By email: d[redacted]

Network Rail
Freedom of Information
The Quadrant
Elder Gate
Milton Keynes
MK9 1EN

T 01908 782405
E FOI@networkrail.co.uk

26th June 2018

Dear [redacted],

Information request
Reference number: FOI2018/00689

Thank you for your email of 1st June 2018. You requested the following information:

'I am currently in the process of writing a dissertation in Railway Systems and Engineering and Integration and wondered whether it would be possible to provide some asset information on Bentley Heath Level Crossing please?

1. *The risk assessment for Bentley Heath Level Crossing*
2. *The expected reliability rate (failure rate) of Bentley Heath Level Crossing as a Mean Time Between Failure (MTBF). (if not a general failure rate of a level crossing would be good).*
3. *The expected maintainability rate of Bentley Heath Level Crossing as a Mean Time To Repair rate (MTTR).'*

I have processed your request under the terms of the Freedom of Information Act 2000 (FOIA).

I can confirm that we hold some of the information you requested. Please find attached the Risk Assessment for Bentley Heath Level Crossing.

In relation to the Mean Time Between Failure (MTBF) rate, we do not hold this information for individual crossings. To assist you further please find attached information relating to the national figures for the type of level crossing that are similar to the one at Bentley Heath.

In relation to Mean Time to Repair (MTTR) rate for Bentley Heath level crossing, our expert in the business has estimated this by using the 'first arrival on site time' and the 'first completed work time' to establish the amount of time on site for each fault to be investigated and repaired, where this information is recorded.

Between 3rd March 2010 and 29th March 2018 there were a total 57 reported faults investigated with a total of 7970 minutes on site which gives an average time to repair of 140 minutes. This figure excludes any travel time to site as this data is not available.

Please note I have removed the names of individuals and the BTP reference numbers from the risk assessment under s40 (2) of the FOIA. This exemption allows us to withhold information in circumstances where its disclosure would breach the data protection principles set out at s.35 of the Data Protection Act 2018 and Article 5 of the General Data Protection Regulations. In this instance, disclosure would breach the first principle which mandates that data must be processed fairly and lawfully. The individuals involved in these incidents would have had no expectation that this information would be disseminated to the world at large through the FOI process. It would not be fair processing of their data to disregard these legitimate expectations.

I hope you find this information useful. 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

London North Western (LNW) Route
Level Crossing Risk Assessment

Bentley Heath

Manually Controlled Barriers with CCTV

14th December 2017

CONTENTS

1 INTRODUCTION

1.1 Reason for the risk assessment

Network Rail has a responsibility and legal duty under the Health and Safety at Work Act 1974 for the health, safety and welfare of its employees and for protecting others against risk.

Network Rail also has a legal responsibility under the Management of Health and Safety at Work Regulations 1999. Section 3 focuses on the requirement for suitable and sufficient assessments of risk to health and safety of employees and others in connection with their undertaking.

Network Rail is committed to reducing the risk on the railway and has identified that one of its greatest public risks is at level crossings. This is where the railway has a direct interface with other elements e.g. vehicles and/or pedestrians. Network Rail is working to reduce this risk to as low as is reasonably practicable.

2 DESCRIPTION OF THE SITE

2.1 Level crossing details

Name of crossing	Bentley Heath
Type	MCBCCTV
Engineers Line Reference (ELR)	DCL
Mileage	119m 43c
OS grid reference	SP164756
Number of lines crossed	2
Line speed (mph)	100
Electrification	No
Signal box	West Midlands Signalling Centre
Risk assessment next due date	14th March 2020

As part of a level crossing risk assessment, data is entered into the industry accepted risk modelling support tool (All Level Crossing Risk Model) which enables Network Rail to compare risk at all level crossings throughout the network. Results for this level crossing are provided below; see Appendix A for further details on how this is calculated.

ALCRM Risk Details	
Risk Score	F4
FWI	0.002387775

Bentley Heath level crossing is a protected crossing. This means that the crossing is protected from train movements ensuring that trains are not authorised to pass over the crossing until the crossing is closed and the crossing area has been checked to be clear.

Bentley Heath level crossing is also known as an active crossing as there is an active method of warning is provided to warn users of an approaching train.

