceleration distance (DD) from speed indicator (for speed reduction from yy mph to xx mph)
	Repeater warning board for temporary speed restriction
	Emergency indicator (for emergency speed restriction)
	AWS magnet for signal
	Portable AWS magnet for temporary speed restriction (permanent magnet only)
	AWS cancelling indicator
	Spate indicator
	Distance between warning board and associated AWS equipment

Definitions

Actual signalling braking distance (ASD)

The actual distance between a signal displaying the first cautionary aspect and the signal displaying the associated stop aspect.

Attainable speed (as applicable to this document)

The maximum speed that any permitted type of rolling stock can achieve over a specific section of line, where it is not possible for any rolling stock authorised to operate on the line to attain the permissible speed. Attainable speed can be used as the basis of deceleration distance calculations for temporary speed restrictions or to enable the driver to bring the train to a stand at a stop signal.

Deceleration distance

The minimum distance at which a warning indicator (for a permissible speed) or a warning board (for a temporary or emergency speed restriction) shall be positioned approaching the start of the change in speed to which it applies, in order to ensure that all trains have sufficient warning to be able to conform to the required reduction in speed.

Differential speed

A permissible speed or speed restriction applicable to a particular type of train, where different values of speed are applicable to different types of trains over the same section of line.

Differential speeds include:

a) Standard differential speed – Two values of permissible speed, or two different speed values for a temporary speed restriction, each of which is applicable to one of two standard categories of trains, as defined in the Rule Book.

b) Non-standard differential speed – A permissible speed for a specific type of train, which is different from that for other types of trains on the same section of line. This comprises 'Permissible speed indicators with letters' and 'Enhanced permissible speed indicators' as described in the Rule Book. Non-standard differential speeds are not applicable to temporary or emergency speed restrictions.

Emergency speed restriction

A speed restriction not shown in the Weekly Operating Notice (WON), or which is more restrictive than shown, or which applies at a time other than that shown in the WON.

Enhanced permissible speed

The permitted speed (higher than the permissible speed) over a section of line which applies to a specific type of train operating at cant deficiencies in excess of those permitted at the permissible speed (see GE/RT8012 and GC/RT5021).

Excess signalling braking distance

The distance by which the actual signalling braking distance exceeds the minimum signalling braking distance.

Lineside operational safety sign

Lineside operational safety signs include speed indicators, warning indicators and emergency indicators, as depicted in GI/RT7033: Lineside Operational Safety Signs, Appendix A, sections AD, AE and AF.

Miniature permissible speed indicator

A reduced size indicator in accordance with GI/RT7033, Appendix A, sections AD and AE showing the permissible speed(s) over a section of line.

Minimum signalling braking distance (MSD)

The calculated minimum distance between a signal displaying the first caution aspect and the signal displaying the associated stop aspect.

Overrun

Passing the end of movement authority (the end of movement authority is the point where a train is required to come to a stand on completion of a signalled movement). On lines signalled with lineside signals, the conventional terminology for an overrun is a signal passed at danger (SPAD). The definition includes both failure to come to a stand at a signal at danger and starting from rest against a signal at danger.

Permissible speed

The authorised maximum speed over a section of line, either for all trains or (where differential speeds are applied) for specific types of trains, as set out in the Sectional Appendix.

Permissible speed indicator

An indicator in accordance with GI/RT7033, Appendix A, sections AD and AE showing the permissible speed(s) over a section of line.

Permissible speed warning indicator

An indicator in accordance with GI/RT7033 showing warning of a reduction of permissible speed over a section of line.

Signal

Throughout this document the word ‘signal’ shall be understood to include any lineside sign that performs the function of a signal.

Signalling braking distance (as applied to this document)

The distance between the signal exhibiting the first caution aspect and the signal at which the train is required to stop

Spate indicator (Speed Previously Applied Terminated Early)

A trackside indicator which informs the driver that a temporary speed restriction has been withdrawn earlier than published or has not been applied.

Temporary speed restriction

A speed, less than the permissible speed, applied for a pre-planned period not normally exceeding six months.

Weekly Operating Notice (WON)

The Weekly Operating Notice (WON) is the official printed notice which includes advice to drivers of temporary speed restrictions and alterations to permissible speeds. GO/RT3215: Requirements for WON, PON and Sectional Appendix, details requirements for the format and contents of the WON.

Other defined terms are included in GK/GN0802: Glossary of Signalling Terms.

Abbreviations and Acronyms

AWS	Automatic warning system
ERTMS	European Rail Traffic Management System
ESR	Emergency speed restriction
PON	Periodic Operating Notice
SPAD	Signal passed at danger
Spate	Speed Previously Applied Terminated Early
TSR	Temporary speed restriction
WON	Weekly Operating Notice

Lineside Signal Spacing and Speed Signage

References

The Catalogue of Railway Group Standards gives the current issue number and status of documents published by RSSB. This information is also available from www.rgsonline.co.uk.

RGSC 01	Railway Group Standards Code
RGSC 02	Standards Manual

Documents referenced in the text

Railway Group Standards

GC/RT5021	Track System Requirements
GE/RT8000	Rule Book
GE/RT8012	Controlling the Speed of Tilting Trains Through Curves
GE/RT8037	Signal Positioning and Visibility
GE/RT8075	AWS and TPWS Interface Requirements
GE/RT8270	Assessment of Compatibility of Rolling Stock and Infrastructure
GI/RT7033	Lineside Operational Safety Signs
GK/RT0045	Lineside Signals, Indicators, and Layout of Signals
GM/RT2041	Braking System Requirements and Performance for Trailer Coaching Stock
GM/RT2042	Braking System Requirements and Performance for Traction Units
GM/RT2043	Braking System and Performance for Freight Trains
GM/RT2044	Braking System Requirements and Performance for Multiple Units
GM/RT2045	Braking Principles for Rail Vehicles
GO/RT3215	Requirements for the Weekly Operating Notice, Periodical Operating Notice and Sectional Appendix

RSSB documents

GK/GN0675	Guidance on Lineside Signal Spacing and Speed Signage
GK/GN0802	Glossary of Signalling Terms
RS521	Signals, handsignals, indicators and signs handbook

APP-D – NARRATIVE RISK ASSESSMENTS (2021)

Rother Valley Railway

New Build Level Crossing Narrative Risk Analysis (NBLC-NRA) – Update 10.02.2021

Contents

1 Introduction

The Rother Valley Railway will provide a Full Barrier Automatic Level Crossing, Locally Monitored (AFBCL) incorporating the latest technology for the operation and protective equipment. The crossing will be fully compliant with what is widely used on Network Rail infrastructure today, thus, ensuring the crossing would not require any product approvals, derogations or changes to standards. The maintenance regime would also be standard and no bespoke parts would need to be produced or stocked specifically for the crossing. For the above reasons, the crossing presents a very low reliability and risk concern and would most likely incur the lowest maintenance costs.

A level crossing does not currently exist on the A21 Robertsbridge, therefore a Quantitative Risk Assessment would not provide sufficient evidence to demonstrate that possible risk has been assessed and managed accordingly. However, it is important to establish possible risk from the introduction of a level crossing and possible mitigation measures at an early stage of development.

This NBLC-NRA analyses all relevant data as well as expert opinion to demonstrate that all possible risk has been addressed as well as embroidering new technology to further enhance the safety of the level crossing, for example;

- CCTV for improved safety & security,
- Obstacle Detection
- Home Office Approved Red Light Cameras
- Evaluate the risks at the level crossing.
- Early engagement with stakeholders from different sectors, local authorities, communities and 'users' associations.
- Take engineering measures and find innovative solutions
- Take educational and awareness measures and collaborate with the rail and road sectors.

The level crossing will be carefully assessed via this analysis in collaboration with railways and the road infrastructure managers, local authorities and industry experts to make it more visible and easier to cross particularly for long, heavy and oversized vehicles.

All stakeholders will be in a position to cooperate and design the best level crossing environment.

Narrative Risk Assessments currently used by Network Rail are enabling better targeting of risk reduction measures; blending quantitative modelled risk with structured observation and judgement from competent staff. The NRA process is considered as part of this analysis to encompass the whole level crossing asset system and assess wider aspects of level crossing risk.

This analysis builds upon excellent safety initiatives which were introduced for the first Automatic Full Barrier level crossing by Network Rail including the safety benefits provided, however, RVR intend to introduce additional safety measures such as the use of Red-light safety equipment (RLSE), which has currently been

installed at 31 public road level Crossings on the National Railway Network to improve user behaviour, deterring deliberate misuse. Trials have demonstrated that these Home Office Type Approved (HOTA) cameras have reduced deliberate misuse by approximately 90 per cent at some locations.

RVR will install an automatic level crossing including an object detection system (AFBCL) at the A21 Robertsbridge level crossing. Crossing obstacle detection systems utilise a combination of RADAR and LIDAR technology to scan the crossing before allowing for trains to safely manoeuvre through. In combination these systems detect obstacles on the ground and around the edge of the barrier lines and deliver unique small object detection protecting children and adults as well as vehicles and other large objects. RVR will monitor and review the installation of the obstacle detection system after the first 12 months of operation to determine if additional safety features could be added to further enhance safety of the level crossing.

2 Level Crossing Overview

This is a risk analysis for the A21 Robertsbridge Road level crossing. However, it should be noted that at present a level crossing does not exist, therefore, the analysis is based on the probability of risk if a level crossing was in place. It is imperative that a full Quantitative (and Narrative) Risk Assessment (QRA) is completed before any trains operate over the crossing and that the QRA is presented to the ORR.

Crossing Details	
Name	A21 Robertsbridge Bypass
Type	AFBCL
Crossing status	Public Highway
Overall crossing status	Design Stage
Engineers Lin Reference	N/A
OS grid reference	
Number of lines crossed	1
Line speed (mph)	10
Electrification	No
Signal box	Yes (A21 level crossing)

3 Information Sources

The table below shows the stakeholder consultation that was undertaken as part of the risk analysis.

- Office of Rail and Road (ORR)
- Kent and East Sussex Railway (K&ESR)
- Bakerail (Track site/project management specialists)
- East Sussex County Council (ESCC)
- Rother District Council (RDC)
- I-Transport (Specialist Planning Transport Consultancy)
- ARUP (Design, Engineering, Architecture and Business consultation Group)
- Level Crossing Risk Management Tool (LXRMT).

Reference sources used during the risk analysis;

- ARUP A21 Options Report
- ARUP Road Safety Audit
- Mott Macdonald road survey report
- Network Rail QRA information
- GG19 Road Safety Report
- ORR Documentation
- GPR219-IDF- Level Crossing Safety
- EU SAFER-LC Project
- Level Crossing Risk Management Tool (LXRMT).

4 Level Crossing Diagrammatic Scheme

The new level crossing to be constructed is a Full Barrier Automatic Level Crossing, Locally Monitored (AFBCL) on the A21 (T) Robertsbridge Bypass.

The road approach speed is 40 mph. the profile of the railway in the vicinity of the crossing has been provided below, as well as the appropriateness of the proposed warning signs in this regard.

Diagram of the proposed railway Alignment

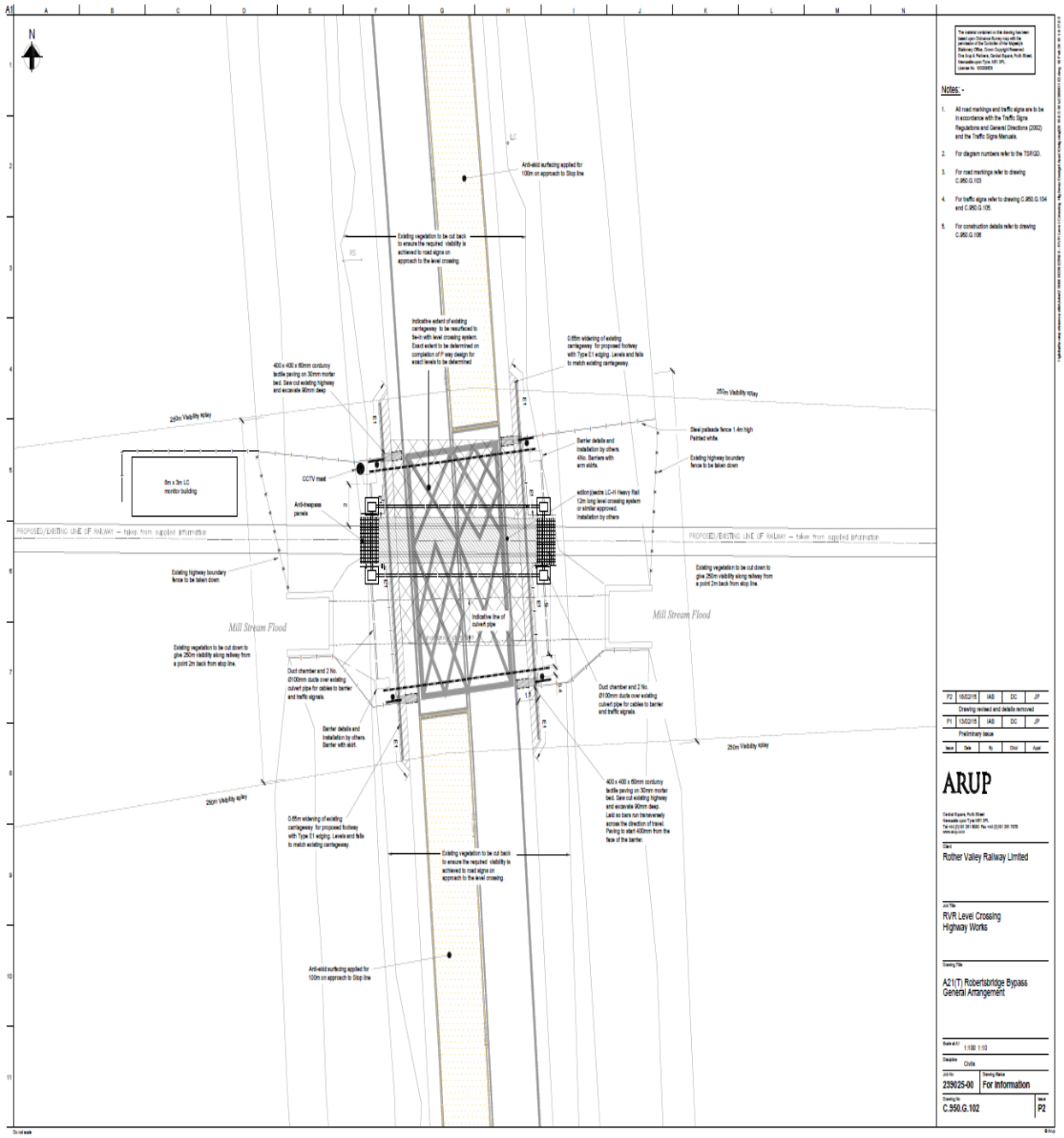
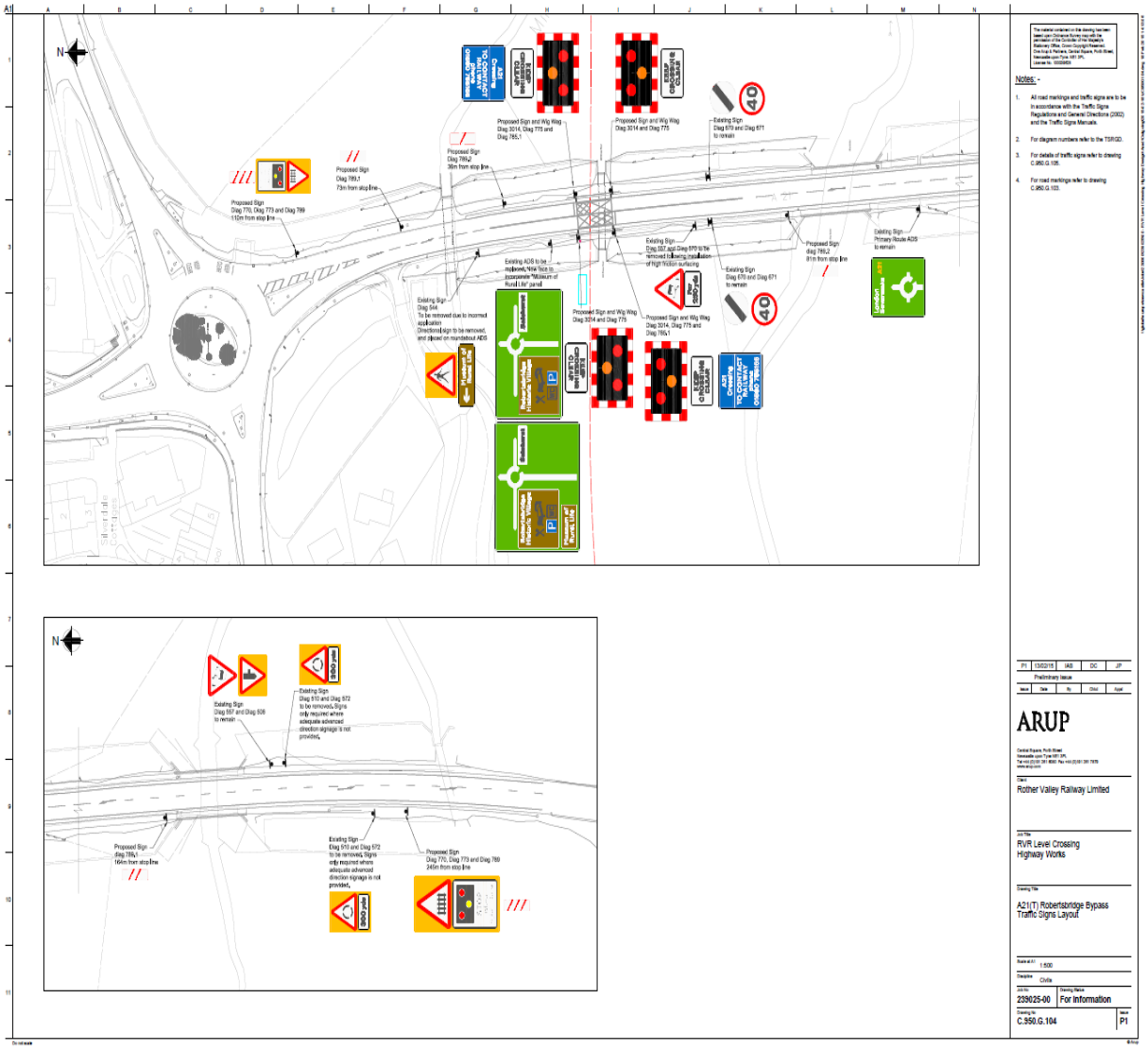
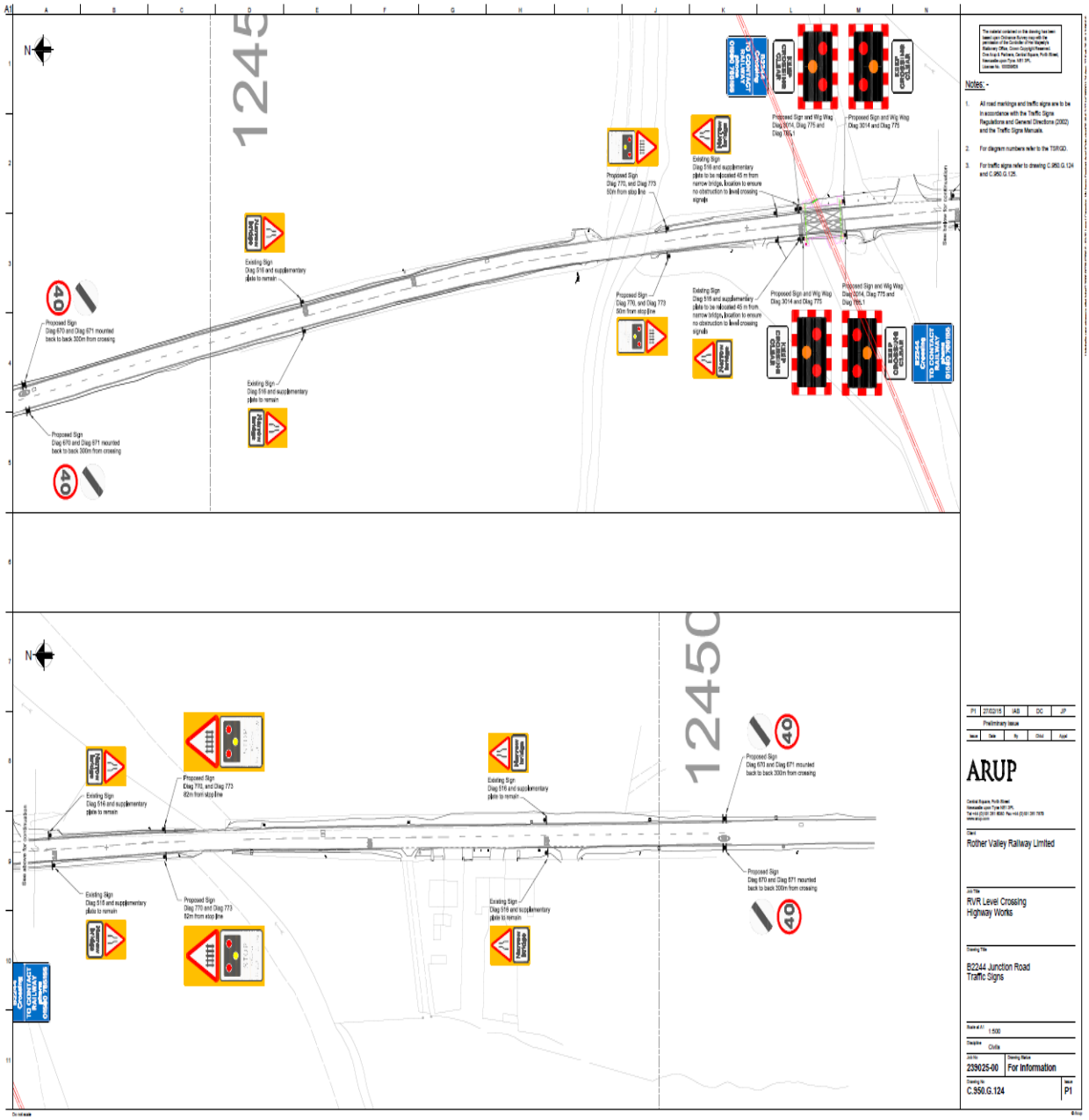


Diagram of the proposed traffic signs

Rother Valley Railway



Rother Valley Railway



5 Site Visit General Observations

The A21(T) Robertsbridge Bypass Stage 1 Road Safety Audit report identified possible road distractions which are considered as part of this analysis, for example,

- Blocking on the circulatory carriageway of a roundabout can lead to significant frustration for drivers on the side roads, not included in the main queue. This can lead to drivers trying to force their way around the junction, resulting in circulatory collisions.

To remove this concern, it is advised to reduce the speed limit over this length of road.

Photograph 1

- The proposed level crossing layout does not consider the existing traffic signing or the effect of the proposed level crossing signing on the existing signing. This could lead to drivers missing some signs and the warnings they portray leading to a range of conflicts and/or collision types, photographs 2 (a), (b) below.

To avoid the risk of confusion between signage a comprehensive review will be conducted as part of detailed design of the level crossing.

Photograph 2(a)

Photograph 2b

- The level crossing is proposed some 40m from the end of the existing street lighting system on the approach to the A21(T) Northbridge Street roundabout. It is not proposed to light the level crossing. Some drivers' eyes can take several seconds to adjust from lit to unlit conditions, and vice versa. A hazard such as a level crossing or queue located within that transition distance could result in shunt type collisions or a collision at the crossing itself.

To remove this concern, it is advised to extend the street lighting system to the south side of the level crossing in order to adequately light the hazard.

Photograph 3

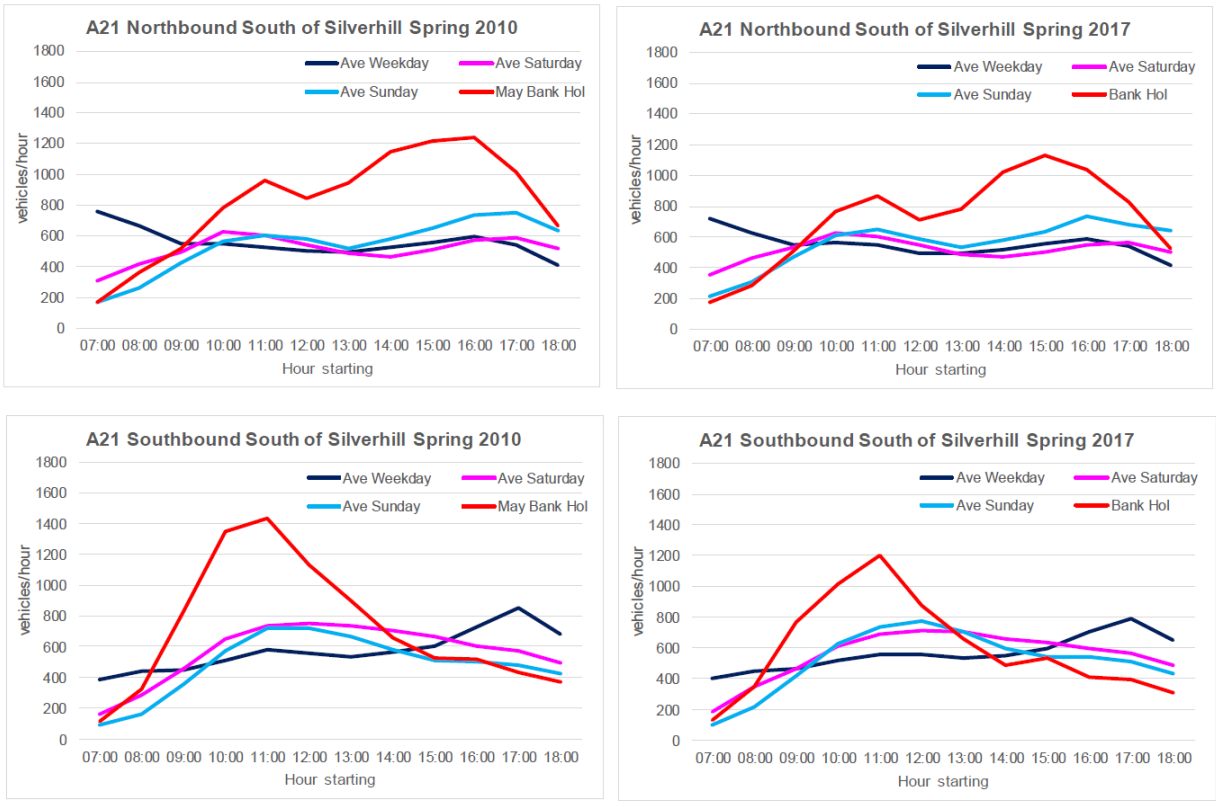
6 A21 Robertsbridge Bypass Traffic Flows

The chart below compares traffic flows on A21(T) Robertsbridge Bypass, for Spring and Summer months, based on ATC data provided by Mott McDonald Addendum to traffic impact study report (2018).

On the A21 at Robertsbridge the changes in traffic demand between 2010 and 2017 are limited with minimal changes on weekdays, some increases on Sundays and on the August Bank Holiday but reduced flow on the May Bank Holiday.

The predicted maximum queue lengths on the A21 are 60m-70m on weekdays, Saturdays and Sundays, increasing to 100m-120m on the Bank Holidays, using 2017 traffic demand. With traffic growth, these queue lengths increase to 2027 although the southbound queue length is only predicted to exceed 140m (the length from the level crossing back to the roundabout) on the May Bank Holiday in 2027 and even then, it is only just exceeded at 143m.
(Mott Macdonald Addendum report 2018).

Figure 4: A21 Traffic Flows South of Silverhill in Spring 2010 and 2017



Queue length results with a 110-second closure.

For the A21, maximum queue lengths of 100m-150m are predicted for weekdays, Saturdays and Sundays, increasing to 160m-240m on the Bank Holidays. With traffic growth, these corresponding queue lengths increase to 120m-180m and 190m-290m by 2027.

For the August Bank Holiday, the average northbound queue lengths are a little higher in 2017 and 2021, when compared to the previous results, and maximum queue lengths are higher by 10m-13m. For the southbound direction, the new results are higher by up to 18m but the maximum queue length in 2021 is 85m, still well below the 140m back to the A21 roundabout.

Traffic Growth Factors 2017 – 2021 – 2027

Table 3: Predicted Queue Lengths at A21 Level Crossing

	2017 Northbound		2017 Southbound		2021 Northbound		2021 Southbound		2027 Northbound		2027 Southbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	51	45	60	49	55	49	65	53	60	53	71	57
Saturday	50	45	61	56	54	48	66	60	59	52	72	66
Sunday	62	52	66	54	67	56	71	58	73	61	78	64
May BH	99	75	121	62	106	81	131	66	116	89	143	72
Summer												
Weekday	50	45	74	54	54	49	80	58	59	53	88	63
Saturday	55	47	65	59	59	51	70	64	65	56	76	70
Sunday	70	60	67	57	75	64	72	61	82	70	79	67
Aug BH	96	70	79	67	103	76	85	72	113	83	93	79

Source: Mott MacDonald analysis of existing and predicted traffic volumes, queue lengths in metres assuming 5.75m/vehicle

Table 6: Predicted Queue Lengths at A21 Level Crossing with 110 Second Closure

	2017 Northbound		2017 Southbound		2021 Northbound		2021 Southbound		2027 Northbound		2027 Southbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	101	90	120	98	109	97	130	105	119	106	141	115
Saturday	101	89	122	112	108	96	131	121	118	105	143	132
Sunday	125	104	132	108	134	112	142	117	147	122	155	127
May BH	197	151	243	123	213	162	261	133	232	177	285	145
Summer												
Weekday	100	90	149	108	108	97	161	116	117	106	175	127
Saturday	110	95	129	118	118	102	139	127	129	111	152	139
Sunday	140	119	134	114	150	129	144	122	164	140	158	134
Aug BH	192	141	158	134	206	152	170	145	225	165	186	158

Source: Mott MacDonald analysis of existing and predicted traffic volumes, queue lengths in metres assuming 5.75m/vehicle

Conclusion;

On the A21 at Robertsbridge the changes in traffic demand between 2010 and 2017 are limited with minimal changes on weekdays, some increases on Sundays and on the August Bank Holiday, however, reduced flow on the May Bank Holiday.

Comparison with the queue length predictions reported in October 2011 shows the new 2017 and 2021 results are generally similar to the previous results for 2016 and 2021 on the A21. The major difference is

that long queues are no longer predicted for the A21 Southbound on the May Bank Holiday. This is because the traffic demand recorded in 2017 is significantly lower than that in 2010 (reduced from around 1,600 vehicles/hour to 1,400 vehicles/hour).

7 The Railway

The train service over the A21 Robertsbridge level crossing will consist of passenger trains only. There will be approximately 10 trains per day. The highest permissible line speed of trains over the crossing will be 10 mph. Trains are timetabled to run for 10 hours per day.

The RVR Level Crossing Operational Management Plan (LCOMP) sets out the strategy for operational management of the A21 Robertsbridge level crossing to be installed on the Rother Valley Railway (RVR) where it interfaces with the road at level grade, so requiring control of road vehicles to enable a train to cross.

The LCOMP describes the principles of how the level crossing is to be operated under normal conditions and in the event of failure.

This shall be the basis for developing operational procedures for the railways operation when services commence to which staff shall be trained and assessed on an ongoing basis.

Compliance with Industry guidelines;

The design for the level crossings, developed from this document, shall be compliant with industry guidelines, e.g. The Office of Rail Regulation: A Guide for Managers, Designers and Operators (Railway Safety Publication 7 December 2011) and approved by a suitably independent person before installation.

A21 Robertsbridge Level Crossing Operation;

It shall be noted that a signaller will be on duty at all times of normal operation. The signaller will monitor operation of the crossings at the A21 via a Closed-Circuit Television link.

Normal operation to and from Robertsbridge

The train will approach the level crossing at a maximum speed of 10 mph, thus ensuring that the train has the ability to stop in 30m. The AFBCL (Automatic Full Barrier Crossing, Locally Monitored) crossing area is equipped with obstacle detection technology that scans the crossing area at various stages during the closure sequence. The crossings are provided with crossing illumination (for night visibility) and a drivers' flashing red and white light indicator in each direction on final approach for local monitoring by the train crew. The speed approaching the AFBCL crossing is limited to 10mph, so the approaching train is able stop under all railhead conditions before the road if the crossing is either visibly blocked or the flashing indicator hasn't changed from red to white. The approach of a train automatically begins the crossing closure sequence. This commences with the road traffic wig-wag signals and audible warnings to indicate to road traffic to stop. Obstacle detection technology prevents

to lowering of the crossing entrance barriers until the crossing is clear. Once the entrance barriers are down and the crossing surface is scanned to continue to be clear the lowering of the exit barriers can commence. If the equipment is proven to be fully functional and the OD sensors have confirmed clearance of the road surface between the fully down barriers then the indicator for the train driver will be showing flashing white light before the train reaches the crossing speed board.

The Drivers White Light is only given if all the barriers are fully down and in the unlikely event of a trapped user (vehicle or pedestrian) the train driver is able to raise and re-lower the exit barriers using a Drivers Release Unit (DRU).

The barriers will rise as soon as practicable after trains for which the lower sequence has been initiated or maintained, have passed clear of the crossing. The sequence of events to open the crossing to road traffic, once the raising cycle has been initiated or maintained is, all the barriers begin to rise simultaneously and should normally rise in 4 to 6 seconds; and the intermittent wig wag red lights should be extinguished as the barriers rise.

Railway signalling and control

Railway signalling will be provided to ensure the level crossing is fully protected on all railway approaches. The railway approach signals are interlocked with the lifting barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers, additionally, it will not be possible to raise the barriers unless the signals are set at Stop and free of approach locking, or the train has passed the signal and traversed the crossings. It will not be possible to clear any protecting signals until ‘crossing clear’ is confirmed either automatically by obstacle detection equipment, or manually when that equipment is not being used. Discrete function controls will be provided at the control point for authorised railway staff use when obstacle detection equipment is not being used.

If a train passes a protecting signal at Stop, the road traffic light signals will immediately show an intermittent red light (omitting the steady amber phase) and the audible warning will start. The barriers will not be lowered as this may strike or trap crossing users.

To ensure that the crossing operates safely when the railway line is open to traffic, indicators at the control point will confirm that the equipment is powered and functioning correctly.

Level Crossing barriers & CCTV Systems Maintenance Plan

The maintenance plan for the three-level crossings shall be based on that recommended by the supplier of the equipment. It shall comprise:

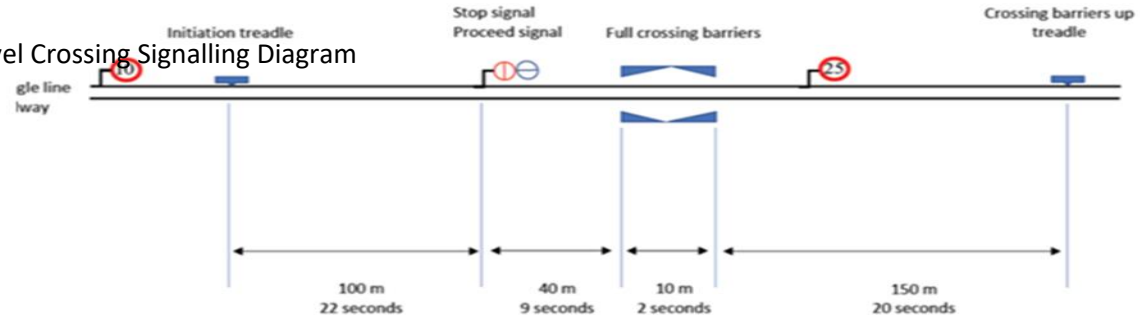
- Regular planned maintenance at the required intervals.
- Work arising from planned maintenance, within the required timescales
- Fault response, within specified timescales.
- Work arising from fault responses, within the required timescales.