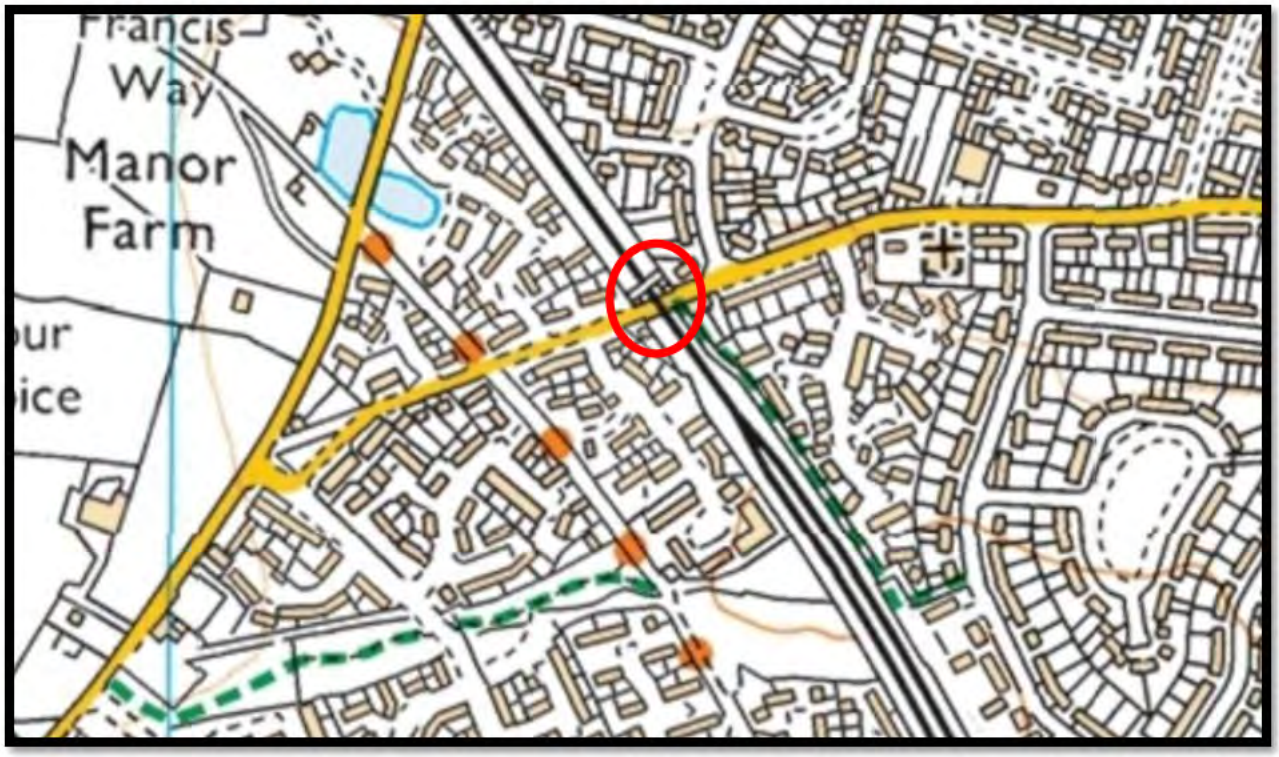
At present, there are 770 level crossings on the LNW route. Out of this figure Bentley Heath crossing is ranked number 116. However, if you compare this level crossing to other crossings of a similar type it is ranked 28 out of 55 (MCBCCTV).

It should be noted that until an updated ranking spreadsheet is produced these rankings are inaccurate. The new ALCRM input and increase in risk score since the last risk assessment will mean that the crossing is ranked higher.

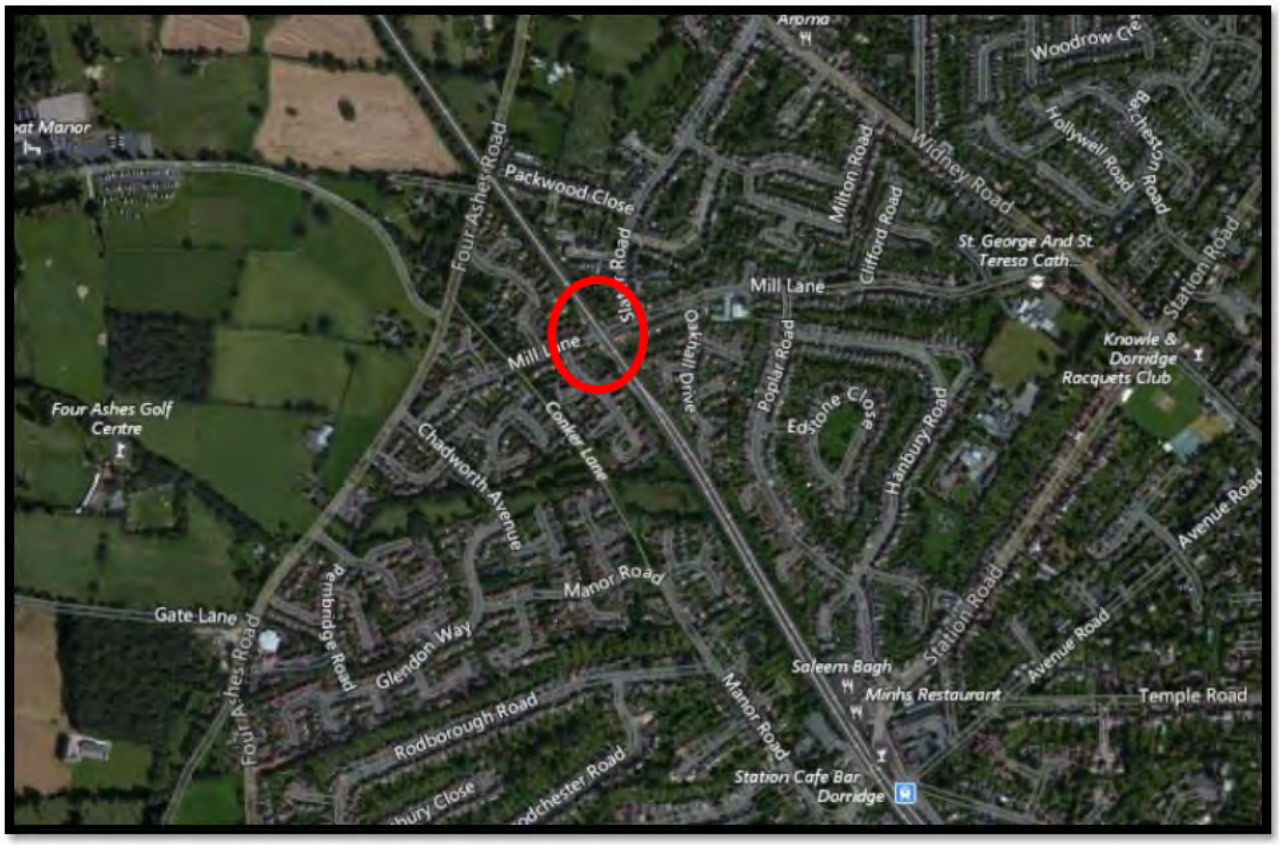
2.2 Crossing imagery

Route View of Crossing

Ordnance Survey Map of Crossing Location



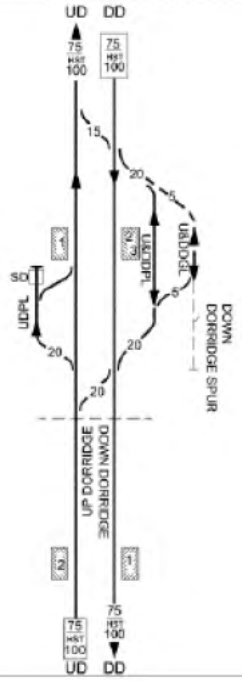
Aerial View of the Surrounding Area (Bing Maps)



Sectional Appendix for Crossing Location

LOR	Seq.	Line of Route Description	ELR	Route	Last Updated
MD401	011	Heyford to Bordesley Junction	DCL	LNW South	01/07/2017

Location	Mileage M Ch	Running lines & speed restrictions	Signalling & Remarks
Dorridge South Jn	118 53		
DORRIDGE	118 75		
Dorridge North Jn	119 38		
Bentley Heath LC (CCTV)	119 43		
WIDNEY MANOR	120 66		



TCB West Midlands S.C. (LJ)
North Warwick Workstation

GSM-R

UD: Up Dorridge
DD: Down Dorridge

Axle Counter area

Class 67, 68 and Mark 3 day coaches are permitted to run at HST speeds between Warwick Parkway and Tyseley.

Platform lengths: Dorridge
Platform 1 - 188 metres (206 yards)
Platform 2 - 188 metres (206 yards)
Platform 3 - 183 metres (200 yards)

U&DDGL: Up & Down Dorridge Goods Loop
Up direction: 810 metres (886 yards)
Down direction: 852 metres (932 yards)
Turnback: 706 metres (772 yards)

U&DDPL: Up & Down Dorridge Passenger Loop
Up direction: 841 metres (920 yards)
Down direction: 852 metres (932 yards)
Turnback: 706 metres (772 yards)

UDPL: Up Dorridge Passenger Loop
525 metres (574 yards)

Exceptional Rail Head conditions:
Down Dorridge between 118m 00ch and 119m 20ch
Up Dorridge between 120m 00ch and 118m 60ch

Platform lengths: Widney Manor
Platform 1 - 143 metres (156 yards)
Platform 2 - 142 metres (155 yards)

Up side approach to the Crossing

Down side approach to the Crossing

Additional photographs of the surrounding environment are provided in Appendix B.

2.3 Crossing environment

The crossing is located between Dorridge and Widney Manor stations on the DCL line that can take passengers between Birmingham and Banbury. The immediate surrounding area to the crossing in all directions consists of residential properties. To the North of the crossing is the village of Bentley Heath, to the North East lies the village of Knowle and to the South lies the village of Dorridge. Further afield to the North is the town of Solihull and to the East is the busy M42, one of the major motorways around the West Midlands area. The majority of the local amenities are found in the village of Dorridge which has the closest railway station and a small town that includes the usual supermarkets, small shops and eateries. It is important to note that there are a number of schools in the area with Bentley Heath Church of England Primary School to the North, Dorridge Primary School to the East, St George and Teresa Catholic Primary School also to the East and the Arden Academy to the North East.

2.4 Approach to crossing

At this location the crossing spans two lines with a maximum line speed of 100mph. The railway is orientated from South East to North West. The crossing and approach roads are orientated from East to West.

The immediate approach from the East of the crossing, Mill Lane, is long and straight with good sighting of the crossing itself and road traffic signals, although if not maintained by the owner of the property or the level crossing manager on the

nearside of the crossing a large holly bush could hinder the nearside road signal. The road is flat and in good condition with no significant gradient. The crossing deck is also flat, in a reasonable condition and is made from rubber. Slater Road is situated around 100m from the crossing itself and this links to Widney Road which is one of the main routes for locals in the area to get to local amenities.

The approach from the West, again Mill Lane, is also long and straight. The road surface is in good condition and flat with no significant gradient. There is good sighting of the crossing and the road traffic signals although at certain times of the year vegetation growth could hinder one or both road traffic signals. With the permission of the property owners the bushes and trees in question are maintained by the local level crossing manager to ensure sighting is acceptable throughout the year. Within 100-200m of the crossing lies Winster Avenue and Buckminster Drive, these are both cul-de-sacs and lead to residential properties only. Further back along Mill Lane the road leads onto Four Ashes Road which is again a busy road for locals to get around.

The road speed from both sides of the crossing is 30mph although approximately 25% of users appear to be travelling above this speed. The barriers at the crossing can be down for a considerable amount of time and on occasions, have been timed at around 10 minutes for numerous trains to pass through. On average, the barriers are down for approximately 5 minutes as it is often the case that more than one train will pass over the crossing when the barriers are activated. It is estimated that the barriers are down for approximately 35-40 minutes in every hour.