- Work arising due to other parties planned work.

Road Crossing Design and Construction

The construction of the road crossings comprise concrete units designed to meet the requirements of a high friction skid resistant road surface through the crossing. This has been tested for the proposed installation and passed the test level requirement as set by The Highways Agency, reference document RD/GN/009 dated September 1989.

Level Crossing Signalling Diagram



Notes:

1 Equipment shown for up direction only, treadles, signals and signs replicated for down direction

2 Transit times assume full line speed

8 5 X 5 Risk Assessment

Hazards are identified, listing possible causes if appropriate and assessed for severity. These are then multiplied by the frequency or likeliness of an incident occurring if no controls were applied. This produces the risk factor; the numerical assessment table gives guidelines on how to assess severity and frequency.

The risk assessments for the crossings are based on generic issues and then modified to reflect the specific issues at the individual crossing to reflect that risk can change significantly from one site to another. The generic risk assessment will be reviewed by the appointed Project Manager and then modified as required to reflect the

hazards and the necessary controls identified during site visits (pre-works) or through information passed to them by stakeholders and any other third party.

Update 10.02.2021

A21 Risk Assessment

Numerical Assessment			
Severity (S)		**Likelihood of Occurrence (L)**	
1	No Injuries / Minor Damage	1	Remote
2	Single Minor Injury	2	Unlikely
3	Single Major Injury / Minor Pollution	3	Occasional
4	Single Fatality / Major Pollution	4	Likely
5	Multiple Fatalities	5	Highly Likely

Risk Factor

		Likelihood of Occurrence (L)				
		5	4	3	2	1
Severity	5	25	20	15	10	5
	4	20	16	12	8	4
	3	15	12	9	6	3
	2	10	8	6	4	2
	1	5	4	3	2	1

Risk Factors between 16 to 25 = Unacceptable Risk. Risk Factors > 8 will be strictly monitored. Hazards Identified with a Severity Assessed at 3 or above will also be strictly monitored.

Hazards and possible causes identified for Robertsbridge AFBCL	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
SIGNALLING								
Relative to previous signals: Will the signal be in a different position, or does it have a different configuration?	Signal position is not consistent with the spacing between preceding signals Signal is of a different design to preceding signals Potential for, Death, Serious injury or injury	4	3	12	The KESR signalling arrangement will have consistent signal design. All staff will receive training before operation commences	3	2	6

Could the signal be confused with other signals on an adjacent line or on the same gantry	Signal is on a post and could be confused with other signals Signal has an identical profile / outline to adjacent signals Death Serious injury Injury	4	3	12	Ensure signals for all lines are visible Shield nearby signals from view Appropriate signal should be clearly associable with its line Driver training	3	2	6
Could the signal be obscured from the driver's view?	Signal reading time is inadequate. Signal is positioned round a curve and the reading angle is inadequate Signal is positioned round a curve and there is an obstruction blocking the signal's line of sight Signal can be obscured by vegetation Signal can be obscured (intermittently or otherwise) by a bridge or other structure, for example station structures edge of signal back plate is less than 100 mm from edge of aspect	3	3	9	Increase backboard size (by 50%) Manage vegetation Maximum train speed is 10 mph Remove / shield potential distractions in stations Reposition signal on straight track Make signal post more conspicuous Driver training	3	2	6
TRACK								
Will the track on approach to the signal suffer from adhesion problems?	Signal is located in an area which suffers from ice, frost, leaf fall, dampness or other adhesion problems	4	3	12	Lineside fencing / netting Railhead conditioning Management of lineside vegetation	2	2	4

	Death Serious injury Injury				Low adhesion warning signs Driver training			
Is there a reduction in permissible speed on the approach to the signal?	There is a reduction in permissible speed on the approach to the signal Death Serious injury Injury	2	2	4	Permissible speed on approach to the level crossing is maximum 10 mph Driver training On site staff monitoring	2	2	4
Is there a falling gradient on approach to the signal?	There is a falling gradient on the approach to the signal	4	3	12	Countdown markers Driver training	3	2	6
COLLISION								
Road Vehicle and train collision risk	Insufficient train warning time for all vehicle types known to be exacerbated by the driving position e.g. Tractor. Level crossing equipment and signage is not conspicuous or optimally positioned. Instructions for safe use may be misunderstood e.g., signage, clutter detracts from key messages, conflicting information given. High volume of unfamiliar users e.g. irregular visitors, migrant workers. Known user complacency leading to high levels of indiscipline. Type of vehicle unsuitable for level crossing; - Large, low, slow, making	4	3	12	Optimising position of equipment at the design stage removing any conflicting or redundant signs. Strike in times optimised. Sighting lines enhanced. Latest technology in place for user-based warning systems including wig-wag lights, sirens, full road barriers, RTL. (AFBCL) Maximum train speed 10 mph implemented. Superior quality crossing surface construction material. De-vegetation programme in place	3	2	6

	access or egress difficult and or vehicle is too heavy for the crossing surface – risk of grounding and or severity of gradient adversely affects ability to traverse. Users experience a long waiting time.							
Pedestrian and train collision risk	Ineffective whistle boards, warning inaudible, insufficient train warning time. Level crossing equipment and signage is not conspicuous or optimally positioned. Instructions for safe use may be misunderstood. Surface condition could lead to slip/trip risk. High volume of unfamiliar users i.e. irregular visitors/ramblers/equestrian. Complacency leading to high levels of indiscipline e.g. users are known to rely on knowledge of timetable. High level of use by vulnerable people. High usage of cyclists.	4	3	12	Optimising position of equipment at the design stage removing any conflicting or redundant signs. Latest technology in place for user-based warning systems including wig-wag lights, sirens, full road barriers, RTL. AFBCL, obstacle detection Maximum train speed 10 mph implemented. Superior quality crossing surface construction material. De-vegetation programme in place. Regular engagement with stakeholders/authorised users reinforcing safe crossing protocol, legal responsibilities and promoting collaborative working.	2	2	4
Hazards and possible causes	Potential Risk or consequences	S	L	RF	Control Measures	S	L	RF

identified	associated with the Hazard							
SPAD OCCURRENCE								
Train driver passes protecting signal without authority	Collision with road vehicle (see above). Collision with member of public (See above). Death Serious injury Injury	4	3	12	If a train passes a protecting signal at Stop, the road traffic light signals will immediately show an intermittent red light (omitting the steady amber phase) and the audible warning will start. The barriers will not be lowered as this may strike or trap crossing users. Driver training. Maximum speed of train 10 mph.	2	2	4
Hazards and possible causes identified	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
Additional Risk Influencing factors								
Distraction								
Can the driver be distracted by something outside the cab?	Driver could be distracted by trespassers	4	3	12	Signal reminder sign	3	2	6
Could the driver be distracted by other tasks at or on approach to the signal?	There is a level crossing in the vicinity of the signal	4	3	12	Position signal where driver not distracted by other duties Driver training	3	2	6
Distractions while using the level crossing might impair the user's ability to cross quickly and safely.	If a user is distracted, there is an increased likelihood that they will not see the crossing warning signs, for example; Other persons in the car (e.g. children) Thoughts on personal matters, work stresses etc. Using the telephone, Behaviour of other crossing users, In car entertainment Seasonal events (e.g. fun fairs, fireworks) Mobile phones, iPads, handheld	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Staff training. Traffic calming measures. Train maximum speed 10 mph. New modern full barrier crossing. AFBCL Education campaign.	2	2	4

	computers etc. Signage (e.g. speed limit signs). Distractions might be more likely for users who frequently use the crossing (e.g. delivery drivers), due to them potentially having a lower level of concentration than those who use it infrequently. A change in speed limit and the associated speed limit signs This proximity of the speed limit signs to the crossing might reduce the attention given to the crossing, or remove attention away from it completely. The signs might also draw a car driver's attention to the vehicle speedometer to check vehicle speed and away from maintaining vision out of the vehicle's windscreen. Other signs in the vicinity of a level crossing that are not related to that crossing could also have been a potential distraction.							
High vehicle approach speeds	The vehicle speed over a level crossing is a factor in vehicle driver errors. Risk factors include, the speed limit(s) in the surround areas, driver's perception and attitude to risk, visibility of warning signs and visibility of the level crossing e.g. rural winding roads. High risk behaviour such as high vehicle speeds and late, heavy braking will result in a higher	4	3	12	Reduced road speed on approach to level crossing. Traffic calming measures. Enhanced signage. New modern full barrier crossing. AFBCL Education campaign.	2	2	4

	frequency of collisions due to driver error.							
Large, slow and low vehicles	Drivers of large vehicles are involved in a disproportionately high number of incidents at level crossings. The size of the vehicles - they have less room for error when compared to cars. They may not be responding to the activation of the crossing warning system in sufficient time. Studies have proposed that large (HGV) vehicles may attempt to traverse the crossing once the barriers have already started to descent, suggesting that it could be to do with the driver's awareness of their vehicle's poorer braking performance, and therefore considering it safer to continue. Other contributory factors might include: The slower acceleration speed of HGVs causing the total time to cross a level crossing from standstill to increase Sightlines from a higher driving position.	4	3	12	Reduced road speed on approach to level crossing. Traffic calming measures. Enhanced signage Yellow box marking Level crossing road surface well maintained Power operated level crossing barriers AFBCL	2	2	4
Ice conditions	Icy weather conditions on the approach and exit to the crossing might affect the behaviour of the crossing, for	3	3	9	Provision of CCTV surveillance cameras. Level crossings local training plans, training and briefing signallersreceive on	2	2	4

	example, prevent vehicles from stopping in a position of safety at the crossing. Encourage vehicle drivers to ignore the initial warning activation when they are close to the train line because of the risk of sliding forward onto the tracks. Cause pedestrians to concentrate on their footing, rather than looking for trains or observing warning signs. Result in pedestrian slips, trips and falls. This is a particular risk for elderly, or mobility impaired, users. Level crossings on 'B' roads might present a particular hazard to vehicle drivers as these roads are not normally gritted in icy conditions.				communications skills, hazards associated with a particular crossing (icy conditions), how to check whether a crossing is clear. Improved crossing surface. Regular monitoring. Tactile surfaces.			
Foliage obscuring warning signs and approaching trains	The visibility (and hence effectiveness) of information on the approach to and at the level crossing is reduced by overgrown foliage. Overgrown foliage on the approach to a level crossing can obscure signs and signals located at the crossing, and also restrict	4	3	12	Cutting back vegetation and removing obstructions the sighting distances for users up and down the track and to signs / warning lights are lengthened. Staff training i.e. HRA Guidance document HGR – A0720 Control of Vegetation (Management plan). Improved sighting distances.	2	2	4

	the visibility of approaching trains. This could result in the user either not seeing the sign or train (complete or partial) or the user not seeing the sign or train in time to sufficiently interpret the information and respond appropriately. This issue can be exacerbated when the visibility of the level crossing is reduced, either due to its type or its location e.g. on the bend in a road or on a high-speed road, as the vehicle driver has even less time to respond. foliage is also applicable to train drivers. Foliage on the lineside might impact on the train driver's ability to see information, objects or people on the crossing.				Train speed max 10 mph. CCTV monitoring. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Reduced road speed on approach to level crossing. Traffic calming measures. Enhanced signage.			
Crossing utilisation or traffic moment	High crossing utilisation by users is associated with a greater chance of user risk taking behaviour.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Level crossings local training plans, training and briefing signallers receive on communications skills, hazards associated with a particular crossing (icy conditions), how to check whether a crossing is clear. Reducing the road approach speed to the level crossing to reduce the risk of collision between vehicles and gates / trains.	2	2	4

					New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Traffic calming measures. Enhanced signage.			
Vulnerable of unfamiliar users, for example, people with dogs on leads, young people, people visiting the area etc.	Vulnerable users and those who are not familiar with the level crossing procedure might apply an incorrect mental model when traversing the crossing. Other risks include, crossing users who are possibly subject to slips, trips and falls, Dog/s might hold user back on tracks, preventing them from completing their traverse. Horses can present additional challenges if it is startled or distracted. Animals might try to run down tracks, especially if startled or skittish or if it smells an animal to chase etc, pulling the user with it. Young people may be distracted by friends, using mobile telephones, headphones and so on. Visiting people may not be familiar with the level crossing operation, distracted by looking for directions' signs etc.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Level crossings local training plans, training and briefing signallers receive on communications skills, hazards associated with a particular crossing (icy conditions), how to check whether a crossing is clear. Reducing the road approach speed to the level crossing to reduce the risk of collision between vehicles and gates / trains. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Traffic calming measures. Enhanced signage	2	2	4

Traffic calming systems Road traffic calming systems on either side of a level crossing might increase the risk of blocking back.	Traffic calming systems, such as road width restrictions/ build-outs, positioned on either side of a level crossing might increase the risk of vehicle drivers blocking back over the crossing. When the crossing is closed to road traffic, queues form along the road. This issue might be exacerbated due to factors such as the time of day (rush hour) and 'herd mentality'. Discomfort for cyclists on the road. Potentially more noisy approach to the crossing leading to possible complaints. If overused in conjunction with changes in speed the mitigation might lose its impact upon behaviour.	3	3	9	Note: The obstacle detection will prevent crossing closure in these circumstances. Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Reducing the road approach speed to a level crossing to reduce the risk of collision between vehicles and gates / trains. A range of enhancements to improve conspicuity, comprehension of and user response to level crossing warning signs.	2	2	4
Multiple traffic signs leading to distraction, missed warnings and road user collisions.	There are a number of existing traffic signs on both the northbound and southbound in the vicinity of the level crossing, notably, direction signing, warning signing, and tourist signs.	3	3	9	Traffic calming measures including a comprehensive review of the existing signing to be incorporated into the detailed design of the level crossing including visibility splays to the various signs to demonstrate there will be no masking. Education campaign.	2	2	4

	The level crossing layout could lead to drivers missing some signs and the warnings they portray leading to a range of conflicts and/or collision types.				Enhanced signage.			
Queuing at the level crossing could block the roundabout leading to injudicious manoeuvres and road user conflicts.	Queue lengths at the level crossing leading to, blocking turning movements. Blocking on the circulatory carriageway of a roundabout can lead to significant frustration for drivers on the side roads, not included in the main queue. This can lead to drivers trying to force their way around the junction, resulting in circulatory collisions	3	3	9	Traffic calming measures. - Introduce yellow box markings to, as far as possible, maintain the turning movements at the roundabout. Education campaign. Enhanced signage	2	2	4
Limited forward visibility. Adjacent features increase the risk of blocking back at the level crossing. Unlit hazard in lighting transition leading to shunt or crossing collisions.	Lack of good visibility at the level crossing leading to shunt type collisions. The level crossing is in close proximity to the end of the existing street lighting system. Some drivers' eyes can take several seconds to adjust from lit to unlit conditions, and vice versa. A hazard such as a level crossing or queue located within that transition distance could result in shunt type collisions or a collision at the crossing itself.	3	3	9	Extend the street lighting system to the south side of the level crossing in order to adequately light the hazard. Introduce a yellow box marking. Traffic calming measures.	2	2	4

Single train line Greater risk-taking behaviour in both vehicle drivers and pedestrians is reported on single train lines. .	This user behaviour is in line with risk compensation theory - the user, perceiving there to be less of a risk to him/herself, behaves less cautiously	2	2	4	AFBCL Provision of CCTV surveillance cameras to deter misuse at a particular crossing and to capture evidence of violations when they arise. Staff Training. Maximum train speed 10 mph. Enhanced signage.	1	1	2
Farming vehicles Farm traffic might influence the speed and behaviour of other vehicles traversing the crossing.	Farm traffic tends to move at a much slower speed and, being much larger, reduce the visibility of other vehicle drivers. This can cause distraction and frustration and change other road user's behaviour; resulting in risk taking actions such as overtaking and not observing the level crossing warning signs.	4	4	16	Power operated barrier. AFBCL CCTV monitoring. Training/Competence. Education campaign. Enhanced signage	2	2	4
Commercial driver	Commercial drivers might have increased risk taking behaviour at level crossings. Commercial vehicle drivers, such as salespersons, work to strict timescales and therefore their driving behaviour is often influenced by having to reach destinations on time. Commercial drivers using a level crossing might be inclined to 'beat the lights' to avoid having	4	4	16	A range of enhancements to improve conspicuity, comprehension of and user response to level crossing warning signs: Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Training/Competence. Education campaign. Enhanced signage.	2	2	4

	to wait at the crossing, or they might fail to follow the correct crossing procedure at unprotected crossings.							
Adverse weather impacting visual information.	The effectiveness of visual information at crossings can be impaired by adverse weather conditions (e.g. fog and snow). The ability of vehicle drivers or other crossing users to detect the presence of level crossings, hazard information, warning lights or approaching trains might be impaired by adverse weather conditions, e.g. fog and snow. This might result in users failing to see warning information or oncoming trains, which could lead to users unintentionally adopting risky behaviour. In addition, in heavy snow users might not be able to see the tracks and inadvertently stand in a position of danger. Visibility in and around the crossing might also be impaired by banks of snow. An example where foggy conditions have been identified	3	3	9	CCTV monitoring. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Reduced road speed on approach to level crossing. Train speed maximum 10 mph Traffic calming measures. Enhanced signage.	2	2	4

	as a causal factor in a level crossing incident investigation is the fatality at Barratt's Lane No.1 footpath crossing.							
Alcohol and drugs	The effects of drink and/or drugs can radically alter user behaviours. Motor and cognitive function might be impaired and users might also have a reduced perception of risk. Users under the influence of alcohol or drugs might exhibit the following behaviours: be more inclined to ignore normal crossing procedures be physically unstable and prone to slips, trips and falls be unable to focus, cognitively and visually have a lower perception of risk.	3	3	9	CCTV monitoring (staff training initiatives). Anti-trespass and cattle guard panels are designed to deter people or animals from crossing the track at unauthorised places. Do not trespass signs. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures. Enhanced signage.	2	2	4
Disabilities.	Disabilities (e.g. reduced mobility, reduced levels of vision/hearing) will influence the behaviour of users at level crossings. Visually impaired users might be unable to see warning lights and signs clearly, or scan for trains before crossing.	3	3	9	CCTV monitoring (staff training initiatives). Increase the volume of the audible warning up to the maximum permitted level to make the alarm more conspicuous and potentially deter pedestrian violations. Additionally, Intelligent auditory alarm – takes account of ambient noise levels and produces alarm 5dB louder so it can	2	2	4

	Hearing impaired users might be unable to hear crossing alarms, train whistles, warnings from people or the sound of approaching trains. Cognitively impaired users might have difficulty understanding and following the correct crossing procedure, or interpreting warning signs. Users with physical impairments (permanent or temporary) might encounter difficulties using level crossings of all types, but especially user worked crossings. Potential difficulties include struggling to cross within the warning time provided; being more prone to slips, trips and falls on the crossing, especially if the crossing surface is uneven or missing. Similarly, mobility scooter users might encounter problems with uneven crossing surfaces and the opening and closing gates or barriers.				always be heard clearly. AFBCL Power operated barriers. Provision of flange gap filler to improve crossing surface. Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). Education campaign. Traffic calming measures. Enhanced signage.			
Incorrect mental model Incidents at level crossings could occur if the user adopts the incorrect mental model of how the crossing works.	Mental models are internal mental representations of an external reality.	3	3	9	CCTV monitoring (staff training initiatives).	2	2	4

	People develop a mental model of how to use a level crossing from their prior experience of using similar or comparable crossings (or road junctions), from instructions or by observing the behaviour of other users. Users familiar with the operation of one type of crossing might apply their mental model at other types of level crossing.				Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures. Enhanced signage.			
Fatigue	Fatigued users will be more susceptible to making errors or to taking shortcuts when crossing. Fatigue has a significant effect on human performance and the likelihood of errors. Level crossing users suffering from fatigue might miss important information (crossing warning signs, lights, etc), or be more inclined to take shortcuts in the crossing procedure (fail to use the telephone, fail to close the gates at user worked crossings, etc).	4	3	12	CCTV monitoring (staff training initiatives). Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures. Enhanced signage.	2	2	4
						2	2	4
Work in or adjacent to public roadways.	Plant, equipment materials striking traffic/members of	3	3	9	Authorised road closures and traffic management.	1	1	2

	public. Traffic colliding with staff.				Implement pedestrian walkways. Plant to be suitable for access to public roads. Comply with New Roads and Street Works Act and Traffic Signs Regulations.			

Rother Valley Railway (Bodiam to Robertsbridge Junction)

Bridleway Crossing 36b at Salehurst, Robertsbridge risk Assessment, including Management arrangements for User Worked Crossings

Prepared for:
The Office of Rail and Road

Update 10.02.2021

Summary

The completion of the Missing Link will bring significant benefits to the local economy and there is no question that a grade level crossing solution at Salehurst is capable of being self-operated safely for horses and pedestrians. The cost differential between the costs of the proposed bridleway crossing (£30K) and implementing and constructing and thereafter maintaining a bridge (approximately £400K) at this location is grossly disproportionate. A tunnel under option is not practical as it would be subject to flooding from the nearby River Rother and would require almost constant pumping to keep it safe for use by pedestrians.

RVR requested Rother District Council (RDC) to review the use of a bridleway bridge at Salehurst, illustrating the type of structure that would be constructed to form a bridge for horses and riders over the approved line of the heritage railway (RR/2014/1608/P). RDC responded to the request on (13 August 2020) stating that:

'RDC would not support a planning application for a bridge to take the bridleway over RVR at Salehurst, and that a proposed bridge to accommodate a bridleway/footpath crossing is a disproportionate response to an issue that is addressed by alternative and rather more sympathetic solutions at other locations along the route of the existing heritage railway line and they appear to function satisfactorily. Additionally, a principal planning issue in considering the proposal would be the impact of the development on the appearance and character of the countryside landscape, which is within the designated High Weald Area of Outstanding Natural Beauty. The Government's planning policies and how they should be applied are set out in the National Planning Policy Framework (NPPF), which states at paragraph 172 that great weight should be given to conserving and enhancing landscape in Areas of Outstanding Natural Beauty, which have the highest status of protection in relation to these issues. The Council's own development plan policies as contained in the Core Strategy (2014) at EN1 and the adopted Development and Sites Allocation Plan (2019) at DEN2 accord with the NPPF and are consistent with this approach. With respect to the proposed development, the railway sits within the broad flat landscape of the Rother Valley at this point and there are long views over the Weald. It is a very attractive rural landscape. The significant scale of the proposed bridge, combined with its very urban character and appearance, would result in it appearing an intrusive and incongruous feature in the countryside landscape. It would be harmful to the character and appearance of the AONB and contrary to the afore-mentioned national and local planning policies. In the circumstances, it is RDC's informal view that a planning application would not be supported by the local planning authority.

I feel as though the proposed bridge to accommodate a bridleway/footpath crossing is a disproportionate response and I would therefore ask that you investigate alternative proposals for a bridleway crossing that would be more appropriate to conserving the AONB countryside setting of the railway'.

Therefore, the only alternative for RVR is to provide an at grade bridleway crossing suitable for all users and local residents (See options below).

1. Introduction

The former railway line between Robertsbridge and Tenterden was closed in 1961. Much of the trackbed remained in place for many years and, in 1974, the line between Tenterden and Rolvenden was re-opened as the Kent and East Sussex Railway (K&ESR). The line was further reinstated to Bodiam (the site of the National Trust's Bodiam Castle) in 2000 and K&ESR has become a successful heritage railway and major tourist attraction. Reinstatement work to date on the K&ESR and the Missing Link has been undertaken mainly by volunteers and local contractors who have developed cost-effective and quality methods for the work.

The "Missing Link" is the section of former railway corridor 3.42km long running from Junction Road (the B2244) in Bodiam to the terminus at Robertsbridge. Policy EM 8 of the Rother District Plan expressly supports the reinstatement of RVR. The local plan was the subject of a Public Inquiry and the Inspector's report gave full support to completing the Missing Link, subject to meeting the following criteria:
"(i) it must not compromise the integrity of the floodplain and the flood protection measures at Robertsbridge;
(ii) it has an acceptable impact on the High Weald Area of Outstanding Natural Beauty;
(iii) it incorporates appropriate arrangements for crossing the A21, B2244 at Udiam, Northbridge Street and the River Rother."
These criteria were all resolved and approved with full Planning approval given by Rother District Council in March 2017. Once completed, visitors will travel on a well-regarded Heritage Railway on the historic route within the Rother Valley between Tenterden and the mainline at Robertsbridge, with stops at a number of attractive tourist destinations.

Over the course of a number of years, planning permission has been obtained for the re-instatement of the railway between Bodiam and Junction Road in 2011, from Robertsbridge to Northbridge Street in 2013 and the construction of Robertsbridge Junction Station. Re-construction of the railway within those sections has now been completed (utilising volunteer professionals and local subcontractors). The connection to the main line was completed in late 2016 with the support of Network Rail.

Following consultation over a period of 6 years, including discussions with all relevant statutory bodies and the local planning authority – as reported in the Consultation Report accompanying the TWAO application - planning consent for the Missing Link was unanimously approved by the Rother District Planning Committee on 17 March 2017. (RR/2014//1608/P). Letters of support for the project from Kent CC, East Sussex CC, Rother DC, Ashford BC, Network Rail, National Trust, and 1066 Country are included in the Consultation Report. The planning consent was accompanied by planning conditions to ensure the safety and effectiveness of the road crossings.

The Missing Link will comprise a simple single-track railway with straightforward construction, utilising the same local contractors and volunteers (qualified and experienced, as appropriate) as on the sections already completed.

This document relates to the proposed level crossing at Bridleway S&R36b at Salehurst as well as management arrangements for user worked crossings.

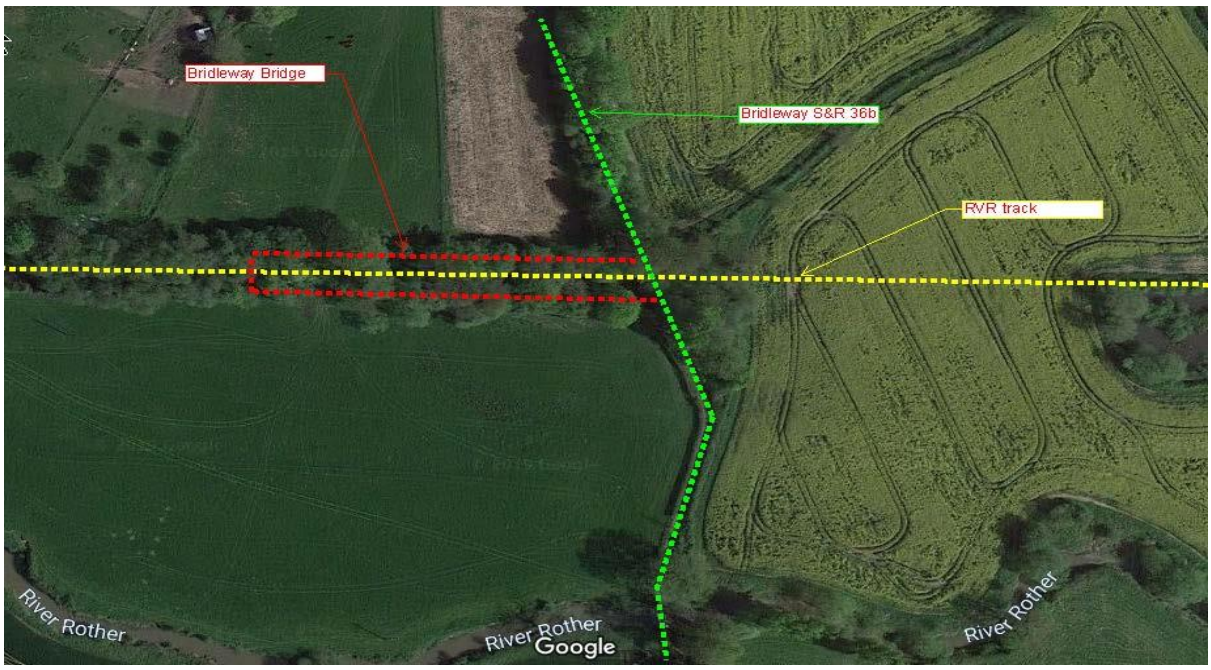


Figure 1 - Proposed location of Bridleway S&R36b crossing at Salehurst

2. Economic Benefits

A comprehensive Economic Benefits Report by Steer, leading UK specialist consultant, in 2018, forecast that the RVR will generate local economic benefits of up to £35 million over a two-year construction period and the first ten years of operation, and up to £4.6 million per annum of local economic benefits from 2030. It will generate approximately 34 jobs in the construction phase and up to 85 in the operational phase. Additional rail revenues of approximately £355,000 per annum are forecast to accrue to the main line operator.

3. Traffic Studies

In respect of the Bridleway Crossing (S&R 36b) at Salehurst, a crossing design similar to that used on the West Highland Railway was proposed and included in the planning documentation that was approved by Rother District Council. (RDC). During the course of the preparation of the planning documentation, extensive discussions and site visits to the location of the bridleway crossing were held with the local representative of the horse riders, the East Sussex County Council Senior Rights of way Officer, the Ramblers Association, and the Horse Society Access Field Officer for London and the South East.

4. Crossing Survey

There are a number of bridleway crossings on the existing Kent and East Sussex Railway that operate safely, effectively and without difficulty. Crossing Surveys were held at the Salehurst site over a period of a week in mid-summer. These showed an average of 4 pedestrians crossing on weekdays, and up to 20 a day at weekends. Whilst no horses were recorded, the local horse representative advised that normally around 4 horses would use the crossing each way at weekends, and less frequently on weekdays and in the winter. The Ramblers Association and the Horse Society advised us that their members are familiar with the bridleway crossing proposed and did not envisage any problems with them, particularly as there would be a maximum of only 10 train crossings a day in the summer months and none in the winter. Additionally, RVR will continue to collaborate with the Horse Society, Ramblers Association and local residents during the design, build and operational stages of the bridleway crossing ensuring we satisfy all concerns by building a robust and safe bridleway crossing that meets the needs of all users.

5. The Crossing Options

At the time of the Planning preparations no other options for the crossing were considered. However, the options considered are: -

(a) Option one, involving an “at grade” level crossing introduces no engineering challenges and would cause minimal disruption during construction. The RVR estimated cost (taking account of preliminary work and advance purchases of materials already completed etc.) is approximately £30,000.

(b) Option 2, considered the feasibility of taking the bridleway beneath the railway either parallel to or at right angles to the railway. Principal engineering and approval challenges are around the bridleway being below the level of the River Rother which is nearby. The tunnel would flood in a 5-year flood and above to a depth of 10 feet and would-be significant risk to local children and pedestrians in wet weather. The estimated cost is £6.8m. Option 2 is therefore unsuitable as an alternative arrangement to Option 1.

(c) Option 3, considers taking the rail over the bridleway. This scheme involves a sizable length of elevated viaduct structure with a significant impact on cost and would involve significant visual intrusion within the AONB. The viaduct would be adjacent to the existing houses in Salehurst and be particularly visible and intrusive to a quiet and most pleasant village. The estimated cost would be similar to that calculated by Arup for the A21 crossing at £20.2m. RDC have informed RVR that they would not support a planning application for a bridleway bridge, therefore taking the

rail over the bridleway would not be supported by RDC as RDC's reasons for not supporting a bridleway bridge would apply equally to rail over the bridleway.

(d) Option 4, would be a bridge carrying the bridleway over the railway. This would involve two long approach ramps either parallel to or at right angles to the railway due to the required maximum gradient for horses of 1 in 16, and the need for intermediate "level landings" to meet normal health and safety requirements. Obviously, the presence of a bridge and ramps directly on the bridleway alignment will prevent its use by farm vehicles, so the bridge has to have sufficient load bearing capacity to carry those vehicles. The Bridge would appear intrusive to the residents of Salehurst and several houses would lose the privacy of their rear gardens. The estimated cost for this option based on similar schemes by Network Rail elsewhere (e.g., over the main line railway at Kings Mill), and pro rata for this more straight forward location, is around £400,000. A recent new pedestrian crossing bridge at Wool Station by Network Rail cost £825,000. This option would also require a significant additional compulsory land take, above that required for option one, the "at grade" crossing. Additionally, RDC have informed RVR that they would not support a planning application for a bridleway bridge.

6. Timing

The majority of the construction materials for Option one would be delivered by rail, the fill material and track ballast via the Network Rail connection at Robertsbridge (from stock piles that RVR are already holding at several south coast ports), and track materials by rail from those already held for the project by Kent and East Sussex Railway (K&ESR) at Northiam Station. Upon gaining access to the land, it is anticipated that there will be 12 months of surveys in order to discharge the relevant planning conditions, with subsequent construction taking approximately 12 months. Commissioning and trials by K&ESR will take approximately 3 months. The reinstated railway will be operated by K&ESR as an integral part of its successful heritage undertaking. (K&ESR has been operating trains since 1974.)

7. Bridleway Design and Build

The bridleway crossing will be constructed from sections of revolutionary lightweight panels and edge beams. Every component weighs less than 60kg so it can be fitted manually by two people without the need for expensive machinery.

It is simple to fit and, unlike timber and heavier rubber systems they, can easily be removed and replaced during routine track maintenance.

The system shares the high grip surface of the heavy-duty steel framed polymer panel, so performs in the wet. It can be painted on in the same way as a road surface and the paint does not wear off easily as it does on other systems.

The surface is integral so does not peel off or need replacing like the expensive surface used on timber decks. The bridleway system is ideal wherever pedestrians or horses cross the track.

The lightweight nature also makes it ideal for remote or difficult to access installations such as rambling routes. Although rated as bridleway level crossing system, it has been tested way in excess of this using concrete blocks and vehicles.

Figure 2 Pedestrian and Bridleway Panels

8. Meerkat System

RVR will install the Meerkat warning device system to reduce user risk at the crossing to as low as reasonably practicable.

The new warning device can detect an oncoming train and provide an audible and visible warning to alert users that a train is approaching, therefore, have a significant impact on public safety at level crossings.

The entrance or decision point to the bridleway, which includes both sides of the railway will be protected by a self-closing wicket gate. Additionally, the wicket gate to be used will be designed to ensure it is possible for a mounted horse rider to open the gates without dismounting. RVR will follow in its entirety the ORR guidelines and current BHS specifications.

When cyclists use the crossing, notices will be sighted encouraging cyclists to dismount.

A sign explaining how to cross safely will also be displayed at the decision point on each side of the crossing. Instructions to users will be placed at appropriate points.

The minimum width between fences guiding users to the decision point or safe waiting area will be a minimum width of 3m. However, these widths may need to be increased depending on user requirements as part of the consultation process.

9. Railway Operation

The nature of the railway operation is an infrequent heritage railway, travelling at a maximum speed of 25mph. The intended design of the Bridleway crossing will incorporate the most recent crossing technology including a maximum speed of 10mph reducing risks to level as low as reasonably practicable.

The reinstated railway will be operated by Kent and East Sussex Railway (K&ESR) as an integral part of its successful heritage undertaking. (K&ESR has been operating trains since 1974). K&ESR have existing operating rules that safely manage these crossing types and which will be used, additionally, this crossing will have much improved safety systems.

10. Risk Assessment

The “Risk Assessment” documentation (Annex A) shows how the risks of a Bridleway crossing would be managed in accordance with ORR guidance.