To note, a few metres away from the crossing on the West side are two access gates, one either side of the road, to railway infrastructure. Please see the table in section 3.2 for the correct mitigation if and when the access gates are required for use.

Access Gates on Either Side of the Crossing

For pedestrian users it is important to note that there is a stepped footbridge located adjacent to the crossing with direct access on either side of the crossing from the approach footpaths. The bridge is well used when the barriers are lowered although mobility impaired users or users with pushchairs and cycles are unable to use it.

Footbridge at the Crossing

2.5 Crossing usage

Normal passenger services run between the hours of 05:00 and 00:00 with freight running through the full 24 hours. For the purposes of the ALCRM input train operating times have been recorded as 24 hours a day.

Research showed that passenger services can number between 206 and 207 services per day so the slightly higher figure was used. Passenger services are operated by West Midlands Trains, Cross Country Trains and Chiltern Trains. Freight services numbered between 59 and 63 services per day, so again the higher figure of 63 was used. The number and frequency of services, specifically freight, can fluctuate depending on operational requirements, engineering works or during times of disruption.

A quick census was completed on the 7th November 2017 which involved a count of users by the risk assessor. During this 30 minute period 37 cars, 1 HGV, 3 small vans/lorries, 1 motor cyclist/cyclist and 6 pedestrians were counted. No buses were

counted as the route over the crossing is not a bus route. To note, 4 of the pedestrian users were using pushchairs.

User Type	Number
Cars	37
Vans / Small Lorries	3
Buses	0
HGVs	1
Pedal / Motor Cycles	1
Pedestrians	6
Horses / Horse Riders	0
Animals on the Hoof	0
Tractors / Farm Vehicles	0

This information was fed into the ALCRM risk model and generated a total usage figure for vehicles of 1107 per day and a total usage figure for pedestrians of 189 per day. In the experience of the risk assessor this information appears to be reasonably accurate. There are no known special events in the local area that would see a dramatic spike in usage levels at a certain time of the year.

During the census there was no evidence to suggest that any of the users would be determined as vulnerable. However, from knowledge of the crossing and despite the fact that the crossing is protected, it is important to note that it is known that a reasonably high number of school children use the crossing to get to school and back so it has been recorded that there are vulnerable users here. There are also a number of elderly users although their numbers are not deemed to be high. It should also be noted that a visual census does not fully identify all users with protected characteristics.

Again, from knowledge and experience of the crossing, it is believed that the majority of users, both in vehicles or as pedestrians, are regular users. It appears from conversations with users that people who use the crossing are locals going to local amenities or using it as a regular route to go to work or school.

3 HAZARDS

3.1 Sighting and traverse

Bentley Heath level crossing is protected by road traffic light signals and lifting barriers on both sides of the railway. An audible warning to pedestrians is also provided. The barriers are normally kept in the raised position and, when lowered, extend across the whole width of the carriageway on each approach. Sighting and traverse times are not calculated for protected crossings.

At this point it is also important to note how the crossing actually works as although the sequence is automated it still has human involvement to ensure that when the

barriers are down it is safe to allow a train to pass over the crossing. A train strikes in at a point on the rails and the sequence for the barriers to lower begins, this is when the CCTV screen for the crossing at the signallers' workstation also activates. For Bentley Heath this involves the North Warwick workstation at the West Midlands Signalling Centre. Once the barriers are lowered the signaller will check the crossing to see if it is safe for a train to pass over it. If it is the signaller will press his crossing clear button and the track signals will show a proceed aspect. If for any reason there is a problem or an incident where a train cannot pass over the crossing the track signal will be kept at danger and trains on the approach to the crossing will have to stop and not be allowed to pass over the crossing.

3.2 Identified hazards and risks

Hazard	Potential impact	Mitigations
Trains	Fatality or serious injury	• Level crossing signage. • Barriers present to prevent access to railway as trains approach. • Road Traffic Signals (RTS) in place for visual warning of crossing sequence. • Audible warning present for pedestrian users to warn of crossing sequence. • Standard crossing layout, compliant with Office of Rail and Road guidance.
Slip, trip, falls	Fatality or serious injury	• Appropriate crossing decking for crossing type and location. • Regular crossing inspections and maintenance regime in place. • Vegetation management plan in place.
Difficulty on hearing approaching trains due to inclement weather	Fatality or serious injury	• Level crossing signage. • Vegetation management plan in place. • Barriers present to prevent access to railway as trains approach. • Road Traffic Signals (RTS) in place for visual warning of crossing sequence. • Audible warning present for pedestrian users to warn of crossing sequence.
Darkness	Fatality or serious injury	• Review of night time usage completed.
Vegetation growth between visits reducing the ability to see trains approaching crossing	Fatality or serious injury	• Vegetation management plan in place. • Regular inspection and maintenance regime in place. • Barriers present to prevent access to railway as trains approach. • Road Traffic Signals (RTS) in place for visual warning of crossing sequence. • Audible warning present for pedestrian users to warn of crossing sequence.
Unfamiliar users	Fatality or serious injury	• Standard crossing layout, compliant with Office of Rail and Road guidance.