11. User Worked Crossings

RVR is required to provide private user worked crossings over the line where property is severed by the reinstated railway. None of those proposed crossings are on the route of public rights of way. While the proposed TWAO Deposited Plans include for the provision of up to nine user worked crossing the draft Order does not seek specific detailed powers for accommodation crossings. Detailed design and operation would therefore be by way of subsequent negotiation following the making of an Order at which time we would approach ORR with proposed fully detailed solutions for each location.

The design and operation of those fully gated user worked crossings would be all as outlined in ORR Level Crossings – a Guide for Mangers, Designers & Operators (latest issue) with associated signage, protection and any other necessary measures to provide a safe solution as detailed in that document. Nevertheless, while the described minimum warning time of trains is achievable at all the proposed user worked crossing locations (ref guidance document 2.145) the crossings would nevertheless be enhanced by way of the provision of visual signal display to the crew of an approaching train indicating that the associated crossing gates are in the closed position.

The maximum line speed for the railway will be 25 mph. Local reduced speed limits will be incorporated where necessary at each user worked crossing set by way of sight line assessment - all as detailed in the Heritage Railway Association HGR-A0458 guidance document endorsed by the ORR for the assessment of user worked crossings.

RVR will enter into consultation with land owners to discuss options for removal of crossings wherever possible and where this is not possible RVR will provide a

variety of control measures to protect users as mentioned above, including providing the minimum safe distance to see an approaching train,

RVR will provide instructions for the safe use of level crossings for authorised users. The instructions will ensure the method of working for each crossing are adequate and suitable to ensure the safety of trains and crossing users. This may include employees, contractors, postal staff, drivers of delivery vehicles and visitors. The safety of those who use private level crossings on farms and other business premises in the course of their work.

The authorised user also has responsibilities for ensuring that everyone who uses the crossing has been properly instructed in how to do this safely. RVR will liaise with the authorised user and jointly prepare a specific joint risk assessment to ensure that a safe method of using the crossing is agreed and adopted. Particular attention will focus on the robustness of any agreed method of work between the two parties for periods of intensive use. The Heritage Railway Association HGR-A0458 guidance document will provide additional guidance and support.

- Provisions to be made available at the crossings include;
- Single gates that open away from the railway and kept closed across the roadway.
- The crossing surface and adequate approaches, suitable for the location and use.
- Vehicular gates may be locked to prevent unauthorised use.
- It is not envisaged that telephones and warning lights are required, however, this will form part of the consideration of the potential control measures identified within each specific crossing risk assessment.
- Instructions will be posted near every access point to the crossing, on a statutory sign.
- Adequate sighting in either direction will be maintained for crossing users
- Crossing with vehicles or livestock: The correct procedure is detailed in the instructions provided at each crossing;

Users will be encouraged to report any deficiencies or problems in using the crossing to the train operator and contact details will be made available at each crossing location.

Hazards and possible causes identified – **Bridleway Risk Assessment**	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
Regular users are more likely to undertake risk taking behaviour at crossings with a low frequency of trains.	The regularity of trains is a risk factor for crossing users, due to "the rarity of them encountering a train and the reduced vigilance that they might therefore demonstrate in crossing". Accidents are associated with lines that have low frequencies of trains.	4	2	8	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of new signage	2	1	2
Regular users and those living close to level crossings are more likely to undertake risk taking behaviour when using the crossing.	Potential behaviour traits of frequent users might include: Expectation by the user that there will not be any trains in the area. Familiar users apply prior knowledge of train times / frequencies. User believes he / she has enough time to beat the train. User has a low level of concentration and is easily distracted. User does not look in both directions. User has low perception of risk. User thinks he / she understands procedure without reading instructions User unaware of risks to subsequent users. User assumes that the train is stopping at the station (based on	4	2	8	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of Bridleway crossing is primarily covered in Local Training Plans and educational material to cover; Hazards associated with the crossing, How to make decisions about whether requests to cross can be granted. how to check whether a crossing is clear.	2	1	2

	prior experience) and chooses to cross in front of the train.							
Low train speeds might increase the risk-taking behaviour of users	It has been established that users might perceive the crossing to be safer to cross when trains are moving more slowly. This might result in them behaving less cautiously e.g. by crossing while a train is in view, crossing more slowly, or checking the line less often while crossing.	4	3	12	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Eyes watching signs to encourage users to behave safely e.g., put dogs on leads, close gates etc. Education Awareness Self-closing gates	3	2	6
Young children who are not old enough to understand safe crossing procedure might cross unsafely.	Young children might not fully understand the risks associated with level crossings or the correct crossing procedure and therefore traverse in an unsafe manner. This issue might be particularly prevalent in locations where it is likely that unaccompanied children use the crossing, such as near residential areas, schools, playgrounds and youth clubs.	4	3	12	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of level crossings is primarily covered in Local Training Plan and educational material to cover; Hazards associated with the crossing, How to make decisions about whether requests to cross can be granted. how to check whether a crossing is clear. Ensure signage is appropriate for the status and specific risks at, and on the approaches to, a crossing.	3	2	6

					Education Campaign.			
Errors by crossing users might increase at crossings without warning signs or lights in the hours of darkness.	Poor lighting conditions at and around the crossing can affect a user's behaviour in several ways: Failure to see the crossing / crossing equipment and signs. Deviation from the crossing Inability to read crossing instructions. Misjudgement of train speed.	3	2	6	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of level crossings is primarily covered in Local Training Plans and educational material to cover; Hazards associated with the crossing, How to make decisions about whether requests to cross can be granted. how to check whether a crossing is clear. Ensure signage is appropriate for the status and specific risks at, and on the approaches to, a crossing. Education Campaign.	2	1	2
The visibility (and hence effectiveness) of information on the approach to and at the crossing is reduced by overgrown foliage.	Overgrown foliage on the approach to a level crossing can obscure signs at the crossing, and also restrict the visibility of approaching trains. This could result in the user either not seeing the sign or train (complete or partial) or the user not seeing the sign or train in time to sufficiently interpret the information and respond appropriately.	3	2	6	Foliage Management System in place. The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat.	2	1	2
An uneven and/or slippery crossing surface might present a potential hazard to those using the crossing.	Poor surfaces might present particular problems for cyclists (especially those wearing cycling shoes with slippery soles), horse riders, mobility scooter users,	3	3	9	Foliage Management System in place which ensures that all crossing surfaces are maintained, including the approach to the crossing, not just the area between the gates	3	2	6

	wheelchair users, the elderly, visually or physically impaired crossing users, and users with encumbrances such as luggage or pushchairs. The crossing surface might also present a hazard to road vehicles in general as well as a hazard to trains. Reasons for uneven/slippery crossing surfaces include: Missing, partial, worn or damaged crossing deck Poor decking panel alignment / position on skewed crossing Wet or icy weather conditions Uneven ballast distribution				and signs. Th Bridleway will allow sufficient space to provide a position of safety before/after the crossing for all users. Additionally, ensuring that the Bridleway crossing surface is profiled as the user moves through the entrance/exit to reduce the risk of slips, trips and fall thus preventing risk of personal injury. The Bridleway crossing will be constructed from sections of revolutionary lightweight panels and edge beams and a high-grip surface.			
User Worked Crossings - Additional								
Unreliable crossing equipment (telephones, warning lights, gates, means to secure gates including toe catches, and signs) due to poor maintenance, vandalism or general deterioration;	Damaged or missing signs can prevent a user understanding the crossing instructions / procedure Damaged equipment can affect its likelihood of use Damaged/difficult to use gates can affect a user's adherence to the correct gate crossing procedure Poorly maintained equipment can create a perception that the level crossing is not in use/ infrequently used and therefore reduce the perceived importance of following	4	3	12	Regular monitoring of the crossing, maintenance program in place Enhanced communication reporting arrangements between user and operator Installation of trespass guards on one or both sides of the crossing, together with any fencing as deemed necessary.	2	2	4

	the correct procedure Poorly maintained level crossing equipment can influence a user's behaviour in a variety of ways: Damaged or missing signs can prevent a user understanding the crossing instructions / procedure.							
Poor, worn or damaged crossing surfaces or cattle guards that cause difficulty in moving vehicles or livestock across the tracks;	Poor crossing surfaces make it more difficult for users to traverse the level crossing by distracting the user and causing them to look at their footing, by increasing user crossing time, and by increasing the potential for slips, trips and falls. In addition, footpath surfaces in a poor condition increase the likelihood of users diverting from the designated footpath or slipping / tripping into the carriageway.	3	2	6	Regular monitoring of the crossing, maintenance program in place Enhanced communication reporting arrangements between user and operator Installation of trespass guards on one or both sides of the crossing, together with any fencing as deemed necessary.	2	2	4
The type of level crossing might be unsuitable for a number of reasons, including its location, train service, line speed and/or user type	UWCs might become unsuitable due to a chance in land use (e.g. farming land diversification) or a new housing development nearby, which results in a higher number of crossing users and a change in user types. Another example might include an industrial estate being developed near to a rural crossing that is unsuitable for HGV use.	3	2	6	Review Signage. Involve users in the RA process Consider is current level crossing is correctly graded.	2	2	4
Restricted sighting of approaching trains caused by;	lineside development, erection of fences, or growth of vegetation, at a user worked crossing without additional protection measures,	3	2	6	Review Signage. Involve users in the RA process Consider is current level crossing is correctly graded. Vegetation clearance	2	2	4

Rother Valley Railway

New Build Level Crossing Narrative Risk Analysis (NBLC-NRA) - Update 10.02.2021

[redacted]

Contents

1 Introduction

The Rother Valley Railway will provide a Full Barrier Automatic Level Crossing, Locally Monitored (AFBCL) incorporating the latest technology for the operation and protective equipment. The crossing will be fully compliant with that is widely used on Network Rail infrastructure today, thus, ensuring the crossing would not require any product approvals, derogations or changes to standards. The maintenance regime would also be standard and no bespoke parts would need to be produced or stocked specifically for the crossing. For the above reasons, the crossing presents a very low reliability and risk concern and would most likely incur the lowest maintenance costs.

A level crossing does not currently exist at Junction Road; therefore, a Quantitative Risk Assessment would not provide sufficient evidence to demonstrate that possible risk has been assessed and managed accordingly. However, it is important to establish possible risk from the introduction of a level crossing and possible mitigation measures at an early stage of development.

This NBLC-NRA analyses all relevant data as well as expert opinion to demonstrate that all possible risk has been addressed as well as embroidering new technology to further enhance the safety of the level crossing, for example;

- CCTV for improved safety & security,
- Obstacle Detection
- Home Office Approved Red Light Cameras
- Evaluate the risks at the level crossing.
- Early engagement with stakeholders from different sectors, local authorities, communities and ‘users’ associations.
- Take engineering measures and find innovative solutions
- Take educational and awareness measures and collaborate with the rail and road sectors.

The level crossing will be carefully assessed via this analysis in conjunction with the railways, and together with the road infrastructure managers, local authorities and industry experts to make it more visible and easier to cross particularly for long, heavy and oversized vehicles.

All stakeholders will be in a position to cooperate and design the best level crossing environment.

Narrative Risk Assessments currently used by Network Rail are enabling better targeting of risk reduction measures; blending quantitative modelled risk with structured observation and judgement from competent staff. The NRA process is considered as part of this analysis to encompass the whole level crossing asset system and assess wider aspects of level crossing risk.

This analysis builds upon excellent safety initiatives which were introduced for the first Automatic Full Barrier level crossing by Network Rail including the safety benefits provided, however, RVR intend to introduce additional safety measures such as the use of Red-light safety equipment (RLSE), which has currently been installed at 31 public road level Crossings on the National Railway Network to improve user behaviour, deterring deliberate misuse. Trials

have demonstrated that these Home Office Type Approved (HOTA) cameras have reduced deliberate misuse by approximately 90 per cent at some locations.

RVR will install an automatic level crossing including an object detection system (AFBCL) at Junction Road level crossing. Crossing obstacle detection systems utilise a combination of RADAR and LIDAR technology to scan the crossing before allowing for trains to safely manoeuvre through. In combination these systems detect obstacles on the ground and around the edge of the barrier lines and deliver unique small object detection protecting children and adults as well as vehicles and other large objects. RVR will monitor and review the installation of the obstacle detection system after the first 12 months of operation to determine if additional safety features could be added to further enhance safety of the level crossing.

2 Level Crossing Overview

This is a risk analysis for Junction Road level crossing. However, it should be noted that at present a level crossing does not exist, therefore, this assessment is based on the probability of risk if a level crossing was in place. It is imperative that a full Quantitative (and Narrative) Risk Assessment (QRA) is completed before any trains operate over the crossing and that the QRA is presented to the ORR.

Crossing Details	
Name	Junction Road
Type	AFBCL
Crossing status	Public Highway
Overall crossing status	Design Stage
Engineers Lin Reference	N/A
OS grid reference	
Number of lines crossed	1
Line speed (mph)	10
Electrification	No
Signal box	Yes (A21 level crossing)

3 Information Sources

The table below shows the stakeholder consultation that was undertaken as part of the risk analysis.

- Office of Rail and Road (ORR)
- Kent and East Sussex Railway (K&ESR)
- Bakerail (Track site/project management specialists)
- East Sussex County Council (ESCC)
- Rother District Council (RDC)

- I-Transport (Specialist Planning Transport Consultancy)
- ARUP (Design, Engineering, Architecture and Business consultation Group)

Reference sources used during the risk analysis;

- ARUP A21 Options Report
- ARUP Road Safety Audit
- Mott Macdonald road survey report
- Network Rail QRA information
- GG19 Road Safety Report
- ORR Documentation
- GPR219-IDF- Level Crossing Safety
- EU SAFER-LC Project
- Level Crossing Risk Management Tool (LXRMT).

4 Level Crossing Diagrammatic Scheme

The new level crossing to be constructed is a Full Barrier Automatic Level Crossing, Locally Monitored (AFBCL) on B2244 Junction Road, East Sussex. The road approach speed is 40 mph. The profile of the railway line in the vicinity of the crossing has been provided (below), as well as the appropriateness of the proposed warning signs in this regard.

Diagram of the proposed railway Alignment

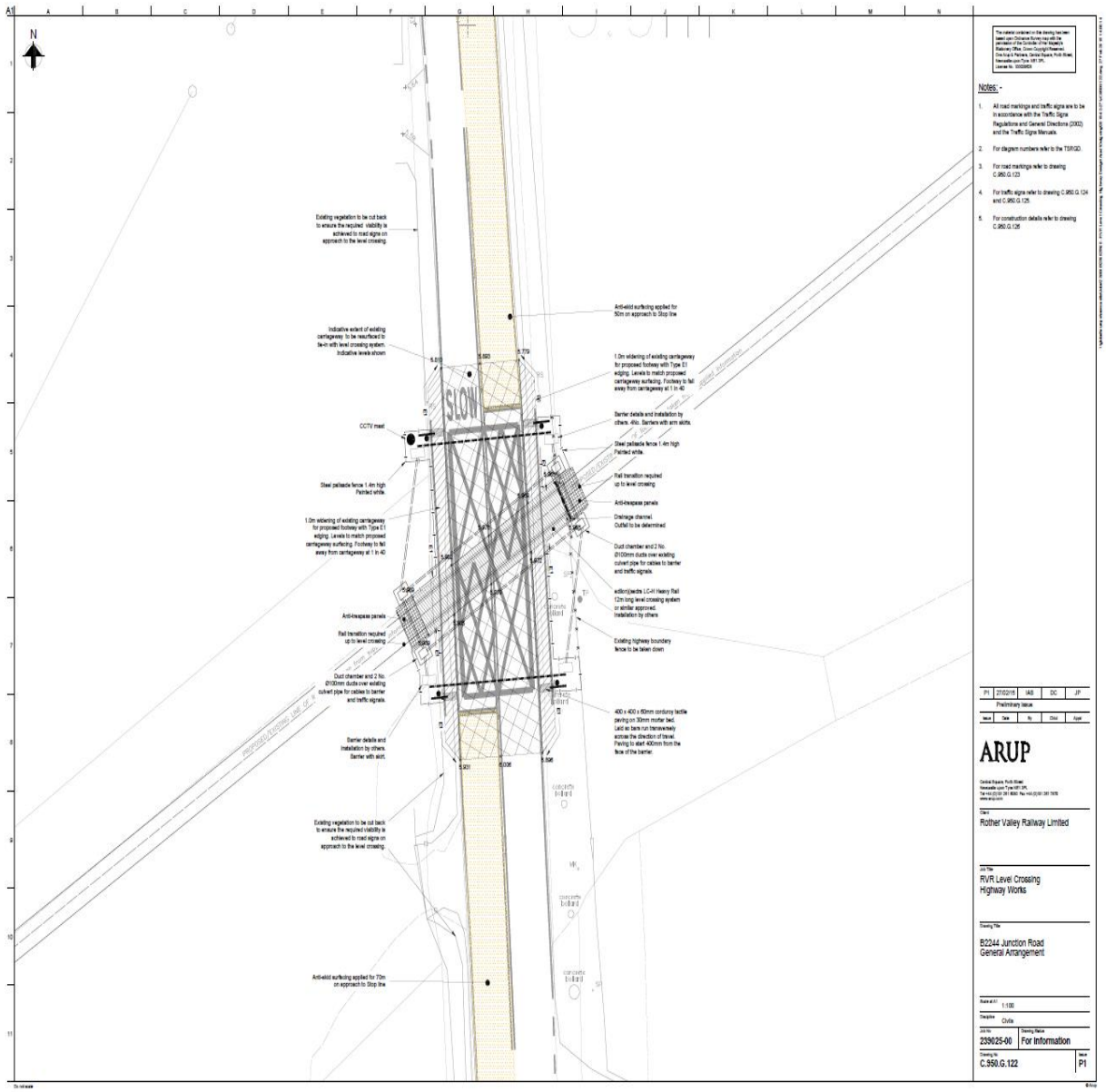
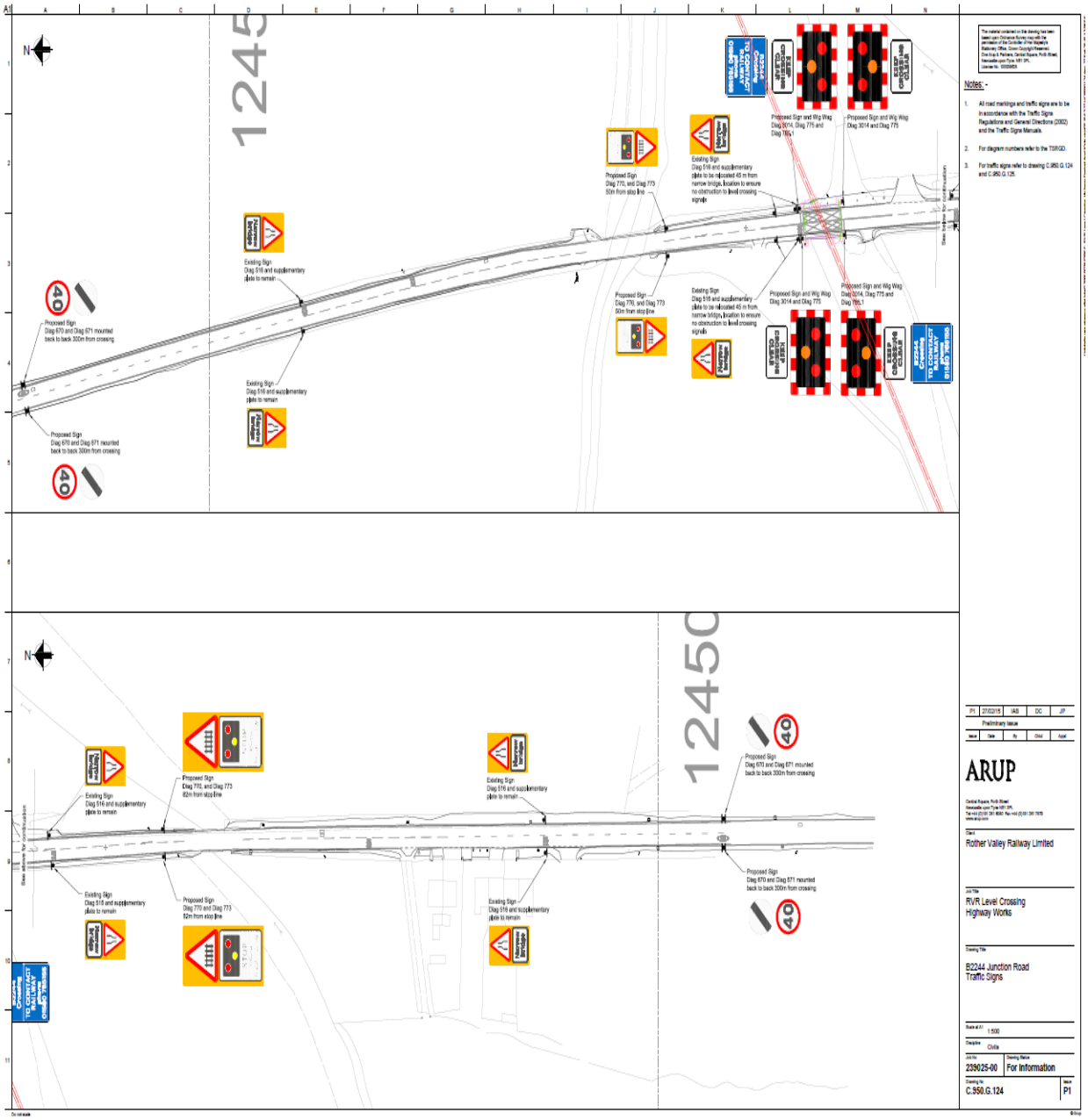


Diagram of the proposed traffic signs



5 Site Visit General Observations

The B2244 Junction Road, Stage 1 Road Safety Audit report (appendix A) identified possible road distractions which are considered as part of this analysis, for example,

- Speeding vehicles pose a threat to other road users along with a high frequency of heavy braking on the approaches to the narrow bridges which could result in higher frequency of collisions due to driver error.

To remove this concern, it is advised to reduce the speed limit over this length of road.

- The adjacent features see in photograph 1 (below) increase the risk of blocking back at the proposed level crossing, additionally, there is a private access road located close to the proposed level crossing location as well as the narrow bridges to the north and south. Turning traffic waiting on the carriageway by the proposed level crossing will increase the risk of blocking back over the crossing leading to potential vehicle/train conflict.

To remove this concern, it is advised to introduce a yellow box marking to deter blocking back at the crossing

Photograph 1

- There are a number of existing traffic signs both north and southbound B2244 in the vicinity of the proposed level crossing, hence, multiple traffic signs could lead to distraction, missing warning signs and possible road user collision as seen in Photograph 2(a) (b) below.

To avoid the risk of confusion between signage a comprehensive review will be conducted as part of detailed design of the level crossing.

Photograph 2(a)

Photograph 2b

- There are two narrow bridges situated either side of the proposed level crossing site. The bridges are too narrow for large vehicles to pass without forcing oncoming traffic to stop leading to the crossing being obstructed and potential vehicle/train conflict, see photographs 3(a) (b) below.

To remove this concern, it is advised to establish priority at the narrowing's for vehicles driving away from the level crossings.

Photograph 3(a)

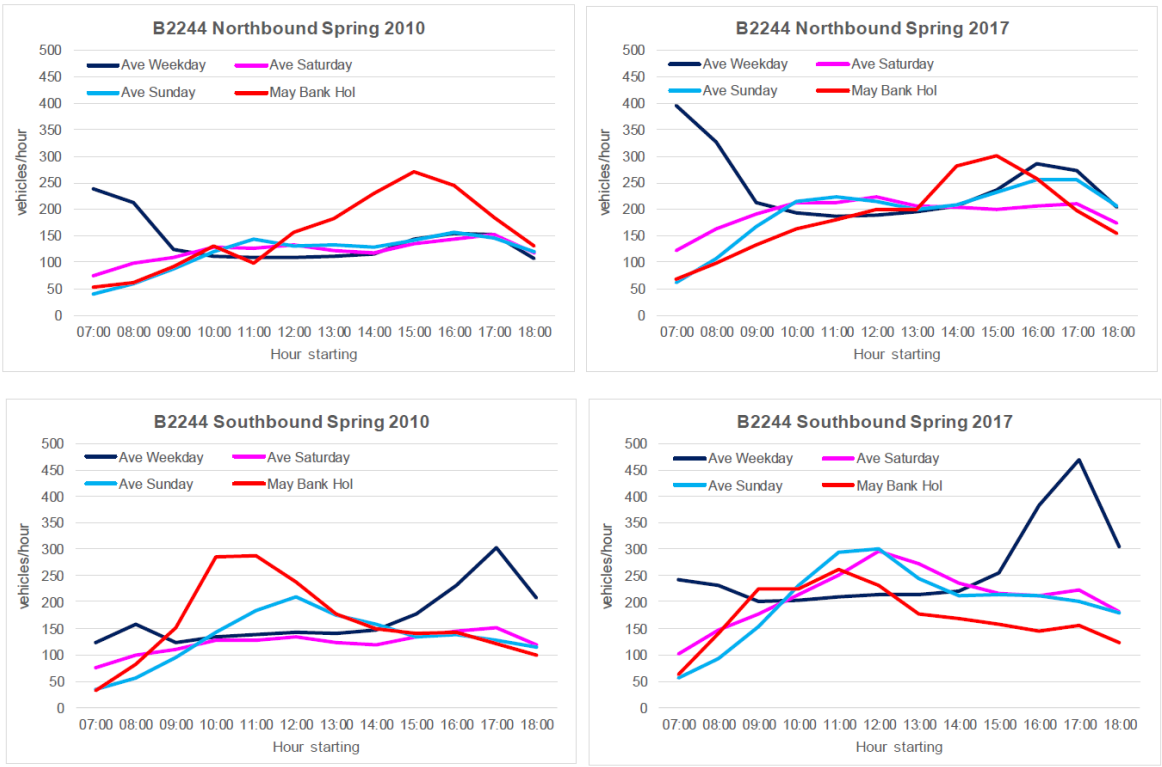
Photograph 3(b)

6 Junction Road Traffic Flows

The chart below compares traffic flows on B2244 Junction Road, for Spring and Summer months, based on ATC data provided Mott McDonald Addendum to traffic impact study report (2018).

For most days and periods, there have been large proportional increases in flow, but volumes remain much lower than on the A21. Increases are highest for the weekday AM and PM peak periods (northbound 07:00-09:00 and southbound 16:00-18:00), as well as on the August Bank Holiday. (Mott Macdonald Addendum report 2018 (Appendix B)

Figure 9: B2244 Traffic Flows in Spring 2010 and 2017



Source: ESCC ATC Site 021

Queuing at the level crossing has been estimated, based upon average vehicle demand per minute during the hour of each barrier closure, as well as length of time that the barrier is down. A barrier close time of 55 seconds has been assumed, with sensitivity testing with a 110-second closure.

Queue lengths have been estimated with 2018 traffic demands and predicted demand in 2021 and 2027.

Traffic Growth for future years;

Traffic forecasts have been produced for 2021 and 2027 using TEMPRO version 7.2 with National Transport Model (NTM) factors (NTM datasheet AF15). To calculate growth factors for Junction Road LC data for Rother District has been used.

For Bank Holidays, it has been assumed that growth will be the same as for Sundays.

Table 1 Traffic Growth Factors; 2017 - 2021

Road Name	Region	Road Type	Average Weekday	Average Saturday	Average Sunday	May Bank Holiday	August Bank Holiday

B2244 Junction Road	East Sussex	Rural Minor	1.063	1.061	1.061	1.061	1.061

Table 2 Traffic Growth Factors 2017 – 2027

Road Name	Region	Road Type	Average Weekday	Average Saturday	Average Sunday	May Bank Holiday	August Bank Holiday
B2244 Junction Road	East Sussex	Rural Minor	1.150	1.149	1.150	1.150	1.150

Predicted Queue Lengths;

Table 3 (below) shows the predicted queue lengths for Junction Road Level Crossing with a 55 second closure.

Table 3: Predicted Queue Lengths at Junction Road Level Crossing

	2017 Northbound		2017 Southbound		2021 Northbound		2021 Southbound		2027 Northbound		2027 Southbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	25	19	34	21	27	20	36	22	29	21	39	24
Saturday	20	18	26	21	21	19	28	23	23	21	30	25
Sunday	23	20	26	21	24	21	28	22	26	22	30	24
May BH	26	20	23	16	28	21	24	17	30	23	26	19
Summer												
Weekday	21	17	33	21	23	18	35	23	25	19	37	25
Saturday	18	17	22	20	19	18	23	21	21	19	25	23
Sunday	21	18	27	22	22	19	29	24	24	21	31	26
Aug BH	25	21	32	26	27	22	34	28	29	24	37	30

Source: Mott MacDonald analysis of existing and predicted traffic volumes, queue lengths in metres assuming 5.75m/vehicle

For the B2244, predicted maximum queue lengths are 20m-30m in 2017, increasing to around 30m-40m in 2027

Queue lengths with a 110-second closure (below) are shown as sensitivity tests. Predicted maximum queue lengths for Junction road are 40m-70m in 2017, increasing to around 40m-80m in 2017.

Table 4 Predicted Queue Lengths at Junction Road Level Crossing with 110 Second Closure

	2017 Northbound		2017 Southbound		2021 Northbound		2021 Southbound		2027 Northbound		2027 Southbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	50	37	67	42	54	39	71	44	58	43	77	48
Saturday	39	37	52	43	42	39	55	45	45	42	60	49
Sunday	45	39	53	42	48	42	56	45	52	45	61	48
May BH	53	39	46	33	56	42	49	35	61	45	53	38
Summer												
Weekday	43	33	65	43	46	35	69	46	49	38	75	49
Saturday	36	33	44	40	38	35	46	43	41	38	50	46
Sunday	41	37	55	45	44	39	58	47	48	42	63	51
Aug BH	50	42	64	52	54	44	68	55	58	48	73	60

Source: Mott MacDonald analysis of existing and predicted traffic volumes, queue lengths in metres assuming 5.75m/vehicle

Conclusion;

On the B2244, there have been large proportional increases in flow for most days and periods, however,

volumes remain much lower than on the A21. Increases are highest for the weekday AM and PM peak periods (northbound 07:00-09:00 and southbound 16:00-18:00, as well as on the August Bank Holiday. Predicted maximum queue lengths are 20m-30m in 2017, increasing to around 30m-40m in 2027.

7 The Railway

The train service over Junction Road level crossing will consist of passenger trains only. There will be approximately 10 trains per day. The highest permissible line speed of trains over the crossing will be 10 mph. Trains are timetabled to run for 10 hours per day.

The RVR Level Crossing Operational Management Plan (LCOMP) sets out the strategy for operational management of the Junction Road level crossing to be installed on the Rother Valley Railway (RVR) where it interfaces with the road at level grade, so requiring control of road vehicles to enable a train to cross.

The LCOMP describes the principles of how the level crossing is to be operated under normal conditions and in the event of failure.

This shall be the basis for developing operational procedures for the railways operation when services commence to which staff shall be trained and assessed on an ongoing basis.

Compliance with Industry guidelines;

The design for the level crossings, developed from this document, shall be compliant with industry guidelines, e.g. The Office of Rail Regulation: A Guide for Managers, Designers and Operators Railway Safety Publication 7 December 2011 and approved by a suitably independent person before installation.

Junction Road Level Crossing Operation;

It shall be noted that a signaller will be on duty at all times of normal operation. The signaller will monitor operation of the crossing via a Closed-Circuit Television link.

Normal operation to from Robertsbridge

The train will approach the level crossing at a maximum speed of 10 mph, thus ensuring that the train has the ability to stop in 30m. The AFBCL (Automatic Full Barrier Crossing, Locally Monitored) crossing area is equipped with obstacle detection technology that scans the crossing area at various stages during the closure sequence. The crossings are provided with crossing illumination (for night visibility) and a drivers' flashing red and white light indicator in each direction on final approach for local monitoring by the train crew. The speed approaching the AFBCL crossing is limited to 10mph, so the approaching train is able stop under all railhead conditions before the road if the crossing is either visibly blocked or the flashing indicator hasn't changed from red to white. The approach of a train automatically begins the crossing closure sequence. This commences with the road traffic wig-wag signals and audible warnings to indicate to road traffic to stop. Obstacle detection technology prevents to lowering of the crossing entrance barriers until the crossing is clear. Once the entrance barriers are down and the crossing surface is scanned to continue to be clear the lowering of the exit barriers can commence. If the equipment is proven to be fully functional and the OD sensors have confirmed clearance of the road surface between the fully down barriers then the indicator for the train driver will be showing flashing white light before the train reaches the crossing speed board.

The barriers will rise as soon as practicable after trains for which the lower sequence has been initiated or maintained, have passed clear of the crossing. The sequence of events to open the crossing to road traffic, once the raising cycle has been initiated or maintained is, all the barriers begin to rise simultaneously and should normally rise in 4 to 6 seconds; and the intermittent wig wag red lights should be extinguished as the barriers rise.

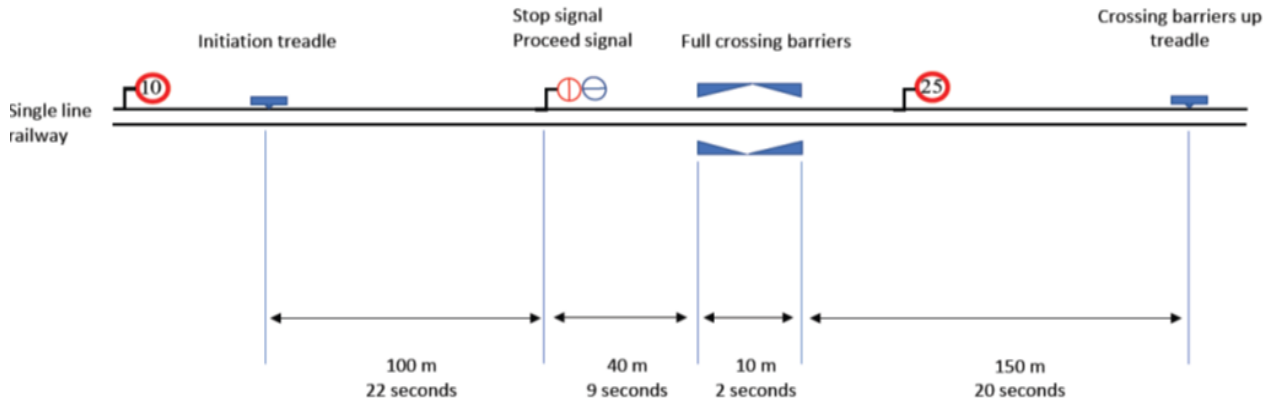
Railway signalling and control

Railway signalling will be provided to ensure the level crossing is fully protected on all railway approaches. The railway approach signals are interlocked with the lifting barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers, additionally, it will not be possible to raise the barriers unless the signals are set at Stop and free of approach locking, or the train has passed the signal and traversed the crossings. It will not be possible to clear any protecting signals until 'crossing clear' is confirmed either automatically by obstacle detection equipment, or manually when that equipment is not being used. Discrete function controls will be provided at the control point for authorised railway staff use when obstacle detection equipment is not being used.

If a train passes a protecting signal at Stop, the road traffic light signals will immediately show an intermittent red light (omitting the steady amber phase) and the audible warning will start. The barriers will not be lowered as this may strike or trap crossing users.

To ensure that the crossing operates safely when the railway line is open to traffic, indicators at the control point will confirm that the equipment is powered and functioning correctly.