		• Instructional signage at crossing • Level crossing safety awareness days. • Barriers present to prevent access to railway as trains approach. • Road Traffic Signals (RTS) in place for visual warning of crossing sequence. • Audible warning present for pedestrian users to warn of crossing sequence.
Increased usage due to future developments	Fatality or serious injury	• Review and update this risk assessment appropriately.
Sun glare	Fatality or serious injury	• Not on the list of crossings potentially at risk of Sun Glare. • Recorded as tolerable risk for sun glare. • Not a known issue at this crossing.

The risk assessment is based on data collected at the crossing and entered into ALCRM. This is a computer-based application used by Network Rail to assist in the risk management of level crossings. The risk result consists of a 'letter' and 'number' classification of safety risk, giving the 'letter' (A-M for individual risk) or 'number' (1-13 for collective risk) band. These rankings represent the range of risk across all types of crossings where A and 1 are the highest and M and 13 are the lowest.

Safety Risk					
Individual Risk	F				
Collective Risk	4				
User Type	**Ind Risk (Fraction)**	**Ind Risk (Numeric)**	**Collective Risk**	**Derailment**	
Car	1 in 3344481	2.99E-07	2.74E-04		
Van / Small Lorries	1 in 216590	4.62E-06	2.22E-05		
HGV	1 in 219154	4.56E-06	2.44E-06		
Bus	0	0	0		
Tractor / Farm Vehicle	0	0	0		
Cyclist / Motorcyclist	1 in 69876	1.43E-05	2.82E-04		
Pedestrian	1 in 69876	1.43E-05	0.001692434		
Passengers			3.08E-05	98.6402322	
Staff			8.41E-05	5.255801208	
Total			**0.002387775**	1.45782803	
Collision Frequencies					
		Train / User		**User Equipment**	**Other**
Vehicle:		3.57E-04		0.19292618	1.89E-04
Pedestrian:		0.002288478		0.002051487	0.003792634

Collision Risk					
		Train / User		**User Equipment**	**Other**
Vehicle:		2.98E-04		0	0
Pedestrian:		0.001858244		3.28E-05	8.34E-05

4 SAFETY MANAGEMENT INFORMATION SYSTEM

4.1 Network Rails internal safety management information systems have been interrogated and revealed that during the previous 5 years there have been 10 reported incidents at the crossing, see details below.

12th December 2017 - 12:57 A breakdown van was trapped inside of Bentley Heath barriers when they lowered in auto mode for 2R25. Signaller noticed the van on the CCTV, did not press crossing clear and raised the barriers. The van then drove off.

30th October 2017 – 15:57 A young cyclist attempted to beat the barriers as they were lowering, caught the barrier and fell from their bike. The signaller raised the barriers and the cyclist got up and walked off.

27th May 2017 – 11:14 WMSC signaller advises that as barriers were lowering for passage of 2D22 and 1G19, a car (Black Peugeot) stopped under the up side entrance barrier. The signaller was unable to stop barrier lowering sequence before barrier struck the roof of the car. The signaller raised barriers and vehicle reversed off crossing. The barriers were then lowered.

24th November 2016 – 12:35 The West Midlands Signalling Centre (WMSC) North Warwickshire signaller advises that a small pick-up truck had jumped the lights at Bentley Heath level crossing. The signaller stopped the sequence, however the driver then reversed and hit the Down side entry barrier. The barriers were stuck in the lowered position but the signaller was unable to get crossing clear. West Midlands Police were advised (reference 1075) and short term traffic management measures requested. The BTP were advised reference [redacted]

26th February 2014 – 17:07 West Midlands Signalling Centre advised that the Down side barrier of Bentley Heath level crossing had struck the bonnet of a White (or light silver coloured) Ford KA. Signaller advised that the barriers were working OK. S&T checked barrier as a precaution and BTP notified ref: [redacted]

20th January 2014 – 13:48 WMSC SSM advised that as barriers at Bentley Heath were lowering, the down side entry barrier was struck by a vehicle believed to be a white Audi. Stop button operated by signaller and vehicle reversed off crossing. There was no apparent damage to barriers and they were working correctly. BTP advised ref [redacted]

27th May 2013 – 14:36 WMSC advised that at 14:19 two males were seen to enter the railway at Bentley Heath CCTV crossing as the barriers were closed and proceeded to walk trackside towards Dorridge station on the down side.

2C40 and 1G31 were cautioned and 2C40 reported that no-one was seen, however a person was sat behind a relay cabinet on return from Dorridge as 2J52.

Details of the trespassers were reported as one male who was wearing a purple hoodie. At 14:38 the BTP were advised (ref: [redacted]). At 14:56 WMSCC advised that 2V36 was also asked to look out for trespassers on departure from Dorridge and reported that no one was seen. Trains were currently being worked normally.

At 15:55 the MOM advised that one male and one female trespasser were apprehended by the police. The trespassers were Latvian nationals who were delivering charity collection bags and decided to take a break in the shade of the trees beside the railway. They were not aware that it was an offence to trespass on the railway in the UK.

24th May 2013 – 23:56 WMSC SSM advised that the driver of a white van (possibly a 'Connect') had twice driven against the barriers at Bentley Heath causing them to fail. The barriers had to be raised to clear the fault and the van had driven off.

26th June 2012 – 21:00 WMP (ref: [redacted]) and BTP (ref [redacted]) that a member of the public had phoned WM Police to alleged that Bentley Heath Crossing had the lights flashing and audible alarm sounding but a train passed with the barriers raised.

WMSC had no known issues with the Crossing. Signal tapes were required to be read to determine the facts and the alleged incident took place at 20:50. Box T.O. was busy with the Snow Hill Signalling failure so this incident was to be dealt with once Snow Hill restored.

On 28/06 at 00:33 Box TO advised that the CCTV footage showed no issue with the crossing equipment. TO suggested that this is passed to the Signalling Manager for further action.

27th February 2012 – 17:30 Signaller advised that he had observed a person cross Bentley Heath CCTV Crossing as the barriers were coming down. Signaller stated that he had to stop the barriers lowering to allow the female to exit the crossing. BTP advised Ref [redacted].

5 OTHER FACTORS AFFECTING THE CROSSING

5.1 At the time of this assessment there were no other known factors such as nearby housing developments that will affect usage levels at the crossing.

6 OPTIONS EVALUATED

6.1 Detailed below are a number of options that have been considered to reduce the risk at the crossing.

Option	Original ALCRM risk score	New ALCRM risk score	New ALCRM FWI	Safety benefit %	Cost	Cost Benefit Ratio
Closure by vehicular over bridge	F4	M13	0.00	100%	£4,000,000	Discounted
Closure by vehicular underpass	F4	M13	0.00	100%	£4,000,000	Discounted
Closure by diversion (no work)	F4	M13	0.00	100%	£40,000	3.23
Closure by diversion (work)	F4	M13	0.00	100%	£2,000,000	0.06
Crossing upgrade MCB-OD	F4	F4	0.00238775	0%	£4,000,000	Discounted
Installation of Red Light Safety Equipment (RLSE)	F4	F4	0.002340019	2%	£135,000	0.01

NOTES
The following CBA criteria are used as a support to decision making:

a. benefit to cost ratio is ≥ 1: positive safety and business benefit established;
b. benefit to cost ratio is between 0.99 and 0.5: reasonable safety and business benefit established where costs are not grossly disproportionate against the safety benefit; and
c. benefit to cost ratio is between 0.49 and 0.0: weak safety and business benefit established.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 *Closure by vehicular overbridge*

The construction of a vehicular overbridge has been considered but due to the costly nature of such a structure and the fact that it would not fit into the current layout of the crossing area due to the proximity of residential property it has been discounted.

Closure by vehicular underpass

The construction of a vehicular underpass has also been considered but again, due to the costly nature of such a structure and the fact that it would not fit into the current layout of the crossing area it has been discounted.

Closure by diversion (no work)

No work means that alternative routes exist and there is no need for Network Rail to create new paths or roads. At Bentley Heath, due to the surrounding area and the road layout a diversion with no work has been considered to close the crossing. This option would see the road crossing closed with the pedestrian footbridge at the site remaining in place for use. The maps below show that alternative routes for users are available and would be approximately 1.5 miles long, which in a car is only a few minutes extra. Many locals in the area avoid the crossing already when the barriers are down and use the alternative routes along Mill Lane/Slater Road/Four Ashes Road/Earlswood Road and Widney Road to get to the local amenities at Dorridge or out of the village. One down side to this option would be that mobility impaired users of the crossing would have to negotiate the stepped footbridge. At this time, although it would most likely meet with local opposition, this option should be considered.

Map of Alternative Route

Closure by diversion (work)

A work required diversion is when new paths or accesses would need to be built to allow for a more appropriate diversion. In this location it would involve the closure of the road crossing as described above, utilising the existing local road layout but with the added option of a ramped footbridge to accommodate mobility impaired passengers. A diversity impact assessment would be required to ascertain if a ramped bridge is required at this location. In the opinion of the assessor a ramped bridge would be required at this located so although the cost benefit analysis is not ideal, this option should be considered to close the crossing and please all parties that may become involved. Further investigation work should take place to obtain initial thoughts of the relevant stakeholders.

Crossing upgrade to manual controlled barriers with obstacle detection

Another suggestion at this location would be to upgrade the crossing to MCB-OD. This would remove the risk of human error at this location as the crossing would be operated by track circuits and scanned by a radar system to ensure it is clear before allowing a train to traverse the crossing. This option is estimated to cost

approximately £4,000,000 plus re-signalling costs and would provide no safety benefit. Although the system removes the risk of human error this option is costly and in the opinion of the assessor, should not be considered at this location. At this time this option should be discounted and any available funding should be considered for closure options instead.

Installation of Red Light Safety Equipment (RLSE)

Red Light Safety Equipment can be used in an effort to reduce deliberate misuse at level crossings. Cameras are visible and would be located in a convenient position on the approach to the crossing. The system records the level crossing sequence and captures any violations which may occur; this information is then sent to the police for processing. This option could help to reduce crossing misuse by allowing easier prosecutions of those who jump the crossing lights or weave the crossing barriers. A 2% reduction in risk has been applied to this option in the ALCRM risk model. This 2% is obtained from level crossing guidance document 14 and from a scale of 0-2%. 2% has been used at this site as the majority of incidents have involved vehicles and it is believed the cameras would combat this type of incident. If the crossing were to remain open, with upgrade options extremely limited for this type of crossing and despite the fact that the cost benefit analysis is not favourable, this option should be considered to help reduce the risk at the crossing due to previous road misuse.

7.2 Network Rail is subject to the requirements of the Health and Safety at Work Act etc. 1974 to reduce risk 'so far as is reasonably practicable'. In simple terms this means that the cost, time and effort required in providing a specific risk reduction measure needs to be commensurate with the safety benefit that will be obtained as a result of its implementation.