Level Crossing Signalling Design



Rother Valley Railway
Level crossing signalling schematic for
manually operated full barriers
Northbridge Street, A21 & Junction Road

Not to scale

Notes:

1 Equipment shown for up direction only, treadles, signals and signs replicated for down direction

2 Transit times assume full line speed

Level Crossing barriers & CCTV Systems Maintenance Plan

The maintenance plan for the three-level crossings shall be based on that recommended by the supplier of the equipment. It shall comprise:

- Regular planned maintenance at the required intervals.
- Work arising from planned maintenance, within the required timescales
- Fault response, within specified timescales.
- Work arising from fault responses, within the required timescales.
- Work arising due to other parties planned work.

Road Crossing Design and Construction

The construction of the road crossings comprise concrete units designed to meet the requirements of a high friction skid resistant road surface through the crossing. This has been tested for the proposed installation and passed the test level requirement as set by The Highways Agency, reference document RD/GN/009 dated September 1989.

8 5 X 5 Risk Assessment

Hazards are identified, listing possible causes if appropriate and assessed for severity. These are then multiplied by the frequency or likeliness of an incident occurring if no controls were applied. This produces the risk factor; the numerical assessment table gives guidelines on how to assess severity and frequency.

The risk assessments for the crossings are based on generic issues and then modified to reflect the specific issues at the individual crossing to reflect that risk can change significantly from one site to another. The generic risk assessment will be reviewed by the appointed Project Manager and then modified as required to reflect the hazards and the necessary controls identified during site visits (pre-works) or through information passed to them by stakeholders and any other third party.

Hazards are identified, listing possible causes if appropriate and assessed for severity. These are then multiplied by the frequency or likeliness of an incident occurring if no controls were applied. This produces the risk factor; the numerical assessment table gives guidelines on how to assess severity and frequency.

This risk assessment is generic and whereas the basic principles will always apply, it is acknowledged risk can change significantly from one site to another. Generic risk assessments will always be reviewed by the appointed Project Manager and then expanded upon if required to nullify or apply the necessary controls to hazards identified during site visits (pre-works) or through information passed to them by a third party.

Numerical Assessment			
Severity (S)		**Likelihood of Occurrence (L)**	
1	No Injuries / Minor Damage	1	Remote
2	Single Minor Injury	2	Unlikely
3	Single Major Injury / Minor Pollution	3	Occasional
4	Single Fatality / Major Pollution	4	Likely
5	Multiple Fatalities	5	Highly Likely

Risk Factor

		Likelihood of Occurrence (L)				
		5	4	3	2	1
Severity	5	25	20	15	10	5
	4	20	16	12	8	4
	3	15	12	9	6	3
	2	10	8	6	4	2
	1	5	4	3	2	1

Risk Factors between 16 to 25 = Unacceptable Risk. Risk Factors > 8 will be strictly monitored.
Hazards Identified with a Severity Assessed at 3 or above will also be strictly monitored.

Junction Road Risk Assessment

Hazards and possible causes identified for Junction Road AFBCL	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
SIGNALLING								
Relative to previous signals: Will the signal be in a different position, or does it have a different configuration?	Signal position is not consistent with the spacing between preceding signals Signal is of a different design to preceding signals Potential for, Death, Serious injury or injury	4	3	12	The KESR signalling arrangement will have consistent signal design. All staff will receive training before operation commences	3	2	6

Could the signal be confused with other signals on an adjacent line or on the same gantry	Signal is on a post and could be confused with other signals Signal has an identical profile / outline to adjacent signals Death Serious injury Injury	4	3	12	Ensure signals for all lines are visible Shield nearby signals from view Appropriate signal should be clearly associable with its line Driver training	3	2	6
Could the signal be obscured from the driver's view?	Signal reading time is inadequate. Signal is positioned round a curve and the reading angle is inadequate Signal is positioned round a curve and there is an obstruction blocking the signal's line of sight Signal can be obscured by vegetation Signal can be obscured (intermittently or otherwise) by a bridge or other structure, for example station structures edge of signal back plate is less than 100 mm from edge of aspect	3	3	9	Increase backboard size (by 50%) Manage vegetation Maximum train speed is 10 mph Remove / shield potential distractions in stations Reposition signal on straight track Make signal post more conspicuous Driver training	3	2	6
TRACK								
Will the track on approach to the signal suffer from adhesion	Signal is located in an area which suffers from ice, frost,	4	3	12	Lineside fencing / netting	2	2	4

problems?	leaf fall, dampness or other adhesion problems Death Serious injury Injury				Railhead conditioning Management of lineside vegetation Low adhesion warning signs Driver training			
Is there a reduction in permissible speed on the approach to the signal?	There is a reduction in permissible speed on the approach to the signal Death Serious injury Injury	2	2	4	Permissible speed on approach to the level crossing is maximum 10 mph Driver training On site staff monitoring	2	2	4
Is there a falling gradient on approach to the signal?	There is a falling gradient on the approach to the signal	4	3	12	Countdown markers Driver training	3	2	6
COLLISION								
Road Vehicle and train collision risk	Insufficient train warning time for all vehicle types known to be exacerbated by the driving position e.g. Tractor. Level crossing equipment and signage is not conspicuous or optimally positioned. Instructions for safe use may be misunderstood e.g., signage, clutter detracts from key messages, conflicting information given. High volume of unfamiliar users e.g. irregular visitors, migrant workers.	4	3	12	Optimising position of equipment at the design stage removing any conflicting or redundant signs. Strike in times optimised. Sighting lines enhanced. Latest technology in place for user-based warning systems including wig-wag lights, sirens, full road barriers, RTL. AFBCL Maximum train speed 10 mph implemented. Superior quality crossing surface construction material. De-vegetation programme in place	3	2	6

	Known user complacency leading to high levels of indiscipline. Type of vehicle unsuitable for level crossing; - Large, low, slow, making access or egress difficult and or vehicle is too heavy for the crossing surface – risk of grounding and or severity of gradient adversely affects ability to traverse. Users experience a long waiting time.							
Pedestrian and train collision risk	Ineffective whistle boards, warning inaudible, insufficient train warning time. Level crossing equipment and signage is not conspicuous or optimally positioned. Instructions for safe use may be misunderstood. Surface condition could lead to slip/trip risk. High volume of unfamiliar users i.e. irregular visitors/ramblers/equestrian.	4	3	12	Optimising position of equipment at the design stage removing any conflicting or redundant signs. Latest technology in place for user-based warning systems including wig-wag lights, sirens, full road barriers, RTL. AFBCL, obstacle detection Maximum train speed 10 mph implemented. Superior quality crossing surface construction material. De-vegetation programme in place. Regular engagement with stakeholders/authorised users reinforcing safe crossing protocol, legal responsibilities and	3	2	6

	Complacency leading to high levels of indiscipline e.g. users are known to rely on knowledge of timetable. High level of use by vulnerable people. High usage of cyclists.				promoting collaborative working.			
Hazards and possible causes identified	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
SPAD OCCURRENCE								
Train driver passes protecting signal without authority	Collision with road vehicle (see above). Collision with member of public (See above). Death Serious injury Injury	4	3	12	If a train passes a protecting signal at Stop, the road traffic light signals will immediately show an intermittent red light (omitting the steady amber phase) and the audible warning will start. The barriers will not be lowered as this may strike or trap crossing users. Driver training. Maximum speed of train 10 mph.	2	2	4

Level Crossing Risk Assessment

Update 10.02.2021

Hazards and possible causes identified	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
Additional Risk Influencing factors								
Distraction								
Can the driver be distracted by something outside the cab?	Driver could be distracted by trespassers	4	3	12	Signal reminder sign	3	2	6
Could the driver be distracted by other tasks at or on approach to the signal?	There is a level crossing in the vicinity of the signal	4	3	12	Position signal where driver not distracted by other duties Driver training	3	2	6
Distractions while using the level crossing might impair the user's ability to cross quickly and safely.	If a user is distracted, there is an increased likelihood that they will not see the crossing, warning signs, for example; Other persons in the car (e.g. children) Thoughts on personal matters, work stresses etc. Using the telephone, Behaviour of other crossing users, In car entertainment Seasonal events (e.g. fun fairs, fireworks) Mobile phones, iPads, handheld computers etc. Signage (e.g. speed limit signs). Distractions might be more likely for users who frequently use the crossing (e.g. delivery drivers), due to them potentially having a lower level of concentration than those who use it infrequently.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Staff training. Traffic calming measures. Train maximum speed 10 mph. New modern full barrier crossing. AFBCL Education campaign.	2	2	4

	A change in speed limit and the associated speed limit signs This proximity of the speed limit signs to the crossing might reduce the attention given to the crossing, or remove attention away from it completely. The signs might also draw a car driver's attention to the vehicle speedometer to check vehicle speed and away from maintaining vision out of the vehicle's windscreen. Other signs in the vicinity of a level crossing that are not related to that crossing could also have been a potential distraction.							
High vehicle approach speeds	The vehicle speed over a level crossing is a factor in vehicle driver errors. Risk factors include, the speed limit(s) in the surround areas, driver's perception and attitude to risk, visibility of warning signs and visibility of the level crossing e.g. rural winding roads. High risk behaviour such as high vehicle speeds and late, heavy braking will result in a higher frequency of collisions due to driver error.	4	3	12	Reduced road speed on approach to level crossing. Traffic calming measures. Enhanced signage. New modern full barrier crossing. AFBCL Education campaign.	2	2	4
Large, slow and low vehicles	Drivers of large vehicles are involved in a	4	3	12	Reduced road speed on approach to level crossing.	2	2	4

	disproportionately high number of incidents at level crossings. The size of the vehicles - they have less room for error when compared to cars. They may not be responding to the activation of the crossing warning system in sufficient time. Studies have proposed that large (HGV) vehicles may attempt to traverse the crossing once the barriers have already started to descent, suggesting that it could be to do with the driver's awareness of their vehicle's poorer braking performance, and therefore considering it safer to continue. Other contributory factors might include: The slower acceleration speed of HGVs causing the total time to cross a level crossing from standstill to increase Sightlines from a higher driving position.				Traffic calming measures. Enhanced signage Yellow box marking Level crossing road surface well maintained Power operated level crossing barriers AFBCL			
Ice conditions	Icy weather conditions on the approach and exit to the crossing might affect the	3	3	9	Provision of CCTV surveillance cameras.	2	3	6

	behaviour of the crossing, for example, prevent vehicles from stopping in a position of safety at the crossing. Encourage vehicle drivers to ignore the initial warning activation when they are close to the train line because of the risk of sliding forward onto the tracks. Cause pedestrians to concentrate on their footing, rather than looking for trains or observing warning signs. Result in pedestrian slips, trips and falls. This is a particular risk for elderly, or mobility impaired, users. Level crossings on 'B' roads might present a particular hazard to vehicle drivers as these roads are not normally gritted in icy conditions.				Level crossings local training plans, on communications skills, hazards associated with a particular crossing (icy conditions). Improved crossing surface. Regular monitoring. Tactile surfaces.			
Foliage obscuring warning signs and approaching trains	The visibility (and hence effectiveness) of information on the approach to and at the level crossing is reduced by overgrown foliage.	4	3	12	Cutting back vegetation and removing obstructions the sighting distances for users up and down the track and to signs / warning lights are lengthened. Staff training i.e. HRA Guidance document HGR – A0720 Control of Vegetation (Management	2	2	4

	Overgrown foliage on the approach to a level crossing can obscure signs and signals located at the crossing, and also restrict the visibility of approaching trains. This could result in the user either not seeing the sign or train (complete or partial) or the user not seeing the sign or train in time to sufficiently interpret the information and respond appropriately. This issue can be exacerbated when the visibility of the level crossing is reduced, either due to its type or its location e.g. on the bend in a road or on a high-speed road, as the vehicle driver has even less time to respond. foliage is also applicable to train drivers. Foliage on the lineside might impact on the train driver's ability to see information, objects or people on the crossing.				plan). Improved sighting distances. Train speed max 10 mph. CCTV monitoring. New modern full barrier crossing (Audible/visual alarms) AFBCL Education campaign. Reduced road speed on approach to level crossing. Traffic calming measures. Enhanced signage.			
Crossing utilisation or traffic moment	High crossing utilisation by users is associated with a greater chance of user risk taking behaviour.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Level crossings local training plans, training	2	2	4

					and briefing on communications skills, hazards associated with a particular crossing (icy conditions)., Reducing the road approach speed to the level crossing to reduce the risk of collision between vehicles and gates / trains. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Traffic calming measures. Enhanced signage.			
Unfamiliar users	Users who are not familiar with the level crossing procedure in the UK might apply an incorrect mental model when traversing the crossing.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Level crossings local training plans, training and briefing on communications skills, hazards associated with a particular crossing (icy conditions)., Reducing the road approach speed to the level crossing to reduce the risk of collision between vehicles and gates / trains. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Traffic calming measures. Enhanced signage	2	2	4

Traffic calming systems Road traffic calming systems on either side of a level crossing might increase the risk of blocking back.	Traffic calming systems, such as road width restrictions/ build-outs, positioned on either side of a level crossing might increase the risk of vehicle drivers blocking back over the crossing. When the crossing is closed to road traffic, queues form along the road. This issue might be exacerbated due to factors such as the time of day (rush hour) and 'herd mentality'. Discomfort for cyclists on the road. Potentially more noisy approach to the crossing leading to possible complaints. If overused in conjunction with changes in speed the mitigation might lose its impact upon behaviour.	3	3	9	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Reducing the road approach speed to a level crossing to reduce the risk of collision between vehicles and gates / trains. A range of enhancements to improve conspicuity, comprehension of and user response to level crossing warning signs:	2	2	4
Multiple traffic signs leading to distraction, missed warnings and road user collisions.	There are a number of existing traffic signs on both the northbound and southbound in the vicinity of the level crossing, notably	3	3	9	Reducing the road approach speed to the level crossing to reduce the risk of collision between vehicles and gates / trains. New modern full barrier crossing (Audible/visual alarms. AFBCL	2	2	4

	those warning drivers of the narrow bridges.				Education campaign. Traffic calming measures. Enhanced signage.			
Pinch points could lead to blocking back at the level crossing.	There are two narrow bridges situated either side of the level crossing site. The bridges are too narrow for large vehicles to pass without forcing oncoming traffic to stop. A platoon of half a dozen vehicles could obstruct the crossing leading to potential vehicle / train conflict	3	3	9	Traffic calming measures. - establish priority at the narrowing's for vehicles driving away from the level crossing. Education campaign. Enhanced signage	2	2	4
Limited forward visibility. Adjacent features increase the risk of blocking back at the level crossing. private access located close to the proposed level crossing location, in addition to the narrow bridges to the north and south.	Lack of good visibility at the level crossing leading to shunt type collisions.	3	3	9	Note: obstacle detection that will prevent crossing closure in these circumstances Introduce a yellow box marking. Traffic calming measures.	2	2	4
Single train line Greater risk-taking behaviour in both vehicle drivers and pedestrians is reported on single train lines. .	This user behaviour is in line with risk compensation theory - the user, perceiving there to be less of a risk to him/herself, behaves less cautiously	2	2	4	AFBCL Staff Training. Maximum train speed 10mph. Enhanced signage.	1	1	2
Farming vehicles Farm traffic might influence the speed and behaviour of	Farm traffic tends to move at a much slower speed	4	4	16	Power operated barrier. AFBCL	2	2	4

other vehicles traversing the crossing.	and, being much larger, reduce the visibility of other vehicle drivers. This can cause distraction and frustration and change other road user's behaviour; resulting in risk taking actions such as overtaking and not observing the level crossing warning signs.				CCTV monitoring. Staff Training/Competence. Education campaign. Enhanced signage			
Commercial driver	Commercial drivers might have increased risk taking behaviour at level crossings. Commercial vehicle drivers, such as salespersons, work to strict timescales and therefore their driving behaviour is often influenced by having to reach destinations on time. Commercial drivers using a level crossing might be inclined to 'beat the lights' to avoid having to wait at the crossing, or they might fail to follow the correct crossing procedure at unprotected crossings.	4	4	16	A range of enhancements to improve conspicuity, comprehension of and user response to level crossing warning signs: AFBCL Staff Training/Competence. Education campaign. Enhanced signage.	2	2	4

Adverse weather impacting visual information.	The effectiveness of visual information at crossings can be impaired by adverse weather conditions (e.g. fog and snow). The ability of vehicle drivers or other crossing users to detect the presence of level crossings, hazard information, warning lights or approaching trains might be impaired by adverse weather conditions, e.g. fog and snow. This might result in users failing to see warning information or oncoming trains, which could lead to users unintentionally adopting risky behaviour. In addition, in heavy snow users might not be able to see the tracks and inadvertently stand in a position of danger. Visibility in and around the crossing might also be impaired by banks of snow. An example where foggy conditions have been identified as a causal factor in a level crossing incident	3	3	9	CCTV monitoring. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Reduced road speed on approach to level crossing. Train speed maximum 10mph Traffic calming measures. Enhanced signage.	2	2	4

	investigation is the fatality at Barratt's Lane No.1 footpath crossing.							
Alcohol and drugs	The effects of drink and/or drugs can radically alter user behaviours. Motor and cognitive function might be impaired and users might also have a reduced perception of risk. Users under the influence of alcohol or drugs might exhibit the following behaviours: be more inclined to ignore normal crossing procedures be physically unstable and prone to slips, trips and falls be unable to focus, cognitively and visually have a lower perception of risk.	3	3	9	Anti-trespass and cattle guard panels are designed to deter people or animals from crossing the track at unauthorised places. Do not trespass signs. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures. Enhanced signage.	2	2	4
Disabilities.	Disabilities (e.g. reduced mobility, reduced levels of vision/hearing) will influence the behaviour of users at level crossings. Visually impaired users might be unable to see warning lights and signs	3	3	9	Increase the volume of the audible warning up to the maximum permitted level to make the alarm more conspicuous and potentially deter pedestrian violations. Additionally, Intelligent auditory alarm – takes account of ambient noise levels and produces alarm 5dB louder so it can always be heard clearly.	2	2	4

	clearly, or scan for trains before crossing. Hearing impaired users might be unable to hear crossing alarms, train whistles, warnings from people or the sound of approaching trains. Cognitively impaired users might have difficulty understanding and following the correct crossing procedure, or interpreting warning signs. Users with physical impairments (permanent or temporary) might encounter difficulties using level crossings of all types, but especially user worked crossings. Potential difficulties include struggling to cross within the warning time provided; being more prone to slips, trips and falls on the crossing, especially if the crossing surface is uneven or missing. Similarly, mobility scooter users might encounter problems with				Provision of flange gap filler to improve crossing surface. Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Crossing attendant (Monitoring). Traffic calming measures. Enhanced signage.			

	uneven crossing surfaces and the opening and closing gates or barriers.							
Incorrect mental model Incidents at level crossings could occur if the user adopts the incorrect mental model of how the crossing works.	Mental models are internal mental representations of an external reality. People develop a mental model of how to use a level crossing from their prior experience of using similar or comparable crossings (or road junctions), from instructions or by observing the behaviour of other users. Users familiar with the operation of one type of crossing might apply their mental model at other types of level crossing.	3	3	9	CCTV monitoring (staff training initiatives). Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures. Enhanced signage.	2	2	4
Fatigue	Fatigued users will be more susceptible to making errors or to taking shortcuts when crossing. Fatigue has a significant effect on human performance and the likelihood of errors. Level crossing users suffering from fatigue might miss	4	3	12	Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures.	2	2	4

	important information (crossing warning signs, lights, etc), or be more inclined to take shortcuts in the crossing procedure (fail to use the telephone, fail to close the gates at user worked crossings, etc).				Enhanced signage.			
Signaller/CCTV Operator:	'Habit intrusion' in CCTV monitoring CCTV operatives follow habituated patterns of behaviour which might result in the entrapment or injury of crossing users at MCB and MCB-CCTV crossings. Use of level crossings is primarily covered in Local Training Plans and by the training and briefing signallers/Operators receive on communications skills. It is important local training plans cover: hazards associated with a particular crossing, how to check whether a crossing is clear. Signaller's/Operators not following the appropriate rules and protocols should	3	3	9	New modern full barrier crossing. AFBCL	2	2	4

	be subject to additional monitoring and development plans. Inefficient CCTV scanning strategy Signaller/Operator uses an inefficient method of scanning CCTV screens. The scanning method employed by a signaller/Operator for monitoring CCTV screens will affect whether they successfully identify information on the CCTV screen. Using an inefficient scanning strategy might result in the signaller/Operator taking a longer time to identify key events, or might result in them missing key events on other CCTV screens. An efficient scanning method is particularly important where there are multiple CCTV screens being monitored by one signaller/Operator, or the signaller/Operator has a							

	high level of workload from other tasks.							
Work in or adjacent to public roadways.	Plant, equipment materials striking traffic/members of public. Traffic colliding with staff.	3	3	9	Authorised road closures and traffic management. Implement pedestrian walkways. Plant to be suitable for access to public roads. Comply with New Roads and Street Works Act and Traffic Signs Regulations.	1	1	2

Road Crossings. Narrative safety report.

New Build Northbridge Street Level Crossing - Narrative Risk Analysis (NBLC-NRA) – Update 10.02.2021

Contents

1 Introduction

The Rother Valley Railway will provide a Full Barrier Automatic Level Crossing, Locally Monitored (AFBCL) incorporating the latest technology for the operation and protective equipment. The crossing will be fully compliant with that is widely used on Network Rail infrastructure today, thus, ensuring the crossing would not require any product approvals, derogations or changes to standards. The maintenance regime would also be standard and no bespoke parts would need to be produced or stocked specifically for the crossing. For the above reasons, the crossing presents a very low reliability and risk concern and would most likely incur the lowest maintenance costs.

A level crossing does not currently exist at Northbridge Street; therefore, a Quantitative Risk Assessment would not provide sufficient evidence to demonstrate that possible risk has been assessed and managed accordingly. However, it is important to establish possible risk from the introduction of a level crossing and possible mitigation measures at an early stage of development.

This NBLC-NRA analyses all relevant data as well as expert opinion to demonstrate that all possible risk has been addressed as well as embroidering new technology to further enhance the safety of the level crossing, for example;

- CCTV for improved safety & security,
- Obstacle Detection
- Home Office Approved Red Light Cameras
- Evaluate the risks at the level crossing.
- Early engagement with stakeholders from different sectors, local authorities, communities and 'users' associations.
- Take engineering measures and find innovative solutions
- Take educational and awareness measures and collaborate with the rail and road sectors.

The level crossing will be carefully assessed via this analysis in collaboration with railway, and the road infrastructure managers, local authorities and industry experts to make it more visible and easier to cross particularly for long, heavy and oversized vehicles.

All stakeholders will be in a position to cooperate and design the best level crossing environment.

Narrative Risk Assessments currently used by Network Rail are enabling better targeting of risk reduction measures; blending quantitative modelled risk with structured observation and judgement from competent staff. The NSA process is considered as part of this analysis to encompass the whole level crossing asset system and assess wider aspects of level crossing risk.

This analysis builds upon excellent safety initiatives which were introduced for the first Automatic Full

Barrier level crossing by Network Rail including the safety benefits provided, however, RVR intend to introduce additional safety measures such as the use of Red-light safety equipment (RLSE), which has currently been installed at 31 public road level Crossings on the National Railway Network to improve user behaviour, deterring deliberate misuse. Trials have demonstrated that these Home Office Type Approved (HOTA) cameras have reduced deliberate misuse by approximately 90 per cent at some locations.

RVR will install an automatic level crossing including an object detection system (AFBCL) at Northbridge Street level crossing. Crossing obstacle detection systems utilise a combination of RADAR and LIDAR technology to scan the crossing before allowing for trains to safely manoeuvre through. In combination these systems detect obstacles on the ground and around the edge of the barrier lines and deliver unique small object detection protecting children and adults as well as vehicles and other large objects. RVR will monitor and review the installation of the obstacle detection system after the first 12 months of operation to determine if additional safety features could be added to further enhance safety of the level crossing.

2 Level Crossing Overview

This is a risk analysis for Northbridge Street level crossing. However, it should be noted that at present a level crossing does not exist, therefore, this analysis is based on the probability of risk if a level crossing was in place. It is imperative that a full Quantitative (and Narrative) Risk Assessment (QRA) is completed before any trains operate over the crossing and that the QRA is presented to the ORR.

Crossing Details	
Name	Northbridge Street
Type	AFBCL
Crossing status	Public Highway
Overall crossing status	Design Stage
Engineers Lin Reference	N/A
OS grid reference	coordinates 573819, 124014
Number of lines crossed	1
Line speed (mph)	10
Electrification	No
Signal box	Yes (A21 level crossing)

3 Information Sources

The table below shows the stakeholder consultation that was undertaken as part of the risk analysis.

Consulted	Attended site
ORR K&SR Bakerail ESCC RVDC I-Transport ARUP	All attended sit visits

Reference sources used during the risk analysis;

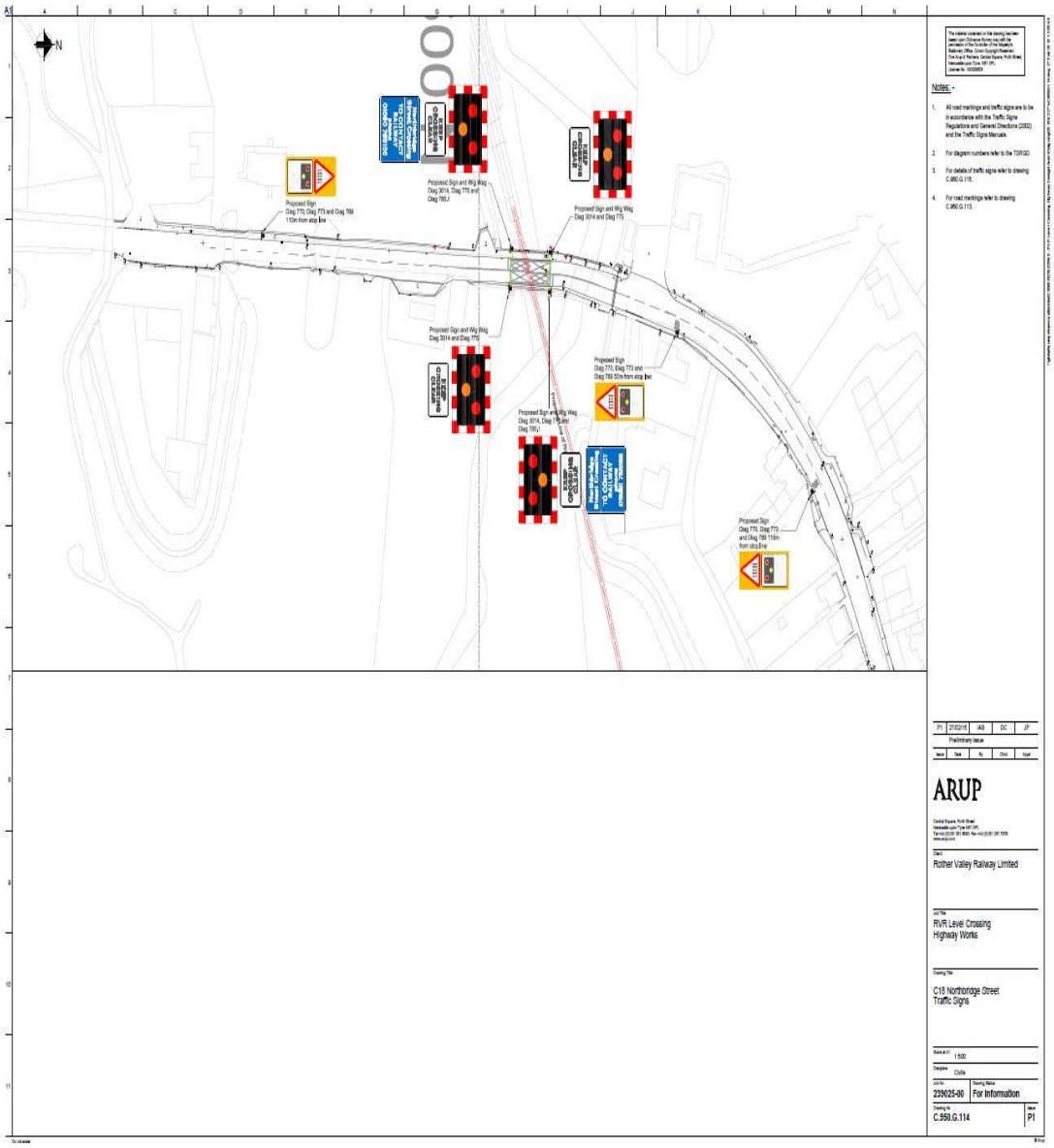
- Office of Rail and Road (ORR)
- Kent and East Sussex Railway (K&ESR)
- Bakerail (Track site/project management specialists)
- East Sussex County Council (ESCC)
- Rother District Council (RDC)
- I-Transport (Specialist Planning Transport Consultancy)
- ARUP (Design, Engineering, Architecture and Business consultation Group)
- Level Crossing Risk Management Tool (LXRMT).

4 Level Crossing Diagrammatic Scheme

The new level crossing to be constructed is an AFBCL level crossing on C18 Northbridge Street, Robertsbridge, East Sussex. The road approach speed is 30 mph. The profile of the railway line in the vicinity of the crossing has been provided (below), as well as the appropriateness of the proposed warning signs in this regard.

Diagram of the proposed railway Alignment

Diagram of the proposed traffic signs



5 Site Visit General Observations

The C18 Northbridge Street, Robertsbridge Stage 1 Road Safety Audit report identified possible road distractions which are considered as part of this analysis, for example,

- Limited forward visibility to level crossing leading to shunt type collisions. The approach to the level crossing is situated on a bend in the road (Photograph 1).

There is a cottage located close to the road limiting drivers' forward visibility on the bend. In the same location there is on-street residents' parking, which requires traffic to cross the carriageway centreline. This could draw drivers' attention away from downstream hazards such as a stationary queue of vehicles at the level crossing, leading to shunt collisions.

To remove this concern, it is advised to move the northern-most warning signs to the northern side of the drainage culvert to provide additional advanced warning.

Photograph 1

- The adjacent access increases the risk of blocking back at the level crossing (Photograph 2a & 2b) below.

There are a number of accesses close to the proposed level crossing location, not least that of a four-hectare industrial development site, which could generate a significant volume of additional traffic movements. A planning proposal has recently been submitted for around 40 houses/flats on the Old Mill site to the North West of the crossing, however it is not anticipated that this small development will affect safety at the crossing other than increased traffic).

The limited carriageway width and on-street parking could result in traffic waiting on the carriageway by the level crossing and will increase the risk of vehicles queuing over the level crossing, leading to potential vehicle / train conflict.

It is intended to Introduce a yellow box marking to deter traffic from queuing over the crossing.

Photograph 2(a)

Photograph 2 (b)

- Insufficient warning for the visually impaired could lead to pedestrian injuries.

Footways are provided along both sides of Northbridge Street in the vicinity of the proposed level crossing (Photograph 3).

The visually impaired use tactile warning surfaces to identify hazards ahead. A visually impaired pedestrian could enter the level crossing zone without realising the hazardous nature of the environment, placing them at risk of being trapped by the barriers.

Tactile warning surfaces will be provided in line with national guidelines on each footway approach to the crossing.

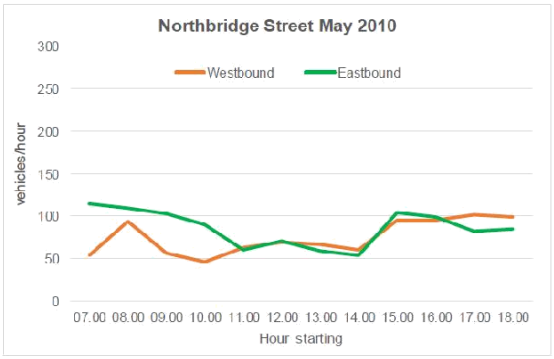
Photograph 3

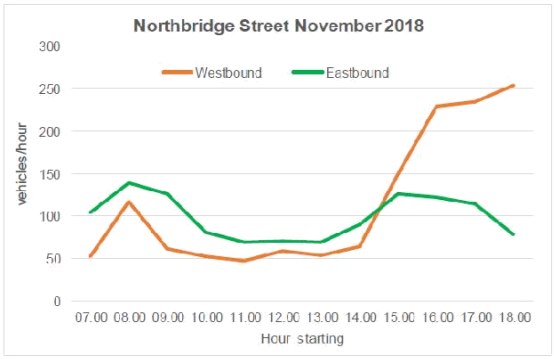
Lighting;

There is currently a system of lighting along the length of Northbridge Street and, due to the proximity of a lighting column at the proposed level crossing in Robertsbridge, it has been deemed necessary to remove that column and introduce a lighting column either side of the crossing at a safe distance. The proposed location of the two columns provides a level of illumination and uniformity consistent with other sections of that road. Consultation has been undertaken with the Parish Council to ensure that their needs are addressed prior to proposing an alteration to the lighting.

6 Northbridge Street Traffic Flows

The chart below compares traffic flows on Northbridge Street to the west of the A21 Roundabout for 2010 and 2018. Flows are generally higher throughout the day but remain relatively low, although large increases are shown for the westbound direction between 16:00-19:00. (Mott Macdonald Addendum report 2018.





Queuing at the level crossing has been estimated, based upon average vehicle demand per minute during the hour of each barrier closure, as well as length of time that the barrier is down. A barrier close time of 55 seconds has been assumed, with sensitivity testing with a 110-second closure.

Queue lengths have been estimated with 2018 traffic demands and predicted demand in 2021 and 2027.

Traffic Growth for future years;

Traffic forecasts have been produced for 2021 and 2027 using TEMPRO version 7.2 with National Transport Model (NTM) factors (NTM datasheet AF15). To calculate growth factors for Northbridge Street LC date for Rother Distract has been used.

For Bank Holidays, it has been assumed that growth will be the same as for Sundays.

Table 1 Traffic Growth Factors 2017 - 2021

Road Name	Region	Road Type	Average Weekday	Average Saturday	Average Sunday	May Bank Holiday	August Bank Holiday
Northbridge Street	Rother District	Rural Minor	1.062	1.060	1.061	1.061	1.061

Table 2 Traffic Growth Factors 2017 –2027

Road Name	Region	Road Type	Average Weekday	Average Saturday	Average Sunday	May Bank Holiday	August Bank Holiday
C18 Northbridge Street	Rother District	Rural Minor	1.151	1.152	1.154	1.154	1.154

Predicted Queue Lengths;

Table 3 (below) shows the predicted queue lengths for Northbridge Street Level Crossing with a 55 second closure.

Table 3: Predicted Queue Lengths at Northbridge Street Level Crossing

	2017 Westbound		2017 Eastbound		2021 Westbound		2021 Eastbound		2027 Westbound		2027 Eastbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	20	8	11	8	21	8	12	8	23	9	13	9

Predicted maximum queue lengths are 20m in 2017 and 23m in 2027.

Queue lengths with a 110-second closure (below) are shown as sensitivity tests. Predicted maximum queue lengths for Northbridge Street LC are 20m –30m in 2017 and 30m –40m in 2027.

Table 4 Predicted Queue Lengths at Northbridge Street Level Crossing with 110 Second Closure

	2017 Westbound		2017 Eastbound		2021 Westbound		2021 Eastbound		2027 Westbound		2027 Eastbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	40	16	22	16	43	17	24	17	46	18	26	18

Conclusion;

On Northbridge Street to the West of the A21 Roundabout 2018 flows are generally higher throughout the day but still remain relatively low, although larger increases are shown for the westbound direction between 16:00 –19:00. It is not anticipated that the increased queue lengths by 2027 would have any significant impact of the Level Crossing operation.

7 The Railway

The train service over Northbridge Street level crossing will consist of passenger trains only. There will be approximately 10 trains per day. The highest permissible line speed of trains over the crossing will be 10 mph. Trains are timetabled to run for 10 hours per day.

The RVR Level Crossing Operational Management Plan (LCOMP) sets out the strategy for operational management of the Northbridge street level crossing to be installed on the Rother Valley Railway (RVR) between Robertsbridge Junction Station and Bodiam where it interfaces with the road at level grade, so requiring control of road vehicles to enable a train to cross.

The LCOMP describes the principals of how the level crossing is to be operated under normal conditions and in the event of failure.

This shall be the basis for developing operational procedures for the railways operation when services commence to which staff shall be trained and be assessed on an ongoing basis.

Compliance with Industry guidelines;

The design for the level crossings, developed from this document, shall be compliant with industry guidelines, e.g. The Office of Rail Regulation: A Guide for Managers, Designers and Operators Railway Safety Publication 7 December 2011 and approved by a suitably independent person before installation.

Northbridge Street Level Crossing Operation;

It shall be noted that a signaller will be on duty at all times of normal operation. The signaller will monitor operation of the crossing via a Closed-Circuit Television link.

To and from Robertsbridge;

The train will approach the level crossing at a maximum speed of 10 mph, thus ensuring that the train has the ability to stop in 30m. The AFBCL (Automatic Full Barrier Crossing, Locally Monitored) crossing area is equipped with obstacle detection technology that scans the crossing area at various stages during the closure sequence. The crossings are provided with crossing illumination (for night visibility) and a drivers' flashing red and white light indicator in each direction on final approach for local monitoring by the train crew. The speed approaching the AFBCL crossing is limited to 10mph, so the approaching train is able stop under all railhead conditions before the road if the crossing is either visibly blocked or the flashing indicator hasn't changed from red to white. The approach of a train automatically begins the crossing closure sequence. This commences with the road traffic wig-wag signals and audible warnings to indicate to road traffic to stop. Obstacle detection technology prevents to lowering of the crossing entrance barriers until the crossing is clear. Once the entrance barriers are down and the crossing surface is scanned to continue to be clear the lowering of the exit barriers can commence. If the equipment is proven to be fully functional and the OD sensors have confirmed clearance of the road surface between the fully down barriers then the indicator for the train driver will be showing flashing white light before the train reaches the crossing speed board.

The barriers will rise as soon as practicable after trains for which the lower sequence has been initiated or maintained, have passed clear of the crossing. The sequence of events to open the crossing to road traffic, once the raising cycle has been initiated or maintained is, all the barriers begin to rise simultaneously and should normally rise in 4 to 6 seconds; and the intermittent wig wag red lights should be extinguished as the barriers rise.

Railway signalling and control

Railway signalling will be provided to ensure the level crossing is fully protected on all railway approaches. The railway approach signals are interlocked with the lifting barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers, additionally, it will not be possible to raise the barriers unless the signals are set at Stop and free of approach locking, or the train has passed the signal and traversed the crossings. It will not be possible to clear any protecting signals until ‘crossing clear’ is confirmed either automatically by obstacle detection equipment, or manually when that equipment is not being used. Discrete function controls will be provided at the control point for authorised railway staff use when obstacle detection equipment is not being used.

If a train passes a protecting signal at Stop, the road traffic light signals will immediately show an intermittent red light (omitting the steady amber phase) and the audible warning will start. The barriers will not be lowered as this may strike or trap crossing users.

To ensure that the crossing operates safely when the railway line is open to traffic, indicators at the control point will confirm that the equipment is powered and functioning correctly.

Level Crossing Maintenance plan

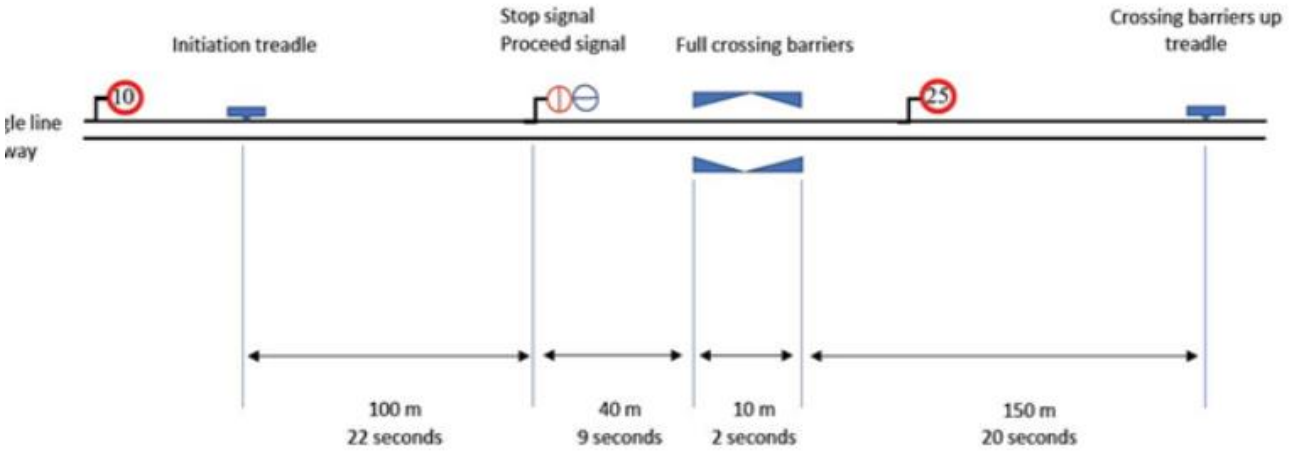
The maintenance plan for the three-level crossings shall be based on that recommended by the supplier of the equipment. It shall comprise:

- Regular planned maintenance at the required intervals.
- Work arising from planned maintenance, within the required timescales
- Fault response, within specified timescales.
- Work arising from fault responses, within the required timescales.
- Work arising due to other parties planned work.

Road Crossing Design and Construction

The construction of the road crossings comprise concrete units designed to meet the requirements of a high friction skid resistant road surface through the crossing. This has been tested for the proposed installation and passed the test level requirement as set by The Highways Agency, reference document RD/GN/009 dated September 1989.

Signalling Diagram Layout



Notes:

1 Equipment shown for up direction only, treadles, signals and signs replicated for down direction

2 Transit times assume full line speed

Rother Valley Railway
Level crossing signalling schematic for manually operated full barriers
Northbridge Street, A21 & Junction Road

Not to scale

8 5 X 5 Risk Assessment

Hazards are identified, listing possible causes if appropriate and assessed for severity. These are then multiplied by the frequency or likeliness of an incident occurring if no controls were applied. This produces the risk factor; the numerical assessment table gives guidelines on how to assess severity and frequency.

The risk assessments for the crossings are based on generic issues and then modified to reflect the specific issues at the individual crossing to reflect that risk can change significantly from one site to another. The generic risk assessment will be reviewed by the appointed Project Manager and then modified as required to reflect the hazards and the necessary controls identified during site visits (pre-works) or through information passed to them by stakeholders and any other third party.

Level Crossing Risk Assessment
Update 10.02.2021

KESR Risk Assessment utilising the 5 X 5 risk assessment table: Severity X Likelihood of occurrence = Risk Factor (S X L = RF)

Signal Overrun Risk Assessment (SPAD) at a level crossing.

The document sets out KESR's approach to the management of signal overrun risk.

Rationale; The hazard of a train passing a stop signal without authority (at a level crossing) shall be evaluated by application of a risk assessment

Hazards are identified, listing possible causes if appropriate and assessed for severity. These are then multiplied by the frequency or likeliness of an incident occurring if no controls were applied. This produces the risk factor; the numerical assessment table gives guidelines on how to assess severity and frequency.

This risk assessment is generic and whereas the basic principles will always apply, it is acknowledged risk can change significantly from one site to another. Generic risk assessments will always be reviewed by the appointed Project Manager and then expanded upon if required to nullify or apply the necessary controls to hazards identified during site visits (pre-works) or through information passed to them by a third party.

Numerical Assessment			
Severity (S)		**Likelihood of Occurrence (L)**	
1	No Injuries / Minor Damage	1	Remote
2	Single Minor Injury	2	Unlikely
3	Single Major Injury / Minor Pollution	3	Occasional
4	Single Fatality / Major Pollution	4	Likely
5	Multiple Fatalities	5	Highly Likely

Risk Factor

		Likelihood of Occurrence (L)				
		5	4	3	2	1
Severity	5	25	20	15	10	5
	4	20	16	12	8	4
	3	15	12	9	6	3
	2	10	8	6	4	2
	1	5	4	3	2	1

Risk Factors between 16 to 25 = Unacceptable Risk. Risk Factors > 8 will be strictly monitored.
Hazards Identified with a Severity Assessed at 3 or above will also be strictly monitored.

Northbridge Street Risk Assessment

Hazards and possible causes identified for Northbridge St AFBCL	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
SIGNALLING								
Relative to previous signals: Will the signal be in a different position, or does it have a different configuration?	Signal position is not consistent with the spacing between preceding signals Signal is of a different design to preceding signals Potential for, Death, Serious injury or injury	4	3	12	The KESR signalling arrangement will have consistent signal design. All staff will receive training before operation commences	3	2	6

Could the signal be confused with other signals on an adjacent line or on the same gantry	Signal is on a post and could be confused with other signals Signal has an identical profile / outline to adjacent signals Death Serious injury Injury	4	3	12	Ensure signals for all lines are visible Shield nearby signals from view Appropriate signal should be clearly associable with its line Driver training	3	2	6
Could the signal be obscured from the driver's view?	Signal reading time is inadequate. Signal is positioned round a curve and the reading angle is inadequate Signal is positioned round a curve and there is an obstruction blocking the signal's line of s Signal can be obscured by vegetation Signal can be obscured (intermittently or otherwise) by a bridge or other structure, for example station structures edge of signal back plate is less than 100 mm from edge of aspect	3	3	9	Increase backboard size (by 50%) Manage vegetation Maximum train speed is 10 mph Remove / shield potential distractions in stations Reposition signal on straight track Make signal post more conspicuous Driver training	3	2	6
TRACK								
Will the track on approach to the signal suffer from adhesion	Signal is located in an area which suffers from ice, frost,	4	3	12	Lineside fencing / netting	2	2	4

problems?	leaf fall, dampness or other adhesion problems Death Serious injury Injury				Railhead conditioning Management of lineside vegetation Low adhesion warning signs Driver training			
Is there a reduction in permissible speed on the approach to the signal?	There is a reduction in permissible speed on the approach to the signal Death Serious injury Injury	2	2	4	Permissible speed on approach to the level crossing is maximum 10 mph Driver training On site staff monitoring	2	2	4
Is there a falling gradient on approach to the signal?	There is a falling gradient on the approach to the signal	4	3	12	Countdown markers Driver training	3	2	6
COLLISION								
Road Vehicle and train collision risk	Insufficient train warning time for all vehicle types known to be exasperated by the driving position e.g. Tractor. Level crossing equipment and signage is not conspicuous or optimally positioned. Instructions for safe use may be misunderstood e.g., signage, clutter detracts from key messages, conflicting information given. High volume of unfamiliar users e.g. irregular visitors, migrant workers.	4	3	12	Optimising position of equipment at the design stage removing any conflicting or redundant signs. Strike in times optimised. Sighting lines enhanced. Latest technology in place for user-based warning systems including wig-wag lights, sirens, full road barriers, RTL. AFBCL Maximum train speed 10 mph implemented. Superior quality crossing surface construction material. De-vegetation programme in place	3	2	6

	Known user complacency leading to high levels of indiscipline. Type of vehicle unsuitable for level crossing; - Large, low, slow, making access or egress difficult and or vehicle is too heavy for the crossing surface – risk of grounding and or severity of gradient adversely affects ability to traverse. Users experience a long waiting time.							
Pedestrian and train collision risk	Ineffective whistle boards, warning inaudible, insufficient train warning time. Level crossing equipment and signage is not conspicuous or optimally positioned. Instructions for safe use may be misunderstood. Surface condition could lead to slip/trip risk. High volume of unfamiliar users i.e. irregular visitors/ramblers/equestrian.	4	3	12	Optimising position of equipment at the design stage removing any conflicting or redundant signs. Latest technology in place for user-based warning systems including wig-wag lights, sirens, full road barriers, RTL. AFBCL Maximum train speed 10 mph implemented. Superior quality crossing surface construction material. De-vegetation programme in place. Regular engagement with stakeholders/authorised users reinforcing safe crossing protocol, legal responsibilities and promoting collaborative working.	3	2	6

	Complacency leading to high levels of indiscipline e.g. users are known to rely on knowledge of timetable. High level of use by vulnerable people. High usage of cyclists.				Signage to encourage users to look for approaching trains as well as providing cyclist dismount signs.			
Hazards and possible causes identified	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
SPAD OCCURRENCE								
Train driver passes protecting signal without authority	Collision with road vehicle (see above). Collision with member of public (See above). Death Serious injury Injury	4	3	12	If a train passes a protecting signal at Stop, the road traffic light signals will immediately show an intermittent red light (omitting the steady amber phase) and the audible warning will start. The barriers will not be lowered as this may strike or trap crossing users. Driver training. Maximum speed of train 10 mph.	2	2	4

Hazards and possible causes identified	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
Additional Risk Influencing factors								
Distraction								
Can the driver be distracted by something outside the cab?	Driver could be distracted by trespassers	4	3	12	Signal reminder sign	3	2	6
Could the driver be distracted by other tasks at or on approach to the signal?	There is a level crossing in the vicinity of the signal	4	3	12	Position signal where driver not distracted by other duties Driver training	3	2	6
Distractions while using the level crossing might impair the user's ability to cross quickly and safely.	If a user is distracted, there is an increased likelihood that they will not see the crossing, train, warning signs, for example; Other persons in the car (e.g. children) Thoughts on personal matters, work stresses etc. Using the telephone, Behaviour of other crossing users, In car entertainment Seasonal events (e.g. fun fairs, fireworks) Mobile phones, iPads, handheld computers etc. Signage (e.g. speed limit signs). Distractions might be more likely for users who frequently use the crossing (e.g. delivery drivers), due to them potentially having a lower level of concentration than those who use it infrequently.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Staff training. Trespass guards. Traffic calming measures. Train maximum speed 10 mph. New modern full barrier crossing. AFBCL Education campaign.	2	2	4

	A change in speed limit and the associated speed limit signs This proximity of the speed limit signs to the crossing might reduce the attention given to the crossing, or remove attention away from it completely. The signs might also draw a car driver's attention to the vehicle speedometer to check vehicle speed and away from maintaining vision out of the vehicle's windscreen. Other signs in the vicinity of a level crossing that are not related to that crossing could also have been a potential distraction.							
Regular users and those living close to level crossings are more likely to undertake risk taking behaviour when using the crossing.	Level crossing users that live or work in close proximity to a crossing can become familiar with the crossing attributes and procedures required for crossing. Regular users are more likely than infrequent users to perceive crossing risk to be low and commit a violation of safe crossing procedure. Potential behaviour traits of frequent users might include: User believes he / she has enough time to beat the	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Staff training. Trespass guards. Traffic calming measures. Train maximum speed 10 mph. New modern full barrier crossing. AFBCL Education campaign.	2	2	4

	train User thinks he / she understands procedure without reading instructions User unaware of risks to subsequent users							
High vehicle approach speeds	The vehicle speed over a level crossing is a factor in vehicle driver errors. Risk factors include, the speed limit(s) in the surround areas, driver's perception and attitude to risk, visibility of warning signs and visibility of the level crossing e.g. rural winding roads.	4	3	12	Reduced road speed on approach to level crossing. Traffic calming measures. Enhanced signage. New modern full barrier crossing. AFBCL Education campaign.	2	2	4
Large, slow and low vehicles	Drivers of large vehicles are involved in a disproportionately high number of incidents at level crossings. The size of the vehicles - they have less room for error when compared to cars. They may not be responding to the activation of the crossing warning system in sufficient time. Studies have proposed that large (HGV) vehicles may attempt to traverse the crossing once the barriers have already started to	4	3	12	Reduced road speed on approach to level crossing. Traffic calming measures. Enhanced signage Yellow box marking Level crossing road surface well maintained Power operated level crossing barriers AFBCL	2	2	4

	descent, suggesting that it could be to do with the driver's awareness of their vehicle's poorer braking performance, and therefore considering it safer to continue. Other contributory factors might include: The slower acceleration speed of HGVs causing the total time to cross a level crossing from standstill to increase Sightlines from a higher driving position.							
Ice conditions	Icy weather conditions on the approach and exit to the crossing might affect the behaviour of the crossing, for example, prevent vehicles from stopping in a position of safety at the crossing. Encourage vehicle drivers to ignore the initial warning activation when they are close to the train line because of the risk of sliding forward onto the tracks. Cause pedestrians to concentrate on their footing,	3	3	9	Provision of CCTV surveillance cameras. Level crossings local training plans, training and briefing on communications skills, hazards associated with a particular crossing (icy conditions), Improved crossing surface. Regular monitoring. Tactile surfaces.	2	3	6

	rather than looking for trains or observing warning signs. Result in pedestrian slips, trips and falls. This is a particular risk for elderly, or mobility impaired, users. Level crossings on 'B' roads might present a particular hazard to vehicle drivers as these roads are not normally gritted in icy conditions.							
Foliage obscuring warning signs and approaching trains	The visibility (and hence effectiveness) of information on the approach to and at the level crossing is reduced by overgrown foliage. Overgrown foliage on the approach to a level crossing can obscure signs and signals located at the crossing, and also restrict the visibility of approaching trains. This could result in the user either not seeing the sign or train (complete or partial) or the user not seeing the sign or train in time to sufficiently interpret the information and respond appropriately.	4	3	12	Cutting back vegetation and removing obstructions the sighting distances for users up and down the track and to signs / warning lights are lengthened. Staff training i.e. HRA Guidance document HGR – A0720 Control of Vegetation (Management plan). Improved sighting distances. Train speed max 10 mph. CCTV monitoring. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Reduced road speed on approach to level crossing. Traffic calming measures.	2	2	4

	This issue can be exacerbated when the visibility of the level crossing is reduced, either due to its type or its location e.g. on the bend in a road or on a high-speed road, as the vehicle driver has even less time to respond. foliage is also applicable to train drivers. Foliage on the lineside might impact on the train driver's ability to see information, objects or people on the crossing.				Enhanced signage.			
Dogs on leads. (crossing located in urban area in proximity to housing)	Users with dogs, even if crossing in accordance with instructions to put their dog on a lead, face particular crossing risks during their traverse. Crossing users walking dogs on leads over crossings are subject to the following risk factors: Dog/s might pull the user over the crossing, making slips, trips and falls more likely.	4	3	12	CCTV monitoring. Pedestrian walkway – defining, Painting of road markings on the crossing that clearly show the area in which pedestrians should walk when traversing the crossing. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Reduced road speed on approach to level crossing. Traffic calming measures.	2	2	4

	Dog/s on lead might become a trip hazard to user. Dog/s might hold user back on tracks, preventing them from completing their traverse. The dog/s can present additional challenges if it is startled or distracted. Dog/s might try to run down tracks, especially if startled or skittish or if it smells an animal to chase etc, pulling the user with it.				Enhanced signage.			
Parked vehicles in close proximity to the crossing. (crossing located in urban area in proximity to housing)	Vehicles parked close to crossing entry and exit points might increase the risk and crossing time of other users. Vehicle drivers who stop or park near a level crossing (e.g. close to the entry and exit points) might create issues for other level crossing users. Potential issues include: Diverted attention from the level crossing and associated warning signs while	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Painting of road markings on the crossing that clearly show the area in which pedestrians should walk when traversing the crossing. Paint yellow box markings on the crossing. Yellow lines (double) on the road approaches to the crossing. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign.	2	2	4

	concentrating on avoiding and manoeuvring around the parked vehicles (or associated pedestrians e.g. school children). Having to drive around the vehicles and onto the other side of the road/down the centre of the road, resulting in conflicts with oncoming vehicles. Parked vehicles obscuring the visibility of signs and signals to other crossing users. Traffic flow problems, such as 'blocking back'. Examples of situations where vehicles might stop or park near a level crossing include: Vehicle drivers dropping off their passengers. Residents without off-street parking (e.g. owners of railway cottages) choosing to park on the approach and exit roads to level crossing.				Traffic calming measures. Enhanced signage.			

	Customers parking to visit the local shops that have limited or no parking. Level crossings in the vicinity of schools might be used by parents as drop-off and collection points for their children. 'Visitors' (crossing inspectors and maintainers) parking in the 'long/slow' vehicle lay by, which is used by long/slow vehicle drivers to stop and contact the signaller. This might prevent drivers of long or slow vehicles from stopping and cause them to drive over the crossing without informing the signaller. 'Visitors' might also park on the immediate approach or exit to the crossing.							
Crossing utilisation or traffic moment	High crossing utilisation by users is associated with a greater chance of user risk taking behaviour.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Level crossings local training plans, training and briefing on communications skills, hazards associated with a particular crossing (icy conditions	2	2	4

					Reducing the road approach speed to the level crossing to reduce the risk of collision between vehicles and gates / trains. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Traffic calming measures. Enhanced signage.			
Unfamiliar users	Users who are not familiar with the level crossing procedure in the UK might apply an incorrect mental model when traversing the crossing.	4	3	12	Provision of CCTV surveillance cameras and signage to deter misuse at a particular crossing and to capture evidence of violations when they arise. Level crossings local training plans, training and briefing on communications skills, hazards associated with a particular crossing (icy conditions Reducing the road approach speed to the level crossing to reduce the risk of collision between vehicles and gates / trains. New modern full barrier crossing (Audible/visual alarms. AFBCL Education campaign. Traffic calming measures. Enhanced signage	2	2	4
Traffic calming systems Road traffic calming systems on either side of a	Traffic calming systems, such as road width	3	3	9	Provision of CCTV surveillance cameras and signage to deter misuse at a particular	2	2	4

level crossing might increase the risk of blocking back.	restrictions/ build-outs, positioned on either side of a level crossing might increase the risk of vehicle drivers blocking back over the crossing. When the crossing is closed to road traffic, queues form along the road. This issue might be exacerbated due to factors such as the time of day (rush hour) and 'herd mentality'. Discomfort for cyclists on the road. Potentially more noisy approach to the crossing leading to possible complaints. If overused in conjunction with changes in speed the mitigation might lose its impact upon behaviour.				crossing and to capture evidence of violations when they arise. Reducing the road approach speed to a level crossing to reduce the risk of collision between vehicles and gates / trains. A range of enhancements to improve conspicuity, comprehension of and user response to level crossing warning signs:			
Housing developments Housing developments increase road traffic, level crossing use and therefore the potential for risk taking behaviour.	With an increase in traffic within the local area, vehicle drivers might be less inclined to stop at a level crossing if their overall journey time has increased since the development of	3	3	9	CCTV monitoring. Staff Training/Competence. Train speed maximum 10mph. Education campaign. Enhanced signage	2	2	4

	new housing and the influx of new residents; thus, increasing the potential for risky behaviour. The level crossing might not be designed to accommodate the increased number of users; therefore information, walkway/ road widths etc. might require updating.				Education campaign. Traffic calming measures. Introduce a yellow box marking.			
Limited forward visibility. The approach to the level crossing is situated on a bend in the road	Lack of good visibility at the level crossing leading to shunt type collisions.	3	3	9	Introduce a yellow box marking. Traffic calming measures.	2	2	4
Single train line Greater risk-taking behaviour in both vehicle drivers and pedestrians is reported on single train lines. .	This user behaviour is in line with risk compensation theory - the user, perceiving there to be less of a risk to him/herself, behaves less cautiously	2	2	4	AFBCL Staff Training. Maximum train speed 10mph. Enhanced signage.	1	1	2
Farming vehicles Farm traffic might influence the speed and behaviour of other vehicles traversing the crossing.	Farm traffic tends to move at a much slower speed and, being much larger, reduce the visibility of other vehicle drivers. This can cause distraction and frustration and change other road user's behaviour; resulting in risk taking actions such as overtaking and not observing the level crossing warning signs.	4	4	16	Power operated barrier. AFBCL CCTV monitoring. Staff Training/Competence. Education campaign. Enhanced signage	2	2	4

Commercial driver	Commercial drivers might have increased risk taking behaviour at level crossings. Commercial vehicle drivers, such as salespersons, work to strict timescales and therefore their driving behaviour is often influenced by having to reach destinations on time. Commercial drivers using a level crossing might be inclined to 'beat the lights' to avoid having to wait at the crossing, or they might fail to follow the correct crossing procedure at unprotected crossings.	4	4	16	A range of enhancements to improve conspicuity, comprehension of and user response to level crossing warning signs: Staff Training/Competence. Education campaign. Enhanced signage. AFBCL	2	2	4
Adverse weather impacting visual information.	The effectiveness of visual information at crossings can be impaired by adverse weather conditions (e.g. fog and snow). The ability of vehicle drivers or other crossing users to detect the presence of level crossings, hazard information, warning lights	3	3	9	CCTV monitoring. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Reduced road speed on approach to level crossing. Train speed maximum 10mph	2	2	4

	or approaching trains might be impaired by adverse weather conditions, e.g. fog and snow. This might result in users failing to see warning information or oncoming trains, which could lead to users unintentionally adopting risky behaviour. In addition, in heavy snow users might not be able to see the tracks and inadvertently stand in a position of danger. Visibility in and around the crossing might also be impaired by banks of snow. An example where foggy conditions have been identified as a causal factor in a level crossing incident investigation is the fatality at Barratt's Lane No.1 footpath crossing.				Traffic calming measures. Enhanced signage.			
Alcohol and drugs	The effects of drink and/or drugs can radically alter user behaviours. Motor and cognitive function might be impaired and users might also have a reduced perception of risk.	3	3	9	CCTV monitoring (staff training initiatives). Anti-trespass and cattle guard panels are designed to deter people or animals from crossing the track at unauthorised places. Do not trespass signs. New modern full barrier crossing (Audible/visual alarms). AFBCL	2	2	4

	Users under the influence of alcohol or drugs might exhibit the following behaviours: be more inclined to ignore normal crossing procedures be physically unstable and prone to slips, trips and falls be unable to focus, cognitively and visually have a lower perception of risk.				Education campaign. Traffic calming measures. Enhanced signage.			
Disabilities.	Disabilities (e.g. reduced mobility, reduced levels of vision/hearing) will influence the behaviour of users at level crossings. Visually impaired users might be unable to see warning lights and signs clearly, or scan for trains before crossing. Hearing impaired users might be unable to hear crossing alarms, train whistles, warnings from people or the sound of approaching trains.	3	3	9	CCTV monitoring (staff training initiatives). Increase the volume of the audible warning up to the maximum permitted level to make the alarm more conspicuous and potentially deter pedestrian violations. Additionally, Intelligent auditory alarm – takes account of ambient noise levels and produces alarm 5dB louder so it can always be heard clearly. Provision of flange gap filler to improve crossing surface. Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign.	2	2	4

	Cognitively impaired users might have difficulty understanding and following the correct crossing procedure, or interpreting warning signs. Users with physical impairments (permanent or temporary) might encounter difficulties using level crossings of all types, but especially user worked crossings. Potential difficulties include struggling to cross within the warning time provided; being more prone to slips, trips and falls on the crossing, especially if the crossing surface is uneven or missing. Similarly, mobility scooter users might encounter problems with uneven crossing surfaces and the opening and closing gates or barriers.				Traffic calming measures. Enhanced signage.			
Incorrect mental model Incidents at level crossings could occur if the user adopts the incorrect mental model of how the crossing works.	Mental models are internal mental representations of an external reality.	3	3	9	CCTV monitoring (staff training initiatives). Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings.	2	2	4

	People develop a mental model of how to use a level crossing from their prior experience of using similar or comparable crossings (or road junctions), from instructions or by observing the behaviour of other users. Users familiar with the operation of one type of crossing might apply their mental model at other types of level crossing.				New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures. Enhanced signage.			
Fatigue	Fatigued users will be more susceptible to making errors or to taking shortcuts when crossing. Fatigue has a significant effect on human performance and the likelihood of errors. Level crossing users suffering from fatigue might miss important information (crossing warning signs, lights, etc), or be more inclined to take shortcuts in the crossing procedure (fail to use the telephone, fail to close the gates at user worked crossings, etc).	4	3	12	CCTV monitoring (staff training initiatives). Provision of tactile edges (and stop lines) and clear delineation of the footway at public vehicular crossings. New modern full barrier crossing (Audible/visual alarms). AFBCL Education campaign. Traffic calming measures. Enhanced signage.	2	2	4

Signaller/CCTV Operator:	'Habit intrusion' in CCTV monitoring CCTV operatives follow habituated patterns of behaviour which might result in the entrapment or injury of crossing users at MCB and MCB-CCTV crossings. Use of level crossings is primarily covered in Local Training Plans and by the training and briefing signallers/Operators receive on communications skills. It is important local training plans cover: hazards associated with a particular crossing, how to check whether a crossing is clear. Signaller's/Operators not following the appropriate rules and protocols should be subject to additional monitoring and development plans. Inefficient CCTV scanning strategy Signaller/Operator uses an inefficient method of scanning CCTV screens.	3	3	9	CCTV monitoring (staff training initiatives). New modern full barrier crossing. AFBCL	2	2	4

	The scanning method employed by a signaller/Oprator for monitoring CCTV screens will affect whether they successfully identify information on the CCTV screen. Using an inefficient scanning strategy might result in the signaller/Operator taking a longer time to identify key events, or might result in them missing key events on other CCTV screens. An efficient scanning method is particularly important where there are multiple CCTV screens being monitored by one signaller/Operator, or the signaller/Operator has a high level of workload from other tasks.							
Work in or adjacent to public roadways.	Plant, equipment materials striking traffic/members of public. Traffic colliding with staff.	3	3	9	Authorised road closures and traffic management. Implement pedestrian walkways. Plant to be suitable for access to public roads. Comply with New Roads and Street Works Act and Traffic Signs Regulations.	1	1	2

Rother Valley Railway

New Build Level Crossing Narrative Risk Analysis (NBLC-NRA)

Contents

1 Introduction

The Rother Valley Railway will provide a Full Barrier Automatic Level Crossing, Locally Monitored (AFBCL) incorporating the latest technology for the operation and protective equipment. The crossing will be fully compliant with what is widely used on Network Rail infrastructure today, thus, ensuring the crossing would not require any product approvals, derogations or changes to standards. The maintenance regime would also be standard and no bespoke parts would need to be produced or stocked specifically for the crossing. For the above reasons, the crossing presents a very low reliability and risk concern and would most likely incur the lowest maintenance costs.

A level crossing does not currently exist on the A21 Robertsbridge, therefore a Quantitative Risk Assessment would not provide sufficient evidence to demonstrate that possible risk has been assessed and managed accordingly. However, it is important to establish possible risk from the introduction of a level crossing and possible mitigation measures at an early stage of development.

This NBLC-NRA analyses all relevant data as well as expert opinion to demonstrate that all possible risk has been addressed as well as embroidering new technology to further enhance the safety of the level crossing, for example;

- CCTV for improved safety & security,
- Obstacle Detection
- Home Office Approved Red Light Cameras
- Evaluate the risks at the level crossing.
- Early engagement with stakeholders from different sectors, local authorities, communities and 'users' associations.
- Take engineering measures and find innovative solutions
- Take educational and awareness measures and collaborate with the rail and road sectors.

The level crossing will be carefully assessed via this analysis in collaboration with railways and the road infrastructure managers, local authorities and industry experts to make it more visible and easier to cross particularly for long, heavy and oversized vehicles.

All stakeholders will be in a position to cooperate and design the best level crossing environment.

Narrative Risk Assessments currently used by Network Rail are enabling better targeting of risk reduction measures; blending quantitative modelled risk with structured observation and judgement from competent staff. The NRA process is considered as part of this analysis to encompass the whole level crossing asset system and assess wider aspects of level crossing risk.

This analysis builds upon excellent safety initiatives which were introduced for the first Automatic Full Barrier level crossing by Network Rail including the safety benefits provided, however, RVR intend to introduce additional safety measures such as the use of Red-light safety equipment (RLSE), which has currently been

installed at 31 public road level Crossings on the National Railway Network to improve user behaviour, deterring deliberate misuse. Trials have demonstrated that these Home Office Type Approved (HOTA) cameras have reduced deliberate misuse by approximately 90 per cent at some locations.

RVR will install an automatic level crossing including an object detection system (AFBCL) at the A21 Robertsbridge level crossing. Crossing obstacle detection systems utilise a combination of RADAR and LIDAR technology to scan the crossing before allowing for trains to safely manoeuvre through. In combination these systems detect obstacles on the ground and around the edge of the barrier lines and deliver unique small object detection protecting children and adults as well as vehicles and other large objects. RVR will monitor and review the installation of the obstacle detection system after the first 12 months of operation to determine if additional safety features could be added to further enhance safety of the level crossing.

2 Level Crossing Overview

This is a risk analysis for the A21 Robertsbridge Road level crossing. However, it should be noted that at present a level crossing does not exist, therefore, the analysis is based on the probability of risk if a level crossing was in place. It is imperative that a full Quantitative (and Narrative) Risk Assessment (QRA) is completed before any trains operate over the crossing and that the QRA is presented to the ORR.

Crossing Details	
Name	A21 Robertsbridge Bypass
Type	AFBCL
Crossing status	Public Highway
Overall crossing status	Design Stage
Engineers Lin Reference	N/A
OS grid reference	
Number of lines crossed	1
Line speed (mph)	10
Electrification	No
Signal box	Yes (A21 level crossing)

3 Information Sources

The table below shows the stakeholder consultation that was undertaken as part of the risk analysis.

- Office of Rail and Road (ORR)
- Kent and East Sussex Railway (K&ESR)
- Bakerail (Track site/project management specialists)
- East Sussex County Council (ESCC)
- Rother District Council (RDC)
- Highways England (extensive consultations have been conducted with Highways England and their predecessor Highways Agency)
- I-Transport (Specialist Planning Transport Consultancy)
- ARUP (Design, Engineering, Architecture and Business consultation Group)
- Level Crossing Risk Management Tool (LXRMT).