Following the completion of the risk assessment and having reviewed all relevant information and options, the assessor recommends that to close the crossing the diversion with work option is the one that would be considered seriously by all stakeholders involved. Although the cost benefit analysis is not favourable, taking away a walking route without providing a new route for mobility impaired users would not be viewed positively by the local authority, in the opinion of the assessor. If funding was available for such a venture in the future, this option should be investigated and contact made with the local authority to ascertain if this is something they would consider. Closure or improvement options at this location are limited due to the residential property surrounding the immediate crossing area so for the foreseeable future the crossing should be maintained in its current state as it provides a high degree of safety for a road crossing.

In terms of improvement options red light enforcement cameras should be installed at the site, funding permitting. There may be local opposition from local residents as to where the cameras are located and although they would only provide a small

reduction in risk they would be a visual deterrent for anyone thinking of jumping the road traffic lights. In the past 5 years there have been ten incidents with the majority involving vehicles so this type of system may reduce this type of occurrence.

8 APPROVAL

Prepared by: [redacted]	Signature: [redacted]
Job Title:	[redacted]
Date:	18th December 2017
Approved by: [redacted]	Signature [redacted]
Job Title:	[redacted]
Date:	19th December 2017

9 APPENDIX A

ALCRM provides an estimate of both the individual and collective risks at a level crossing.

The individual and collective risk is expressed in Fatalities and Weighted Injuries (FWI). The following values help to explain this:

- **1** = 1 fatality per year or 10 major injuries or 200 minor RIDDOR events or 1000 minor non-RIDDOR events
- **0.1** = 20 minor RIDDOR events or 100 minor non-RIDDOR events
- **0.005** = 5 minor non-RIDDOR events

INDIVIDUAL RISK

This is the annualised probability of fatality to a 'regular user'. *NOTE: A regular user is taken as a person making a daily return trip over the crossing; assumed 500 traverses per year.*

Individual risk:

- Applies only to crossing users. It is not used for train staff and passengers
- Does not increase with the number of users.
- Is presented as a simplified ranking:
  - Allocates individual risk into rankings A to M
    (A is highest, L is lowest, and M is 'zero risk' e.g. temporary closed, dormant or crossings on mothballed lines)
  - Allows comparison of individual risk to average users across any crossings on the network

Individual Risk Ranking	Upper Value (Probability)	Lower Value (Probability)	Upper Value (FWI)	Lower Value (FW)
A	1 in 1	Greater than 1 in 1,000	1	0.001000000
B	1 in 1,000	1 in 5,000	0.001000000	0.000200000
C	1 in 5,000	1 in 25,000	0.000200000	0.000040000
D	1 in 25,000	1 in 125,000	0.000040000	0.000008000
E	1 in 125,000	1 in 250,000	0.000008000	0.000004000
F	1 in 250,000	1 in 500,000	0.000004000	0.000002000
G	1 in 500,000	1 in 1,000,000	0.000002000	0.000001000
H	1 in 1,000,000	1 in 2,000,000	0.000001000	0.000000500
I	1 in 2,000,000	1 in 4,000,000	0.000000500	0.000000250
J	1 in 4,000,000	1 in 10,000,000	0.000000250	0.000000100
K	1 in 10,000,000	1 in 20,000,000	0.000000100	0.000000050
L	Less than 1 in 20,000,000	Greater than 0	0.000000050	Greater than 0
M	0	0	0	0

COLLECTIVE RISK

This is the total risk for the crossing and includes the risk to users (pedestrian and vehicle), train staff and passengers.

Collective risk:

- Is presented as a simplified ranking:
  - Allocates collective risk into rankings 1 to 13
    (1 is highest, 12 is lowest, and 13 is 'zero risk' e.g. temporary closed, dormant or crossings on mothballed lines)
  - Can easily compare collective risk between any two crossings on the network

Collective Risk Ranking	Upper Value (FWI)	Lower Value (FW)
1	Theoretically infinite	Greater than 5.00E-02
2	0.050000000	0.010000000
3	0.010000000	0.005000000
4	0.005000000	0.001000000
5	0.001000000	0.000500000
6	0.000500000	0.000100000
7	0.000100000	0.000050000
8	0.000050000	0.000010000
9	0.000010000	0.000005000
10	0.000005000	0.000001000
11	0.000001000	0.000000500
12	0.0000005	0
13	0.00E+00	0.00E+00

10 APPENDIX B

Additional photographs of crossing environment.

View from the up side in the up direction

View from the up side in the down direction

View from the down side in the up direction

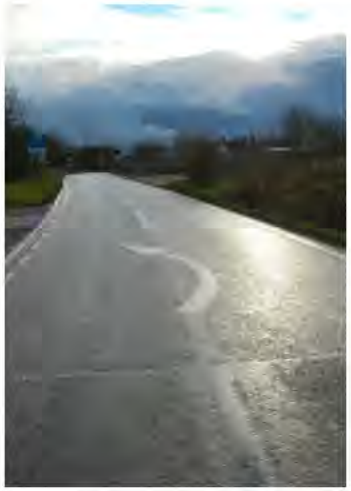
View from the down side in the down direction

Up side across the Crossing

Down side across the Crossing

11 APPENDIX C

SUN GLARE ASSESSMENT			
Step	**Question**	**Outputs**	**Answers**
-	ALCRM ID / Name of Crossing		Bentley Heath
-	Name of Assessor		[redacted]
-	Time & Date of Visit		7th November 2017 – 12:12
-	Weather Conditions		Overcast and Wet
1	Is this crossing in the list of 'Crossings potentially at risk of Sun Glare'?	If 'yes', then continue to Q2. If 'no', then record 'Tolerable, no work required' in the narrative risk assessment. End of Process.	No – Tolerable.
2	Is the crossing fitted with 50W halogen wig-wag signals? *Note: these have a red domed lens as shown:* 	If 'yes', then record 'Non-Urgent, requires work' and go to Q4. If 'no', then continue to Q3.	
3	If LED Wig-Wag signals are fitted, do they suffer from significantly reduced visibility in bright sunlight? *Note: LED Wig-Wag signals have a flat front lens as shown opposite, and flash on-off abruptly, i.e. no fade.* 	If 'yes', then record 'Non-Urgent, requires work' and go to Q4. If 'no', then continue to Q4.	