Reference sources used during the risk analysis;

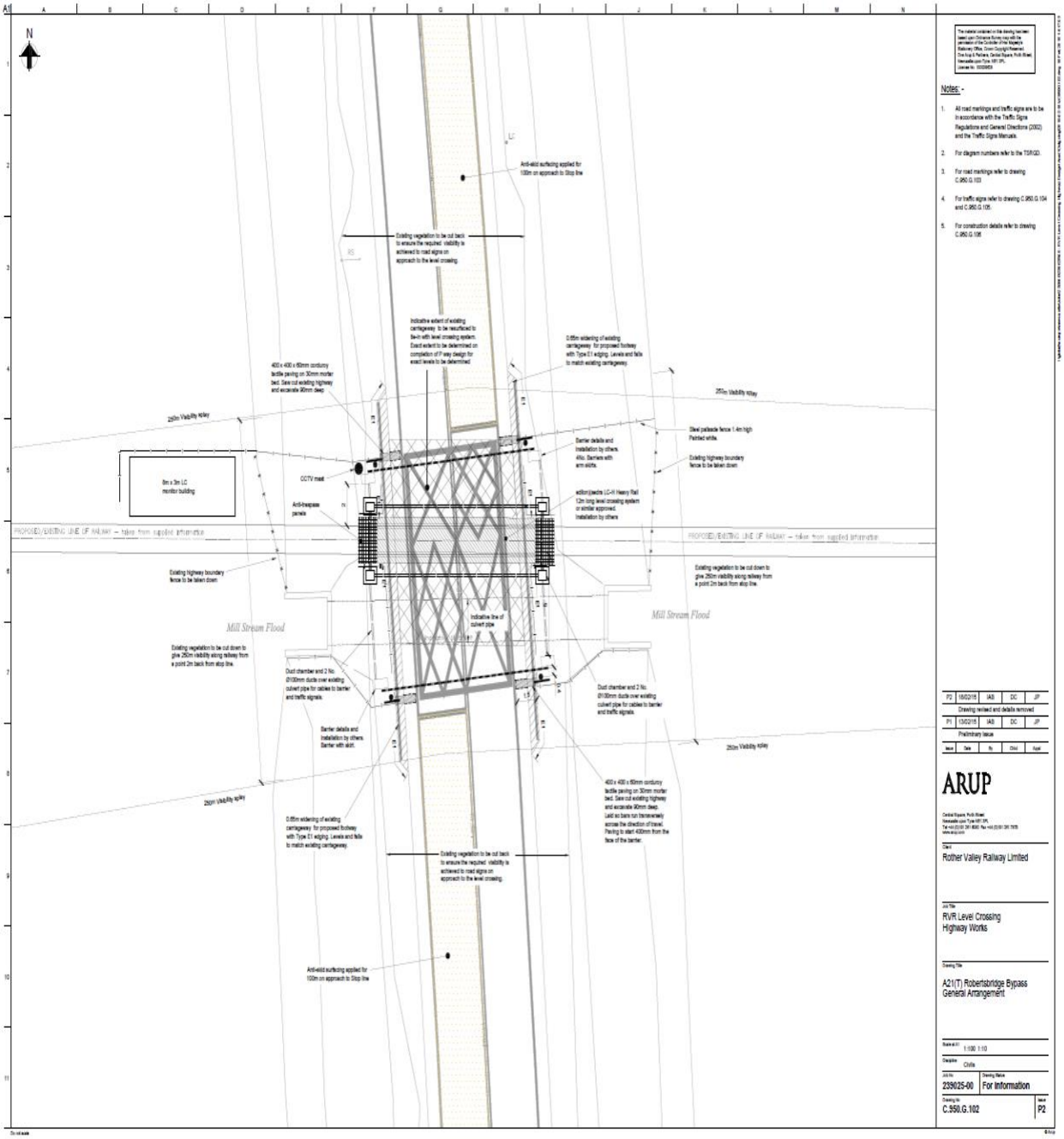
- ARUP A21 Options Report
- ARUP Road Safety Audit
- Mott Macdonald road survey report
- Network Rail QRA information
- GG19 Road Safety Report
- ORR Documentation
- GPR219-IDF- Level Crossing Safety
- EU SAFER-LC Project
- Level Crossing Risk Management Tool (LXRMT).

4 Level Crossing Diagrammatic Scheme

The new level crossing to be constructed is a Full Barrier Automatic Level Crossing, Locally Monitored (AFBCL) on the A21 (T) Robertsbridge Bypass.

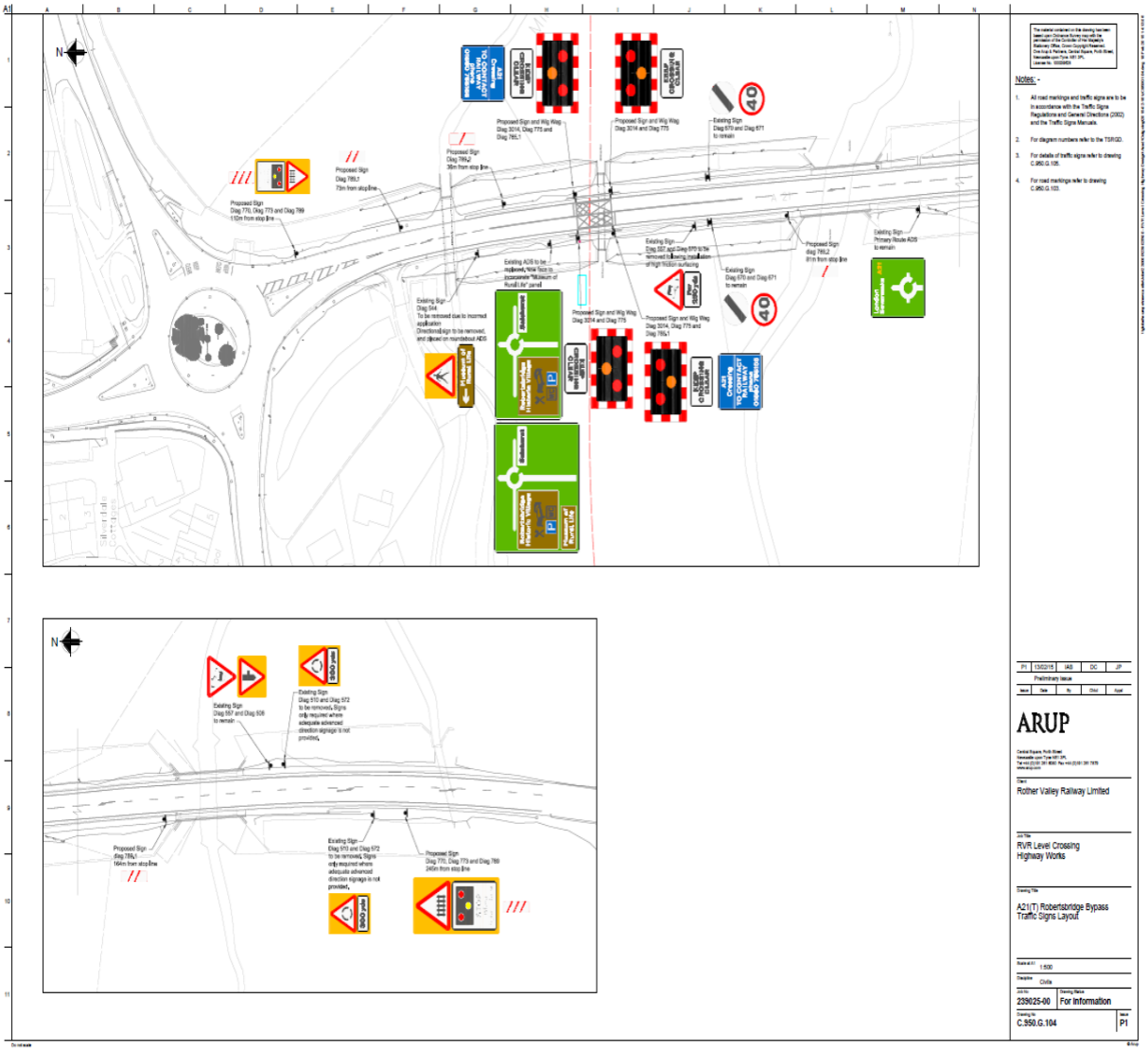
The road approach speed is 40 mph. the profile of the railway in the vicinity of the crossing has been provided below, as well as the appropriateness of the proposed warning signs in this regard.

Diagram of the proposed railway Alignment

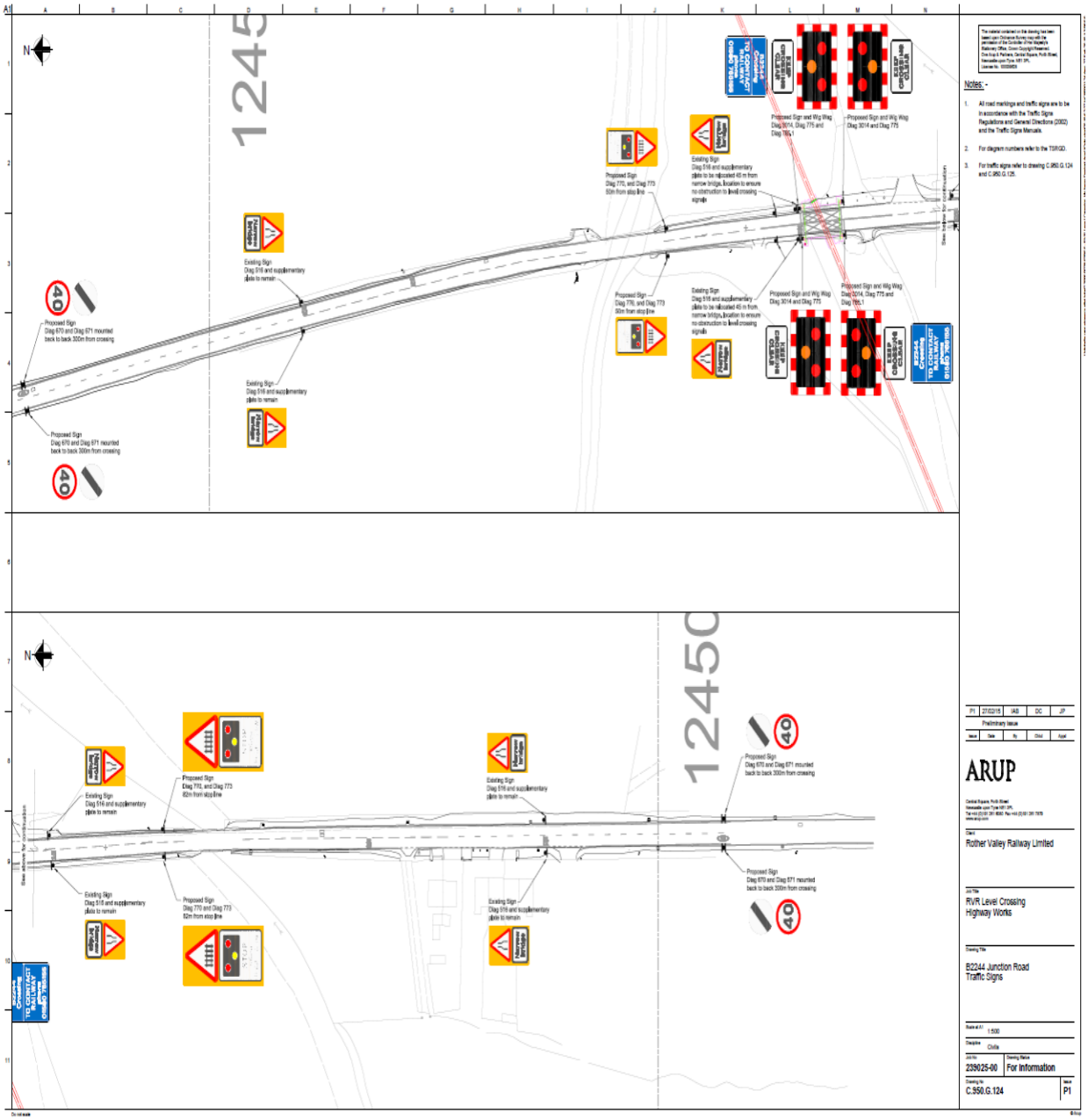


Rother Valley Railway

Diagram of the proposed traffic signs



Rother Valley Railway



5 Site Visit General Observations

The A21(T) Robertsbridge Bypass Stage 1 Road Safety Audit report identified possible road distractions which are considered as part of this analysis, for example,

- Blocking on the circulatory carriageway of a roundabout can lead to significant frustration for drivers on the side roads, not included in the main queue. This can lead to drivers trying to force their way around the junction, resulting in circulatory collisions.

To remove this concern, it is advised to reduce the speed limit over this length of road.

Photograph 1

- The proposed level crossing layout does not consider the existing traffic signing or the effect of the proposed level crossing signing on the existing signing. This could lead to drivers missing some signs and the warnings they portray leading to a range of conflicts and/or collision types, photographs 2 (a), (b) below.

To avoid the risk of confusion between signage a comprehensive review will be conducted as part of detailed design of the level crossing.

Photograph 2(a)

Photograph 2b

- The level crossing is proposed some 40m from the end of the existing street lighting system on the approach to the A21(T) Northbridge Street roundabout. It is not proposed to light the level crossing. Some drivers' eyes can take several seconds to adjust from lit to unlit conditions, and vice versa. A hazard such as a level crossing or queue located within that transition distance could result in shunt type collisions or a collision at the crossing itself.

To remove this concern, it is advised to extend the street lighting system to the south side of the level crossing in order to adequately light the hazard.

Photograph 3

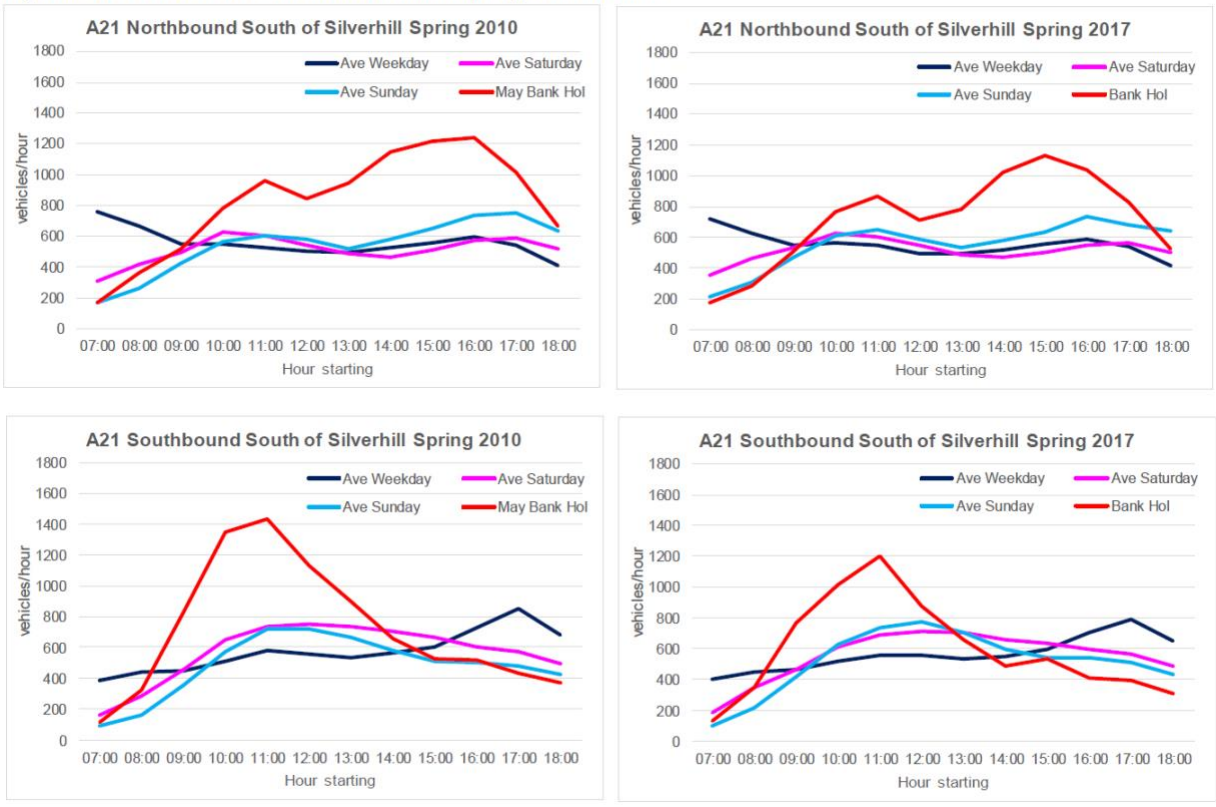
6 A21 Robertsbridge Bypass Traffic Flows

The chart below compares traffic flows on A21(T) Robertsbridge Bypass, for Spring and Summer months, based on ATC data provided by Mott McDonald Addendum to traffic impact study report (2018).

On the A21 at Robertsbridge the changes in traffic demand between 2010 and 2017 are limited with minimal changes on weekdays, some increases on Sundays and on the August Bank Holiday but reduced flow on the May Bank Holiday.

The predicted maximum queue lengths on the A21 are 60m-70m on weekdays, Saturdays and Sundays, increasing to 100m-120m on the Bank Holidays, using 2017 traffic demand. With traffic growth, these queue lengths increase to 2027 although the southbound queue length is only predicted to exceed 140m (the length from the level crossing back to the roundabout) on the May Bank Holiday in 2027 and even then, it is only just exceeded at 143m.
(Mott Macdonald Addendum report 2018).

Figure 4: A21 Traffic Flows South of Silverhill in Spring 2010 and 2017



Queue length results with a 110-second closure.

For the A21, maximum queue lengths of 100m-150m are predicted for weekdays, Saturdays and Sundays, increasing to 160m-240m on the Bank Holidays. With traffic growth, these corresponding queue lengths increase to 120m-180m and 190m-290m by 2027.

For the August Bank Holiday, the average northbound queue lengths are a little higher in 2017 and 2021, when compared to the previous results, and maximum queue lengths are higher by 10m-13m. For the southbound direction, the new results are higher by up to 18m but the maximum queue length in 2021 is 85m, still well below the 140m back to the A21 roundabout.

Traffic Growth Factors 2017 – 2021 – 2027

Table 3: Predicted Queue Lengths at A21 Level Crossing

	2017 Northbound		2017 Southbound		2021 Northbound		2021 Southbound		2027 Northbound		2027 Southbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	51	45	60	49	55	49	65	53	60	53	71	57
Saturday	50	45	61	56	54	48	66	60	59	52	72	66
Sunday	62	52	66	54	67	56	71	58	73	61	78	64
May BH	99	75	121	62	106	81	131	66	116	89	143	72
Summer												
Weekday	50	45	74	54	54	49	80	58	59	53	88	63
Saturday	55	47	65	59	59	51	70	64	65	56	76	70
Sunday	70	60	67	57	75	64	72	61	82	70	79	67
Aug BH	96	70	79	67	103	76	85	72	113	83	93	79

Source: Mott MacDonald analysis of existing and predicted traffic volumes, queue lengths in metres assuming 5.75m/vehicle

Table 6: Predicted Queue Lengths at A21 Level Crossing with 110 Second Closure

	2017 Northbound		2017 Southbound		2021 Northbound		2021 Southbound		2027 Northbound		2027 Southbound	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Spring/Autumn												
Weekday	101	90	120	98	109	97	130	105	119	106	141	115
Saturday	101	89	122	112	108	96	131	121	118	105	143	132
Sunday	125	104	132	108	134	112	142	117	147	122	155	127
May BH	197	151	243	123	213	162	261	133	232	177	285	145
Summer												
Weekday	100	90	149	108	108	97	161	116	117	106	175	127
Saturday	110	95	129	118	118	102	139	127	129	111	152	139
Sunday	140	119	134	114	150	129	144	122	164	140	158	134
Aug BH	192	141	158	134	206	152	170	145	225	165	186	158

Source: Mott MacDonald analysis of existing and predicted traffic volumes, queue lengths in metres assuming 5.75m/vehicle

Conclusion;

On the A21 at Robertsbridge the changes in traffic demand between 2010 and 2017 are limited with minimal changes on weekdays, some increases on Sundays and on the August Bank Holiday, however, reduced flow on the May Bank Holiday.

Comparison with the queue length predictions reported in October 2011 shows the new 2017 and 2021 results are generally similar to the previous results for 2016 and 2021 on the A21. The major difference is

that long queues are no longer predicted for the A21 Southbound on the May Bank Holiday. This is because the traffic demand recorded in 2017 is significantly lower than that in 2010 (reduced from around 1,600 vehicles/hour to 1,400 vehicles/hour).

7 The Railway

The train service over the A21 Robertsbridge level crossing will consist of passenger trains only. There will be approximately 10 trains per day. The highest permissible line speed of trains over the crossing will be 10 mph. Trains are timetabled to run for 10 hours per day.

The RVR Level Crossing Operational Management Plan (LCOMP) sets out the strategy for operational management of the A21 Robertsbridge level crossing to be installed on the Rother Valley Railway (RVR) where it interfaces with the road at level grade, so requiring control of road vehicles to enable a train to cross.

The LCOMP describes the principles of how the level crossing is to be operated under normal conditions and in the event of failure.

This shall be the basis for developing operational procedures for the railways operation when services commence to which staff shall be trained and assessed on an ongoing basis.

Compliance with Industry guidelines;

The design for the level crossings, developed from this document, shall be compliant with industry guidelines, e.g. The Office of Rail Regulation: A Guide for Managers, Designers and Operators (Railway Safety Publication 7 December 2011) and approved by a suitably independent person before installation.

A21 Robertsbridge Level Crossing Operation;

It shall be noted that a signaller will be on duty at all times of normal operation. The signaller will monitor operation of the crossings at the A21 via a Closed-Circuit Television link.

Normal operation to and from Robertsbridge

The train will approach the level crossing at a maximum speed of 10 mph, thus ensuring that the train has the ability to stop in 30m. The AFBCL (Automatic Full Barrier Crossing, Locally Monitored) crossing area is equipped with obstacle detection technology that scans the crossing area at various stages during the closure sequence. The crossings are provided with crossing illumination (for night visibility) and a drivers' flashing red and white light indicator in each direction on final approach for local monitoring by the train crew. The speed approaching the AFBCL crossing is limited to 10mph, so the approaching train is able stop under all railhead conditions before the road if the crossing is either visibly blocked or the flashing indicator hasn't changed from red to white. The approach of a train automatically begins the crossing closure sequence. This commences with the road traffic wig-wag signals and audible warnings to indicate to road traffic to stop. Obstacle detection technology prevents

to lowering of the crossing entrance barriers until the crossing is clear. Once the entrance barriers are down and the crossing surface is scanned to continue to be clear the lowering of the exit barriers can commence. If the equipment is proven to be fully functional and the OD sensors have confirmed clearance of the road surface between the fully down barriers then the indicator for the train driver will be showing flashing white light before the train reaches the crossing speed board.

The Drivers White Light is only given if all the barriers are fully down and in the unlikely event of a trapped user (vehicle or pedestrian) the train driver is able to raise and re-lower the exit barriers using a Drivers Release Unit (DRU).

The barriers will rise as soon as practicable after trains for which the lower sequence has been initiated or maintained, have passed clear of the crossing. The sequence of events to open the crossing to road traffic, once the raising cycle has been initiated or maintained is, all the barriers begin to rise simultaneously and should normally rise in 4 to 6 seconds; and the intermittent wig wag red lights should be extinguished as the barriers rise.

Railway signalling and control

Railway signalling will be provided to ensure the level crossing is fully protected on all railway approaches. The railway approach signals are interlocked with the lifting barriers so that it is not possible to clear the signals unless the road is fully closed by the barriers, additionally, it will not be possible to raise the barriers unless the signals are set at Stop and free of approach locking, or the train has passed the signal and traversed the crossings. It will not be possible to clear any protecting signals until 'crossing clear' is confirmed either automatically by obstacle detection equipment, or manually when that equipment is not being used. Discrete function controls will be provided at the control point for authorised railway staff use when obstacle detection equipment is not being used.

If a train passes a protecting signal at Stop, the road traffic light signals will immediately show an intermittent red light (omitting the steady amber phase) and the audible warning will start. The barriers will not be lowered as this may strike or trap crossing users.

To ensure that the crossing operates safely when the railway line is open to traffic, indicators at the control point will confirm that the equipment is powered and functioning correctly.

Level Crossing barriers & CCTV Systems Maintenance Plan

The maintenance plan for the three-level crossings shall be based on that recommended by the supplier of the equipment. It shall comprise:

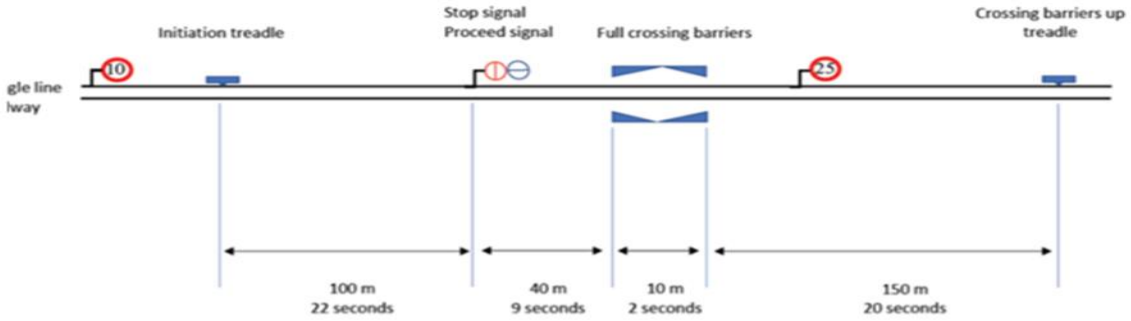
- Regular planned maintenance at the required intervals.
- Work arising from planned maintenance, within the required timescales
- Fault response, within specified timescales.
- Work arising from fault responses, within the required timescales.

- Work arising due to other parties planned work.

Road Crossing Design and Construction

The construction of the road crossings comprise concrete units designed to meet the requirements of a high friction skid resistant road surface through the crossing. This has been tested for the proposed installation and passed the test level requirement as set by The Highways Agency, reference document RD/GN/009 dated September 1989.

Level Crossing Signalling Diagram



Rother Valley Railway
Level crossing signalling schematic for manually operated full barriers
Northbridge Street, A21 & Junction Road

Not to scale

Notes:

1 Equipment shown for up direction only, treadles, signals and signs replicated for down direction

2 Transit times assume full line speed

8 5 X 5 Risk Assessment

Hazards are identified, listing possible causes if appropriate and assessed for severity. These are then multiplied by the frequency or likeliness of an incident occurring if no controls were applied. This produces the risk factor; the numerical assessment table gives guidelines on how to assess severity and frequency.

The risk assessments for the crossings are based on generic issues and then modified to reflect the specific issues at the individual crossing to reflect that risk can change significantly from one site to another. The generic risk assessment will be reviewed by the appointed Project Manager and then modified as required to reflect the

hazards and the necessary controls identified during site visits (pre-works) or through information passed to them by stakeholders and any other third party.

Rother Valley Railway (Bodiam to Robertsbridge Junction)

Bridleway Crossing 36b at Salehurst, Robertsbridge risk Assessment, including Management arrangements for User Worked Crossings

Prepared for:
The Office of Rail and Road

21 April 2021

Summary

The completion of the Missing Link will bring significant benefits to the local economy and there is no question that a grade level crossing solution at Salehurst is capable of being self-operated safely for horses and pedestrians. The cost differential between the costs of the proposed bridleway crossing (£30K) and implementing and constructing and thereafter maintaining a bridge (approximately £400K) at this location is grossly disproportionate. A tunnel under option is not practical as it would be subject to flooding from the nearby River Rother and would require almost constant pumping to keep it safe for use by pedestrians.

RVR requested Rother District Council (RDC) to review the use of a bridleway bridge at Salehurst, illustrating the type of structure that would be constructed to form a bridge for horses and riders over the approved line of the heritage railway (RR/2014/1608/P). RDC responded to the request on (13 August 2020) stating that:

‘RDC would not support a planning application for a bridge to take the bridleway over RVR at Salehurst, and that a proposed bridge to accommodate a bridleway/footpath crossing is a disproportionate response to an issue that is addressed by alternative and rather more sympathetic solutions at other locations along the route of the existing heritage railway line and they appear to function satisfactorily. Additionally, a principal planning issue in considering the proposal would be the impact of the development on the appearance and character of the countryside landscape, which is within the designated High Weald Area of Outstanding Natural Beauty. The Government's planning policies and how they should be applied are set out in the National Planning Policy Framework (NPPF), which states at paragraph 172 that great weight should be given to conserving and enhancing landscape in Areas of Outstanding Natural Beauty, which have the highest status of protection in relation to these issues. The Council's own development plan policies as contained in the Core Strategy (2014) at EN1 and the adopted Development and Sites Allocation Plan (2019) at DEN2 accord with the NPPF and are consistent with this approach. With respect to the proposed development, the railway sits within the broad flat landscape of the Rother Valley at this point and there are long views over the Weald. It is a very attractive rural landscape. The significant scale of the proposed bridge, combined with its very urban character and appearance, would result in it appearing an intrusive and incongruous feature in the countryside landscape. It would be harmful to the character and appearance of the AONB and contrary to the afore-mentioned national and local planning policies. In the circumstances, it is RDC’s informal view that a planning application would not be supported by the local planning authority.

I feel as though the proposed bridge to accommodate a bridleway/footpath crossing is a disproportionate response and I would therefore ask that you investigate alternative proposals for a bridleway crossing that would be more appropriate to conserving the AONB countryside setting of the railway’.

Therefore, the only alternative for RVR is to provide an at grade bridleway crossing suitable for all users and local residents (See options below).

1. Introduction

The former railway line between Robertsbridge and Tenterden was closed in 1961. Much of the trackbed remained in place for many years and, in 1974, the line between Tenterden and Rolvenden was re-opened as the Kent and East Sussex Railway (K&ESR). The line was further reinstated to Bodiam (the site of the National Trust's Bodiam Castle) in 2000 and K&ESR has become a successful heritage railway and major tourist attraction. Reinstatement work to date on the K&ESR and the Missing Link has been undertaken mainly by volunteers and local contractors who have developed cost-effective and quality methods for the work.

The "Missing Link" is the section of former railway corridor 3.42km long running from Junction Road (the B2244) in Bodiam to the terminus at Robertsbridge. Policy EM 8 of the Rother District Plan expressly supports the reinstatement of RVR. The local plan was the subject of a Public Inquiry and the Inspector's report gave full support to completing the Missing Link, subject to meeting the following criteria:
"(i) it must not compromise the integrity of the floodplain and the flood protection measures at Robertsbridge;
(ii) it has an acceptable impact on the High Weald Area of Outstanding Natural Beauty;
(iii) it incorporates appropriate arrangements for crossing the A21, B2244 at Udiam, Northbridge Street and the River Rother."
These criteria were all resolved and approved with full Planning approval given by Rother District Council in March 2017. Once completed, visitors will travel on a well-regarded Heritage Railway on the historic route within the Rother Valley between Tenterden and the mainline at Robertsbridge, with stops at a number of attractive tourist destinations.

Over the course of a number of years, planning permission has been obtained for the re-instatement of the railway between Bodiam and Junction Road in 2011, from Robertsbridge to Northbridge Street in 2013 and the construction of Robertsbridge Junction Station. Re-construction of the railway within those sections has now been completed (utilising volunteer professionals and local subcontractors). The connection to the main line was completed in late 2016 with the support of Network Rail.

Following consultation over a period of 6 years, including discussions with all relevant statutory bodies and the local planning authority – as reported in the Consultation Report accompanying the TWAO application - planning consent for the Missing Link was unanimously approved by the Rother District Planning Committee on 17 March 2017. (RR/2014//1608/P). Letters of support for the project from Kent CC, East Sussex CC, Rother DC, Ashford BC, Network Rail, National Trust, and 1066 Country are included in the Consultation Report. The planning consent was accompanied by planning conditions to ensure the safety and effectiveness of the road crossings.

The Missing Link will comprise a simple single-track railway with straightforward construction, utilising the same local contractors and volunteers (qualified and experienced, as appropriate) as on the sections already completed.

This document relates to the proposed level crossing at Bridleway S&R36b at Salehurst as well as management arrangements for user worked crossings.

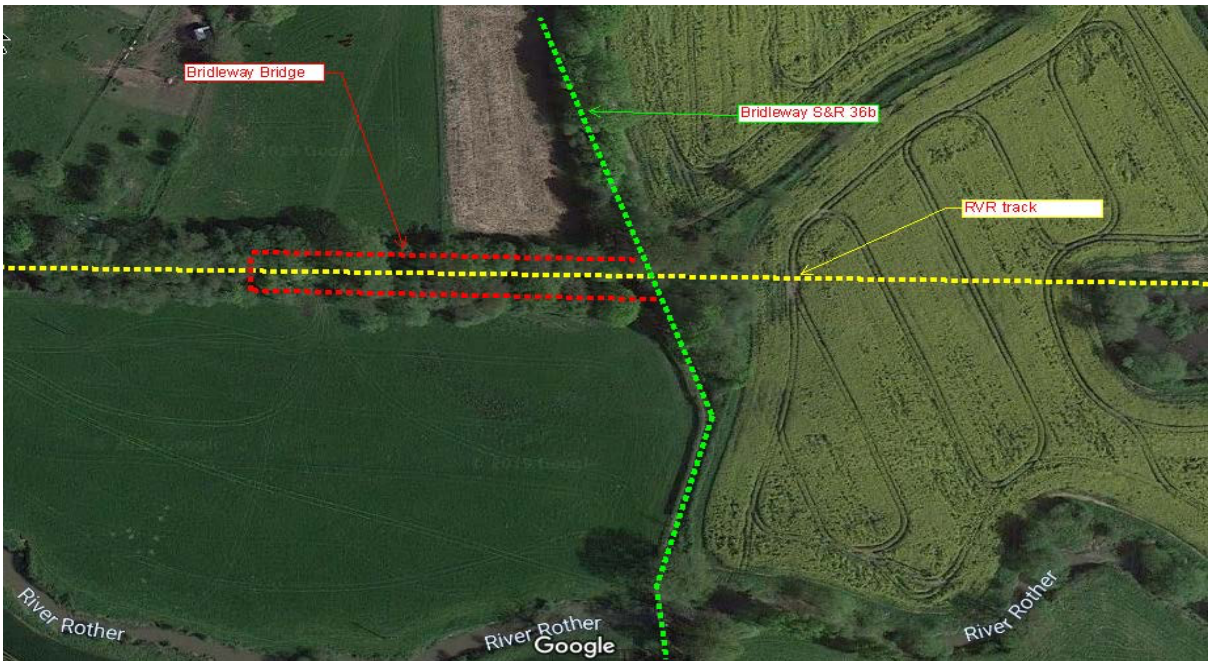


Figure 1 - Proposed location of Bridleway S&R36b crossing at Salehurst

2. Economic Benefits

A comprehensive Economic Benefits Report by Steer, leading UK specialist consultant, in 2018, forecast that the RVR will generate local economic benefits of up to £35 million over a two-year construction period and the first ten years of operation, and up to £4.6 million per annum of local economic benefits from 2030. It will generate approximately 34 jobs in the construction phase and up to 85 in the operational phase. Additional rail revenues of approximately £355,000 per annum are forecast to accrue to the main line operator.

3. Traffic Studies

In respect of the Bridleway Crossing (S&R 36b) at Salehurst, a crossing design similar to that used on the West Highland Railway was proposed and included in the planning documentation that was approved by Rother District Council. (RDC). During the course of the preparation of the planning documentation, extensive discussions and site visits to the location of the bridleway crossing were held with the local representative of the horse riders, the East Sussex County Council Senior Rights of way Officer, the Ramblers Association, and the Horse Society Access Field Officer for London and the South East.

4. Crossing Survey

There are a number of bridleway crossings on the existing Kent and East Sussex Railway that operate safely, effectively and without difficulty. Crossing Surveys were held at the Salehurst site over a period of a week in mid-summer. These showed an average of 4 pedestrians crossing on weekdays, and up to 20 a day at weekends. Whilst no horses were recorded, the local horse representative advised that normally around 4 horses would use the crossing each way at weekends, and less frequently on weekdays and in the winter. The Ramblers Association and the Horse Society advised us that their members are familiar with the bridleway crossing proposed and did not envisage any problems with them, particularly as there would be a maximum of only 10 train crossings a day in the summer months and none in the winter. Additionally, RVR will continue to collaborate with the Horse Society, Ramblers Association and local residents during the design, build and operational stages of the bridleway crossing ensuring we satisfy all concerns by building a robust and safe bridleway crossing that meets the needs of all users.

5. The Crossing Options

At the time of the Planning preparations no other options for the crossing were considered. However, the options considered are: -

(a) Option one, involving an “at grade” level crossing introduces no engineering challenges and would cause minimal disruption during construction. The RVR estimated cost (taking account of preliminary work and advance purchases of materials already completed etc.) is approximately £30,000.

(b) Option 2, considered the feasibility of taking the bridleway beneath the railway either parallel to or at right angles to the railway. Principal engineering and approval challenges are around the bridleway being below the level of the River Rother which is nearby. The tunnel would flood in a 5-year flood and above to a depth of 10 feet and would-be significant risk to local children and pedestrians in wet weather. The estimated cost is £6.8m. Option 2 is therefore unsuitable as an alternative arrangement to Option 1.

(c) Option 3, considers taking the rail over the bridleway. This scheme involves a sizable length of elevated viaduct structure with a significant impact on cost and would involve significant visual intrusion within the AONB. The viaduct would be adjacent to the existing houses in Salehurst and be particularly visible and intrusive to a quiet and most pleasant village. The estimated cost would be similar to that calculated by Arup for the A21 crossing at £20.2m. RDC have informed RVR that they would not support a planning application for a bridleway bridge, therefore taking the

rail over the bridleway would not be supported by RDC as RDC's reasons for not supporting a bridleway bridge would apply equally to rail over the bridleway.

(d) Option 4, would be a bridge carrying the bridleway over the railway. This would involve two long approach ramps either parallel to or at right angles to the railway due to the required maximum gradient for horses of 1 in 16, and the need for intermediate "level landings" to meet normal health and safety requirements. Obviously, the presence of a bridge and ramps directly on the bridleway alignment will prevent its use by farm vehicles, so the bridge has to have sufficient load bearing capacity to carry those vehicles. The Bridge would appear intrusive to the residents of Salehurst and several houses would lose the privacy of their rear gardens. The estimated cost for this option based on similar schemes by Network Rail elsewhere (e.g., over the main line railway at Kings Mill), and pro rata for this more straight forward location, is around £400,000. A recent new pedestrian crossing bridge at Wool Station by Network Rail cost £825,000. This option would also require a significant additional compulsory land take, above that required for option one, the "at grade" crossing. Additionally, RDC have informed RVR that they would not support a planning application for a bridleway bridge.

6. Timing

The majority of the construction materials for Option one would be delivered by rail, the fill material and track ballast via the Network Rail connection at Robertsbridge (from stock piles that RVR are already holding at several south coast ports), and track materials by rail from those already held for the project by Kent and East Sussex Railway (K&ESR) at Northiam Station. Upon gaining access to the land, it is anticipated that there will be 12 months of surveys in order to discharge the relevant planning conditions, with subsequent construction taking approximately 12 months. Commissioning and trials by K&ESR will take approximately 3 months. The reinstated railway will be operated by K&ESR as an integral part of its successful heritage undertaking. (K&ESR has been operating trains since 1974.)

7. Bridleway Design and Build

The bridleway crossing will be constructed from sections of revolutionary lightweight panels and edge beams. Every component weighs less than 60kg so it can be fitted manually by two people without the need for expensive machinery.

It is simple to fit and, unlike timber and heavier rubber systems they, can easily be removed and replaced during routine track maintenance.

The system shares the high grip surface of the heavy-duty steel framed polymer panel, so performs in the wet. It can be painted on in the same way as a road surface and the paint does not wear off easily as it does on other systems.

The surface is integral so does not peel off or need replacing like the expensive surface used on timber decks. The bridleway system is ideal wherever pedestrians or horses cross the track.

The lightweight nature also makes it ideal for remote or difficult to access installations such as rambling routes. Although rated as bridleway level crossing system, it has been tested way in excess of this using concrete blocks and vehicles.

Figure 2 Pedestrian and Bridleway Panels

8. Meerkat System

RVR will install the Meerkat warning device system to reduce user risk at the crossing to as low as reasonably practicable.

The new warning device can detect an oncoming train and provide an audible and visible warning to alert users that a train is approaching, therefore, have a significant impact on public safety at level crossings.

The entrance or decision point to the bridleway, which includes both sides of the railway will be protected by a self-closing wicket gate. Additionally, the wicket gate to be used will be designed to ensure it is possible for a mounted horse rider to open the gates without dismounting. RVR will follow in its entirety the ORR guidelines and current BHS specifications.

When cyclists use the crossing, notices will be sighted encouraging cyclists to dismount.

A sign explaining how to cross safely will also be displayed at the decision point on each side of the crossing. Instructions to users will be placed at appropriate points.

The minimum width between fences guiding users to the decision point or safe waiting area will be a minimum width of 3m. However, these widths may need to be increased depending on user requirements as part of the consultation process.

9. Railway Operation

The nature of the railway operation is an infrequent heritage railway, travelling at a maximum speed of 25mph. The intended design of the Bridleway crossing will incorporate the most recent crossing technology including a maximum speed of 10mph reducing risks to level as low as reasonably practicable.

The reinstated railway will be operated by Kent and East Sussex Railway (K&ESR) as an integral part of its successful heritage undertaking. (K&ESR has been operating trains since 1974). K&ESR have existing operating rules that safely manage these crossing types and which will be used, additionally, this crossing will have much improved safety systems.

10. Risk Assessment

The “Risk Assessment” documentation (Annex A) shows how the risks of a Bridleway crossing would be managed in accordance with ORR guidance.

Risk Profile

The risk profile of the bridleway has been assessed by considering the calculations provided within Network Rail’s strategy document ‘transforming Level Crossings 2015 – 2040, for example, passive crossing types are so called because they do not provide users with warning or protection from approaching trains. The primary method of operation for passive crossings is through users observing whether it is safe to cross. For this method of operation there needs to be enough sighting distance available to provide users with adequate time to cross and this is based on the railway line speed. Where pedestrians use the crossing the traverse time is affected by use by vulnerable users or those with mobility impairments. Passive crossing types include footpaths, station crossings, bridleways, user worked crossings and user worked crossings with telephones.

Table 1 below provides a breakdown of the passive level crossing numbers in more detail along with the total risk in Fatalities and Weighted Injuries (FWI) for each core crossing type.

Table 1

Source – ALCRM, August 2015	**Crossing core type**	**Number of level crossings on the network**	**FWI (as calculated by ALCRM) (All Level Crossing Risk Model)**
Passive level crossings	UWC/Bridleway (with telephone)	1717	1.1

	Footpath/bridleway/station	2246	2.8
	UWC	686	0.4
	Open crossing	48	0.1

The network Rail data does not provide a realistic FWI when compared with Salehurst Bridleway due to the slow speeds operated on Kent and East Sussex Railway, and that mitigation is provided by a very low speed over the crossing allowing any train to stop before any possible conflict with horse or human. Additionally, RVR will be installing the Meerkat system as described above, therefore reducing the risk to as low as reasonably practicable. However, Network Rail's FWI indicators as well as supporting data are a useful guide to assist in the management of safety at level crossings. RVR are monitoring the results of Network Rail's strategy document, transforming Level Crossings 2015 – 2040. In channelling its efforts further, RVR is focussed on the key objectives of the level crossing safety strategy as outlined within RSSB's Level crossings document 2019/20, A summary of health and safety performance, operational learning, and risk reduction activities on Britain's railway, for example,

- Crossings that are not equipped with automatic train-detection warning equipment remain a key focus for Network Rail. In partnership with one of its suppliers, Network Rail, is developing a new cost-effective train-detection warning solution for deployment at footpath and bridleway crossings. The project, named Meerkat, is well-advanced in its development and Network Rail has targeted to add this solution to its suite of risk controls before the end of the financial year. Should Network Rail identify any further improvements to the Meerkat system, RVR will install any updated latest technology available.

11. User Worked Crossings

Where property is severed by the reinstated railway, RVR are committed to work with all affected parties to ensure all possible safe access routes are considered. For example, seeking alternatives to crossings wherever possible, and that if any crossings are required that they would be spaced and located relative to other crossing points to reduce operational confusion, additionally subject to any necessary operational controls deemed necessary such as speed limits on approach.

RVR ensure that after consultations with all parties concerned, only the safest option will be installed as described within the Railway Clauses Consolidation Act 1845, section 68,

None of the proposed crossings are on the route of public rights of way. Whilst the proposed TWAO Deposited Plans include for the provision of up to nine user worked

crossings, the draft Order does not seek specific detailed powers for accommodation crossings. Detailed design and operation would therefore be by way of subsequent negotiation following the making of an Order at which time we would approach ORR with proposed fully detailed solutions for each location.

The design and operation of those fully gated user worked crossings would be all as outlined in ORR Level Crossings – a Guide for Managers, Designers & Operators (latest issue) with associated signage, protection and any other necessary measures to provide a safe solution as detailed in that document. Nevertheless, while the described minimum warning time of trains is achievable at all the proposed user worked crossing locations (ref guidance document 2.145) the crossings would nevertheless be enhanced by way of the provision of visual signal display to the crew of an approaching train indicating that the associated crossing gates are in the closed position.

The maximum line speed for the railway will be 25 mph. Local reduced speed limits will be incorporated where necessary at each user worked crossing set by way of sight line assessment - all as detailed in the Heritage Railway Association HGR-A0458 guidance document endorsed by the ORR for the assessment of user worked crossings.

RVR will enter into consultation with land owners to discuss options for removal of crossings wherever possible and where this is not possible RVR will provide a variety of control measures to protect users as mentioned above, including providing the minimum safe distance to see an approaching train,

RVR will provide instructions for the safe use of level crossings for authorised users. The instructions will ensure the method of working for each crossing are adequate and suitable to ensure the safety of trains and crossing users. This may include employees, contractors, postal staff, drivers of delivery vehicles and visitors. The safety of those who use private level crossings on farms and other business premises in the course of their work.

The authorised user also has responsibilities for ensuring that everyone who uses the crossing has been properly instructed in how to do this safely. RVR will liaise with the authorised user and jointly prepare a specific joint risk assessment to ensure that a safe method of using the crossing is agreed and adopted. Particular attention will focus on the robustness of any agreed method of work between the two parties for periods of intensive use. The Heritage Railway Association HGR-A0458 guidance document will provide additional guidance and support.

- Provisions to be made available at the crossings include;
- Single gates that open away from the railway and kept closed across the roadway.
- The crossing surface and adequate approaches, suitable for the location and use.
- Vehicular gates may be locked to prevent unauthorised use.
- It is not envisaged that telephones and warning lights are required, however, this will form part of the consideration of the potential control measures identified within each specific crossing risk assessment.

- Instructions will be posted near every access point to the crossing, on a statutory sign.
- Adequate sighting in either direction will be maintained for crossing users
- Crossing with vehicles or livestock: The correct procedure is detailed in the instructions provided at each crossing;

Users will be encouraged to report any deficiencies or problems in using the crossing to the train operator and contact details will be made available at each crossing location.

RVR is also aware that it is likely that new and emerging risks will materialise during the implementation stages and beyond; either following accidents or incidents, through new stakeholder concerns or through changes in user behaviour. This is foreseeable and will result in a fresh set of safety concerns to address in the future. To move to a truly proactive strategy RVR will critically evaluate level crossing designs using hazard identification, based on current progressive thinking regards level crossing safety. As part of the operational control measures, RVR have identified the following areas as key to safe operation of the level crossings,

- Risk Management
- Influencing user behaviour
- Implementing a level crossing strategy
- Monitoring and review

RVR will run targeted education campaigns for external stakeholders and users of all level crossings and continue to support Kent and East Sussex Railway to manage their level crossings effectively through improved knowledge, equipment, and IT solutions.

Hazards and possible causes identified – **Bridleway Risk Assessment**	Potential Risk or consequences associated with the Hazard	S	L	RF	Control Measures	S	L	RF
Regular users are more likely to undertake risk taking behaviour at crossings with a low frequency of trains.	The regularity of trains is a risk factor for crossing users, due to "the rarity of them encountering a train and the reduced vigilance that they might therefore demonstrate in crossing". Accidents are associated with lines that have low frequencies of trains.	4	2	8	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of new signage	2	1	2
Regular users and those living close to level crossings are more likely to undertake risk taking behaviour when using the crossing.	Potential behaviour traits of frequent users might include: Expectation by the user that there will not be any trains in the area. Familiar users apply prior knowledge of train times / frequencies. User believes he / she has enough time to beat the train. User has a low level of concentration and is easily distracted. User does not look in both directions. User has low perception of risk. User thinks he / she understands procedure without reading instructions User unaware of risks to subsequent users. User assumes that the train is stopping at the station (based on	4	2	8	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of Bridleway crossing is primarily covered in Local Training Plans and educational material to cover; Hazards associated with the crossing, How to make decisions about whether requests to cross can be granted. how to check whether a crossing is clear.	2	1	2

	prior experience) and chooses to cross in front of the train.							
Low train speeds might increase the risk-taking behaviour of users	It has been established that users might perceive the crossing to be safer to cross when trains are moving more slowly. This might result in them behaving less cautiously e.g. by crossing while a train is in view, crossing more slowly, or checking the line less often while crossing.	4	3	12	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Eyes watching signs to encourage users to behave safely e.g., put dogs on leads, close gates etc. Education Awareness Self-closing gates	3	2	6
Young children who are not old enough to understand safe crossing procedure might cross unsafely.	Young children might not fully understand the risks associated with level crossings or the correct crossing procedure and therefore traverse in an unsafe manner. This issue might be particularly prevalent in locations where it is likely that unaccompanied children use the crossing, such as near residential areas, schools, playgrounds and youth clubs.	4	3	12	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of level crossings is primarily covered in Local Training Plan and educational material to cover; Hazards associated with the crossing, How to make decisions about whether requests to cross can be granted. how to check whether a crossing is clear. Ensure signage is appropriate for the status and specific risks at, and on the approaches to, a crossing.	3	2	6

					Education Campaign.			
Errors by crossing users might increase at crossings without warning signs or lights in the hours of darkness.	Poor lighting conditions at and around the crossing can affect a user's behaviour in several ways: Failure to see the crossing / crossing equipment and signs. Deviation from the crossing Inability to read crossing instructions. Misjudgement of train speed.	3	2	6	The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat. Use of level crossings is primarily covered in Local Training Plans and educational material to cover; Hazards associated with the crossing, How to make decisions about whether requests to cross can be granted. how to check whether a crossing is clear. Ensure signage is appropriate for the status and specific risks at, and on the approaches to, a crossing. Education Campaign.	2	1	2
The visibility (and hence effectiveness) of information on the approach to and at the crossing is reduced by overgrown foliage.	Overgrown foliage on the approach to a level crossing can obscure signs at the crossing, and also restrict the visibility of approaching trains. This could result in the user either not seeing the sign or train (complete or partial) or the user not seeing the sign or train in time to sufficiently interpret the information and respond appropriately.	3	2	6	Foliage Management System in place. The introduction of an audible alarm to provide users with a warning that a train is approaching. RVR intend to install the most relevant up to date safety equipment i.e., Meerkat.	2	1	2
An uneven and/or slippery crossing surface might present a potential hazard to those using the crossing.	Poor surfaces might present particular problems for cyclists (especially those wearing cycling shoes with slippery soles), horse riders, mobility scooter users,	3	3	9	Foliage Management System in place which ensures that all crossing surfaces are maintained, including the approach to the crossing, not just the area between the gates	3	2	6

	wheelchair users, the elderly, visually or physically impaired crossing users, and users with encumbrances such as luggage or pushchairs. The crossing surface might also present a hazard to road vehicles in general as well as a hazard to trains. Reasons for uneven/slippery crossing surfaces include: Missing, partial, worn or damaged crossing deck Poor decking panel alignment / position on skewed crossing Wet or icy weather conditions Uneven ballast distribution				and signs. Th Bridleway will allow sufficient space to provide a position of safety before/after the crossing for all users. Additionally, ensuring that the Bridleway crossing surface is profiled as the user moves through the entrance/exit to reduce the risk of slips, trips and fall thus preventing risk of personal injury. The Bridleway crossing will be constructed from sections of revolutionary lightweight panels and edge beams and a high-grip surface.			
User Worked Crossings - Additional								
Unreliable crossing equipment (telephones, warning lights, gates, means to secure gates including toe catches, and signs) due to poor maintenance, vandalism or general deterioration;	Damaged or missing signs can prevent a user understanding the crossing instructions / procedure Damaged equipment can affect its likelihood of use Damaged/difficult to use gates can affect a user's adherence to the correct gate crossing procedure Poorly maintained equipment can create a perception that the level crossing is not in use/ infrequently used and therefore reduce the perceived importance of following	4	3	12	Regular monitoring of the crossing, maintenance program in place Enhanced communication reporting arrangements between user and operator Installation of trespass guards on one or both sides of the crossing, together with any fencing as deemed necessary.	2	2	4

	the correct procedure Poorly maintained level crossing equipment can influence a user's behaviour in a variety of ways: Damaged or missing signs can prevent a user understanding the crossing instructions / procedure.							
Poor, worn or damaged crossing surfaces or cattle guards that cause difficulty in moving vehicles or livestock across the tracks;	Poor crossing surfaces make it more difficult for users to traverse the level crossing by distracting the user and causing them to look at their footing, by increasing user crossing time, and by increasing the potential for slips, trips and falls. In addition, footpath surfaces in a poor condition increase the likelihood of users diverting from the designated footpath or slipping / tripping into the carriageway.	3	2	6	Regular monitoring of the crossing, maintenance program in place Enhanced communication reporting arrangements between user and operator Installation of trespass guards on one or both sides of the crossing, together with any fencing as deemed necessary.	2	2	4
The type of level crossing might be unsuitable for a number of reasons, including its location, train service, line speed and/or user type	UWCs might become unsuitable due to a chance in land use (e.g. farming land diversification) or a new housing development nearby, which results in a higher number of crossing users and a change in user types. Another example might include an industrial estate being developed near to a rural crossing that is unsuitable for HGV use.	3	2	6	Review Signage. Involve users in the RA process Consider is current level crossing is correctly graded.	2	2	4
Restricted sighting of approaching trains caused by;	lineside development, erection of fences, or growth of vegetation, at a user worked crossing without additional protection measures,	3	2	6	Review Signage. Involve users in the RA process Consider is current level crossing is correctly graded. Vegetation clearance	2	2	4

APP-E – ORR STRATEGY FOR REGULATION OF HEALTH AND SAFETY RISKS 7

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

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 Commissions[1] 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 prevention[2] 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.*

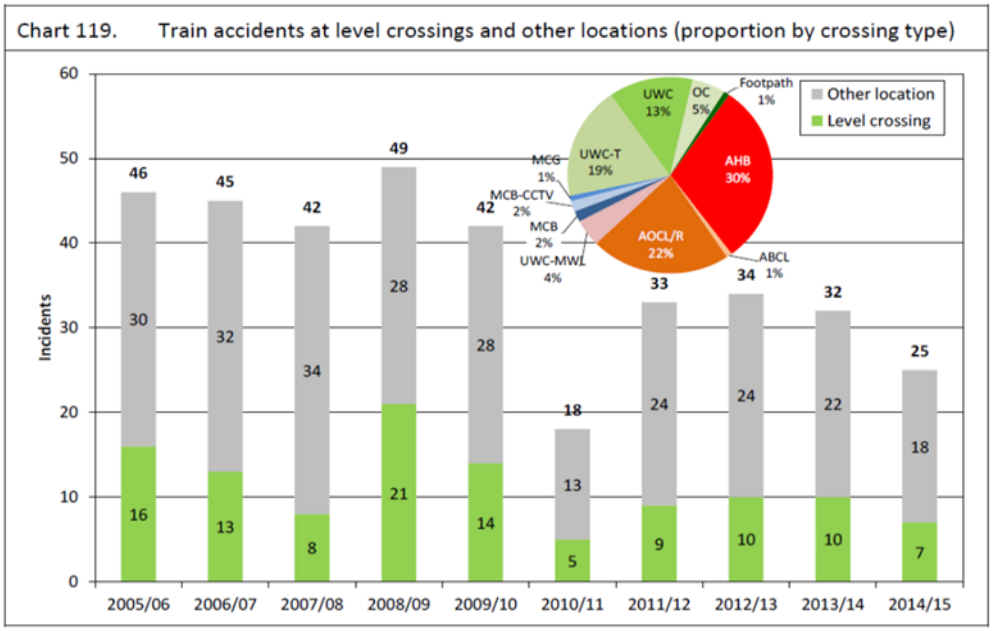
11. The table below documents the **harm** caused by level crossings.

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 8.1[3], 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 data[6], 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.

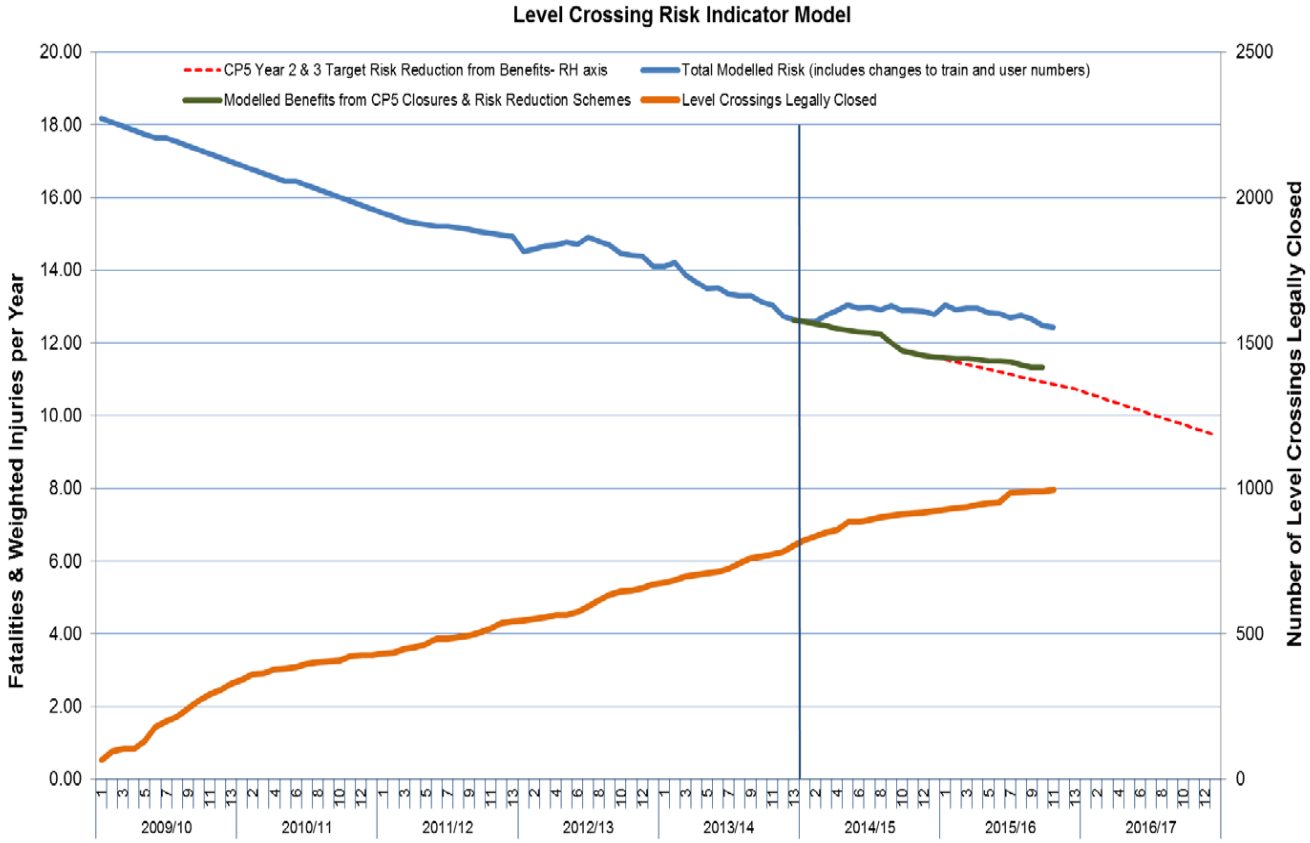
20. Responsibility for controlling level crossing risk is shared between the railway infrastructure manager, the train operating companies, highway authorities and users of the crossing. Effective co-operation and collaboration between these parties is critical and each has a role to play, although the 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 FWI[7] 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 crossings[9], 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 prevention[10].

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 Britain[11].

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**
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	No substantial increase in the number of level crossings, and a reduction in the number if reasonably practicable.
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.	Proportionate, risk-based supervision of management of level crossings, targeting areas where we anticipate that improvements may be needed. Checking that rail infrastructure managers are protecting the safety of level crossing users and train occupants.
Encouraging Network Rail to develop a level crossing strategy which (amongst other things) should identify how it can make passive crossings active. For consistency, discussing the creation of a level crossing strategy for its sector with the Heritage Railway Association.	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. (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.)

Encouraging Network Rail to carry out narrative risk assessment and not rely solely on ALCRM assessments. 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.	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.
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	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.
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.	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.
Processing submissions for the authorisation of level crossings and significant change to existing crossings in line with Level Crossing Orders**.**	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.
Inspecting level crossings to ensure compliance with the law, and any Level Crossing Order.	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

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

APP-F – HERITAGE RAIL ASSOCIATION HGR-A0458

Ref No: HGR-A0458

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HERITAGE RAILWAY ASSOCIATION

GUIDANCE NOTE

LEVEL CROSSING SIGHTING DISTANCES

for Footpath and Vehicular User-Worked Crossings

Purpose

This document describes good practice in relation to its subject to be followed by Heritage Railways, Tramways and similar bodies to whom this document applies.

Endorsement

This document has been developed with and is fully endorsed by Her Majesty's Railway Inspectorate (HMRI), a directorate of the Office of Rail Regulation (ORR).

Disclaimer

The Heritage Railway Association has used its best endeavours to ensure that the content of this document is accurate, complete and suitable for its stated purpose. However it makes no warranties, express or implied, that compliance with the contents of this document shall be sufficient to ensure safe systems of work or operation. Accordingly the Heritage Railway Association will not be liable for its content or any subsequent use to which this document may be put.

Supply

This document is published by the Heritage Railway Association (HRA).

Copies are available electronically via its website www.heritagerailways.com

Users of this Guidance Note should check the HRA website to ensure that they have the latest version.

Table of Contents

1. Introduction

This Guidance has been provided to assist the duty holder of heritage railways and tramways in the assessment and measurement of the minimum necessary Sighting Distances for Footpath and Vehicular User-Worked Crossings.

Duty holders will be aware that they have a legal obligation to passengers, contractors, other visitors, staff and volunteers under the Health and Safety at Work etc Act, 1974. It is therefore important that they relate and interpret this part of the Regulations relative to the safe operation of their railway.

The term ‘man’ or ‘men’ in this Guidance Note should be read as applying equally to men and women and ‘he’ and ‘him’ should be similarly interpreted.

The term ‘staff’ in this Guidance Note should be taken to include unpaid volunteer workers as well as paid staff.

2. Recommendations

This guidance note is issued as recommendations to railway and tramway duty holders with regard to the assessment and measurement of the minimum necessary Sighting Distances for Footpath and Vehicular User-Worked Crossings..

Many railways are already operating systems which are to higher standards than those set out in this guidance note. This highlights the fact that it is the responsibility of duty holders to implement a level of risk assessments and controls which they feel are applicable and necessary relative to the operating conditions on their railway or tramway.

Where railways decide to take actions that are not in agreement with these recommendations, following appropriate risk assessments or for other reasons, it is recommended that those decisions are reviewed by the senior management body of the organisation and a formal minute is recorded of both the decision reached and the reasons for reaching it.

3. General

a) The Office of Rail Regulation (Her Majesty’s Railway Inspectorate) has produced a guidance note for the use of duty holders entitled ’Level crossings: A guide for managers, designers and operators‘, reference RSP007, 2011

b) The ORR guidance is intended to cover all railways in the United Kingdom. However, as a result the guidance regarding the minimum necessary sighting distance for footpath and user-worked crossings requires precautions that, in the case of a heritage railway operating at 25 mph (40 km/h) or less may be considered as greater than is reasonably practicable. This guidance note is intended to help the duty holder of a heritage railway with a maximum speed of no more than 25 mph (40 km/h) to assess what safe sighting distance for a footpath or user-worked crossing may be considered as reasonably practicable.

c) RSP007 defines a footpath crossing, a user worked crossing, a decision point and the sighting distance. This document uses these definitions throughout.

   i) A ‘Decision point’ applies to user worked crossings, footpath crossings and bridleway crossings. It is a point where guidance on crossing safely is visible and at which a decision to cross or wait can be made in safety

   ii) ‘Sighting distance’ is the distance measured along the railway from a decision point to the point at which an approaching train becomes visible in any direction from which a train may approach.

d) A boning rod comprises two pieces of timber fixed together in the shape of a T. The cross arm is about 300 mm long and must be at right angles to the upright arm, which should be 1.050 m long.

e) This document is designed to give specific guidance for establishing and measuring sighting distances on footpath crossings and user-worked crossings where vehicles cross the line on heritage railways that operate at speeds of 40kph (25mph) or less. It does not in any way relieve the duty holder of his duties to risk assess the crossing.

f) THIS GUIDANCE CANNOT BE USED TO CALCULATE A SAFE TIME FOR FARM ANIMALS TO CROSS A RAILWAY LINE

g) The basic requirement of RSP007, for both a footpath crossing and a vehicular user-worked crossing, is that the duty holder should, if reasonably practicable, provide a minimum sighting distance such that:

i) for a pedestrian crossing, a pedestrian who cannot see a train approaching when he is standing at the decision point can cross the line at a normal walking pace to a point clear of the track on the far side of the crossing without risk of being struck by a train; or

ii) for a user worked vehicular crossing, the driver of a vehicle that is parked with its front at the decision point can cross the line at a slow driving speed so that the rear of the vehicle is clear of the far decision point without risk of being struck by a train.

h) If the minimum sighting distance cannot be maintained, for example because of a wall or a bridge abutment obstructing the visibility, then the duty holder should investigate and provide alternative means to ensure the safe operation of the crossing, as laid down in RSP007. These means might include:

i) Slowing down the trains to give a sighting distance commensurate with the reduced speed of the trains; or

ii) Provision of audible warning by approaching trains.

i) Whilst this document shows a method of calculating the visibility requirements, and checking the adequacy of sighting distances at footpath and user-worked level crossings, it is not mandatory, and a duty holder may use other methods that produce an equal level of risk control.

4. Assessment of sighting distance - principles

a) The duty holder should assess the sighting distance at a height of 1.05m above ground level. This height allows for the vision of a child of sufficient age to be out alone standing at the decision point, and the vision of the driver of a car seated at the steering wheel.

b) The duty holder should have four pegs installed at the foot of the cess ballast shoulder on both sides of the track at the minimum sighting distance from the crossing in each direction (see sections 4 and 5 below). The head of the pegs should be no higher than level of the nearest rail; if pegs are left permanently in situ then they should be made visible by painting to minimise any tripping risk.

c) The person assessing the sighting distance should use a 1.05 metre high boning rod (Diagram 1).

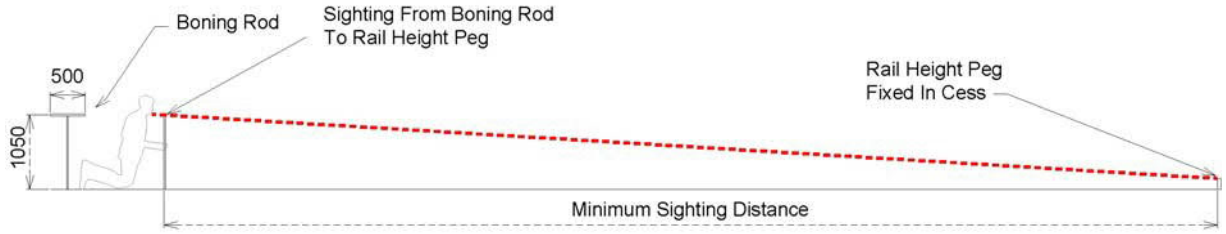

Diagram 1 – Boning Rod and sighting pegs

d) If the person assessing the sighting distance on any crossing can see the head of all four sighting pegs with his eyes place level with the top of the boning rod then the visibility of the track on that side of the crossing is adequate, as the whole of the front of a train will be visible from this point (Diagrams 2 & 3).

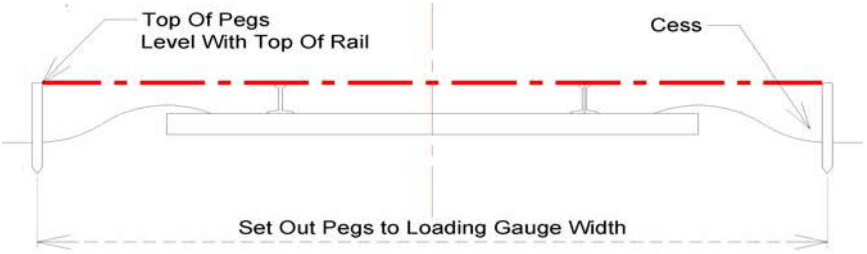

Diagram 2 – position of pegs

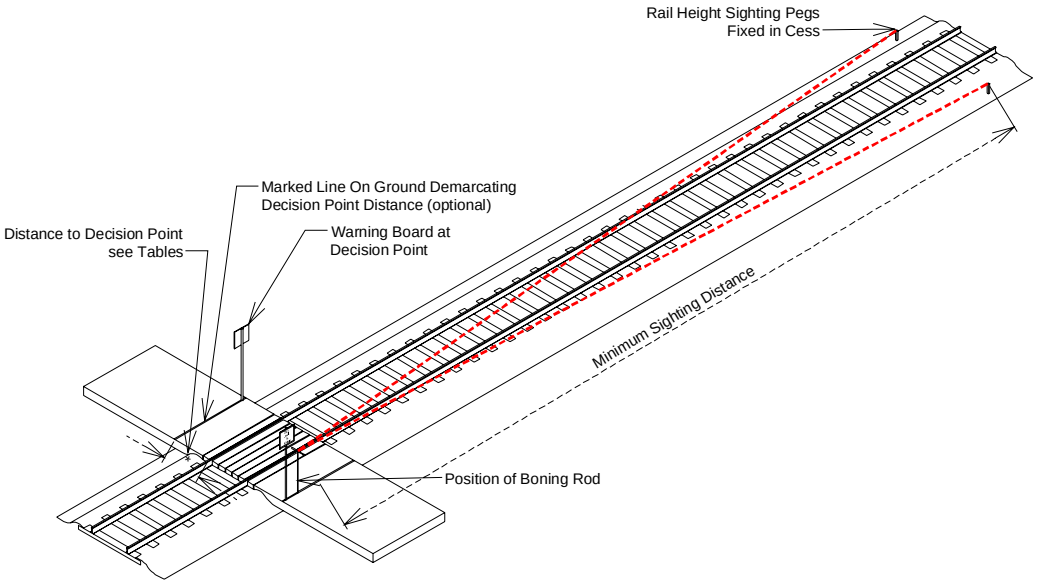

Diagram 3 – sighting from boning rod to peg on a single track

e) If the person assessing the sighting distance cannot see the head of a peg that should be visible with his or her eyes placed at the boning board then the visibility at that crossing is not adequate, as a person at the decision point may not see the whole of an approaching train: the person assessing the sighting distance should report this fact, and the reasons for the obstruction of the visibility, to the duty holder as soon as possible.

f) The person assessing the crossing should also carry out a visual check from the decision point at adult eye level (and at 3m height if the crossing is used by horses) to check that no overhanging branches can interfere with visibility.

5. Maintenance of sighting distance

a) It is essential that the clear visibility of the minimum sighting distance is maintained at all times. Accordingly, the duty holder should arrange for the safe sighting distance to be checked at least twice a year, with one of these checks taking place towards the end of the spring, when vegetation is likely to be at its maximum.

b) A major risk of obstructing the visibility of the minimum sighting distance is growing vegetation. The duty holder should arrange for vegetation to be cut back as often as is necessary, throughout the year, to maintain the minimum sighting distance.