SUN GLARE ASSESSMENT			
Step	**Question**	**Outputs**	**Answers**
4	During the assessment, if the sun disk becomes directly visible on the approach to the crossing, is a glare index of 1, 2 or 3 obtained? *Note: The glare index is shown below.* Or (if the sun disk is not visible) is the horizon/background scene such that the sun disk may be directly visible and likely to cause unacceptable levels of glare?	If 'yes', then record 'CRITICAL, requires work' and go to Step 7. If 'no', then continue to Q5.	
5	Is the road surface worn or smooth such that it is potentially susceptible to bright reflections of sunlight? Or is the road surface potentially susceptible to pooled water? *Examples are given below.*   	If 'yes', then record 'Non-Urgent, requires work' and continue to Q6. If 'no', then continue' to Q6. *Note that susceptible road surfaces tend to be smooth; non-susceptible surfaces tend to have greater texture. Also, some darker surfaces may be smooth, i.e. more susceptible to glare than rougher, light grey road surfaces for example. Reflections from car headlights may be useful in assessing the reflectivity of the road surface.*	

SUN GLARE ASSESSMENT			
Step	**Question**	**Outputs**	**Answers**
6	Is the approach to the crossing and/or the background scene optically complex, e.g. contains lights, signs or other features that may cause distraction or confusion?	If 'yes', then record 'Non-Urgent, requires work' and complete the final outcome before continuing to Step 7. If 'no', then record 'Tolerable, no work required' and complete the final outcome. End of process.	
		Outcome Indicate the final outcome: □ Critical, work required □ Non-urgent, work required □ Tolerable, no work	
7	Consider Risk Mitigation measures (see below)	Indicate which risk mitigation measure(s) are required. Please also list those measures which are considered to be not suitable.	Suitable: 1. 2. 3. 4. 5.
			Not suitable: 1. 2. 3. 4. 5.

Glare scale index developed for Sun Glare at Level Crossings			
Glare Criterion	**Glare Index**	**Example**	**Acceptable**
Intolerable and unacceptable	1	Glare source prevents visibility of other lights and objects. Visual pain may be experienced.	No
Just tolerable and unacceptable	2	Glare source significantly reduces visibility of other lights and objects. Visual discomfort is likely.	No
Just unacceptable	3	Glare source reduces visibility of other lights and objects. Visual discomfort is likely.	No
Just acceptable	4	Glare source has a noticeable effect on the visibility of other lights and objects. Visual discomfort is possible.	Just
Acceptable	5	The visibility of other lights and objects is not significantly affected. Visual discomfort is possible.	Yes
Distracting	6	The visibility of other lights and objects is slightly affected. Visual discomfort is possible.	Yes
Perceptible	7	Presence of the glare source is apparent, but it has negligible effect on the visibility of other lights and objects.	Yes
Just perceptible	8	Presence of the glare source is just apparent, but it has no effect on the visibility of other lights and objects.	Yes
Imperceptible	9	Presence of the glare source is barely detectable, and it has no effect on the visibility of other lights and objects.	Yes

List of Sun glare Risk Mitigation Measures		
#	**Risk Mitigation Measure**	**Benefit / Effective**
1	Modified / Supplementary advance signage	Useful where signage is required before a junction or a bend in the road on approach to a crossing.
2	Countdown Markers	These are useful in complex areas, providing additional warning of the hazards ahead.
3	Rumble Strips	
4	New road markings	
5	Extended hoods for non-LED Wig-Wag signals	These shield the wig-wag front lens when the sun is low in the sky and/or slightly to the side of the axis of the signal. See Annex L.
6	High output LED Wig-Wag signals	These are expected to give the highest available optical performance in sun glare viewing conditions.
7	Relocation / realignment of the Wig-Wag signals	In the event of obscuration or non-optimal viewing.
8	Enhanced barrier boom features	This may include increased numbers of boom lights, brighter boom lights, 'animated' boom light sequence, boom skirts, and retro-reflective materials.
9	Extended back-boards	Where the sun disk may pass through the sky directly behind the signals. Note: larger back boards increase the wind loading on wig-wag signals and the support structures.
10	Screening (other than back-boards)	Where the sun disk may be visible behind / to the side of the crossing. Subject to clearances and wind loading.
11	Road surface treatment	In the case of worn and/or smooth road surfaces on the approach to 'at risk' crossings, a darker, non-reflective road surface is expected to reduce the reflected glare.
12	Active road-car warning system	Future technology may permit a transmitter below the road surface to transmit 'warning – level crossing' into road vehicles fitted with suitable technology
13	Repairs to existing features	This may apply if existing features are damaged or degraded.