6. Calculation of minimum sighting distances - footpath crossings

a) RSP007, Appendix A and paragraph 155, requires that a decision point is marked by a sign at the point at which the pedestrian can make a final decision as to whether or not it is safe to cross the line. It states that the decision point shall be a minimum of 2 metres from the nearest running edge for a footpath crossing, and 3m for a bridleway crossing.

b) The minimum distance to the decision point specified in RSP007 allows for a train passing at high speed, and possible aerodynamic effects. For a heritage railway with a maximum speed of 25 mph (40 km/h) such aerodynamic effects are greatly reduced, and the distance from the nearest running edge to the decision point can be lower. The individual railway should decide what distance to a decision point is appropriate for a particular crossing, but it should not normally be so small that a child under the age of ten years standing at the decision point could reach out and touch a passing train.

   i) For a standard gauge line, the duty holder should not consider a decision point for a footpath crossing at less than 1.5 metres from the nearest rail.

ii) For a narrow gauge line, the duty holder should not consider a decision point for a footpath crossing at less than 1.25 metres from the nearest rail

c) As specified in RSP007, the duty holder should, wherever possible, lay out footpath crossings at right angles to the track so as to minimise crossing time.

d) For a **right angled footpath crossing over a single track railway** a range of typical minimum sighting distances is as shown in the table below:

Crossing speed and gauge Gauge	10 mph / 16km/h 1432 mm	25 mph / 40 km/h 1432 mm	10 mph / 16 km/h 600 mm	25 mph / 40 km/h 600 mm
Minimum sighting distance in metres if decision point is 1.25 metres from track	N/A	N/A	35	87
Minimum sighting distance in metres if decision point is 1.5 metres from track	40	100	37	92
Minimum sighting distance in metres if decision point is 2 metres from track	44	110	41	102

Other circumstances can be interpolated from these tables, or the duty holder can obtain the spreadsheets behind these table from the Heritage Railway Association on application, and re-calculate the figures for their own circumstances

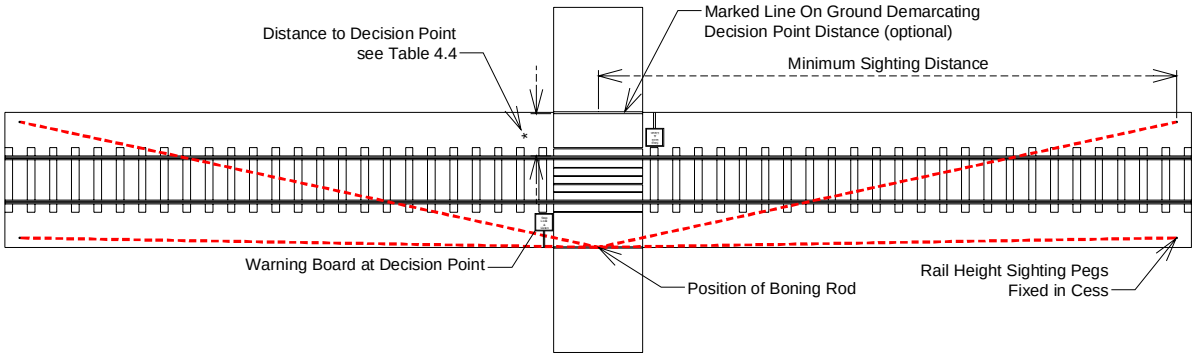

Diagram 4 – sighting for a right angled footpath crossing on a single track railway

e) For a **right angled footpath crossing over a double track railway**, a range of typical minimum sighting distances is given in the table below:

Crossing speed and gauge Gauge	10 mph / 16km/h 1432 mm	25 mph / 40 km/h 1432 mm	10 mph / 16 km/h 600 mm	25 mph / 40 km/h 600 mm
Minimum sighting distance in metres if decision point is 1.25 metres from track	N/A	N/A	45	111
Minimum sighting distance in metres if decision point is 1.5 metres from track	53	133	47	116
Minimum sighting distance in metres if decision point is 2 metres from track	57	143	51	127

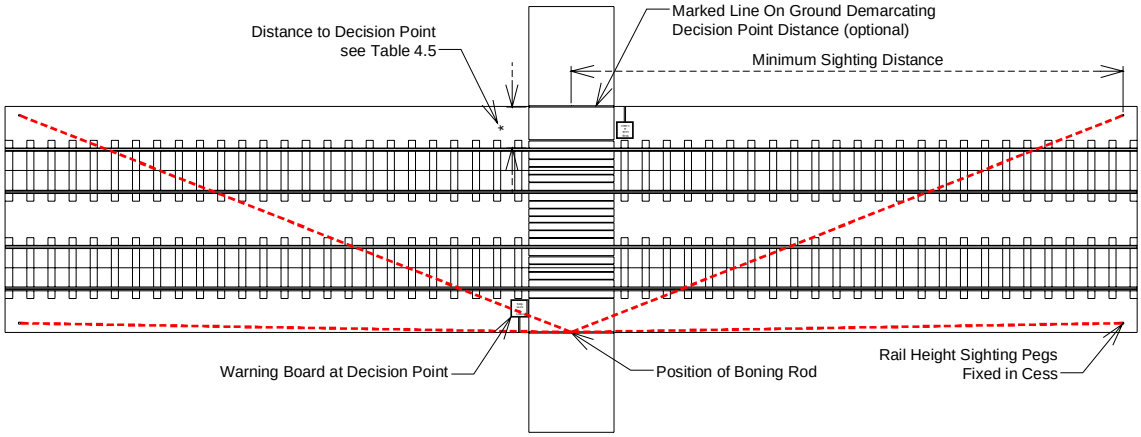

Diagram 5 – sighting for a right angled footpath crossing on a double track railway

7. Calculation of minimum sighting distances – vehicular user worked crossings

a) Whilst the same basic principle applies to user worked crossings, the following extra issues have to be taken into account:

   i) Whereas a pedestrian can be considered as a single point, a road vehicle, and in particular an agricultural vehicle, has a length. RSP007 gives an example of an 18 metre long agricultural vehicle, which figure is used in the tables in this guidance note. Another length, either longer or shorter can be substituted in the supporting spreadsheet if local assessment shows it to be appropriate

   ii) The driver of a road vehicle is normally set back from the front of the vehicle, assumed to be 1.66 metres. Accordingly the boning rod needs to be used at the position of the driver rather than the decision point.

   iii) The road vehicle driver takes additional time to start the vehicle after making the decision to cross.

b) The duty holder should not reduce the decision point for a road vehicle crossing below 2 metres **square to the line** in any circumstances, as the driver of a train should be able to see that a road vehicle that is stationary at the decision point is clear of the train.

c) If a road vehicle crossing is angled to the track then the distance from the decision point to the track increases for the road vehicle driver, with a consequent increase in the crossing distance and the time to cross the line

d) Allowing for these factors, for a **user-worked vehicular single track crossing** a range of typical minimum sighting distances is given in the table below:

Train Speed	10 mph / 16km/h	25 mph / 40 km/h
Minimum sighting distance in metres with a crossing angle of 90°	112	280
Minimum sighting distance in metres with a crossing angle of 60°	125	312
Minimum sighting distance in metres with a crossing angle of 45°	147	366

The effect of the criteria that increase crossing distance for user-worked crossings is to reduce the effect of track gauge on the minimum sighting distance, so this guidance is given for standard gauge only. The duty holders of narrow gauge lines may follow this guidance, or recalculate for the narrower gauge if the exact figure is critical for a particular crossing

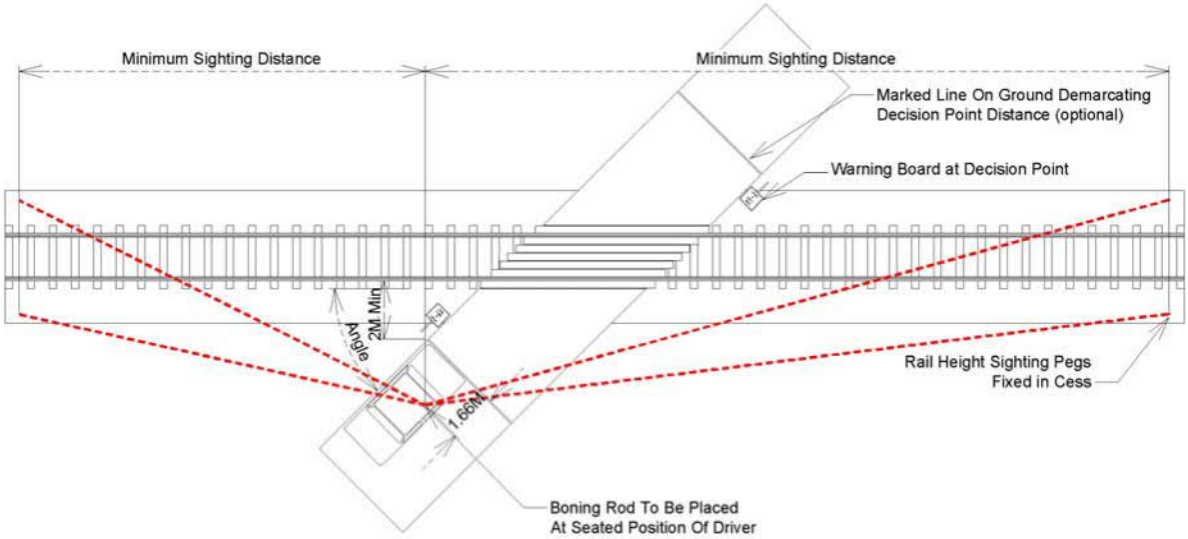

Diagram 6 – sighting for a user-worked crossing on a single track railway

e) For a **vehicular user-worked double track crossing** a range of typical minimum sighting distances is given in the table below:

Train Speed	10 mph / 16km/h	25 mph / 40 km/h
Minimum sighting distance in metres with a crossing angle of 90°	123	307
Minimum sighting distance in metres with a crossing angle of 60°	137	344
Minimum sighting distance in metres with a crossing angle of 45°	162	405

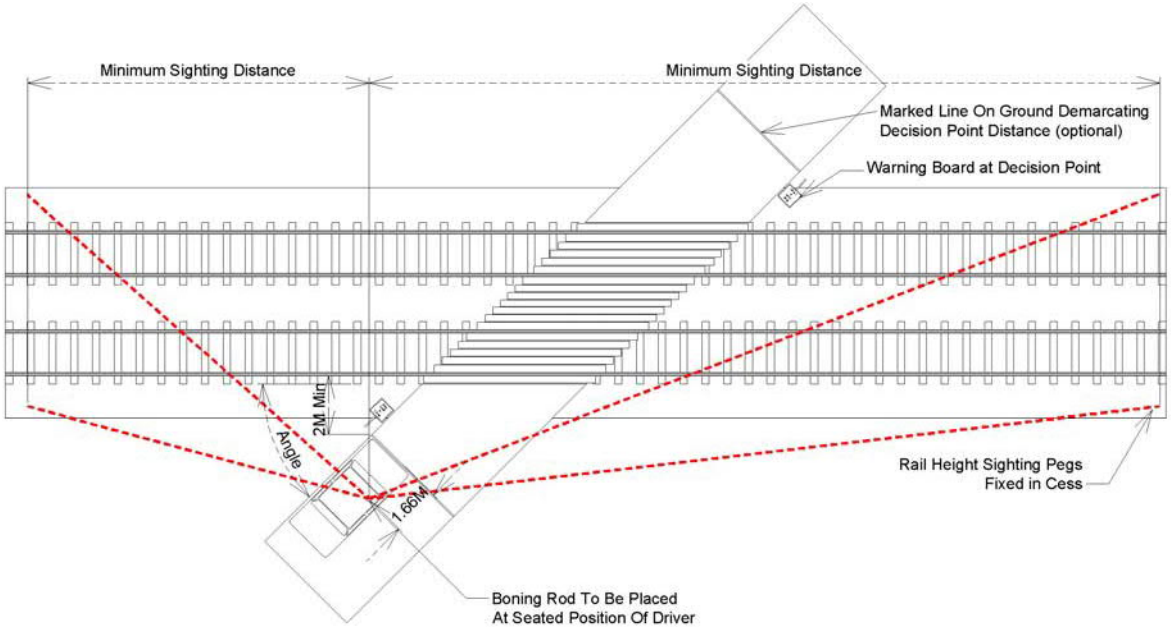

Diagram 7 – sighting for a user-worked crossing on a double track railway

end of main document

Appendix A: Criteria used in this document for assessing a footpath crossing

Footpath crossings are set at right angles to the track(s).

Pedestrian crossing speed is 1.1 metres per second (2.5 mph)

A pedestrian who crosses the line when no train is visible from the decision point will be clear of the far decision point at least five seconds before any train arrives at the crossing

Warning time is the time taken to make a crossing over the distance defined in section 3(f) I plus 5 seconds

Sighting distance = Train Speed (metres / sec) x warning time (sec)

Formula for calculating distances for differing gauges & line speeds

The figures given in the body of the text cover the majority of uses. Where conditions are significantly different duty holders may calculate the distances by applying the following formula:

Warning time = (Crossing distance in metres / 1.1) + 5 seconds

Crossing distance = Distance from the decision point on one side of a crossing to the decision point on the other side measured on the centreline of the crossing over all tracks.

Appendix B: Criteria in this document for assessing a vehicular user-worked crossing

Vehicle crossing speed is 1.34 metres per second (3 mph)

The vehicle is at least 2 metres from the crossing when the vehicle driver decides whether or not to cross the line

The vehicle driver is located 1.66 metres behind the front of his vehicle

The vehicle is 18 metres long (Figure should be confirmed and values adjusted if justified locally)

The vehicle will not start to move for 1.5 seconds after the driver reaches a decision to cross the line

If a vehicle driver decides to cross the line when no train is visible from the driving position, when the front of the vehicle is at the decision point, then the rear of the vehicle will be at least 2 metres clear of the tracks five seconds before any train arrives at the crossing

Warning time is the time taken to make a crossing over the distance defined in section 3(f) ii plus 6.5 secs.

Safe Sighting distance = Train Speed (metres / sec) x warning time (sec)

Formula for calculating distances for differing gauges & line speeds

The figures given in the body of the text cover the majority of uses. Where conditions are significantly different duty holders may calculate the distances by applying the following formula:

For vehicular crossings:

Warning time = (Crossing distance in metres / 1.34) + 6.5 seconds.

Crossing distance = (Distance from the decision point on one side of a crossing to the decision point on the other side measured on the centreline of the crossing over all tracks + overall length of vehicle and any trailer).

end of appendices

APP-G – DEFRA SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE, 2008

SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1.

Suresh Surendran and Geoff Gibbs (Environment Agency),
Steven Wade and Helen Udale-Clarke (HR Wallingford)
May 2008

Introduction

This document is a supplementary note to reconcile information provided in the 'Flood Risks to People Methodology' (FD2321/TR1[1]) and the 'Framework and Guidance for Assessing and Managing Flood Risk for New Development' (FD2320/TR2[2]) reports about the Flood Hazard Rating. It has been produced because both PPS25 in England and TAN15 in Wales require that people should be appropriately safe around new development. The document emphasises that for FRAs and FCAs at all levels to inform development allocations and proposals the simplified approach of FD2320 with regard to flood hazard rating should be used rather than the approach in FD2321. Although the final version of FD2321/TR1 post-dates FD2320/TR2, the work presented actually pre-dates the guidance in FD2320/TR2. This supplementary guidance is issued for those involved in development planning and control and to clarify the detail or difference of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1.

FD2321/TR1 was a research project based on the detailed literature review and analysis of empirical evidence related to flood hazard, derived mainly from theoretical assumptions and some basic laboratory experiments. Factors that affected flood hazard and vulnerability were combined in a form of multi-criteria analysis that was be used to identify the hot-spots and broadly estimate the probability of people seriously harmed and fatalities during the event of a flood. The multi-criteria method was calibrated to actual events, validated using data from seven flood events and shown to work well. The FD2321 (Risk to people) methodology illustrates the fundamental concepts and demonstrate how the approach could be used for different applications - it did not set a policy for flood hazard thresholds.

(Nevertheless there are a number of assumptions used in the FD2321 methodology, particularly with respect to the impact of debris and people's behaviour during flood events. There is a requirement for further research to collate more evidence on flood hazard, particularly the impacts of debris, and vulnerability in order to refine assumptions made in the flood hazard calculations, flood hazard thresholds and risks to people guidance. The study recommend more laboratory and field based tests on the impact of physical water quality aspect such as debris, mudflow; chemical and biological water quality that cause seriously harm or fatalities to people.)

[1] Defra and Agency (2006) *The Flood Risks to People Methodology*, Flood Risks to People Phase 2, FD2321 Technical Report 1, HR Wallingford et al. did the report for Defra/EA Flood and Coastal Defence R&D Programme, March 2006.
(http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2321_3436_TRP.pdf)
[2] Defra and Agency (2005) *Framework and Guidance for Assessing and Managing Flood Risk for New Development*, Flood Risk Assessment Guidance for New Development, FD2320 Technical Report 2, HR Wallingford et al. did the report for Defra/EA Flood and Coastal Defence R&D Programme, October 2005.
(http://sciencesearch.defra.gov.uk/Document.aspx?Document=FD2320_3364_TRP.pdf)

FD2320/TR2 (FRA guidance for new development) provides guidance that is a specific interpretation of the methodology developed under FD2321, within the context of development planning and control. Based on FD2320 consultation workshops, the project board (key users and experts) advised the project team to provide a simple methodology. Due uncertainties and limitations related to estimating risks to people, FD2320 adopted a precautionary approach, particularly with respect to the selection of debris factors and flood hazard thresholds

Risk to People (Ninj)

Ninj = **Nz** x **Flood Hazard Rating** x **Area Vulnerability** x **People Vulnerability**

where,

Ninj (Risk to People) = number of injuries within a particular hazard 'zone';
Nz = number of people within the hazard zone (at ground/basement level);
Flood Hazard Rating = HR = function of flood depth/velocity (within the hazard zone being considered) and debris factor;
Area Vulnerability = function of effectiveness of flood warning, speed of onset of flooding and nature of area (including types of buildings); and
People Vulnerability = function of presence of people who are very old and/or infirm/disabled/long-term sick

Flood Hazard Rating (HR) and thresholds

The revised 'hazard rating' expression based primarily, on consideration to the direct risks of people exposed to floodwaters.

HR = **d** x (**v** + **n**) + **DF**

where, HR = (flood) hazard rating;
d = depth of flooding (m);
v = velocity of floodwaters (m/sec); and
DF = debris factor (0, 0.5, 1 depending on probability that debris will lead to a hazard)
n = a constant of 0.5

This final revised Flood Hazard Rating formula from the Flood Risks to People project is presented on page 10 (section 3.5) of FD2321/TR1. The formula is identical in both FD2320 and FD2321 reports.

Based on Table 3.2 of FD2321, the Figure 3.2 of FD2321 illustrates the "Hazard to People Classifications" as a function of depth, velocity and debris factor. Such categorisation and the look-up table with flood hazard threshold could be useful for a range of application as an initial indication of Risks to People.

In this case (Figure 3.2 of FD2321) the calculation takes a debris factor as zero (**HR** = **d** x (**v** + **0.5**) + **0**).

However FD2321 strongly recommends the use of the debris factor and the formulas described in the Guidance Document for further calculation. The Table 3.1 of FD2321/TR1 (Table 1 of this note) suggests appropriate debris factors for different depths, velocities and the dominant land use.

Table 1: Guidance on debris factors for different flood depths, velocities and dominant land uses. (Source FD2321 Table 3.1):

Depths (d)	**Pasture/Arable**	**Woodland**	**Urban**
0 to 0.25 m	0	0	0
0.25 to 0.75 m	0	0.5	1
d>0.75 m and\or v>2	0.5	1	1

The way that Flood Hazard Rating and thresholds have been presented in Table 13.1 in FD2320/TR2 compared to Figure 3.2 of FD2321/TR1

A concern was raised in the FD2320 consultation workshops and by the FD2320 Project Board during discussions on FD2321, that the methodology was complex and the results presented in the Figure 3.2 of FD2321 were not reflecting the potential risk to people (as this table was of hazard rating for different depths and velocity without debris). There was a need for further work to include debris, area vulnerability and people vulnerability aspects. They requested a simpler single table to represent the risk to people.

For example Figure 3.2 of FD2321 did not reflect the fact that there is a risk from drowning even at low depths and velocities. In reality FD2321/TR1 recognises this but only in the subsequent "people vulnerability" calculation (risk to children, old, sick and disable). For still water up to 1.25m depth, the Figure 3.2 of FD2321/TR1 assumes that there is low hazard, if there are no debris or vulnerable group. However to avoid further calculation, but include the vulnerability aspect the Table 13.1 of FD2320 for still water with the depths between 0.25–1.25m were reclassified as "danger to some", which was felt to be more appropriate for development planning and control, where users may make use of flood hazard without completing he more complex full calculations including people and area vulnerability.

Similarly Figure 3.2 of FD2321/TR1 shows that at the depth of 0.25m, if there is no debris then up to the flow velocity of 2.0 m/sec there would be low hazard. However FD2321/TR1 suggests the usage of an appropriate debris factor dependent on depth, velocity and the dominant land use. To make the process simpler (whatever the land use), FD2320/TR2 includes a default debris factor. In the Table 13.1 of FD2320/TR2 a debris factor of 0.5 has been applied for depths less than and equal to 0.25m and a debris factor of 1.0 has been used for depths greater than 0.25m. Therefore, in the Table 13.1 of FD2320/TR2 at the depth of 0.25m, up to the flow velocity of 0.30 m/sec is treated as low hazard.

Table 3.2 of FD2321/TR1 (Table 2 of this note) provides thresholds for classifying the hazard to people. In the FD2321/TR1 report the threshold between "danger for most" and "danger for all" is 2.5 and it was used as an initial indication of Risk to People (further calculation is recommended using the formulas). However as there is no further analysis in FD2320 but the Project Board decided that the threshold between "danger for most" and "danger for all" should be more precautionary and a Flood Hazard Rating of 2.0 is selected as a key threshold. i.e. In FD2321 the threshold for "danger for all" is 2.5 and it lowered to 2.0 in FD2320. Therefore, the Flood Hazard Rating between 2.0 to 2.5 in FD2320 is not classified as it is in FD2321.

Table 2: Hazard to People (Source Table 3.2 in FD2321/TR1)

Thresholds for Flood Hazard Rating H = d x (v + 0.5) + DF		**Degree of Flood Hazard**	**Description**
FD2321	**FD2320**		
<0.75	<0.75	Low	**Caution -** "Flood zone with shallow flowing water or deep standing water"
0.75 - 1.25	0.75 - 1.25	Moderate	**Dangerous for some (i.e. children) -** "Danger: Flood zone with deep or fast flowing water"
1.25 - 2.5	1.25 - 2.0	Significant	**Dangerous for most people -** "Danger: flood zone with deep fast flowing water"
>2.5	>2.0	Extreme	**Dangerous for all -** "Extreme danger: flood zone with deep fast flowing water"

The final difference between Table 13.1 in FD2320/TR2 and Figure 3.2 of FD2321/TR1 is the use of smaller increments of depth, so that lower depths are presented more fully in FD2320/TR2. This was felt to be more helpful for identifying what might be judged as acceptable depending on site specific circumstances.

Conclusions

Table 13.1 of FD2320 and Figure 3.2 of FD2321 look very similar but there are significant differences (see Table 3 of this paper). Either Table/Figure can be used as the basis for assessing the risks to people associated with different flood depths velocities and debris factors.

Table 3: comparison of Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1

	In Table 13.1 of FD2320/TR2	**In Figure 3.2 of FD2321/TR1**
The depths above 0.25m	Danger for some, most or all	For still water, up to 1.25m the hazard is low (In addition to hazard rating further calculation to include vulnerability aspect is recommended)
Debris factor	Debris factor of 0.5 has been applied for depths $\leq$0.25m and a debris factor of 1.0 has been used for depths $\geq$ 0.25m.	In this case a Debris factor of zero applied (in addition to this further calculation is recommended using debris factor and the formulas)
HR Thresholds for "Dangerous for all" hazard classification	>2.0 (precautionary due to uncertainties and to avoid further calculation as FD2321)	>2.5
Increments of depth	Small increments at lower depths	Every 0.25 m

Table 13.1 of FD2320/TR2 is a simple method applies the precautionary principle and uses suitable assumptions (so that there is no need for further calculations) for application in the development planning and control context (see Table 4 of this paper - an extended version of table 13.1).

This table is recommended for development planning and control use.

Table 4 – Hazard to People Classification using Hazard Rating *(HR= d x (v + 0.5) + DF)* for (Source Table 13.1 of FD2320/TR2 - Extended version)

HR	Depth of flooding - d (m)												
	DF = 0.5				DF = 1								
Velocity - v (m/s)	0.05	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.0	0.03 + 0.5 = 0.53	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.13 + 0.5 = 0.63	0.15 + 1.0 = 1.15	0.20 + 1.0 = 1.20	0.25 + 1.0 = 1.25	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.75 + 1.0 = 1.75	1.00 + 1.0 = 2.00	1.25 + 1.0 = 2.25
0.1	0.03 + 0.5 = 0.53	0.06 + 0.5 = 0.56	0.12 + 0.5 = 0.62	0.15 + 0.5 = 0.65	0.18 + 1.0 = 1.18	0.24 + 1.0 = 1.24	0.30 + 1.0 = 1.30	0.36 + 1.0 = 1.36	0.48 + 1.0 = 1.48	0.60 + 1.0 = 1.60	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50
0.3	0.04 + 0.5 = 0.54	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.19 + 0.5 = 0.69	0.23 + 1.0 = 1.23	0.30 + 1.0 = 1.30	0.38 + 1.0 = 1.38	0.45 + 1.0 = 1.45	0.60 + 1.0 = 1.60	0.75 + 1.0 = 1.75	1.13 + 1.0 = 2.13	1.50 + 1.0 = 2.50	1.88 + 1.0 = 2.88
0.5	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.25 + 0.5 = 0.75	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.60 + 1.0 = 1.60	0.80 + 1.0 = 1.80	1.00 + 1.0 = 2.00	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	2.50 + 1.0 = 3.50
1.0	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.38 + 0.5 = 0.88	0.45 + 1.0 = 1.45	0.60 + 1.0 = 1.60	0.75 + 1.0 = 1.75	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50	2.25 + 1.0 = 3.25	3.00 + 1.0 = 4.00	3.75 + 1.0 = 4.75
1.5	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.50 + 0.5 = 1.00	0.60 + 1.0 = 1.60	0.80 + 1.0 = 1.80	1.00 + 1.0 = 2.00	1.20 + 1.0 = 2.20	1.60 + 1.0 = 2.60	2.00 + 1.0 = 3.00	3.00 + 1.0 = 4.00	4.00 + 1.0 = 5.00	5.00 + 1.0 = 6.00
2.0	0.13 + 0.5 = 0.63	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	0.63 + 0.5 = 1.13	0.75 + 1.0 = 1.75	1.00 + 1.0 = 2.00	1.25 + 1.0 = 2.25	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	3.50	4.75	6.00	7.25
2.5	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.60 + 0.5 = 1.10	0.75 + 0.5 = 1.25	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50	1.80 + 1.0 = 2.80	3.40	4.00	5.50	7.00	8.50
3.0	0.18 + 0.5 = 0.68	0.35 + 0.5 = 0.85	0.70 + 0.5 = 1.20	0.88 + 0.5 = 1.38	1.05 + 1.0 = 2.05	1.40 + 1.0 = 2.40	1.75 + 1.0 = 2.75	3.10	3.80	4.50	6.25	8.00	9.75
3.5	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.80 + 0.5 = 1.30	1.00 + 0.5 = 1.50	1.20 + 1.0 = 2.20	1.60 + 1.0 = 2.60	3.00	3.40	4.20	5.00	7.00	9.00	11.00
4.0	0.23 + 0.5 = 0.73	0.45 + 0.5 = 0.95	0.90 + 0.5 = 1.40	1.13 + 0.5 = 1.63	1.35 + 1.0 = 2.35	1.80 + 1.0 = 2.80	3.25	3.70	4.60	5.50	7.75	10.00	12.25
4.5	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	1.00 + 0.5 = 1.50	1.25 + 0.5 = 1.75	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	3.50	4.00	5.00	6.00	8.50	11.00	13.50
5.0	0.28 + 0.5 = 0.78	0.60 + 0.5 = 1.10	1.10 + 0.5 = 1.60	1.38 + 0.5 = 1.88	1.65 + 1.0 = 2.65	3.20	3.75	4.30	5.40	6.50	9.25	12.00	14.75

Flood Hazard Rating (HR)	Colour Code	Hazard to People Classification
Less than 0.75		Very low hazard - Caution
0.75 to 1.25		Danger for some – includes children, the elderly and the infirm
1.25 to 2.0		Danger for most – includes the general public
More than 2.0		Danger for all – includes the emergency services

APP-H – ECML FREEDOM OF INFORMATION REQUEST FOI 696

Peter Easthope
By email: request-284313-83580abb@whatdotheyknow.com

Network Rail
Freedom of Information
The Quadrant
Elder Gate
Milton Keynes
MK9 1EN

T 01908 782405
E FOI@networkrail.co.uk

10 September 2015

Dear Mr Easthope,

Information request
Reference number: FOI2015/00696

Thank you for your request of 8 August 2015 You originally requested the following information:

'How many minutes delay have OD (Obstacle Detection) *crossings incurred compared to the manned level crossings they replaced?*
Also; how many of the installed OD crossings are still 'manned', by Network Rail staff or not, to ensure they function correctly.'

After we sought clarification and advised you to narrow your request, you requested the following:

'Please limit the information for delay minutes to;
North Carr LC
As a manned crossing for the period 01/02/2014 to 01/08/2014
As a OD crossing for the period 01/02/2015 to 01/08/2015 also
for any single one of the recently converted crossings on the East Coast main line
As a manned crossing for the final six months of its manned operation
As a OD crossing for the most recent six months of operation as an OD crossing.

The query regarding recently converted OD crossings being manned, by NR staff or otherwise, remains.'

I have processed your request under the terms of the Freedom of Information Act 2000 (FOIA).

Delay minutes

I can confirm that we hold the information you requested. Please find attached the delay minutes for North Carr level crossing from 1 February 2014 to 1 August 2014 and from 1 February 2015 to 1 August 2015. Please also find attached the delay minutes for Moss level crossing on the East Coast Main Line from 1 September 2014 to 28 April 2015 and from 29 April 2015 (date of conversion to OD level crossing) to 31 July 2015. Please note these are the delay minutes caused at the level crossing and do not specifically relate to a fault caused by the OD aspect of the crossing.

'Manned' OD Crossings

Manually Controlled Barrier (MCB)-Obstacle Detection level crossings are not manned. However, when MCB-OD level crossings are new to an area, an attendant is sometimes organised for a couple of weeks after the commissioning as a precaution to reduce train delay and congestion. The attendant is able to provide a rapid response to any issue that may arise and be the first "railway" responder on site. In the case of a large number of new MCB-OD crossing conversions a couple of attendants may be provided.

Obstacle Detection level crossings- further information

An MCB-OD crossing is an evolution of MCB or MCB-CCTV style of crossing where the crossing clear function that the signaller would normally provide is now provided by OD technology. The OD system uses two forms of technology to scan the crossing, one is a radar system and the other is a laser scanning system called LiDAR. The role of radar system is to check that there are no large obstacles remaining on the crossing before the protecting signal is allowed to be cleared. Several European railways use radar technology to monitor level crossings. The radar cannot detect an individual lying on the track, although this does not represent a derailment risk, to improve public safety we have included a secondary piece of equipment called LIDAR to detect the presence of a person lying on the crossing.

There are currently 61 MCB-OD crossings nationally with various configurations. For example there may be variation in the number of barriers, number of railway lines, types of level crossing controller, types of signalling interlocking system and types of signallers control (panels and visual display units). The first crossings were installed in August 2012.

We have learned a number of lessons after the initial installation of the OD level crossings. These have related to various problems including the site specific setup, the equipment itself and the number and position of the scanners. Some examples of

the types of issues we have encountered and addressed to improve OD level crossings are included below.

1. LiDAR dirty lenses – motorised shutters are now included to keep LiDAR lenses clean from spray from passing trains. Not all sites have been retrofitted yet, where this is the case the lenses are cleaned on a regular basis.
2. Low Level LiDAR scanner configuration – the safety benefit of low level LiDAR scanners was reviewed following initial problems with unwanted detection of debris, vegetation, fallen snow etc. After application of the new Low Level LiDAR setup, the reliability has been significantly improved.
3. New setup procedures and parameters in the Radar and LiDAR scanners have been implemented to make them more effective in extreme weather, these measures have significantly improved reliability.

We have identified and addressed several OD technology related issues and when the OD level crossings are installed and set up using all the latest techniques the crossings have performed well. Level crossing failures can also occur from non-OD related issues, such as barrier machine failures, relay high resistance failures and would occur even if the crossing were not an MCB-OD, these non-OD related types of failures cause a larger proportion of faults than OD related failures.

If you have any enquiries about this response, please contact me in the first instance at FOI@networkrail.co.uk or on 01908 782405. Details of your appeal rights are below.

Please remember to quote the reference number at the top of this letter in all future communications.

Yours sincerely

Danielle Stratton
Information Officer

Appeal Rights
If you are unhappy with the way your request has been handled and wish to make a complaint or request a review of our decision, please write to the FOI Compliance and Appeals Manager at Network Rail, Freedom of Information, The Quadrant, Elder Gate, Milton Keynes, MK9 1EN, or by email at foi@networkrail.co.uk. Your request must be submitted within 40 working days of receipt of this letter.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at:

Information Commissioner's Office
Wycliffe House
Water Lane
Wilmslow
Cheshire SK9 5AF

Section Name	Date	Attributed Minutes	Incident Number	Incident Reason	Incident Reason Name	Incident Description	Incident Reason Description	Incident Category	Incident Category Description
Bessacarr Jn to Gainsborough Trent Jns	05/02/2015	516	176594	ID	LEVEL XING	BECKGHM OD LC FLR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Bessacarr Jn to Gainsborough Trent Jns	04/03/2015	8	239408	ID	LEVEL XING	BECKGHM NORTH CARR LC FLR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Bessacarr Jn to Gainsborough Trent Jns	10/04/2015	14	322948	ID	LEVEL XING	BECKGHM LC FLR NORTH CARR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Bessacarr Jn to Gainsborough Trent Jns	31/05/2015	13	425755	ID	LEVEL XING	BECKGHM LC FLR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Bessacarr Jn to Gainsborough Trent Jns	22/06/2015	23	470984	ID	LEVEL XING	BECKGHM NORTH CARR LC FLR OD	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Bessacarr Jn to Gainsborough Trent Jns	02/07/2015	3	493718	ID	LEVEL XING	BECKGHM LC FLR NORTH CAR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
	TOTAL MINUTES	**577**							

Section Name	Date	Attributed Minutes	Incident Number	Incident Reason	Incident Reason Name	Incident Description	Incident Reason Description	Incident Category	Incident Category Description
Shaftholme Jn	10/06/2015	3	446628	ID	LEVEL XING	MOSS LC FLR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Shaftholme Jn to Temple Hirst Jn.	05/05/2015	111	371685	ID	LEVEL XING	JNCRMOS MOSS LC FLR BOOM	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Shaftholme Jn to Temple Hirst Jn.	05/05/2015	3	372278	ID	LEVEL XING	MOSS OD LC FLR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Temple Hirst Jn. to Shaftholme Jn	04/05/2015	600	370450	ID	LEVEL XING	JNCRMOS LC FLR	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
Temple Hirst Jn. to Shaftholme Jn	12/06/2015	55	451126	ID	LEVEL XING	MOSS LC FLR MOSS	Level crossing failure incl. barrow/foot crossings & crossing treadles	103	Level crossing failures
	TOTAL MINUTES	**772**							

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